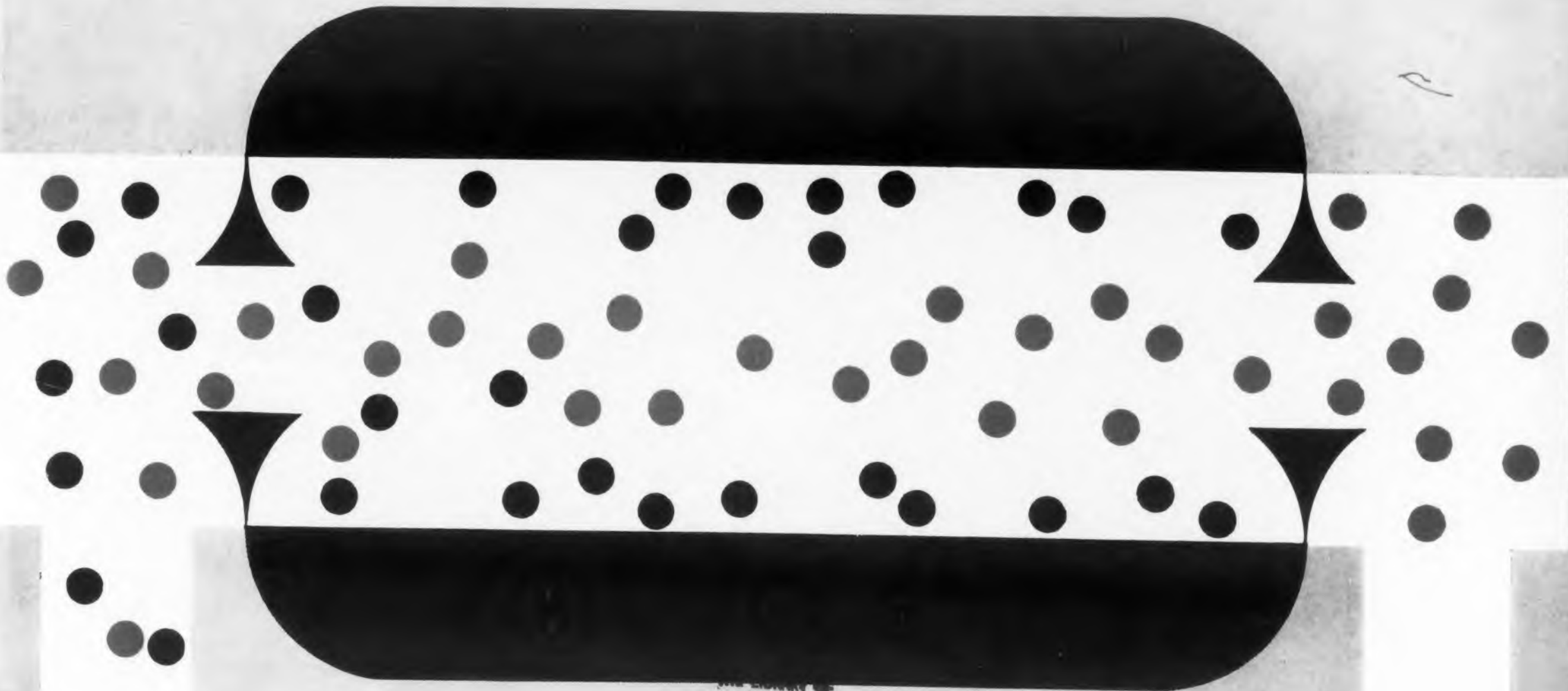


March 5 1958

ELECTRONIC DESIGN

MARCH 19, 1958

596030



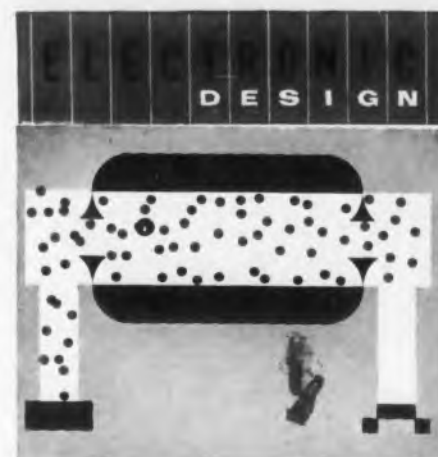
THE LIBRARY OF
CONGRESS
SERIAL RECORDS

APR 2 - 1958

596

Maser is Here! page 28





COVER STORY

Maser is Here!—For Sale p 24

An important technological breakthrough is the first commercial Maser, a portable, sealed ammonia type. The Maser oscillator generates a 23.8701294 kmc signal with unprecedented accuracy and stability. Maser provides the world's most accurate time.

VHF Matching Network Design p 20

Mr. Sanderson presents here a new method of designing optimum band-pass filters and matching networks. The method involves a plot of impedance against frequency on a Smith chart. Since the design equations use no approximations, the method is valid for narrow and wide band networks.

Feedback Amplifier Design with the Nichols Chart . . . p 32

The Nichols Chart, is a useful design tool like the Bode chart or phase-attenuation curves. Unlike these, it allows the designer to obtain closed loop data directly from open loop information. Mr. Wade's article will save a lot of time in feedback amplifier design.

Thyristor p 48

The Thyristor is a new transistor that behaves much like a thyatron. It can be triggered "on" and "off" with low power and has a collector voltage drop of only about 0.5 volts during conduction. It is almost a perfect switch having a collector current rise and fall time of less than 0.1 microsecond. Characteristics and circuit applications are described.



**YOU CAN
COUNT
ON**

—and 5 Big Reasons why:

1) IRC Molded Metal Film Resistors are available in 5 wattage ratings, 2) The metallic resistive films they feature are accurately controlled and applied to special high quality ceramic cores, 3) They surpass characteristics A and B of specification MIL-R-10509B, 4) show a low noise level independent of range, and 5) provide a negligible voltage coefficient.

There are other good reasons, too—IRC Molded Metal Film Resistors set new performance standards—they can take full load at 125° C. ambient with linear derating to zero at 175° C. (except 2 watt size which is rated full load at 100° C. ambient) . . . combine stability on load with a low, controlled temperature coefficient never before obtainable in film resistors . . . provide low conductance and shunt capacity . . . show excellent high frequency characteristics.

Even more: IRC Molded Metal Film Resistors are small in size and weight, can replace precision wire wound resistors in numerous applications . . . available in 3 standard and 2 special temperature coefficient spans for maintaining or controlling resistance over

broad temperature ranges. Feature for feature, IRC Molded Metal Film Resistors are just what you want—and need—for high stability under severe load and humidity conditions.

Here's one more tip: Look into IRC Molded Metal Film Resistors for high frequency applications, too.

Find out the complete details about IRC Molded Metal Film Resistors—write today for Bulletin B-3b.



INTERNATIONAL RESISTANCE CO. Dept. 333, 401 N. Broad St., Philadelphia 8, Pa.
In Canada: International Resistance Co., Ltd., Toronto, Licensee
CIRCLE 1 ON READER-SERVICE CARD

ELECTRONIC DESIGN

DATA REQUEST PROCESS CARD
Use Before Apr. 30th, 1958



Name	Title
Company	
Company Address	City Zone State
For Change of Address: Old Company Name	Old Company Address

10 20 30 40	100 110 120 130 140	200 210 220 230 240	300 310 320 330 340	400 410 420 430 440	500 510 520 530 540
1 11 21 31 41	101 111 121 131 141	201 211 221 231 241	301 311 321 331 341	401 411 421 431 441	501 511 521 531 541
2 12 22 32 42	102 112 122 132 142	202 212 222 232 242	302 312 322 332 342	402 412 422 432 442	502 512 522 532 542
3 13 23 33 43	103 113 123 133 143	203 213 223 233 243	303 313 323 333 343	403 413 423 433 443	503 513 523 533 543
4 14 24 34 44	104 114 124 134 144	204 214 224 234 244	304 314 324 334 344	404 414 424 434 444	504 514 524 534 544
5 15 25 35 45	105 115 125 135 145	205 215 225 235 245	305 315 325 335 345	405 415 425 435 445	505 515 525 535 545
6 16 26 36 46	106 116 126 136 146	206 216 226 236 246	306 316 326 336 346	406 416 426 436 446	506 516 526 536 546
7 17 27 37 47	107 117 127 137 147	207 217 227 237 247	307 317 327 337 347	407 417 427 437 447	507 517 527 537 547
8 18 28 38 48	108 118 128 138 148	208 218 228 238 248	308 318 328 338 348	408 418 428 438 448	508 518 528 538 548
9 19 29 39 49	109 119 129 139 149	209 219 229 239 249	309 319 329 339 349	409 419 429 439 449	509 519 529 539 549
50 60 70 80 90	150 160 170 180 190	250 260 270 280 290	350 360 370 380 390	450 460 470 480 490	550 560 570 580 590
51 61 71 81 91	151 161 171 181 191	251 261 271 281 291	351 361 371 381 391	451 461 471 481 491	551 561 571 581 591
52 62 72 82 92	152 162 172 182 192	252 262 272 282 292	352 362 372 382 392	452 462 472 482 492	552 562 572 582 592
53 63 73 83 93	153 163 173 183 193	253 263 273 283 293	353 363 373 383 393	453 463 473 483 493	553 563 573 583 593
54 64 74 84 94	154 164 174 184 194	254 264 274 284 294	354 364 374 384 394	454 464 474 484 494	554 564 574 584 594
55 65 75 85 95	155 165 175 185 195	255 265 275 285 295	355 365 375 385 395	455 465 475 485 495	555 565 575 585 595
56 66 76 86 96	156 166 176 186 196	256 266 276 286 296	356 366 376 386 396	456 466 476 486 496	556 566 576 586 596
57 67 77 87 97	157 167 177 187 197	257 267 277 287 297	357 367 377 387 397	457 467 477 487 497	557 567 577 587 597
58 68 78 88 98	158 168 178 188 198	258 268 278 288 298	358 368 378 388 398	458 468 478 488 498	558 568 578 588 598
59 69 79 89 99	159 169 179 189 199	259 269 279 289 299	359 369 379 389 399	459 469 479 489 499	559 569 579 589 599

Home Address City Zone State For Personnel Ads Only (Nos. 550-599)

ELECTRONIC DESIGN

DATA REQUEST PROCESS CARD
Use Before Apr. 30th, 1958



Name	Title
Company	
Company Address	City Zone State
For Change of Address: Old Company Name	Old Company Address

10 20 30 40	100 110 120 130 140	200 210 220 230 240	300 310 320 330 340	400 410 420 430 440	500 510 520 530 540
1 11 21 31 41	101 111 121 131 141	201 211 221 231 241	301 311 321 331 341	401 411 421 431 441	501 511 521 531 541
2 12 22 32 42	102 112 122 132 142	202 212 222 232 242	302 312 322 332 342	402 412 422 432 442	502 512 522 532 542
3 13 23 33 43	103 113 123 133 143	203 213 223 233 243	303 313 323 333 343	403 413 423 433 443	503 513 523 533 543
4 14 24 34 44	104 114 124 134 144	204 214 224 234 244	304 314 324 334 344	404 414 424 434 444	504 514 524 534 544
5 15 25 35 45	105 115 125 135 145	205 215 225 235 245	305 315 325 335 345	405 415 425 435 445	505 515 525 535 545
6 16 26 36 46	106 116 126 136 146	206 216 226 236 246	306 316 326 336 346	406 416 426 436 446	506 516 526 536 546
7 17 27 37 47	107 117 127 137 147	207 217 227 237 247	307 317 327 337 347	407 417 427 437 447	507 517 527 537 547
8 18 28 38 48	108 118 128 138 148	208 218 228 238 248	308 318 328 338 348	408 418 428 438 448	508 518 528 538 548
9 19 29 39 49	109 119 129 139 149	209 219 229 239 249	309 319 329 339 349	409 419 429 439 449	509 519 529 539 549
50 60 70 80 90	150 160 170 180 190	250 260 270 280 290	350 360 370 380 390	450 460 470 480 490	550 560 570 580 590
51 61 71 81 91	151 161 171 181 191	251 261 271 281 291	351 361 371 381 391	451 461 471 481 491	551 561 571 581 591
52 62 72 82 92	152 162 172 182 192	252 262 272 282 292	352 362 372 382 392	452 462 472 482 492	552 562 572 582 592
53 63 73 83 93	153 163 173 183 193	253 263 273 283 293	353 363 373 383 393	453 463 473 483 493	553 563 573 583 593
54 64 74 84 94	154 164 174 184 194	254 264 274 284 294	354 364 374 384 394	454 464 474 484 494	554 564 574 584 594
55 65 75 85 95	155 165 175 185 195	255 265 275 285 295	355 365 375 385 395	455 465 475 485 495	555 565 575 585 595
56 66 76 86 96	156 166 176 186 196	256 266 276 286 296	356 366 376 386 396	456 466 476 486 496	556 566 576 586 596
57 67 77 87 97	157 167 177 187 197	257 267 277 287 297	357 367 377 387 397	457 467 477 487 497	557 567 577 587 597
58 68 78 88 98	158 168 178 188 198	258 268 278 288 298	358 368 378 388 398	458 468 478 488 498	558 568 578 588 598
59 69 79 89 99	159 169 179 189 199	259 269 279 289 299	359 369 379 389 399	459 469 479 489 499	559 569 579 589 599

Home Address City Zone State For Personnel Ads Only (Nos. 550-599)



VIA AIR MAIL

B U S I N E S S R E P L Y C A R D

First Class Permit No. 725, Sec. 34.9, P. L. & R., New York, N. Y.

8 CENTS AIR MAIL POSTAGE WILL BE PAID BY

**ELECTRONIC DESIGN
Statistical Tabulating Dept.**

830 Third Avenue
New York 22, New York



VIA AIR MAIL

B U S I N E S S R E P L Y C A R D

First Class Permit No. 725, Sec. 34.9, P. L. & R., New York, N. Y.

8 CENTS AIR MAIL POSTAGE WILL BE PAID BY

**ELECTRONIC DESIGN
Statistical Tabulating Dept.**

830 Third Avenue
New York 22, New York



SUBSCRIPTION POLICY

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies. If design for manufacturing is your responsibility, you qualify for subscription without charge provided you send us the following information on your company's letter head: Your name and engineering title, your company's main products, and description of your design duties. The letter must be signed by you personally. Any address changes for old subscribers necessitates a restatement of these qualifications. Subscription rate for non-qualified subscribers—\$15.00 for 1 year only.

Hayden Publishing Co., Inc., 830 Third Avenue, New York 22, N.Y.

CONTENTS

Editorial	19	We Refuse To Boast
Engineering Review	5	Two Signals Simultaneously Televised Over One Channel
Washington Report	14	DOD Enlarges Use of Industry's Technicians
Features	20	VHF Matching Network Design, A. E. Sanderson
	24	Maser is Here!
	26	Zener Diode Characteristics
	32	Feedback Amplifier Design with the Nichols Chart, W. D. Wade
	36	Rapid Testing of Tube Shorts and Continuity
	40	Completely Electronic High Vacuum Pump
	42	Miniature Accelerometer
	48	The Thyristor, L. E. Barton
	52	How to Minimize Radar Effects on Electronics Circuits, W. G. Egan
	64	Differential Meter Relay
Background for Designers	44	Applications of Non-Linear Magnetics, Part II, H. F. Storm
Ideas for Design	104	Rapid Design of Transistorized Regulated Power Supplies
Russian Translations	114	What the Russians are Writing
Abstract	120	Electrical Characteristics of Printed Circuit Panels
Departments	16	Meetings
	56	New Products
	94	New Materials
	100	New Literature
	108	Report Briefs
	110	Patents
	112	Books
	124	Standards and Specs
	125	Careers Section
	126	Advertisers' Index



ELECTRONIC DESIGN is published bi-weekly by Hayden Publishing Company, Inc., 830 Third Avenue, New York 22, N. Y., T. Richard Gascoigne, President; James S. Mulholland Jr., Vice-President & Treasurer; and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Accepted under section 34.6. P. L. & R. authorized. Copyrighted 1958 Hayden Publishing Company, Inc. 30,000 copies this issue.

New Speed...Versatility...Reliability...



TRANSISTORIZED DIGITAL MAGNETIC TAPE HANDLER MODEL 906

Optimum performance in virtually all tape handling applications

The advanced design of the completely transistorized Potter Model 906 Tape Handler provides improved performance in virtually any tape handling application.

Replaceable Capstan Panel permits use as Perforated Tape Reader with a remarkable new brake capable of stopping on the stop character at speeds up to 1000 characters per second. Using a small vacuum loop buffer, Model 906 features:

- Complete front accessibility—single panel construction
- Pinch rollers capable of 100 million start-stop operations
- In-line threading, end of tape sensing and tape break protection
- Speeds up to 150 ips
- As many as 4 speeds forward and reverse
- Capable of continuous cycling at any frequency from 0 to 200 cps without flutter
- Rewind or search at 400 ips
- 3 millisecond starts
- 1.5 millisecond stops
- Tape widths to 1-1/4"
- Up to 47 channels
- All functions remotely controllable

The 906 may be supplied with a transistorized Record-Playback Amplifier featuring a separate module for each channel. Electronic switching from record to playback function is available as an optional feature.

Other Potter products include Transistorized Frequency Time Counters, Magnetic Tape Handlers, Perforated Tape Readers, High Speed Printers, Record-Playback Amplifiers and Record-Playback Heads.

SEE US AT I.R.E. SHOW—BOOTH #1912-14

POTTER INSTRUMENT COMPANY, Inc.

Sunnyside Boulevard, Plainview, New York

Overbrook 1-3200

CIRCLE 2 ON READER-SERVICE CARD



At your command for all military applications

THESE **RAYTHEON** PREFERRED
RELIABLE TUBES



Approved Miniatures and Subminiatures for guided missile, computer, communication, radar, radiation measuring, instrument and other military applications requiring *Reliability Plus*.

	TYPE	DESCRIPTION	Spec. Number MIL-E-1/	Vibration Output (maximum) mVac	Heater		Plate		Grid Volts or Rk	Screen		#	Sm μ mhos
					Volts	mA.	Volts	mA.		Volts	mA.		
SUBMINIATURE	1AD4	RF Ampl. Pentode	20C	200*	1.25	100	45	3.0	Rg = 2 meg.	45	0.9	—	2000
	1AH4	RF Ampl. Pentode	316A	200*	1.25	40	45	0.75	Rg = 5 meg.	45	0.2	—	750
	5639	Video Amplifier Pentode	169C	100†	6.3	450	150	21	100 Ω	100	4	—	9000
	5643	Thyratron	757C	—	6.3	150	epx = 500 v max; ip = 100 ma max; I _p = 16 mAdc max.						
	5672	RF Output Pentode	280	200*	1.25	50	67.5	3.25	-6.5	67.5	0.95	—	650
	5702WA	Video Amplifier Pentode	82B	50†	6.3	200	120	7.5	200 Ω	120	2.6	—	5000
	5702WB	Video Amplifier Pentode	1069(N)	50† 240*	6.3	200	120	7.5	200 Ω	120	2.6	—	5000
	5703WA	High Frequency Triode	293C	10†	6.3	200	120	9.4	220 Ω	—	—	25.5	5100
	5703WB	High Frequency Triode	1070(N)	10† 50*	6.3	200	120	9.4	220 Ω	—	—	25.5	5000
	5744WA	High Mu Triode	84C	25†	6.3	200	250	4.2	500 Ω	—	—	70	4000
	5744WB	High Mu Triode	1073(N)	15† 75*	6.3	200	250	4.2	500 Ω	—	—	70	4000
	5783WA	Voltage Reference	87C	20†	Operates at approximately 85 volts between 1.5 and 3.5 mA.								
	5784WA	RF Mixer Pentode	88D	100†	6.3	200	120	5.5	230 Ω	120	4.1	—	3200
	5784WB	RF Mixer Pentode	1096(N)	75† 300*	6.3	200	120	5.5	230 Ω	120	4.1	—	3200
	5787WA	Voltage Regulator	89B	20†	Operates at approximately 98 volts between 5 and 25 mA.								
	5829WA	Dual Diode	292A	—	6.3	150	Max. I _o = 5.5 mA. per plate						
	5902	Beam Pwr. Pentode	175C	100†	6.3	450	110	30	270 Ω	110	2.2	—	4200
	6021	Medium Mu Dual Triode	188B	50†	6.3	300	100	6.5	150 Ω	—	—	35	5400
	6088	Output Pentode	694	—	1.25	20	45	0.65	-1.25	45	0.15	—	625
	6111	Medium Mu Dual Triode	189B	50†	6.3	300	100	8.5	220 Ω	—	—	20	5000
6112	High Mu Dual Triode	190C	25†	6.3	300	100	0.8	1500 Ω	—	—	-70	1800	
6533	Low Microphonic Triode	975	1.0†	6.3	200	120	0.9	1500 Ω	—	—	54	1750	
MINIATURE	OA2WA	Voltage Regulator	290B	100*	Operates at approximately 150 volts between 5 and 30 mA.								
	OB2WA	Voltage Regulator	291	—	Operates at approximately 108 volts between 5 and 30 mA.								
	6AH6WA	Video Pentode	1130	100*	6.3	450	300	10	160 Ω	150	2.5	—	9000
	6AN5	Power Pentode	117	1000*	6.3	450	120	33	125 Ω	120	11	—	8500
	6AN5WA	Power Pentode	839A	100*	6.3	450	120	33	125 Ω	120	11	—	8500
	5517	Cold K Rectifier	690A	—	Peak Inverse = 2800 volts I _o = 12 mAdc.								
	5651WA	Voltage Reference	825A	—	Operates at approximately 85 volts between 1.5 and 3.5 mA.								
	5654/6AK5W	RF Ampl. Pentode	4A	150*	6.3	175	120	7.5	-2	120	2.5	—	5000
	5670	Medium Mu Dual Triode	5A	100*†	6.3	350	150	8.2	240 Ω	—	—	35	5500
	5687WA	Low Mu Dual Triode	779A	100*	6.3	900	120	36	-2	—	—	18.5	11000
5814A	Low Mu Dual Triode	12A	100*†	6.3	350	250	10.5	-8.5	—	—	17	2200	

*2.5g, 25 cps. fixed frequency
†15g, 40 cps. fixed frequency

‡Sections in parallel
(N) Navy Specification

All ratings for dual tubes are for each section
*Peak to peak, 15g, 30 to 1000 cps.

STAFF

Editor Edward E. Grazda

Managing Editor J. A. Lippke

Associate Editor Laurence D. Shergalis
Associate Editor G. H. Rostky

Assistant Editors S. Dresner
T. E. Mount
D. S. Viebig
E. T. Blake
M. M. Robinson
B. Patrusky

Contributing Editors S. H. Hubelbank
J. G. Adashko
E. Brenner

Editorial Assistants F. Muehleck
M. S. Buckley
N. A. Leftwich
H. E. Dadinos

Art Director S. Sussman
Asst. Art Director R. A. Schulze
Designer S. F. Richter

Production Manager T. V. Sedita
Asst. Prod. Manager M. D. Hedrick
Production Assistant J. Siegel
Business Manager P. L. Canfield
Circulation Manager N. M. Elston
Asst. Circ. Manager A. C. Lovett
Reader Service E. Hession

CO-PUBLISHERS

T. Richard Gascoigne
James S. Mulholland, Jr.

ADVERTISING REPRESENTATIVES

Advertising Sales Manager

Bryce Gray, Jr.

New York: Owen A. Kean
830 Third Avenue Robert W. Gascoigne
Plaza 1-5530 Blair McClenahan
Richard Parker
James P. Quinn
Charles C. Wadsworth

Chicago: Thomas P. Kavooras
664 N. Michigan Ave. Berry Conner, Jr.
SUPERIOR 7-8054 Fred T. Bruce

Los Angeles: Robert E. Ahrensdorf
5720 Wilshire Blvd. John Quillman
WEBSTER 8-3881 Stanley I. Ehrenclou

San Francisco: Stanley I. Ehrenclou
260 Kearny Street
EXbrook 7-0690



INDUSTRIAL TUBE DIVISION

Reliable Miniature and Subminiature Tubes • Voltage Reference Tubes • Voltage Regulator Tubes • Rectifiers • Nuclonic Tubes

CIRCLE 3 ON READER-SERVICE CARD

Newton, Mass.: 55 Chapel St., Bigelow 4-7500

New York: 589 Fifth Ave., Plaza 9-3900

Chicago: 9501 Grand Ave., Franklin Park, National 5-6130

Los Angeles: 5236 Santa Monica Blvd., NORmandy 5-4221

ENGINEERING REVIEW

For more information on developments described in "Engineering Review," write directly to the address given in the individual item.

Two Signals Simultaneously Televised Over One Channel

A compatible television system which would enable two different programs to be broadcast simultaneously on the same channel was demonstrated by Blonder-Tongue, Newark, New Jersey.

The technique of multiplexing the signals in this system, dubbed Bi-Tran, is pictorially represented in the accompanying diagram. Programs A and B are submitted to the transmitter. All of the frames of A are of the same polarity. B offers an alternating polarity sequence due to the phase inverter and the coding box. The coding box

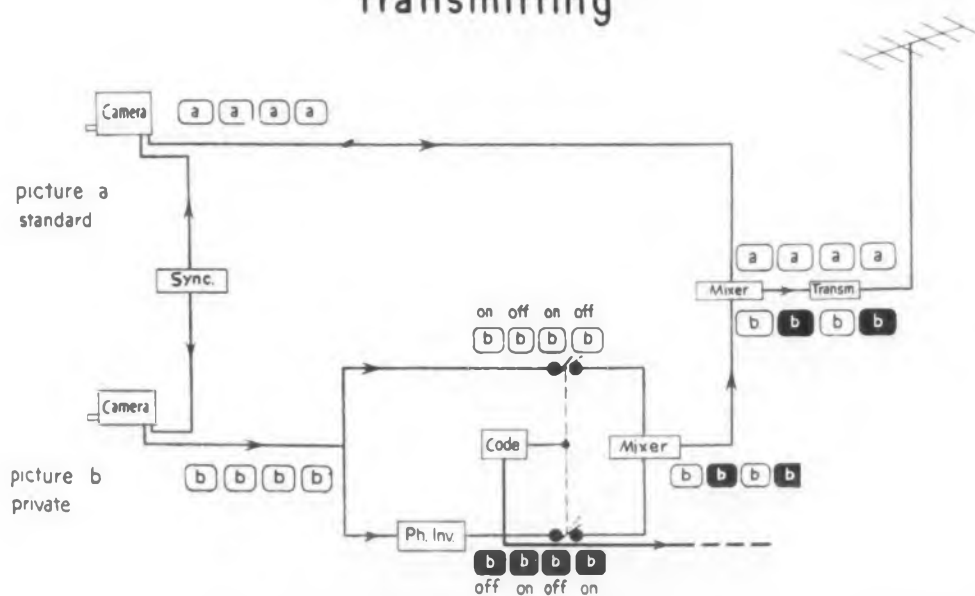
contains a gating circuit.

Standard receivers equipped with the decoding circuit indicated across points KN would pick up both signals. A detailed account of how visual translation of programs A or B is accomplished is illustrated on the following page. With a decoding signal applied an alternating polarity pattern of signal A results. Because of phosphor persistence and eye retentivity the alternating pattern will cancel out and picture B will be observed.

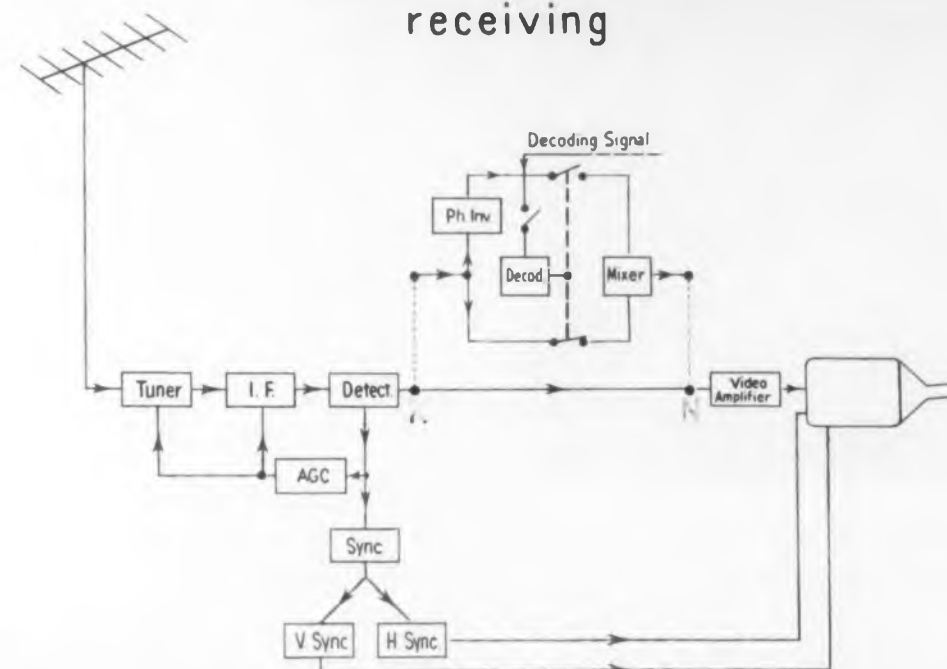
(Continued on following page)



transmitting



receiving



Both signals A and B, of the same and alternating polarity sequence, will be received by standard sets containing the additional circuitry across KN.

Which ceramic characteristics do you need

Characteristic	Material								
	Electrical Porcelain	Steatite	Fused Quartz	Magnesia	Cordierite	Glass Bonded Mica	Raytheon R-95 High Alumina	Forsterite	Zircon
Dielectric Constant (1 mc)	6-7	5.5-6.5	3.7	5.8	4-5	7-8	9	6.5	9
Power Factor (1 mc)	.009	.0008	.00035	.0008	.008	.002	.001	.0002	.0014
Loss Factor (1 mc)	.055	.004	.0013	.004	.03	.016	.009	.0014	.013
Water Absorption (%)	0-1.0	0-0.01	0	16	3-8	0.5	0.0	0-0.01	0-0.01
Tensile Strength (p.s.i. x 10 ³)	2.6	13	8	2.8	3	8	25	10	10
Flexural Strength (p.s.i. x 10 ³)	11	20	—	6	7-10	18	45	12	18.5
Compressive Strength (p.s.i. x 10 ³)	30-65	65	200	48	50-95	25	250	80	80
Dielectric Strength (volts/mil)	100-200	250	200	65	200	245	450	250	200
Hardness, Moh's scale	7.5	7.5	5	6	7	—	9	7.5	8
Modulus of Elasticity (p.s.i. x 10 ⁶)	10	14	4	—	5	—	42	—	21
Specific Gravity	2.4	2.6	2.2	3.0	2.5	—	3.7	2.8	3.7
Linear Thermal Expansion 20-100°C (in./in./°C x 10 ⁻⁶)	3.6	6	.20	9.4	2.5-4	—	6.2	8.5	2.5-5
T _E Value (°C)*	—	450°-800°	—	—	750°	—	980°	990°	700°

*T_E is that temperature at which the volume resistivity reaches 1 Meg.

Approximate characteristics of "electronic" ceramic materials. Source: manufacturer sales literature

Reprinted from Electronic Design, November 1, 1956

How Raytheon R-95 High-Alumina Ceramic can save you money—do a better job



See Raytheon at the I.R.E.—
Booths 2611-2614

Consider well the unusual properties present in Raytheon R-95 High-Alumina Ceramic. If your needs are for a less specialized material, you may find a satisfactory performer at lower cost.

However, when you require a material with remarkably *high resistance to high temperature, shock and vibration; high dielectric strength and high electrical resistance at all temperatures; extreme hardness; high mechanical strength and positive sealing capability*—then you will surely want to be familiar with the ratings of Raytheon's R-95. Proper application of this superior material assures continuing design and assembly economy, particularly where ceramic seals are a factor.

Ceramic parts manufactured from Raytheon R-95 High Alumina are available, either alone or as hermetic ceramic-to-metal assemblies, in accordance with your specifications. The assemblies can be soft or hard soldered into your production in your own plant.

Send sketches or drawings outlining dimensions and tolerances, together with operational conditions. We will be pleased to supply information and help on any of your ceramic needs.

Write for complete specification sheet and your copy of *Ceramics in Electronic Design*, comprehensive questions and answers on the growing role of ceramics in modern design. No cost or obligation, of course.

RAYTHEON MANUFACTURING COMPANY

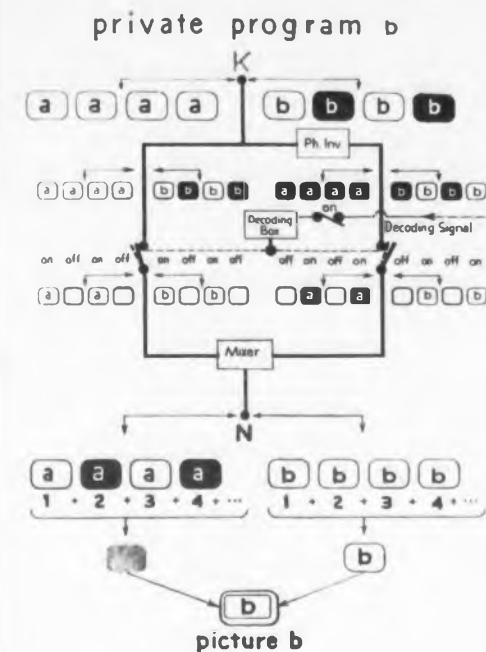


Excellence
in Electronics

Ceramic Sales

Waltham 54, Massachusetts

ENGINEERING REVIEW



Here is a detailed account of how either program A or B may be observed. Application of decoding signal will produce program B.

On the other hand, with no decoding signal introduced, the standard program A will be viewed.

As yet efforts have not yet been extended in developing a multiplexing system for sound transmission. Development engineers have indicated, however, that the problem is "not too difficult."

Blonder-Tongue, which originally presented the system to the FCC last September, has invited Commission members to witness their

◀ CIRCLE 4 ON READER-SERVICE CARD

demonstration. If the system proves feasible to the FCC, licensed channels may apply for Bi-Tran and use it in a limited area for experimental purposes.

It is suggested that the Bi-Tran System could be adapted for educational public service, medical TV, and military and uhf applications.

Physicists Baffled by Neutron Characteristics

The protons and neutrons of atomic nuclei have been explored to within 30 millionths of a billionth of a centimeter of their cores by Stanford University physicists. Both appear to consist of clouds of mesons growing denser toward the center. Both clouds are equal in magnetic size, each with an average radius 8×10^{-14} cm.

These findings were discussed at a meeting of the American Physical Society of New York. Recent measurements have verified the magnetic size equality of neutrons and protons. Physicists are at a loss to reconcile the neutron's unexpectedly large magnetic size with its small charge size. It implies that present theories upon which their ideas of the atom are based may not be valid for studies of such fine dimensions. The nuclear probe used by the Stanford group was an electron beam of energies varying from 500 to 650 mev. Its target was the deuteron nucleus of deuterium. A revolving 55-ton magnetic spectrometer was used at the target end as the measuring device.

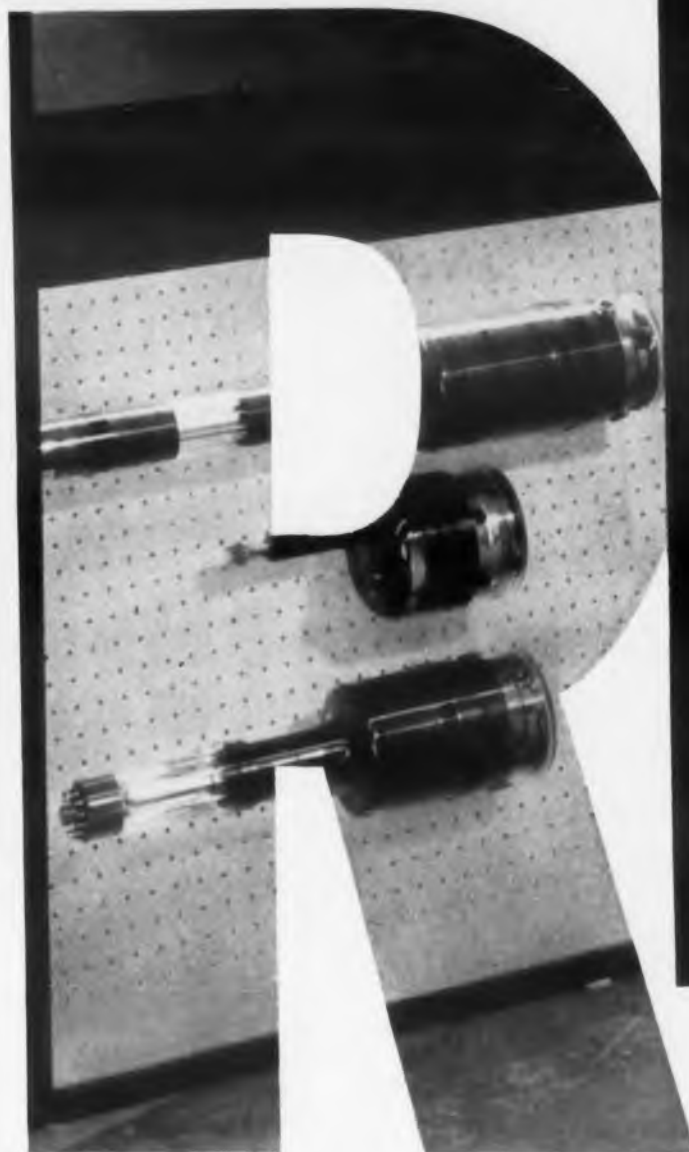


Transistorized frequency converter with cooling fins gives the benefits of high-frequency lighting: ballast size, weight and losses are drastically reduced. Small 1500 cycle ballast is compared to low frequency ballast; the transistorized power source will handle 32 forty-watt lamps.

ELECTRONIC DESIGN • March 19, 1958



booths 2801-05



SEE THE TUBES WITH DISPLAYS THAT STAY! All Hughes direct-display cathode-ray tubes have the ability to store information for extended periods of time.



the MEMOTRON®
tube will display **SUCCESSIVE TRANSIENT WRITINGS** until intentionally erased.



the TONOTRON*
tube presents a complete spectrum of grey shades. The **HIGH LIGHT OUTPUT** facilitates viewing even in full daylight.



the TYPOTRON®
tube is the only available **CHARACTER WRITING STORAGE TUBE** which displays any combination of 63 characters or symbols until intentionally erased.

For a period of years these Hughes cathode-ray tubes have been in commercial and military operation and have established an outstanding record of reliability. See these tubes actually perform in typical applications at the I.R.E. show in New York. Or, for further technical data write: Hughes Products, Electron Tubes, International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

© 1958. HUGHES AIRCRAFT COMPANY

*Trademark of Hughes Aircraft Co.

CIRCLE 5 ON READER-SERVICE CARD



Tantalum Deliveries

You can get **IMMEDIATE DELIVERY** of **FANSTEEL TANTALUM POWDERS, OXIDES, CARBIDES AND COMPOUNDS**

If you are now using tantalum or are designing this metal into your product, you'll be happy to know that we can now offer immediate delivery of Fansteel tantalum powders, oxides, carbides and compounds in any quantity.

And what's more important, the delivery of Fansteel tantalum in all forms is improving almost by the day. For instance, in recent weeks we have been able to cut off 6 months from our scheduled delivery. Soon, backed by the full production of our new Muskogee, Oklahoma Plant, Fansteel will be able to fulfill all of your immediate tantalum requirements.

In the past year, we produced more tantalum—delivered more tantalum than ever before, but still the de-

mand for this outstanding metal continues to grow.

To keep pace with this ever-increasing demand . . .

—we put our new Muskogee Plant into operation in late fall to increase our production of tantalum powders and ingots by 50%.

—we have added new buildings to the main plant at North Chicago, new research laboratories, and are now completing an extensive installation of additional processing and fabricating equipment.

All of this adds up to more Fansteel tantalum for you . . . delivered on time . . . in quantities to meet your production requirements.



WE'LL HAVE ANOTHER IMPORTANT ANNOUNCEMENT ABOUT TANTALUM SOON

We are continuing in our constant efforts to improve our service to all tantalum users, and will be able to release additional good news in the very immediate future.

In the meantime, if our tantalum engineers can be of any service to your designers or production men, please call on us. Or write for the latest technical bulletins on tantalum.

SEE OUR BOOTHS 4021 AND 4022 RADIO ENGINEERING SHOW, N. Y. COLISEUM

K581

FANSTEEL®

TANTALUM • MOLYBDENUM • COLUMBIUM • TUNGSTEN • FANSTEEL 77 METAL

FANSTEEL METALLURGICAL CORPORATION • NORTH CHICAGO, ILLINOIS, U. S. A.

CIRCLE 6 ON READER-SERVICE CARD

ENGINEERING REVIEW

Microminiature Torroidal Coil Winder

A machine which can wind coils on torroidal cores almost invisible to the naked eye has been developed by Stanford Research Institute. Most machinery on the market makes use of a split bobbin (or circular mandrel) that is first placed through the hole in the core through which the coil is to be wound. In such cases, the size hole through which a coil can be wound is limited to a dimension slightly larger than the combined size of the finished coil and the bobbin. Also, it would be impossible to wind a coil through two adjacent holes in the same surface.

The new machine is capable of winding coils whose outside diameter is equal to the diameter of the hole through which they are wound either from the center to the outside of the core, or through two adjacent holes in the same core. The ability of the machine to wind such coils is not impaired by the diameter-to-length ratio of hole or holes through which the coil is to be wound. For example, it is possible to wind a coil through



"Pinhole" Coil Winder developed by Stanford Research Institute's Computer Development Group. Core is held in clamp immediately to left of operator's hand.



— for twenty years the leader
in subminiature tubes

Presents the
first complete line of

PNP GERMANIUM

RELIABLE SUBMIN TRANSISTORS

In large quantity production — available from stock

featuring **PROVED PERFORMANCE**

Over one half million in service

Low leakage current (I_{CO})

High frequency characteristics



These new Raytheon Submin Transistors have one-fourteenth the volume of the JETEC-30 package.

SUBMIN Type	JETEC-30 Electrical Equivalent	V_{CE}	$f_{\alpha b}$	H_{FE1}	H_{FE2}	Rise Time*
		max. volts	ave. Mc	ave. $I_B = 1 \text{ ma}$ $V_{CE} = -0.25V$	ave. $I_B = 10 \text{ ma}$ $V_{CE} = -0.35V$	max. μSEC
CK25	2N425	-20	4	30	18	1.0
CK26	2N426	-18	6	40	24	0.55
CK27	2N427	-15	11	55	30	0.44
CK28	2N428	-12	17	80	40	0.33

* $I_C = 50 \text{ ma}$; $I_B = 5 \text{ ma}$; $R_L = 200 \Omega$; $I_B = 5 \text{ ma}$; Grounded Emitter Circuit

SUBMIN Type	JETEC-30 Electrical Equivalent	V_{CE}	Beta	Power Gain Class A	I_{CO}	Noise Factor
		max. volts	ave. small signal	ave. db	ave. μa	ave. db
CK22	2N422	-20	90	40	6	6 max.
CK64	2N464	-40	22	40	6	12
CK65	2N465	-30	45	42	6	12
CK66	2N466	-20	90	44	6	12
CK67	2N467	-15	180	45	6	12

SUBMIN Type	JETEC-30 Electrical Equivalent	V_{CE}	$f_{\alpha b}$	Beta	C_{ob}	r_b
		max. volts	ave. Mc	ave.	ave. μf	ave. ohms
CK13	2N413	-18	2.5	25	12	70
CK14	2N414	-15	6	40	12	80
CK16	2N416	-12	10	60	12	90
CK17	2N417	-10	20	80	12	100

Dissipation Coefficients for all submin types: in air, 0.75°C/mW; infinite sink, 0.35°C/mW



SEMICONDUCTOR DIVISION

Silicon and Germanium Diodes and Transistors • Silicon Rectifiers

Newton, Mass.: 55 Chapel St., Bigelow 4-7500
New York: 589 Fifth Ave., Plaza 9-3900
Chicago: 9501 Grand Ave., Franklin Park, NAional 5-6130
Los Angeles: 5236 Santa Monica Blvd., NORmandy 5-4221

VISIT RAYTHEON BOOTHS 2611-12-13-14, I.R.E. SHOW, N.Y.C.

CIRCLE 7 ON READER-SERVICE CARD



Typical coils wound on the "Pinhole" Coil Winder.

no 0.010 in. holes spaced on 0.060 in. centers in 3 in. thick core.

The wire forming the coil is made to pull itself through the hole or holes through which the coil is wound. The set-up time on the laboratory model of this machine is about the same as on a standard commercial toroidal winding machine and can be reduced drastically on a production model. Actual winding time per turn is about equal to a standard commercial machine.

In continuing development of the machine, Raytheon is hoping to achieve a completely automatic component-winding mechanism.

Simultaneous Transmission of Telephone, TV Signals Feasible

Stacking or double decking television and telephone circuits has proved to be feasible and economical where telephone circuit requirements are limited and system lengths range from 100 to 1000 miles. In a report delivered at the winter meeting of the AIEE, H. E. Curtis of the Telephone Labs, New York; U. C. P. Hlendorf and A. J. Wade of the Bell Telephone Company of Canada, Montreal, Que. reported a successful field experiment conducted on the Bell Telephone Laboratories early in 1954 on a 1133 mile TD-2 route, from Halifax to Victoria, Canada, using standard telephone and television terminal equipment. In this experiment, two conventional highpass-lowpass filters were used to combine and separate the signals on the TD-2 terminals. Field results indicated that two or three telephone supergroups, of 60 channels each, could be stocked in the 6 to 7 mc band above the television signal.

If it's worth engineers' time...

...it's worth engineered cable



Belden

TV CAMERA CABLE

Belden quality built to exacting specifications for black-and-white or color cameras. Harmonizing color—lightweight for easier handling.

MICROPHONE CABLE

A type for every requirement, designed for highest efficiency, easiest use, longest service life.
"Items from the Complete Belden Line"



Belden

WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

5-8

Magnet Wire • Lead and Fixture Wire • Power Supply Cords, Cord Sets and Portable Cord • Aircraft Wires
Welding Cable • Electrical Household Cords • Electronic Wires • Automotive Wire and Cable

SEE US IN BOOTH 1630—I.R.E. SHOW, New York Coliseum, March 24-27
CIRCLE 8 ON READER-SERVICE CARD

ENGINEERING REVIEW



Helical coil balance used in the National Bureau of Standards' original determination and re-evaluation of the standard ampere. The large outer coil has a tap at the center so it is actually two coils. The small coil which is shown on top of the larger coil is lowered to the mid-point when the evaluation is taking place.

Drift of the Standard Ampere Measured at NBS

A recent experiment at the National Bureau of Standards has shown that the standard ampere maintained by the Bureau has drifted no more than a few parts per million in the last 15 years. Such a small apparent change may well be due to slight errors in measurement so that the standard ampere may actually have remained perfectly stable since its original evaluation in 1942.

Because of the importance of precise electrical measurements to modern science and industry, the Bureau maintains permanent primary standards of two basic electrical quantities, voltage and resistance. From these basic electrical standards, the Bureau has derived other standards for all electrical quantities in use today. Be-

cause
ampe
objec
the v
the o
quire
ard v
law.
times
resist
of th
ampe
ampe
ally i
and t
In
and
the s
two
curre
other
whic
of sy
foun
curre
ampe
near
ampe
of 5
made
ation
then
trical
decre
hand
curre
coun

Har

Sil

Dow

the

rejec

expe

almo

at S

uffe

appa

ment

was

it dis

from

Cor

A

giver

of B

The

whic

ELEC

cause current is transitory, the primary standard ampere cannot be kept in the form of a material object such as the standard cells that maintain the volt or the standard resistors that maintain the ohm. Each time the standard ampere is required, it must be obtained anew from the standard volt and the standard ohm by use of Ohm's law. However, a gradual change might sometimes occur in the standard cells or the standard resistors. One method of checking the stability of these standards is to compare the standard ampere derived from them with the "absolute" ampere, that is, the ampere obtained experimentally in terms of mechanical units of length, mass, and time.

In the present determination, R. L. Driscoll and R. D. Cutkosky of the Bureau staff measured the standard ampere in absolute amperes using two different sets of apparatus. One was the current balance used in the 1942 evaluation; the other was a Pellat type electro-dynamometer, which was introduced to reduce the possibility of systematic errors. The standard ampere was found to equal 1.000008 absolute amperes by the current balance method and 1.000013 absolute amperes by the Pellat instrument. The weighted mean of these two values is 1.000010 absolute amperes, but in this mean there is an uncertainty of 5 parts per million. If no accidental errors were made in either the original or the present evaluation and if all systematic errors remained fixed, then the value of the current yielded by the electrical standards of resistance and voltage has decreased by 6 parts per million. On the other hand, known sources of accidental error in the current balance determinations could easily account for the apparent drift.

Hand Cream Cures Motor Rash!

Silicare by Revlon, a product formulated with Dow Corning Silicones, has found its place on the small-motor production line. It cuts motor rejects besides eliminating serious skin irritations experienced by motor winders. Until recently, almost every one of 60 women winding motors at Stator Electric Co. at Woodside, N.Y. was suffering from one form or another of skin rash, apparently caused by handling these components. The cream, a heavy but greaseless liquid, was simply rubbed into the hands and arms until it disappeared. The motor rejection rate dropped from 20 per cent to near-zero.

Correction

A decimal point lost in the shuffle may have given some a wrong impression of the linearity of Beckman-Helipot's series 5000 potentiometers. The figure is ± 0.5 per cent, not the ± 5 per cent which appeared in the January 22 issue.

Another Clevite Break-through!

HIGH FREQUENCY POWER TRANSISTORS



This history-making addition to Clevite's line of PNP germanium power transistors offers long-sought advantages to designers of high frequency audio amplifiers as well as high-speed switching and core driver circuitry in digital computers.

For high frequency audio amplifiers:

(TYPE CTP 1133)

POWER DISSIPATION = 10 WATTS

at 70°C base temperature

POWER GAIN = 27 to 33 db

when $I_c = 420$ ma and power output = 2.0 w

POWER GAIN CUTOFF FREQUENCY = 20 kc minimum

... compared with 5 to 7 kc for conventional transistors

DISTORTION = 5% maximum

at 1.2 w output

For high-speed switching:

(TYPE CTP 1135)

POWER DISSIPATION = 10 WATTS

at 70°C base temperature

DC CURRENT GAIN = 40 minimum

at 0.5 amp

COMMON EMITTER GAIN BANDWIDTH PRODUCT = 1 megacycle

SEE US AT BOOTH 2626 AT THE I.R.E. SHOW

OTHER CLEVITE DIVISIONS: Brush Instruments • Clevite Ltd. • Clevite Ordnance • Cleveland Graphite Bronze • Clevite Harris Products, Inc. • Clevite Electronic Components • Clevite Research Center • Intermetall G. m. b. H.

CIRCLE 9 ON READER-SERVICE CARD

For complete information
write or phone:

CLEVITE
TRANSISTOR PRODUCTS

241 Crescent St., Waltham 54, Mass.
Twinbrook 4-9330

A DIVISION OF

CLEVITE

PHILCO

Silicon Transistors

2N495 - 2N496

For outstanding performance
at high junction temperatures

- Excellent performance at Temperatures from -65°C to $+140^{\circ}\text{C}$
- Collector Saturation Voltage of 0.1 Volt or Under
- Maximum Frequency of Oscillation in the 15 Megacycle Range

These new Philco PNP Surface Alloy Silicon Transistors permit transistorization of circuits where high ambient temperatures are encountered.

Type 2N495 is a general purpose silicon transistor, with excellent performance and reliability in amplifier and oscillator applications at frequencies through 15 mc. Units are rated at 150 mw total dissipation with a collector voltage rating of 25v.

Type 2N496 is specifically designed for high speed switching circuits . . . f_{ab} typically over 17 mc. This unit gives the designer the advantages of low saturation, low voltage operation and minimum load impedance even at junction temperatures as high as 140°C .

Make Philco your prime source for information and prices on silicon transistors.
Write Dept. ED 358

PHILCO CORPORATION

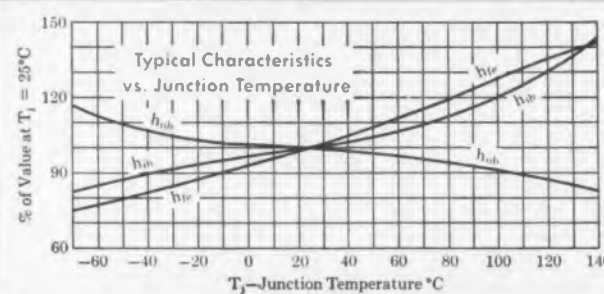
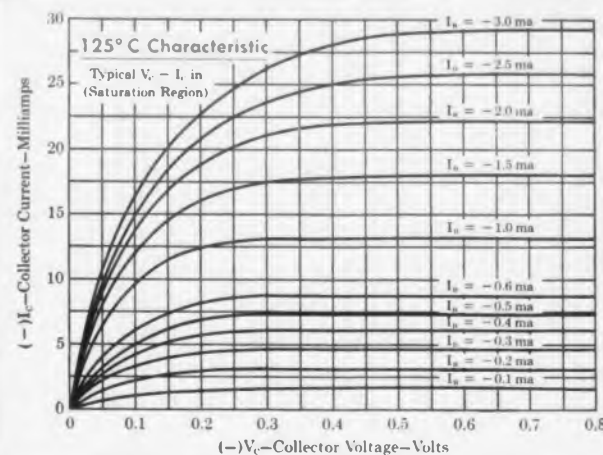
LANSDALE TUBE COMPANY DIVISION
LANSDALE, PENNSYLVANIA

CHARACTERISTICS OF TYPES 2N495 and 2N496

CHARACTERISTIC	CONDITION	TYPICAL VALUE	
		2N495	2N496
Current Amplification Factor, h_{fe}	$V_{CE} = -6\text{ v}$ $I_E = 1\text{ ma}$	18	
Current Amplification Factor, h_{FE}	$V_{CE} = -0.5\text{ v}$ $I_C = -15\text{ ma}$		12
Output Capacitance, C_{ob}	$V_{CB} = -6\text{ v}$ $I_E = 1\text{ ma}$	7 μf	7 μf
Maximum Frequency of Oscillation, $f_{os\text{ max}}$	$V_{EB} = -6\text{ v}$ $I_E = 1\text{ ma}$	15 mc	
Frequency for Beta = 1, f_t^*	$V_{EB} = -6\text{ v}$ $I_E = 1\text{ ma}$ $f = 4\text{ mc}$		15 mc
Cutoff Current, I_{CBO} or I_{EBO}	V_{CB} or $V_{EB} = -10\text{ v}$	.001 μa	.001 μa

Maximum Power Dissipation—150 mw
Maximum Collector Voltage 2N495—25 V
2N496—10 V

* f_t (the frequency at which beta is unity) is typically 85% of the alpha cutoff frequency.



ENGINEERING REVIEW

Higher Strength Mylar Tape For Recording

A new tempered Mylar tape has been developed by DuPont, and is being tested by Audio Devices, Inc., 444 Madison Ave., N.Y.C., as replacement for double-length magnetic recording tape. The new material called "50-Mylar-T" is six-tenths of a mil thick, compared to a half-mil for standard Mylar.

Double-length tape tends to stretch or break by machine tensions. A special prestressing process realigns the molecules, increasing from two pounds to four pounds the tension needed to stretch a tape made of the material, and from three pounds to six pounds the tension needed to break it. The much higher yield strength of the new tempered Mylar is expected to make the double-length, thin tape useable on machines exerting a high tension. Quantity production of the new tape is expected to begin in a few months.

Electronic Highway Control

An electronic highway control system developed by RCA has been successfully tested on a 300 experimental highway at Lincoln, Nebraska. The RCA system consists basically of a series of electronic detector units buried in and along the highway, and a guidance cable buried in the center of a traffic lane along the length of the road. The detector units, in which signals are generated by the passage of vehicles, are used to activate various systems of warning lights and can eventually be combined with simple receivers and automatic equipment in vehicles to control speed and braking. The guidance cable radiates a constant signal which is employed in conjunction with a car receiver and automatic steering equipment to keep a vehicle centered in its lane.

The system includes provision

◀ CIRCLE 10 ON READER-SERVICE CARD

for a radio "tail warning" that extends any desired distance behind each passing vehicle to warn or control following cars equipped with receivers, or to operate warning lights along the roadside.

The next logical step, according to RCA vice-president Dr. V. K. Zworykin, is the construction of an enlarged test facility which would permit testing the various features of the system at full scale and at normal speeds with completely controlled experimental vehicles. Such a facility should be at least two miles in length and be constructed with means for performing tests needed for determining the optimum length and shape for the warning "tail," the optimal dimensions and installations for the detector units, the comparative performance of different types of detectors, and the proper functioning of other components of the complete system.

Transistorized Land Mine Detector Has Greater Sensitivity

A new light-weight transistorized land mine detector has been developed by Texas Instruments Inc. for the U.S. Army, with reportedly great increased sensitivity over detectors currently in use.

The transistorized detector also has a much longer battery life and higher reliability under rugged field conditions. Use of transistors also has permitted miniaturization of the device to the point where all parts except the antenna can be carried under the operator's clothing. This is considered of special importance where the detector is to be used in Arctic regions. The detector also is fungus proof for advantageous use in the tropics.

Texas Instrument's Apparatus Division worked with the Engineering Development Laboratories, Corps of Engineers, Ft. Belvoir, Va., in developing the transistorized land mine. The unit is currently in pilot production.

CIRCLE 11 ON READER-SERVICE CARD ➤

STEMCO THERMOSTATS

for electronic and avionic applications

Features to fit your *special requirements* for avionic and electronic applications—from standard, production-line Stemco thermostats. That's just *part* of the Stemco story.

Because Stevens makes the widest range of bimetal thermostats in the industry, we offer an unusual number of basic design types . . . various terminal arrangements and mounting provisions . . . different temperature ranges and performance characteristics. In addition, Stemco thermostats feature small cubage, light weight and proven reliability—at a *production price*.

So get the Stemco story *first*. Write, call or wire *now* while your product is in the planning stage.

*Refer to Guide 400 EO for U.L. and C.S.A. approved ratings.



TYPE A*

Semi-enclosed

Insulated, electrically independent bimetal disc gives fast response and quick, snap-action control. Operation from -10 to 400 F or higher on special order. Various mountings and terminals. Rated from 4 to 13 amps at 115 volts AC, depending on service conditions. 4 amps at 230 volts AC and 28 volts DC. Bulletin 3000.



TYPE A

Hermetically sealed

Electrically identical to semi-enclosed Type A. Temperatures from -10 to 300 F. Various enclosures and mountings, including brackets, available. For appliance, electronic, apparatus applications. Bulletin 3000.



TYPE C

Semi-enclosed

Small, positive acting Electrically independent bimetal strip for operation from -10 to 300 F. Rated at approximately 3 amps, depending on application. Terminals and mountings to customer specifications. Bulletin 5000.



TYPE C

Hermetically sealed

Electrically identical to semi-enclosed Type C but sealed in crystal can. Also supplied as double thermostat "alarm" type. Turret terminals or wire leads. Bulletin 5000.



TYPE M*

Semi-enclosed

Electrically independent bimetal disc type for appliance and electronic applications. From -10 to 350 F. Rating 8 amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. Virtually any type terminal. Bulletin 6000.



TYPE M

Hermetically sealed

Electrically same as semi-enclosed Type M. Can be furnished with pin or solder type terminals, wire leads and various mounting brackets. Bulletin 6000.

STEVENS manufacturing company, inc.

Lexington and Mansfield, Ohio

AA-6306

STEMCO

THERMOSTATS

SENSITIVITY:

100 μ VOLTS

PER SCALE DIVISION

(without
pre-amplification)

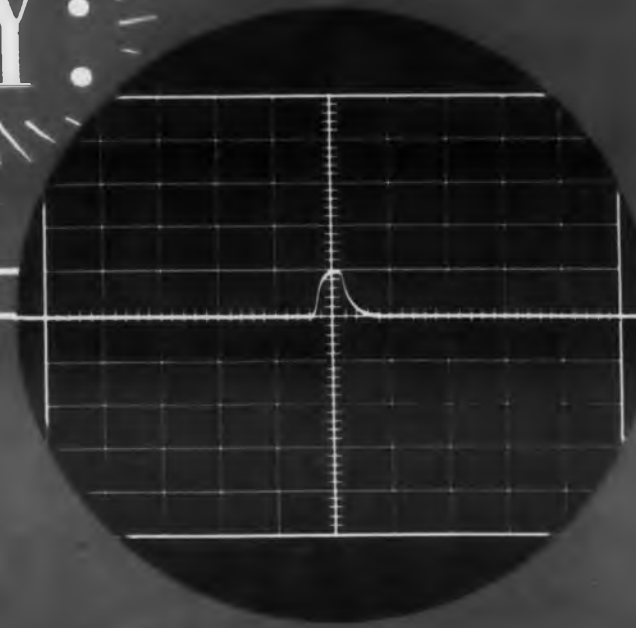


PHOTO REDUCED 33%

DU MONT 403



complete details on request...

DU MONT[®]

INSTRUMENT DIVISION
Allen B. Du Mont Laboratories, Inc., Clifton, N. J., U.S.A.

The Du Mont 403 is the most sensitive oscilloscope commercially available. This outstanding sensitivity permits direct measurements from low output transducers such as strain gages, pressure pickups, accelerometers, heart monitoring equipment, and others that normally require pre-amplification.

The 403, when used as a direct-reading voltmeter, offers full scale amplitude measurements from 1 millivolt to 500 volts, continuously variable in 17 steps. At maximum sensitivity, the 403 allows resolution of signals in the region of 20 microvolts.

Stability, commensurate with this outstanding sensitivity, is another feature of the 403.

The 403 is another in the Du Mont 400 Series Instruments. It is designed for fast, easy, and accurate measurements, along with complete accessibility and reliability.

One of the  Series

FEATURING

AMPLIFIERS: Direct coupled amplifiers. Single-ended or balanced Y-input.

EXTREME SENSITIVITY: 1 millivolt to 500 volts full scale, continuously variable.

FREQUENCY RANGE: DC to 300 KC.

Y AMPLIFIER CALIBRATION: 5%.

SWEEPS: 19 calibrated linear sweeps, 0.5 sec/cm to 0.5 μ sec/cm. Calibrating accuracy, 5%.

EXPANDED SWEEP: Any 10 cm portion of 50 cm sweep may be expanded 4 times and positioned on screen.

\$580

F.O.B. Clifton, N. J.

WASHINGTON REPORT

Herbert H. Rosen

DOD Enlarges Use of Industry's Technicians

A unified policy for hiring civilian technicians for military jobs has been established by the Department of Defense. Until now, the individual services have conducted programs under their own self-originated instructions. Examples are the Air Force contracts for the operation of Cape Canaveral and the DEWline. The Navy's Tech Rep program is also a variation on the same idea.

Under a new directive signed by Defense Secretary McElroy, certain guidelines are set down for buying the services of industry's technicians and engineers. As defined in the directive: "Industrial and Commercial Technical Services are those services pertaining to the installation, operation, and maintenance of weapons, equipment, and systems, including the instruction of personnel therefrom which are made available to the Military Services by industrial and commercial organizations through the utilization of their technically trained personnel. These services are provided either by specific contractual arrangements between the using military Service and the supplier, or are covered as part of the overhead or percentage of end item cost in the procurement contract."

The personnel mentioned are either equipment technicians, instructors, or more broadly qualified Tech Reps. Some will be designated to work only on the equipment manufactured by the company they represent. Others will not have this limitation, and will be allowed to work on any equipment for which they qualify.

While each Service may select the contractor to perform these jobs, the selection is guided by the DOD directive. In general, the contractor should be a manufacturer of equipment or systems for the Department of Defense. The contractor could also be a firm of design, maintenance, or consulting engineers engaged in a defense or commercial equipment engineering project.

The technicians and engineers who join the military units will be under the control of their companies. But, they will simultaneously be subject to the direction and supervision of the contracting military department. This means they will be subject to the rules, security regulations, and privileges of Service personnel.

CIRCLE 12 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 19, 1958

ARPA Director Named

Less than a week after Congress struck all mention of Defense's Advanced Research Projects Agency from the supplemental appropriations bill, Secretary of Defense Neil McElroy appointed an Agency director. He named Roy Johnson, Vice President of General Electric, to the post. Johnson is scheduled to start his job full time on April 1. Meanwhile, he will serve only two or three days a week.

His responsibilities have been very broadly defined so as to give the director and the Agency wide latitude. He will:

- Direct R & D projects designated by the Secretary of Defense;
- Arrange for performance of R & D by any other Federal Agency;
- Contract with individuals, private entities, educational, research, or scientific institutions;
- Contract for or acquire "such research, development, and test facilities and equipment as may be approved by the Secretary of Defense."

Johnson's first job will be to hire a well-rounded scientist to be his technical director. Next, he will have to assemble a staff of engineers and scientists familiar both with Government procedure and space technology.

Although no detailed program has been developed for ARPA, it is thought that the first project Johnson will handle will be the antimissile missile. The responsibility is now shared by the Army and the Air Force. The Army must develop the launching mechanisms and vehicle. The Air Force, the electronics. Actually, the Army and Air Force are working on competing electronic guidance and ground equipment systems. This is a demonstration of necessary duplication.

For the remainder of this fiscal year, ARPA has a budget of \$10 million from which to pay salaries and perform a small number of projects. After June 30, and if Congress is as generous as it was with the supplemental request, Johnson will have \$340 million to play with.

US-USSR Arrange Technical Exchange

Within the next two years, scientists and engineers from Russia and the U.S. will be touring each other's countries. They will deliver lectures and hold seminars. Some will conduct joint studies, probably only in the basic sciences.

This is the intent of an agreement signed recently between the U. S. and the USSR. Very likely, the electronics industry will be involved in the exchanges now being developed.

Both countries have agreed to promote the exchange of publications in science and technology between scientific institutions and societies. Individuals are also invited to participate.

A pot you can bet on

When you're playing with a hot system and the stakes are high . . . raise!

Raise as high as 150° C . . . and HELIPOT® series 5000 precision potentiometers will still operate continuously with 1 watt dissipation.

Although it's only 1/2 inch in diameter and weighs but 0.3 ounce, on this pot you can bet the limit. You'll hold the winning hand with these five high cards off the top of the Helipot deck:

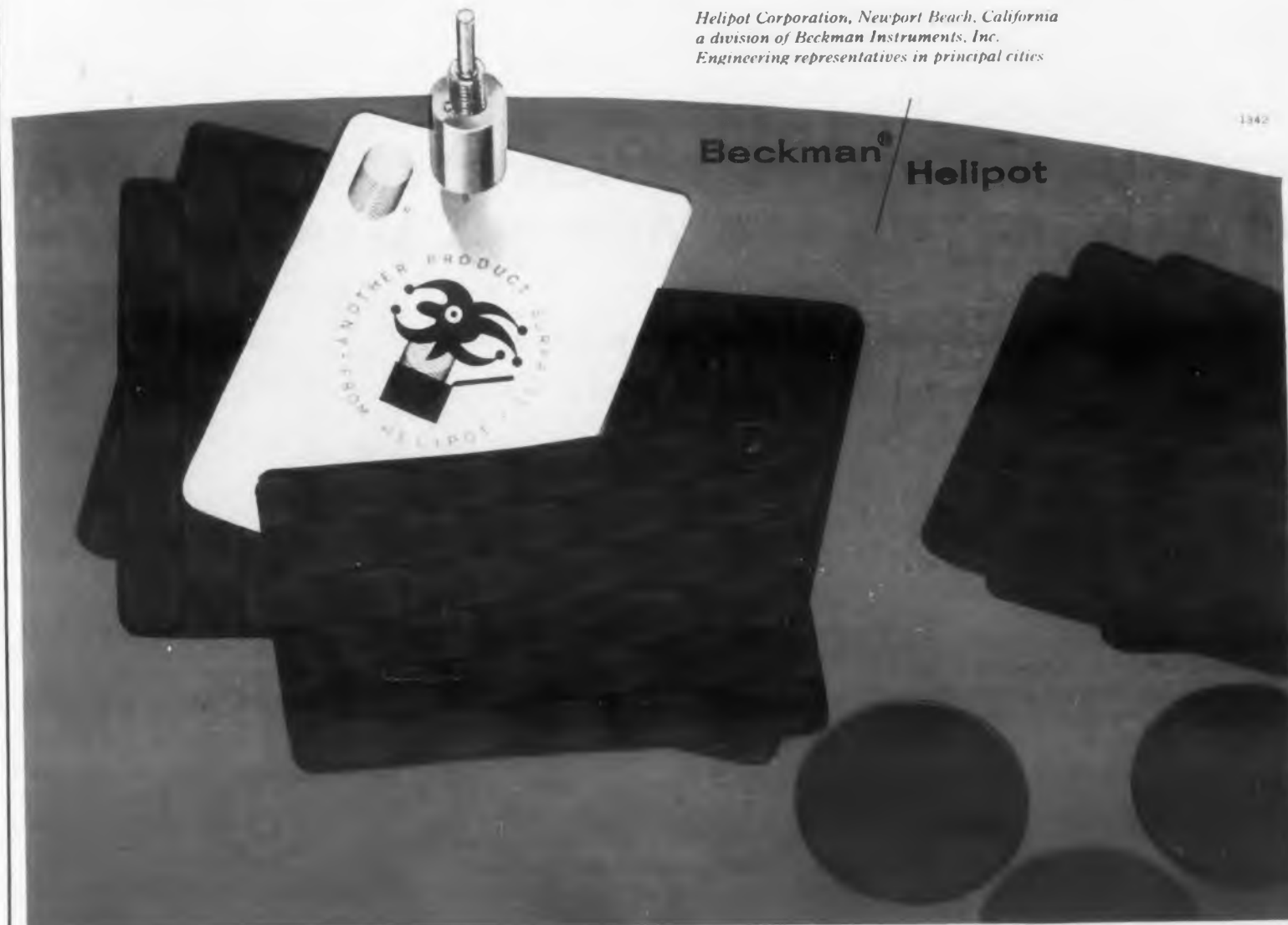
- stainless steel construction
- excellent linearity ($\pm 0.25\%$ best practical, $\pm 0.5\%$ standard)
- 500 to 100,000 ohms standard resistance range
- one-piece housing
- all-metal card for uniform heat dissipation

When the chips are down, these three standard models will strengthen your hand: the bushing-mount precision 5001, the servo-mount precision 5002, the trimming-type 5016.

There's a house full of specs the series 5000 meets or beats: JAN-R-19(7), MIL-E-5272A, NAS-710, MIL-R-12934A, MIL-E-5400, MIL-R-19518, MIL Std 202.

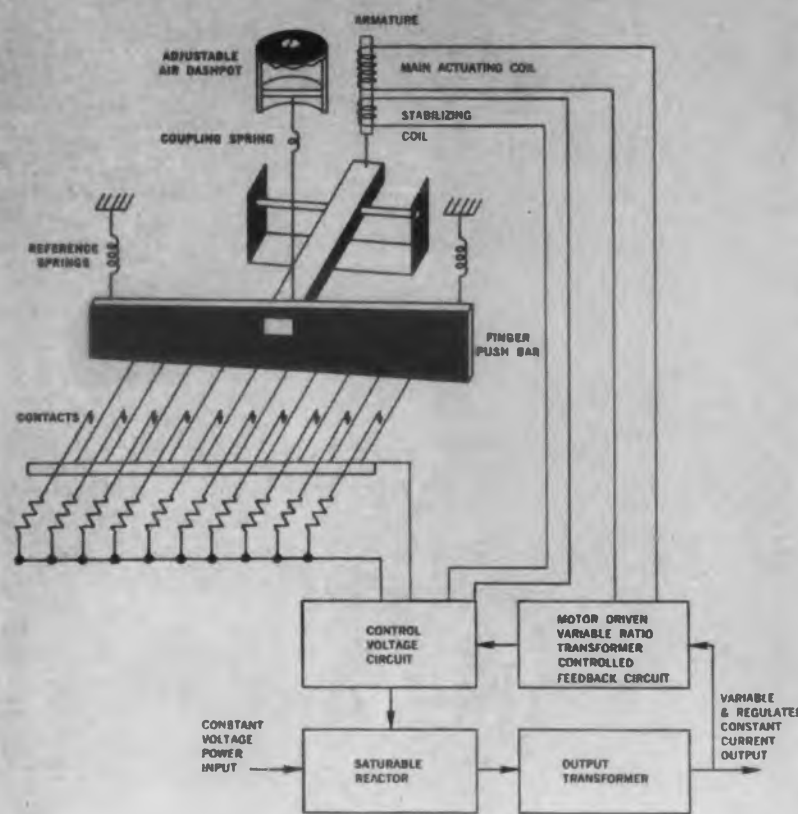
The straight inside story on the new series 5000 is available in data file 32C.

*Helipot Corporation, Newport Beach, California
a division of Beckman Instruments, Inc.
Engineering representatives in principal cities*



CIRCLE 13 ON READER-SERVICE CARD

REGOHM SOLVES Another Electronics Control Problem



REGOHM MAINTAINS OPTIMUM CURRENT LEVEL IN HEVI-DUTY'S CAA AIRPORT LIGHT SYSTEM

Hevi-Duty Electric Company, of Milwaukee, uses REGOHM in its Brightness Control Regulator (Type SCRVB), designed to meet the Civil Aeronautics Authority specifications for control of runway lighting. The rigid requirements of C.A.A. on lighting conditions, call for variable lumen output to meet different weather conditions—but demand strict conformance to the degree of illumination selected.

The Brightness Control system not only corrects for voltage variations in power supply lines, it also corrects for sudden changes in the load circuits. This critical control function is maintained by a Regohm unit that is monitoring the load circuits. The Regohm immediately senses any change in the current in the series lighting circuit, and corrects for the change by modifying the DC current feeding the saturable element in the regulator assembly.

Current to the lamps is kept constant at any preset level from 2.8 to 6.6 amperes and is within ± 0.10 amperes at maximum brightness for changes of -5% to $+10\%$ in the supply voltage and any changes in load

impedance. Thus if one or more lamps should fail during the aircraft's landing, there is no surge in the current to the lamps or change in lumen output.

Whenever close control is essential in electronic or electrical equipment, designers find big advantages in the Regohm's remarkable ratings on sensitivity, stability, wide range of control, resistance, durability, permanence of adjustment, rugged design and surprisingly low cost.

Electric Regulator Corporation produces many other control devices — line-load regulators, filament regulators, voltage and frequency monitors, airborne magnetic amplifiers, speed controls, servo motor controls, diesel governors, and MAGOHM magnetic voltage regulators.

Our engineers will be glad to show you how the right control can simplify many problems, both in performance and in cost. You may likely find your problem answered by some application already established. Call wire, or write: Electric Regulator Corporation, Norwalk, Connecticut.

CIRCLE 14 ON READER-SERVICE CARD



Please write for design, data and performance specs on REGOHM multi-stage regulators in applications similar to this.



ELECTRIC REGULATOR CORPORATION
NORWALK CONNECTICUT

MEETINGS

Mar. 27-29: Ninth Biennial Electrical Industry Show and Fifth Electrical Maintenance Conference

Shrine Exposition Hall, Los Angeles, Calif. Some of the topics to be discussed are maintenance to prevent breakdown, maintenance of electrical and electronic equipment and maintenance of lighting to assure peak output. For more details write Paul H. Henrichs, Southern California Edison Co., P.O. Box 351, Los Angeles, Calif.

Mar. 31-Apr. 2: AIEE South West District Meeting
Tulsa, Okla. For information send to the AIEE, 33 West 39th St., New York, N.Y.

Mar. 31-Apr. 2: Instruments and Regulators Conference

University of Delaware, Newark, Del. Sponsored by the IRE, ASME, AIChE, and ISA. For details send to E. M. Grabbe, P.O. Box 45067, Airport Station, Los Angeles 45, Calif.

Apr. 2-4: ASME Conference on Automatic Optimization

University of Delaware, Wilmington, Del. AIEE, IRE, ISA, AIChE with professional groups analogous to the IRE will participate in the conference by sponsoring technical papers centered around the theme, "Automatic Optimization." For details write W. E. Vannah, Control Engineering, 330 W. 42nd St., N. Y. 36, N. Y.

Apr. 8-10: Sixth National Conference on Electromagnetic Relays

Oklahoma State University, Student Union Building, Stillwater, Okla. Sponsored by the National Association of Relay Manufacturers. Papers will include the results of individual investigation by the authors. More information may be obtained from Charles F. Cameron, Dept. of Electrical Engineering, Oklahoma State University, Stillwater, Okla.

Apr. 8-10: Symposium on Electronic Waveguides
Auditorium of Engineering Societies Bldg., 33 W. 39th St., New York. Sponsored by IRE, PGED and PGMTT, and the Department of Defense Research Agencies. The symposium will deal

with the interaction of electromagnetic fields and electron or plasma beams in general waveguide regions. The symposium covers the fields of electron beams, plasmas, and electromagnetics to compare the rather widely disparate theories and techniques employed to describe the wave phenomena encountered in the interaction of such fields. For further information contact the Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, New York.

Apr. 10-12: IRE South West Regional Conference and Electronics Show

San Antonio Hotel and Municipal Auditorium, San Antonio, Tex. Write for details to J. O. Parr, Jr., 202 Janis Ave., San Antonio, Tex.

Apr. 14-16: Conference on Automatic Techniques

Statler Hotel, Detroit, Mich. Sponsored by the IRE, AIEE, and ASME. Information may be obtained by writing to J. E. Eiselein, Radio Corporation of America, Bldg. 10-7, Camden 2, N.J.

Apr. 17-18: Second Annual Technical Meeting of the Institute of Environmental Engineers

Hotel New Yorker, New York. A display of the earth satellite model and an address by Kurt R. Stehling, Propulsion Head of the Vanguard Missile Project, Naval Research Laboratory, will highlight the meeting. Write Institute of Environmental Engineers, 9 Spring St., Princeton, N. J., for further information.

Apr. 22-24: 1958 Electronic Components Conference

Ambassador Hotel, Los Angeles, Calif. Sponsored by the IRE, AIEE, EIA, and WCEMA. With "Reliable Application of Component Parts" as its main theme, the conference has been planned to cover the following general topics: resistors, capacitors, and dielectrics; transistors and solid state devices; component reliability; electron tubes and their application; and progress with materials. For complete information write to David M. Knox, Packard-Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64, Calif.

Apr. 24-26: URSI Spring Meeting

Willard Hotel, Washington, D. C. Sponsored by the PGAP, PGMT&T, PGCT, PGIT, PGI, and URSI. For information, contact John P. Hagen, Naval Research Lab., Washington 25, D. C.

NEW HIGH RELIABILITY



IN ELECTROLYTIC CAPACITORS!

These new dry electrolytic capacitors are especially built for applications that require an extremely high level of reliability over long periods of time.

Sangamo Type TR capacitors are designed to operate in a temperature range from -20°C to $+85^{\circ}\text{C}$.

The Type TR is well suited for use in communication systems; in all types of electronic industrial controls, laboratory test instruments, computer equipments, and in many other similar applications. Type TR capacitors are available in ratings from 3 to 450 volts D.C.

Sangamo Type TR TWIST-TAB ELECTROLYTICS



have a life expectancy of at least 10 years when operated within their ratings

These high reliability dry electrolytics are designed with safety factors to pass high ripple currents. The use of high purity aluminum foil assures lower leakage current, and a highly effective end seal gives these capacitors unusually long operating life provided they are operated within their ratings.

Engineering Bulletin TSC 119 gives full information.

SANGAMO
Electric Company
SPRINGFIELD, ILLINOIS

SC50-1
CIRCLE 15 ON READER-SERVICE CARD



1200 Printed boards assembled per hour . . . using Allen-Bradley composition resistors. Pressure sensitive tape holds resistors in place on reels for ease in automatic feeding.

Physical uniformity of ALLEN-BRADLEY resistors permits high-speed mechanized assembly

Allen-Bradley's exclusive process used in making its solid molded resistors assures dimensional uniformity that is astounding. Consequently, their use in mechanized assembly virtually eliminates costly shutdowns to clear jammed stations resulting from "off-size" units. The clean, tough surface of A-B molded resistors will withstand mechanized handling without chipping or cracking. Since wax is *not* used to provide moisture resistance, this source of trouble is also eliminated. Differentially tempered leads permit bending without wire breakage.

Electrically, Allen-Bradley resistors are universally recognized for their conservative ratings and stable characteristics. To realize the maximum output from your high-speed assembly process, specify Allen-Bradley *quality* resistors. Write for technical data, today.

Allen-Bradley Co., 1344 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.



A-B fixed resistors are available in 1/10, 1/4, 1/2, 1, and 2-watt sizes, in all RETMA values. Also carton packed for manual assembly.

ALLEN-BRADLEY

RADIO, ELECTRONICS, AND TELEVISION COMPONENTS

CIRCLE 16 ON READER-SERVICE CARD

MEETINGS

Apr. 28-30: AIMEE Middle Eastern District Meeting

Washington, D. C.

Apr. 30-May 1-2: 7th Regional Technical Conference & Trade Show

Hobbies Bldg., State Fair Grounds, Sacramento, Calif. Write Ewald W. Berger, 3421 58th St., Sacramento 20, Calif. for information.

May 1-8: ASTE Tool Show

Convention Center, Philadelphia, Pa. A complete integrated technical program of papers, panels, seminars, plant tours, and related activities will be offered. For further information, write Richard Gebers, Public Relations Manager, 10700 Puritan, Detroit 38, Mich.

May 4-7: 4th National Flight Text Instrumentation

Park-Sheraton Hotel, New York City. Sponsored by the Instrument Society of America. Coverage of all phases of instrumentation for aircraft testing will be offered including sessions on helicopter and power plant instrumentation. Three sessions will be specifically devoted to Missile Instrumentation. Another session will be spent on the instrumentation for ground testing of aircraft and aircraft systems. Theme of the Symposium is "More Data Per Dollar." For details write P.O. Box 113, Bethpage, N. Y.

May 5-7: AIEE Great Lakes District Meeting

Michigan State University, East Lansing, Mich.

May 6-9: Western Joint Computer Conference

Ambassador Hotel, Los Angeles, Calif. Cosponsored by IRE, ACM, and AIEE. Theme of the conference will be "Contrasts in Computers," with panel discussions on controversial aspects of modern computers. For more information write David Parry, 6363 Wilshire Blvd., Los Angeles 48, Calif.

May 13-15: AIEE East Central District Meeting

Huntington, W. Va.

EDITORIAL

We Refuse To Boast

Sometimes the urge to toot our own horn is almost irresistible. Lately we have been tempted to boast about our foresight in translating and abstracting important Russian engineering articles as early as August 1955.

Sometimes, in moments of forgetfulness, we want to sing our own praises, and tell the world how, long before Sputnik, we engaged one of the country's foremost scientific translators, Mr. J. George Adashko, to abstract articles from Russia's leading electronics journals for ELECTRONIC DESIGN.

When, three years ago, we shouted from the rooftops

"Let's read what the Russians are writing. They refer to our scientific works, and they've probably learned a lot from us. Let's read their literature, if only to learn what they are up to technologically."

we felt that someday everybody would be echoing us.

- President Eisenhower, in his education message to Congress on January 27th asked for funds to help improve foreign language study in our schools. Marion B. Folsom, Secretary of Health, Education and Welfare, following the president, estimated that 10,000,000 Russians are studying English, while fewer than 8,000 Americans are studying Russian.

- Also in January, the U.S. Department of Commerce requested \$300,000 to initiate a Foreign Technical Information program to set up a central clearinghouse to collect, evaluate and distribute valuable foreign scientific and technical literature for American scientists and engineers.

- Last August the National Science Foundation granted \$70,000 for translating three of the Russian journals which ELECTRONIC DESIGN has been reviewing regularly—*Radiotekhnika*, *Elektrosvyaz'*, and *Radiotekhnika i Elektronika*.

- Last month, General Electric, the Mohawk-Hudson Council on Educational Television, and the Northeastern branch of the American Chemical Society began teaching Russian on television.

We are gratified to see these developments and to note the leap in reader interest in our Russian Translations. It was Sputnik that started the ball rolling, but we are elated that we were among the first to see the need. The temptation is great indeed, but we refuse to boast.—GR



*complete instrumentation
systems by HALLAMORE*

A NEW CONCEPT IN VOLTAGE CONTROLLED OSCILLATORS



module size 2" x 7 $\frac{3}{4}$ "... adjustable internal bias... all standard IRIG channels... The voltage controlled subcarrier oscillator, shown in this building block type FM instrumentation system, is the latest in a series of building-block components developed by Hallamore Electronics Company for the instrumentation field. Engineered for stability and flexibility, the unit designated HEC-0161 is entirely compatible with existing systems and offers unusual advantages in improved accuracy, operational simplicity, and the saving of space. A standard module case will accommodate up to six oscillators and a summing amplifier, HEC-0165. A common supply, HEC-0144, integral to the module case, provides the power in this configuration, while an individual supply, HEC-0143, is available to provide complete isolation for each transducer input.

The basic Hallamore voltage controlled subcarrier oscillator unit, HEC-0161, can be instantly converted to any IRIG telemetering channel by plug-in channel selectors, HEC-0164, and output filters, HEC-0163. Plug-in units for non-standard channels and bandwidths can be supplied. For complete specifications and operational data, write Hallamore Electronics Company, Dept. 24J, 352 Brookhurst Avenue, Anaheim, Calif.



**HALLAMORE ELECTRONICS
COMPANY** *a division of the SIEGLEN CORPORATION*

CIRCLE 17 ON READER-SERVICE CARD

VHF Matching Network Design

A. E. Sanderson
Aircraft Radio Corp.

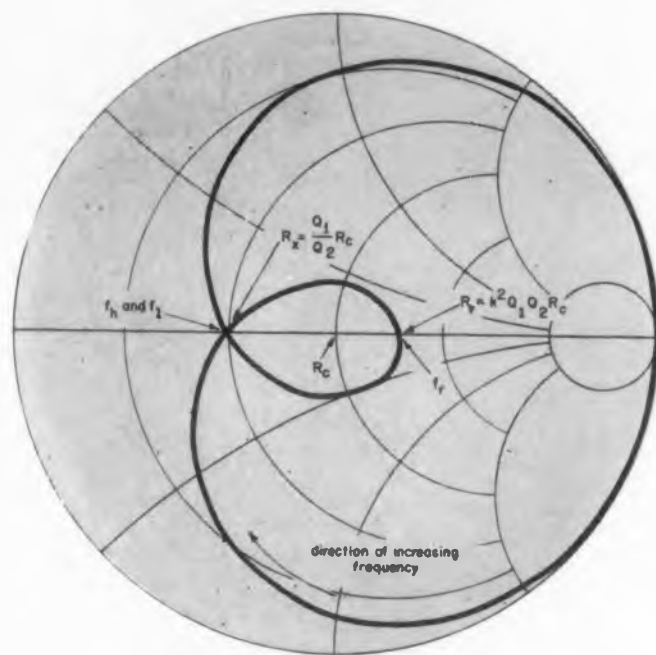


Fig. 1. Input impedance curve of two over-coupled, synchronously tuned circuits.

A NEW METHOD of designing optimum bandpass filters and matching networks utilizes the analysis of a curve of input impedance vs frequency plotted on the Smith chart. The method is valid when loaded Q 's are much less than unloaded Q 's, and means are given to check this condition. It is valid for narrow band and wide band networks because the design equations involve no approximations. A vhf impedance or admittance bridge and associated generator and detector are required, as well as a vhf transmission line calculator¹ to remove the unavoidable effect of line length be-

tween the bridge and the network under design.

Two typical problems which can be handled by this method are:

- Using one tuned circuit as a matching section, match a quarter-wave resonant antenna to a 50 ohm transmission line. Keep the vswr as low as possible over the band 118 to 148 mc.

- Design a double tuned bandpass filter to match a 500 ohm resistive load to a 50 ohm transmission line. Keep the vswr 2:1 or less over the band 118 to 148 mc. Use the highest possible Q 's in the design to obtain the best skirt selectivity.

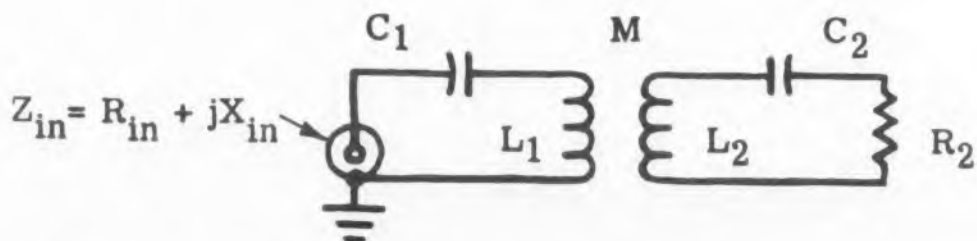


Fig. 2. Circuit for the mathematical analysis of synchronously tuned coupled circuits.

Exact values for the circuit Q 's and for the coefficients of coupling can be obtained for these and similar problems.

At high frequencies, the effective values of capacity and inductance are usually different from their nominal values. Stray capacity and lead inductance become important; ordinarily the first model of a network will not give the desired response. This method will point out which components to change in value, and how much to change them, to compensate for these effects and bring the network into agreement with the theoretical response it should have.

Circuit Analysis

Consider the input impedance of the circuit shown in Fig. 2. Straightforward analysis yields:

$$R_{in} = \frac{\omega^2 M^2}{R_2^2 + X_2^2} R_2; \quad (1)$$

$$X_{in} = X_1 - \frac{\omega^2 M^2}{R_2^2 + X_2^2} X_2;$$

where $X_1 = \omega L_1 - 1/\omega C_1$, and $X_2 = \omega L_2 - 1/\omega C_2$

A plot on the Smith chart of $Z_{in} = R_{in} + jX_{in}$ from zero to infinite frequency is shown in Fig. 1 for overcoupled circuits both resonant at f_r . From this it can be seen that the input impedance curve forms a loop. The size and placing of this loop can be related easily to Q_1 , Q_2 and k .

Note that Z_{in} is a pure resistance at three frequencies: the resonant frequency f_r , at a higher frequency f_h and at a lower frequency f_l . The resistance at resonance is R_r . The crossover falls on the resistive axis, and the crossover resistance is designated R_x . Equations (1) and (2) can be solved for R_r and R_x by solving for R_{in} with $X_{in} = 0$.

$$R_r = k^2 Q_1 Q_2 R_c \quad (3)$$

$$R_x = (Q_1/Q_2) R_c \quad (4)$$

where R_c is the characteristic impedance of transmission line, to which all measurements are normalized, and

$$Q_1 = \frac{\omega_r L_1}{R_c}, \quad Q_2 = \frac{\omega_r L_2}{R_2}, \quad k^2 = \frac{M^2}{L_1 L_2},$$

$$\omega_r = 1/\sqrt{L_1 C_1} = 1/\sqrt{L_2 C_2}$$

Equations (3) and (4) prove several interesting things about the loop. As the coefficient of coupling, k , is varied, the loop grows and shrinks, but the point of crossover remains fixed. As Q_1 is varied, the loop is shifted to the left or right, but its size is held constant. As Q_2 is varied, the size of the loop changes, but the center of the loop does not move. Each of the variables, Q_1 , Q_2 and k , has a separate and distinct effect upon the loop, so that it is possible to tell exactly what is wrong with a network under design by analyzing a curve of its input impedance.

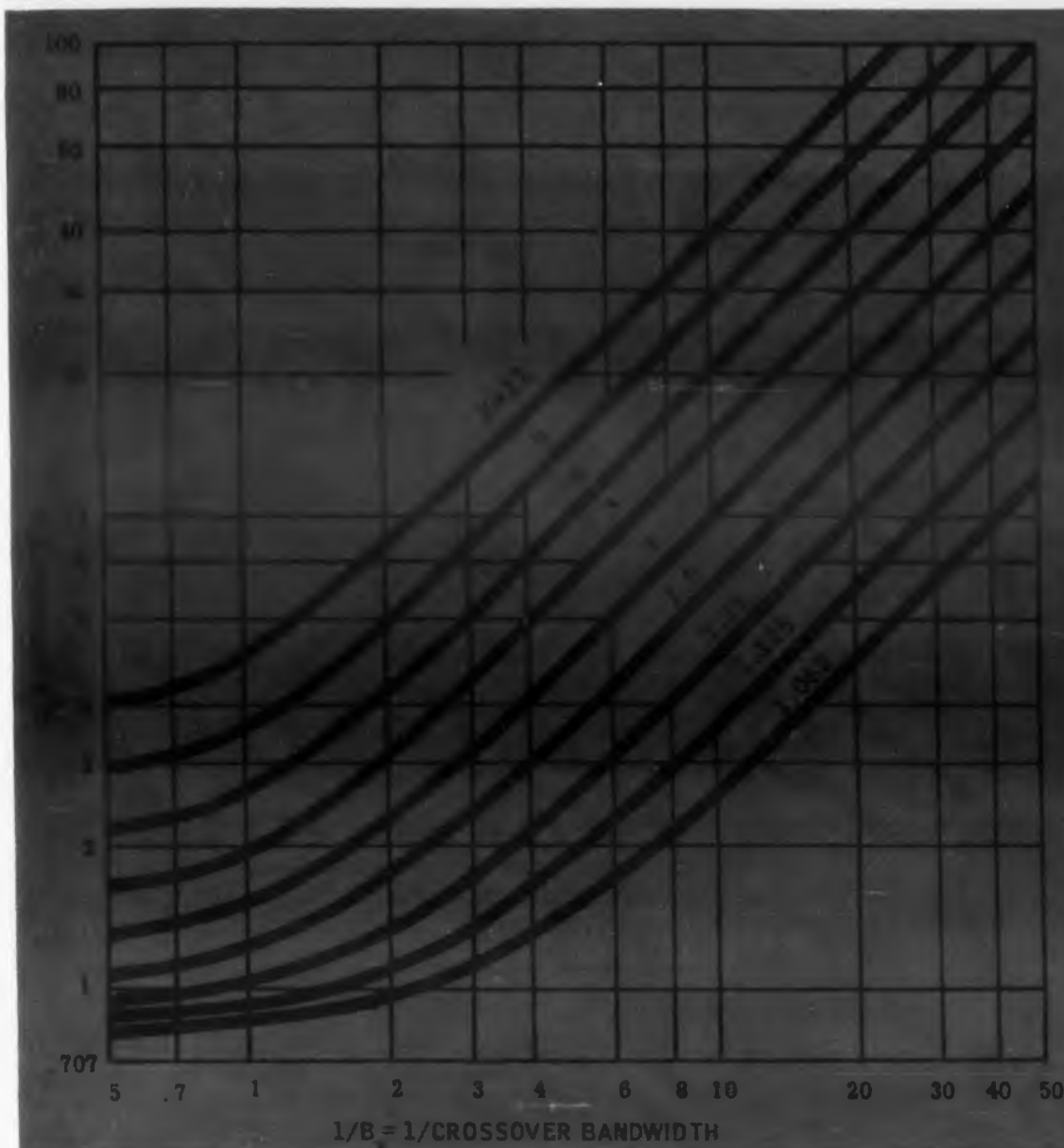


Fig. 3. Solution of problem 2. Match 50 ohm cable to 500 ohm resistive load, over band of 118 to 148 mc. Keep VSWR less than 2.

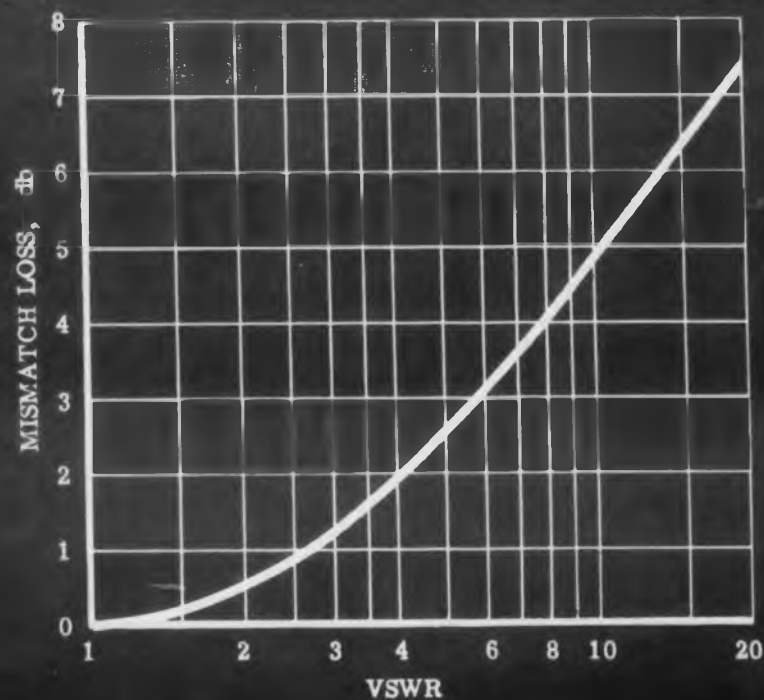


Fig. 4. Relation between VSWR and mismatch loss.

It is possible for two networks to have the same size and placing of the loop and yet have different bandwidths, so a bandwidth must be assigned to this figure. Using the two frequencies associated with the crossover, a new term will be defined as *crossover bandwidth*, B_c .

$$B_c = 2 \frac{f_h - f_l}{f_h + f_l} \quad (5)$$

This is the frequency difference divided by the average of f_h and f_l rather than the geometric mean. An exact expression for B_c has been derived:

$$B_c = \frac{2}{A + \sqrt{A^2 - 1}} \quad (6)$$

$$\text{where } A = \frac{2Q_2^2 - 1}{\sqrt{(\gamma - 1)(4Q_2^2 - 1)}} \quad (7)$$

and γ is the loop ratio: the ratio of the maximum resistive component of the input impedance to the resistance at the crossover point.

$$\gamma = R_{max}/R_c$$

Since the maximum resistive component of the impedance does not occur quite at resonance,

$$R_r = R_{max} (1 - 1/4 Q_2^2) \text{ and} \\ \gamma \cong R_r/R_c = k^2 Q_2^2.$$

These equations show another unusual feature of the loop. Both the crossover bandwidth and the loop ratio are independent of Q_1 .

Equation (6) is plotted exactly in Fig. 3. The left hand axis corresponds to a bandwidth of 2, which would be a high-pass or low-pass network having the specified value of γ . This always requires that $k = 1$, so the network reduces to a conventional three-element filter. For most purposes an approximate formula is sufficiently accurate, and easy to remember:

$$B_c = \frac{\sqrt{\gamma - 1}}{Q_2} \quad (8)$$

The curve of Fig. 2 is uniquely determined by specification of R_c , γ , f_h and f_l . The question remains as to what position of the curve will give optimum results for a particular design problem. Two general cases need to be considered. In one case a reactance associated with the load limits the

match which can be obtained over a specified bandwidth. In the other case a specified maximum limit on mismatch over a specified bandwidth sets an upper limit on the magnitude of the Q 's which may be used.

General Case 1

Q_2 is fixed. Q_1 and k are variable. Minimum vswr is realized for a specified bandwidth when the loop is made to encircle the R_c point symmetrically, so that

$$R_x/R_c = R_c/R_{max}$$

Those frequencies which fall on the loop are within the passband, so that B_c equals the specified bandwidth, and $\sqrt{\gamma}$ equals the maximum vswr within the band. Having specified Q_2 and B_c , the lowest possible γ is determined from Fig. 3, or by solving approximate eq (8) for γ :

$$\gamma = (B_c Q_2)^2 + 1.$$

Solving for Q_1 and k explicitly:

$$Q_1 = Q_2/\sqrt{\gamma} \text{ and } k = 1/Q_1.$$

In practice, Q_2 may not be known in advance. It

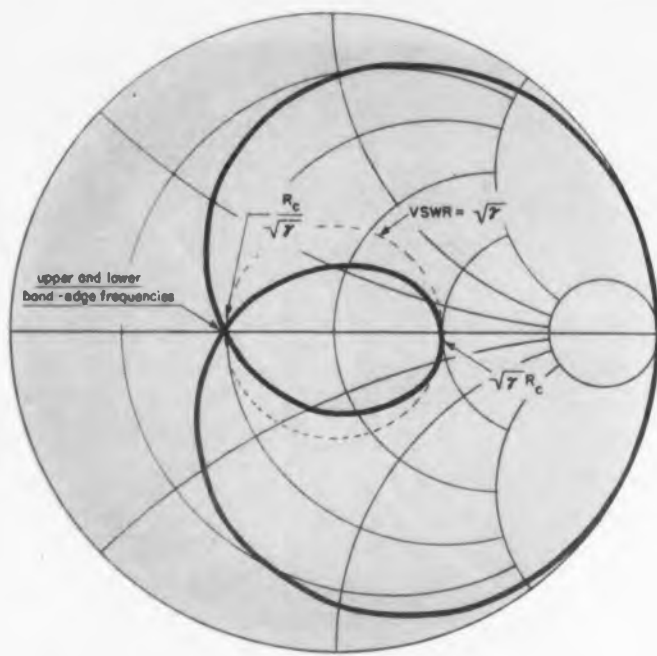


Fig. 5. Impedance curve for minimum VSWR, given fixed bandwidth and secondary circuit Q .

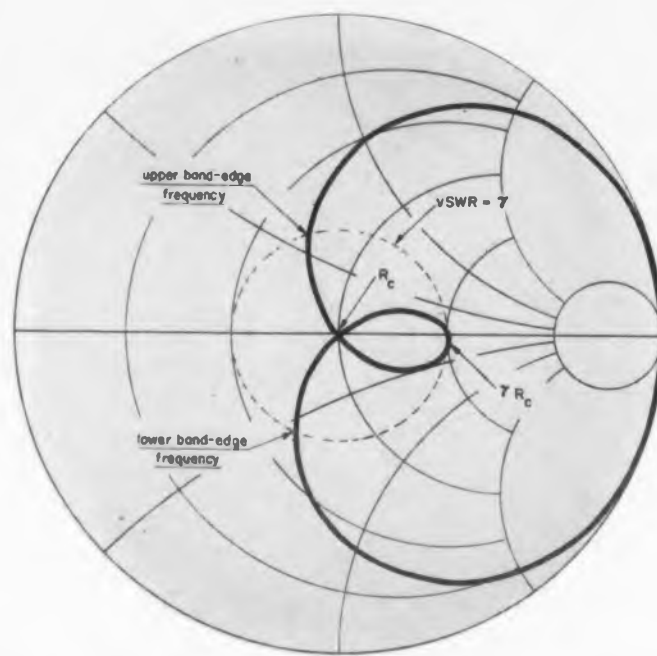


Fig. 6. Impedance curve for highest possible circuit Q 's, given fixed bandwidth and secondary circuit Q .

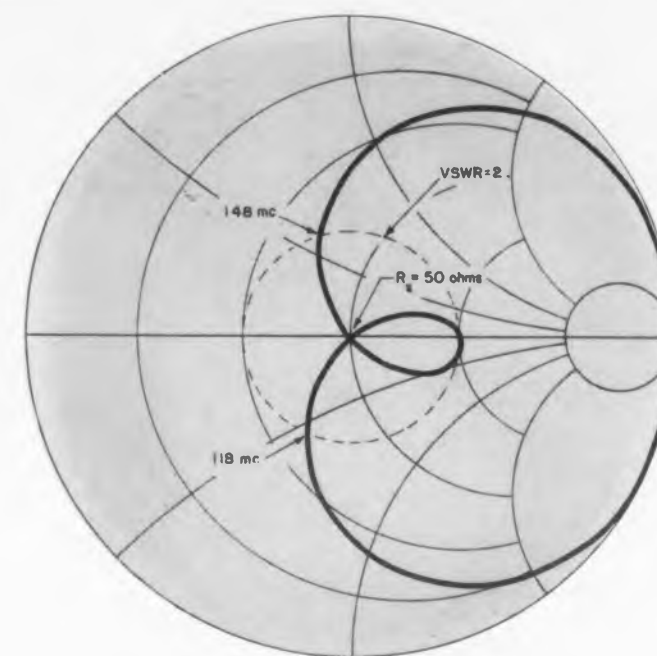


Fig. 8. VHF Matching network design.

may be possible to measure Q_2 , but it is better to calculate it from measured values of B_x and γ and after a trial network has been constructed.

General Case 2

R_2 is fixed. Q_1 , Q_2 and k are variable. Both bandwidth and maximum vswr within the band can be specified. In order to determine what vswr is tolerable, the relation between vswr and mismatch loss in db is shown in Fig. 4. Maximum mean Q , and therefore maximum skirt selectivity, is realized when $Q_1 = Q_2$. This requires the crossover to be at R_c . The maximum vswr at the center of the band equals γ , and the passband includes those frequencies which fall within the circle of $vswr = \gamma$. Specified bandwidth equals $\sqrt{2} \cdot B_x$ for moderate bandwidths, and the error is less than 1 per cent for a bandwidth of 1.0.

Solving for Q_1 , Q_2 and k explicitly:

$$\gamma = vswr_{max}$$

$$Q_1 = Q_2 = \sqrt{\gamma - 1} B_x \text{ and } k = \sqrt{\gamma} Q_1$$

Tune Up Considerations

Inspection of the impedance curve will determine if both circuits are tuned to the same frequency. Detuning the primary to a lower frequency results in shifting the loop to a lower position on the Smith chart. A properly tuned network has two equal minima on the vswr vs frequency curve; the axis of symmetry of the loop must therefore pass through the center of the chart. In practice, stray effects may cause this crossover axis to be tilted, although the network is properly tuned. In this case, base all calculations upon the intersections of the impedance curve with the crossover axis, rather than the horizontal axis.

It is sometimes useful to know, in tuning up, that the resonant frequency of the secondary is roughly equal to $(f_h + f_l)/2$. In general it is faster to use some independent method to tune up.²

Alternate Circuits

The above results can be generalized to apply to any pair of coupled circuits. The method of coupling the two circuits together has no effect upon the curve shapes; it may be T or π , inductive or capacitive, or any other. The choice depends upon the practicability of the required component values, and the relative steepness required of the selectivity curve above the band to that required below the band.

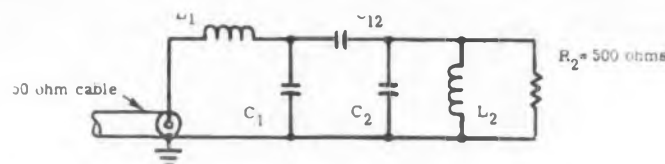


Fig. 7. Circuit for the solution of problem 2.

If the primary circuit is connected in parallel across the source, instead of in series as shown, then the curves will be rotated 180 deg from the positions shown. This will invert the formulas for R_x , R_r and γ as follows, using primes to denote parallel connection.

$$R'_x = (Q_2 / Q_1) R_c, R'_r = R_c / k^2 Q_1 Q_2, \gamma \cong R'_x / R'_r.$$

The remaining formulas are unaffected.

Design Procedure

Once the network configuration has been decided upon, the input impedance curve can be sketched on the Smith chart by inspection. The connection of the primary circuit determines whether the curve will be series type or parallel type. In either case

frequency will always increase in the clockwise direction around the curve and around any loops which are formed. The required behavior within the passband determines R_x and R_r and enables the curve to be completed.

Using the calculated values for Q_1 , Q_2 and k , numerical values are calculated for each of the circuit elements. The network is constructed using components having these nominal values, tuned up, and an impedance curve is taken. In general the result will not be very close to the optimum curve due to stray effects. From this first curve the true values of Q_1 , Q_2 and k are calculated, and then the effective values of L and C of all the individual components. All components whose effective values do not agree with the required values are removed. They are replaced by components whose nominal values are above or below the required values by such an amount that their effective values when placed in the circuit will equal the required values. For example, if a nominal 10 μf capacitor calculates to have 14 μf effective capacity in the circuit, remove it and replace it with a nominal 7 μf condenser.

An impedance curve on the second network should agree closely with the optimum curve. If it does not, the above steps are repeated. *Convergence on the desired result is very rapid because all the components are being tested simultaneously and independently. The method points out which components are in error, and tells exactly how much of a correction is required.* Trial and error procedures are eliminated.

After the construction of a network, it is necessary to determine whether substantially all of the power being delivered into its input is going into the load. This will be true only if the unloaded Q 's of the network are high compared to the loaded Q 's.

To check this condition, remove the terminating load from the network. This may be a crystal mixer, a radiating antenna or a vacuum tube input impedance, for example. The vswr is measured over the band. Then the load terminals are shorted together, and the vswr measurements repeated. Power loss will be approximately $1/vswr$, where vswr is the smallest of the values determined above. For example, if the vswr becomes as low as 10, the power loss will be about 0.5 db.

Numerical Example

The solution of *Example 2* will be used as a numerical example. The circuit of Fig. 7 was chosen for convenience. The primary L and C are in series, so the impedance curve will be the series type as shown in Fig. 8. Since the load is resistive, the Q's will be equal and the crossover will be at 50 ohms. Specified bandwidth is 30 mc, so crossover bandwidth, B_r , will be $30/\sqrt{2}$ or 21.2 mc, divided by the center frequency, 133 mc.

$$B_r = 1/6.27.$$

The vswr will be 2 at resonance, so $R_r = 100$ ohms. Since $R_r = 50$ ohms, $\gamma = 2$. Using these values of B_r and γ , a value of $Q_2 = 6.4$ is obtained from Fig. 3. Therefore, $Q_1 = 6.4$. From the equation for k , we have $k = \sqrt{2}/6.4 = 0.22$.

Applying these values of Q_1 , Q_2 and k to this circuit:

$$\omega_r L_1 = 50 \times 6.4 = 320 \text{ ohms} \quad L_1 = 0.38 \mu h$$

$$\omega_r L_2 = 500 / 6.4 = 78 \text{ ohms} \quad L_2 = 0.094 \mu h$$

$$\frac{1}{\omega_r(C_1 + C_{12})} = 320 \text{ ohms} \quad C_1 + C_{12} = 3.8 \mu f$$

$$\frac{1}{\omega_r(C_2 + C_{12})} = 78 \text{ ohms} \quad C_2 + C_{12} = 15.2 \mu f$$

$$k = \frac{C_{12}}{\sqrt{(C_1 + C_{12})(C_2 + C_{12})}} = 0.22 \quad \begin{array}{l} C_{12} = 1.7 \mu f \\ C_1 = 2.1 \mu f \\ C_2 = 13.5 \mu f \end{array}$$

Now the network must be constructed, measured, and effective values calculated for all components. The proper replacement of all components not producing the required effective values will yield a network whose input impedance will be a close approximation to Fig. 8.

References

1. VHF Transmission Line Calculator, A. E. Sanderson. *Electronics*, Dec. 1955, p. 168. This calculator is available in red or black from Radio Activities, Inc., Boonton, N.J.
2. Alignment of Filters, M. Dishal. *Proc. IRE*, Nov. 1951, p. 1448.
3. An Admittance Chart, H. M. Wasson. *RCA Report LB-976*.

For a free reprint of this article, turn to the Reader's Service Card and circle 19.

AMP's custom-designed
and versatile line

FOR RADAR AND ELECTRONIC EQUIPMENT APPLICATIONS

Ampli-FILM® the all-purpose high voltage dielectric
... is not affected by acids or organic solvents
... undergoes no distortion under high temperatures and pressures
... is readily bonded by adhesives
... is easy to handle and fabricate

CAPITRON® WAFER CAPACITOR—Ampli-FILM® dielectric sheets and high conductivity copper electrodes are bonded together under high heat in hydraulic presses using a special non-polar thermo-plastic bonding resin to obtain a solid, void-free sealed capacitor for rugged requirements in high voltage circuits. Having indefinite shelf life, these capacitors are designed for use in oil filled assembly, but also they are well suited for many applications in potted or encapsulated assemblies. They can be supplied in various form factors including curved shapes.

CAPITRON® POWER SUPPLIES—Use of Capitron® Wafer Capacitors enables AMP to provide a wide variety of high voltage power supplies for radar indicators and radar modulators. The small size and light weight of these units dictates their use in many airborne applications. They are supplied either as oil filled metal cased units or as epoxy encapsulated units. AMP's LGH terminals solve high altitude application problems.

CAPITRON® ARMORED WAFER CAPACITOR—Factors of this Capacitor are as follows

- Armor type encapsulation to resist extreme thermal and mechanical shock.
- Eliminates high altitude flash-over, as metal terminals are not exposed . . . they are enclosed within the armor encasement.
- Multiple connections to capacitor leads can be made with little or no increase in over-all size of the capacitor.
- Versatility of design eliminates revamping assembly to accommodate the capacitor.

CAPITRON® PULSE SYSTEM PACKAGE—Charging choke, pulse forming network and pluse transformers are combined in a unit of minimum size and weight to work with a specific magnetron. All components are designed by and manufactured under the direct control of AMP's pulse specialists.

CAPITRON® PULSE FORMING NETWORKS—AMP pulse forming networks can be supplied to meet rigorous specifications with special emphasis on high reliability, small size and light weight for airborne radar applications.

CAPITRON® WAFER CAPACITOR



CAPITRON®
CURVED WAFER CAPACITOR



CAPITRON® POWER SUPPLY



CAPITRON® POWER PACK



CAPITRON®
ARMORED WAFER CAPACITOR



CAPITRON®
PULSE SYSTEM PACKAGE



CAPITRON®
PULSE FORMING NETWORKS

AMP INCORPORATED CAPITRON DIVISION

155 Park Street, Elizabethtown, Pennsylvania

A-MP products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

CIRCLE 18 ON READER-SERVICE CARD

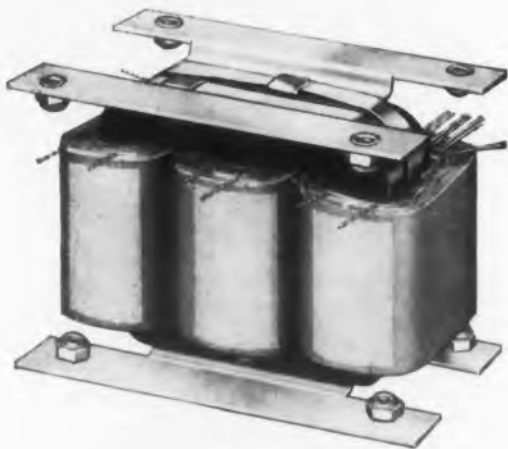
AMP

This Transformer Provides Perfect Performance Over a Total Temperature Range



-55°C to +300°C

The encapsulated transformer shown above is rated at 60 VA, 6.3 volts; input 115 volts 400 cycle. Overall dimensions 2 x 2-1/16 x 2-3/16. Weight 6 ounces. Temperature range -55°C to +300°C. This transformer could be called a product example of Acme Electric research into transformer performance under wide differences of environmental conditions. In designing, building, testing and breakdown analyzing of transformers that have been subject to a 355°C temperature range, Acme Electric engineers accumulated a wealth of information and facts about materials and construction. This experience is available to you, if you need transformers as components to equipment that must meet unusual temperature requirements.



Another construction design (shown above) is also for high temperature environmental operation. Special, thoroly tested materials and new construction principles are features that provide required performance.

ACME ELECTRIC CORPORATION
903 WATER STREET • CUBA, NEW YORK

Acme Electric
TRANSFORMERS

CIRCLE 20 ON READER-SERVICE CARD

MASER is Here

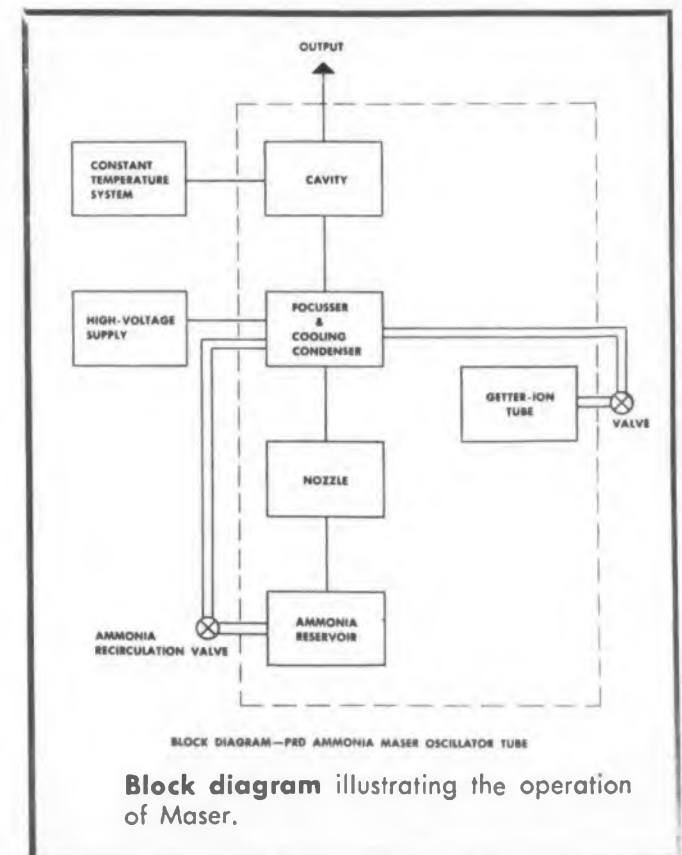
For Sale

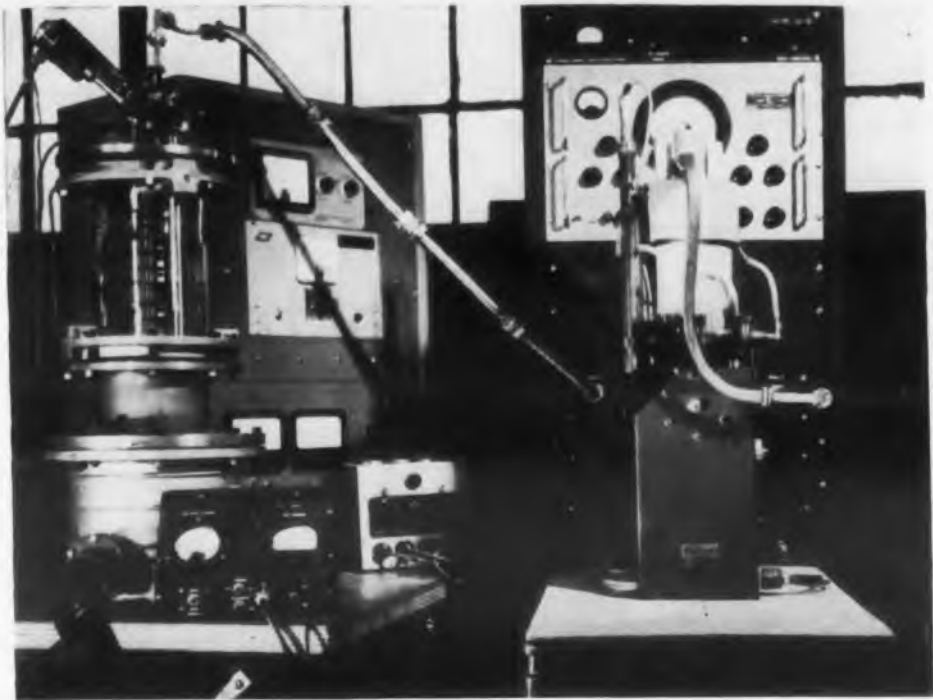


The first portable, sealed ammonia-type Maser oscillator.

IF YOU want the exact time, you might want to check your watch against a Maser oscillator. You can buy one now (for about \$7000) to generate a signal at 23.8701924 kmc ± 0.0000005 kmc, the most accurate time available. Stability is better than one part in a billion. If you don't believe it, check it.

Maser (for Microwave Amplification by Stimulated Emission of Radiation) has till now been a laboratory curiosity. A few labs in the country have built





Maser at work.

Masers just to investigate their properties. Polytechnic Research & Development Co., Inc. of 202 Tillary St., Brooklyn, N.Y., has built the first units for sale, and portable ones at that. They weigh only 20 pounds and occupy 1/4 cubic foot.

These Masers are sealed ammonia types. They may have important applications in space guidance and navigation, coded communications and Doppler navigation. They have excellent potential

as basic research tools for establishing new theories and re-evaluating existing theories in physics, chemistry and other branches of science.

An ammonia type Maser directs the flow of ammonia molecules within a low pressure system into an electrostatic field. Liquid nitrogen cools a condensation chamber surrounding the field. This field focuses the molecules in the upper energy states and beams them into a high Q resonant cavity operating in the TM^{010} mode. Lower energy molecules are deflected away from the cavity and condense on the chilled (!) chamber walls.

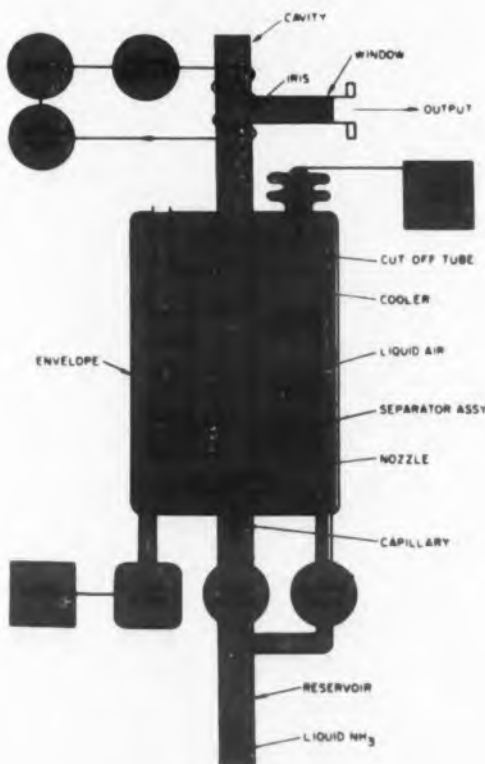
When the molecules entering the cavity return to their lower energy state, a stimulated emission takes place resulting in electro-magnetic oscillation. The accompanying block diagram illustrates the operation.

A high vacuum, essential to the system, is maintained by a getter-ion tube, which flashes periodically to remove residual gases. Stability of the system is further assured by a temperature control system which regulates the temperature of the resonant cavity to within 0.02 deg C.

You can operate this Maser more than 500 hours without breaking the vacuum seal, and then an additional 500 hours, after replacing some inexpensive parts. Maser's shelf life is at least one year.

More information is available if you turn to the Reader's Service Card and Circle 21.

Booth 3602, 3604 at the IRE show.



Cross-section of Maser.



NOW-
**IMC'S versatile new
 3800 MOTOR**

IMC's new 3800 Frame series is the ultimate in diversity for motors of this type. These AC motors, available for induction, torque or hysteresis synchronous applications, are designed to all commercial and military specifications, with built-in resistance to humidity, vibration, shock, radio noise and salt spray. The unit can be supplied as self cooled with internal fan.

SPECIFICATIONS—3800 FRAME AC MOTORS

INPUT VOLTAGE: 26 to 230 volts AC 1, 2 and 3 phase

INPUT FREQUENCY: 25 to 400 cycles

NUMBER OF POLES: 2, 4, 6, 8 and 12 poles

OUTPUT POWER: Induction motors—to 1 hp

Torque motors—10 to 200 oz. in. stall torque

Hysteresis synchronous motors—1/200 to 1/4 hp

(Can be wound for single, dual or three speed)

AMBIENT TEMPERATURE: -55° to +71° C. standard
 -55° to +150° C. available

BEARINGS: Ball or sleeve

MOUNTING: Round or square flange and/or base

SHAFT: Single or double extension—max. dia.—.4997

WEIGHT: 8-11 lbs.

The 3800 Series can also be supplied for use as fan and blower motors and permanent magnet generators. Request Bulletin 38 from



Induction Motors Corp.

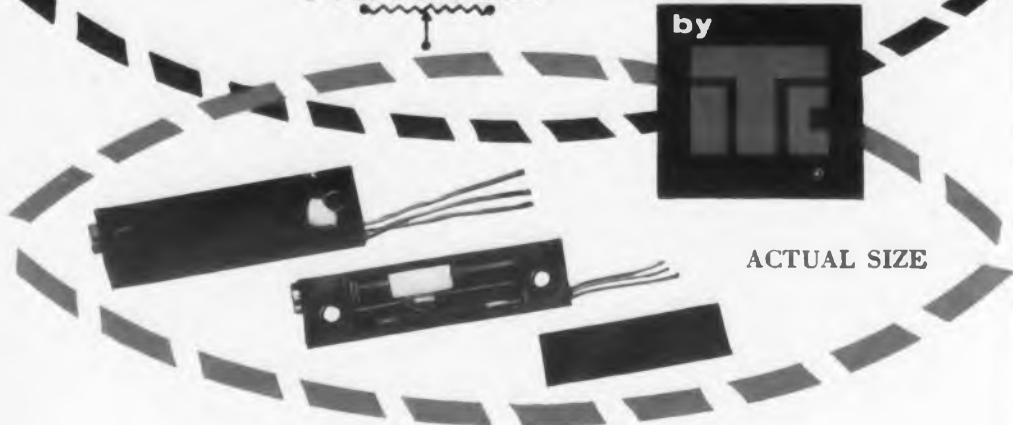
570 Main St., Westbury, L. I., N. Y.

Phone EDgewood 4-7070

CIRCLE 22 ON READER-SERVICE CARD

NEW SUBMINIATURE HIGH TEMPERATURE

TRIMMER



Now available as a wirewound or film type trimmer that is moisture proof, subminiature in size and withstands a temperature of 225°C., in a higher resistance range.

FEATURES:

Type RTW (wirewound) Resistance Range 100 ohms to 100,000 ohms

Type RTF (film) Resistance Range 100 ohms to 25,000 ohms, providing infinite resolution

25 turn lead-screw adjustment

Unique stop-overide safety mechanism

Housing of High Temperature Molded Plastic

Variety of mountings: Printed Circuit Lugs
Printed Circuit Wires
Tinned Leads

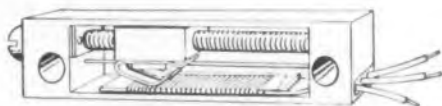
Virtually hermetic sealed meets Mil std. 202 Procedure 106 Humidity Test with rated power applied

Precious metal take off and end tabs

Dual stainless steel contacts on winding and slip ring for extra reliability

Power rating of .83 watts at 80° C., .1 watt at 200° C.

Engineered, quality controlled manufacture and environmental tested to meet the exacting demands of missile and other military applications, make these new low cost trimmers a long-sought contribution to design and production problems.



Write wire or call for full details and technical data.

TECHNOLOGY INSTRUMENT CORP.
555 Main St., Acton, Mass., COLonial 3-7711
North Hollywood, California
POplar 5-8620 STanley 7-0286



CIRCLE 23 ON READER-SERVICE CARD

Zener Diode Characteristics

THIS LIST of 321 Zener diodes, one section of D.A.T.A.'s semi annual complete Semiconductor Diode and Rectifier list, has been compiled by Derivation and Tabulation Associates, Inc., West Orange, N.J. These Zener diodes are listed by their electrical characteristics, in order of minimum Zener voltage, maximum Zener voltage, type number.

Zener diodes are intended for use in applications where it is important to maintain a constant dc voltage level. They can be used to great advantage in conjunction with transistors and magnetic amplifiers to correct characteristic variations brought about by temperature changes. Silicon Zener diodes can maintain a constant voltage level under conditions of high temperature, severe shock, and vibration.

The Zener breakdown is similar to the action of glow-discharge gas tubes. Accumulation of current carriers make possible a high reverse current flow. In fact, beyond the breakdown point, the silicon diode has almost identical characteristics to the gas regulator tube; it

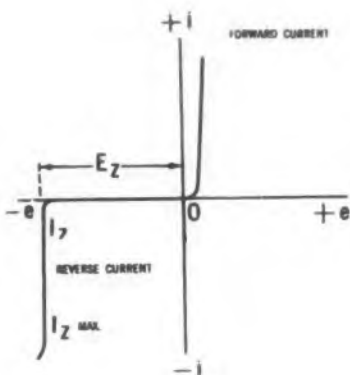


Fig. 1. Typical voltage drop and reverse resistance.

^oFigures and information from International Rectifier Corporation literature.

MANUFACTURERS

BTHB—British Thomson-Houston Export Co., Ltd., Rugby, Warwickshire, England.

INT. RECT. — International Rectifier Corp., 1521 East Grand Ave., El Segundo, Calif.

STCBS—Standard Telephones and Cables Ltd., Connaught House, 63 Aldwych, London WC 2, England.

TEC—Transitron Electronic Corp., Melrose 76, Mass.

TII — Texas Instruments Inc., Semiconductor Products Div., 6000 Lemmon Ave., Dallas 9, Texas.

WEC—Western Electric Co., Inc., Radio Div., 120 Broadway, New York 5, N.Y.

SEM—U.S. Semiconductor Products, Inc., 3536 West Osborn Rd., Phoenix, Arizona.

may be considered the semiconductor equivalent. The effect can be used in exactly the same manner to maintain a constant voltage output.

From Fig. 1^o shows that a constant voltage drop exists over a wide range of current, and the reverse resistance is extremely low. The slope of the curve

$$\frac{\Delta E_z}{\Delta I_z}$$

illustrates in general the regulation ability of the diode, and may be expressed as resistance. It is equivalent to a fraction of an ohm for low voltage Zener diodes, up to several hundred ohms for higher voltage types.

The Zener diode has many advantages over the gas-discharge tubes: Zener diodes are available with any required voltage up to 1000 v, while gas tubes are limited to specific values between 60 and 150 v. In a Zener diode, minimum starting potential and working potential are virtually the same. Photoelectric effects are negligible for encapsulated Zener diodes. Zero temperature coeffi-

ZENER REFERENCE DIODES

In order of Min. E_{b1} , Max. E_{b2} , and type no.

Type No.	Zener Voltage Range			Dynamic Impedance		Max. Diss. (mw)	Max. Temp. (°C)	Mfr.	Type No.	Zener Voltage Range			Dynamic Impedance		Max. Diss. (mw)	Max. Temp. (°C)	Mfr.
	Min. E_{b1} (volts)	Max. E_{b2} (volts)	@ I_z (ma)	Z (ohms)	@ I_z (ma)					Z (ohms)	@ I_z (ma)	Min. E_{b1} (volts)	Max. E_{b2} (volts)	@ I_z (ma)				Z (ohms)	@ $I_z$ (ma)
SJDX9/3	2.5	3.5	10				250	BTHB	ZZ5.6 ^d	5.1	6.2		5.0	14	350		INT. RECT.
Z2A33	2.5	4.0	20	30	20	750	100	STCB	652CO	5.2	5.8	5.0			150	150A	TII
IN471 ^d	3.0	3.9	5.0	50	10	200	200A	HSD	SV123	5.2	5.8	10	20	10	250	150	TEC
650CO	3.5	3.9	5.0			150	150A	TII	SV1006	5.2	5.8	10	20	10	750	150	TEC
SJDX9/4	3.5	4.5	10				250	BTHB	SV2006	5.2	5.8	1000	.70	1000	10W	150	TEC
650C1	3.6	4.0	5.0			150	150A	TII	IN474 ^d	5.2	6.4	5.0	20	10	200	200A	HSD
3Z3.9	3.6	4.3		.50	150	3500		INT. RECT.	652C	5.2	6.4	5.0			150	150	TII
10Z3.9	3.6	4.3		.25	500	10W		INT. RECT.	652C1	5.3	5.9	5.0			150	150A	TII
IZ3.9	3.6	4.3		1.0	50	1000		INT. RECT.	652C2	5.4	6.0	5.0			150	150A	TII
MZ3.9	3.6	4.3		1.5	25	500		INT. RECT.	Z2A68	5.4	8.5	20	15	20	750	100	STCB
ZZ3.9 ^d	3.6	4.3		3.0	22	350		INT. RECT.	652C3	5.5	6.1	5.0			150	150A	TII
Z2A47	3.6	5.8	20	25	20	750	100	STCB	SJDX9/6	5.5	6.5	10				250	BTHB
650C2	3.7	4.1	5.0			150	150A	TII	652C4	5.6	6.2	5.0			150	150A	TII
IN472 ^d	3.7	4.5	5.0	45	10	200	200A	HSD	652C5	5.7	6.3	5.0			150	150A	TII
650C	3.7	4.5	5.0			150	150A	TII	SV124	5.7	6.3	10	20	10	250	150	TEC
650C3	3.8	4.2	5.0			150	150A	TII	SV1007	5.7	6.3	10	20	10	250	150	TEC
650C4	3.9	4.3	5.0			150	150A	TII	SV2007	5.7	6.3	1000	.70	1000	10W	150	TEC
650C5	4.0	4.4	5.0			150	150A	TII	652C6	5.8	6.4	5.0			150	150A	TII
650C6	4.1	4.5	5.0			150	150A	TII	IN429	5.9	6.5	7.5	20	7.5	200	200A	HSD
650C7	4.2	4.6	5.0			150	150A	TII	652C7	5.9	6.5	5.0			150	150A	TII
651C0	4.3	4.7	5.0			150	150A	TII	652C8	6.0	6.6	5.0			150	150A	TII
SV121	4.3	4.7	10	55	10	250	150	TEC	652C9	6.1	6.7	5.0			150	150A	TII
SV1004	4.3	4.7	10	55	10	750	150	TEC	653C0	6.2	6.8	5.0			150	150A	TII
SV2004	4.3	4.7	1000	.50	1000	10W	150	TEC	SV125	6.2	6.8	10	8	10	250	150	TEC
3Z4.7	4.3	5.1		.50	125	3500		INT. RECT.	SV1008	6.2	6.8	10	8	10	750	150	TEC
10Z4.7	4.3	5.1		.25	400	10W		INT. RECT.	SV2008	6.2	6.8	1000	.80	1000	10W	150	TEC
IZ4.7	4.3	5.1		1.0	40	1000		INT. RECT.	3Z6.8	6.2	7.5		1.0	100	3500		INT. RECT.
MZ4.7	4.3	5.1		1.5	20	500		INT. RECT.	10Z6.8	6.2	7.5		.50	300	10W		INT. RECT.
ZZ4.7 ^d	4.3	5.1		4.0	18	350		INT. RECT.	IZ6.8	6.2	7.5		2.0	30	1000		INT. RECT.
IN473 ^d	4.3	5.4	5.0	35	10	200	200A	HSD	MZ6.8	6.2	7.5		3.0	15	500		INT. RECT.
651C	4.3	5.4	5.0			150	150	TII	ZZ6.8 ^d	6.2	7.5		10	12	350		INT. RECT.
SV5	4.3	5.4	10	55	10	250	150	TEC	IN475 ^d	6.2	8.0	5.0	10	10	200	200A	HSD
SV804	4.3	5.4	150	55		150	150	TEC	653C	6.2	8.0	5.0			150	150	TII
SV904	4.3	5.4	2000	.50		150	150	TEC	SV7	6.2	8.0	30	8.0		150	150	TEC
651C1	4.4	4.8	5.0			150	150A	TII	SV806	6.2	8.0	90	8.0		150	150	TEC
651C2	4.5	4.9	5.0			150	150A	TII	SV906	6.2	8.0	1200	.80			150	TEC
SJDX9/5	4.5	5.5	10				250	BTHB	653C1	6.3	6.9	5.0			150	150A	TII
651C3	4.6	5.0	5.0			150	150A	TII	653C2	6.4	7.0	5.0			150	150A	TII
651C4	4.7	5.2	5.0			150	150A	TII	653C3	6.5	7.1	5.0			150	150A	TII
651C5	4.8	5.3	5.0			150	150A	TII	SJDX9/7	6.5	7.5	10				250	BTHB
SV122	4.8	5.3	10	55	10	250	150	TEC	3Z8.2	7.5	9.1		1.5	80	3500		INT. RECT.
SV1005	4.8	5.3	10	55	10	750	150	TEC	10Z8.2	7.5	9.1		.75	250	10W		INT. RECT.
SV2005	4.8	5.3	1000	.50	1000	10W	150	TEC	IZ8.2	7.5	9.1		3.0	25	1000		INT. RECT.
651C6	4.85	5.36	5.0			150	150A	TII	653C4	6.7	7.4	5.0			150	150A	TII
651C7	4.94	5.46	5.0			150	150A	TII	SV126	6.7	7.4	10	8	10	250	150	TEC
651C8	5.0	5.6	5.0			150	150A	TII	SV1009	6.7	7.4	10	8	10	750	150	TEC
651C9	5.1	5.7	5.0			150	150A	TII	SV2009	6.7	7.4	1000	.80	1000	10W	150	TEC
3Z5.6	5.1	6.2		.75	110	3500		INT. RECT.	653C5	6.8	7.6	5.0			150	150A	TII
10Z5.6	5.1	6.2		.40	350	10W		INT. RECT.	653C6	7.0	7.8	5.0			150	150A	TII
IZ5.6	5.1	6.2		1.5	35	1000		INT. RECT.	SV127	7.1	7.9	10	8	10	250	150	TEC
MZ5.6	5.1	6.2		2.3	17.5	500		INT. RECT.									

Following Type No.

r — Military use only

d — Double Anode Zener Types

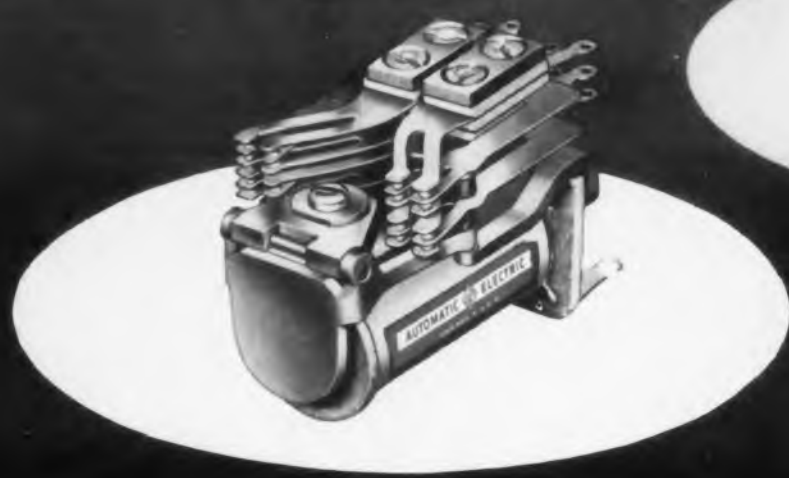
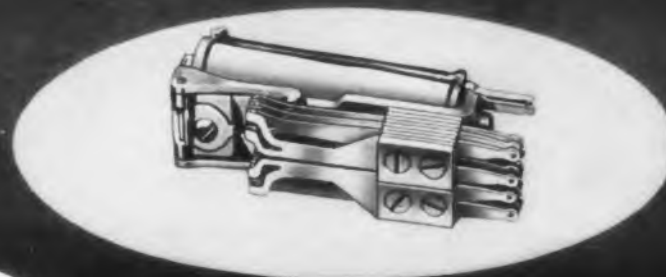
Following Temp.

A — Ambient

B — Junction

S — Storage

Newest in a long line of relays for industrial control



the Class "E"

This is the relay you've asked us to build. Now Automatic Electric is happy to present its latest achievement—the miniature Class "E". We're proud because this husky baby brother of the Class "B" condenses all of its famous features in a minimum of space and weight . . . with no sacrifice of quality! Many Class "E" features appear for the first time in a relay of such compact size. Here's a relay which is indispensable where small size and weight (coupled with reliable performance) are of prime importance.

This new miniature relay comes to you with a solid reputation, backed by 65 years of leadership in automatic dial telephone equipment for America's Independent telephone companies and leadership in industrial controls for industry.

Check these features of the new Class "E"—

- miniaturized, telephone-style, base mounting for rear-connected wiring.
- heavy thickness armature arms (previously available only in larger relays).

- heavy-duty backstop that won't wear out.
- adequate terminal clearances for easy wiring.
- long-life, lubricant-retaining bearing also allows for an easy check of the heelpiece airline setting, without disturbing the adjustment.
- fully independent twin contact springs.
- sturdy, strain-relieved heelpiece insures stability of adjustment.

For more information, call or write Automatic Electric Sales Corporation, Northlake, Illinois. *In Canada: Automatic Electric Sales (Canada) Ltd., Toronto. Offices in principal cities.*

AUTOMATIC ELECTRIC
A member of the General Telephone System
One of America's great communications systems



CIRCLE 24 ON READER-SERVICE CARD

cients may be obtained and they may be shunted by large values of capacitance without danger of oscillation. They have small size and weight, and are very rugged.

Fig. 2 shows the typical use of the Zener diode in a dc regulating, or reference circuit. The diode shunt regulator draws variable current through the resistor R , dependent upon the load requirements. As the load increases or decreases, the Zener shunt element will

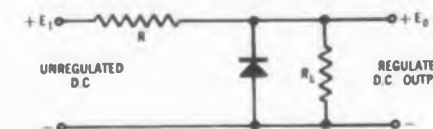


Fig. 2. Zener diode in reference circuit.

draw more or less current. The net result is a practically constant output voltage across R_L . The constancy of this voltage is dependent then upon the impedance of the Zener diode, i.e., the slope of

$$\frac{\Delta E_Z}{\Delta I_Z}$$

The regulation factor with respect to load variations will be

$$\frac{\delta E_o}{E_o} \frac{E_o}{\delta R_L / R_L}$$

Resistor R should be so selected that the current in the diode does not exceed I_Z max or exceed the maximum power dissipation rating if the load R_L were removed. In practice I_Z is chosen as approximately 20 per cent of I_Z max and as a shunt regulator, will absorb current vibrations between the I_Z and I_Z max limits.

The maximum current which can flow through the diode is limited by the heat generated at the junction. Thus, the use of a Zener diode as a voltage regulator is limited only by its rated current handling capabilities.

The Zener regulator provides a low impedance bias supply for use with both vacuum tubes and transistors. Figs. 3 and 4 illustrate its use as a cathode bias element. Fig. 3 provides a bias for the amplifier that is close to cut-off. As long as a small current is flowing to cause a breakdown within the diode, current through the tube will be insufficient to

ZENER REFERENCE DIODES

In order of Min. E_{b1} , Max. E_{b2} , and type no.

Type No.	Zener Voltage Range			Dynamic Impedance		Max. Diss. (mw)	Max. Temp. (°C)	Mfr.	Type No.	Zener Voltage Range			Dynamic Impedance		Max. Diss. (mw)	Max. Temp. (°C)	Mfr.
	Min. E_{b1} (volts)	Max. E_{b2} (volts)	@ I_z (ma)	Z (ohms)	@ I_z (ma)					Z (ohms)	@ I_z (ma)						
SV1010	7.1	7.9	10	8	10	750	150	TEC	3Z12	11.0	13.0	4.0	50	3500		INT. RECT.	
SV2010	7.1	7.9	1000	.80	1000	10W	150	TEC	10Z12	11.0	13.0	2.0	170	10W		INT. RECT.	
653C7	7.2	8.0	5.0			150	150A	TII	GA52931r	11.0	13.0	6.0	10	500	135	WEC	
653C8	7.4	8.2	5.0			150	150A	TII	IZ12	11.0	13.0	7.5	15	1000		INT. RECT.	
MZ8.2	7.5	9.1		4.5	12.5	500		INT. RECT.	MZ12	11.0	13.0	12	7.5	500		INT. RECT.	
ZZ8.2d	7.5	9.1		15	10	350		INT. RECT.	ZZ12d	11.0	13.0	40	7.5	350		INT. RECT.	
SJDX9/8	7.5	8.5	10				250	BTHB	IN227d	11.0	14.5			150	150A	HSD	
IN225d	7.5	10.0	.20			150	150A	HSD	IN1315	11.0	14.5			150	150A	HSD	
IN1313	7.5	10.0				150	150A	HSD	IN1353A	11.4	12.6	2.0	10	10W	155A	HSD	
653C9	7.6	8.4	5.0			150	150A	TII	SV135	11.4	12.6	70	5.0	250	150	TEC	
SV128	7.6	8.4	10	15	10	250	150	TEC	SV1017	11.4	12.6	70	5.0	750	150	TEC	
SV1011	7.6	8.4	10	15	10	750	150	TEC	SV2017	11.4	12.6	2.0	500	10W	150	TEC	
SV2011	7.6	8.4	1000	.80	1000	10W	150	TEC	IN1354	11.7	14.3	2.0	10	10W	155A	TEC	
ZZA100	7.8	12.2	20	20	20	750	100	STCB	ZZA150	11.8	18.2	45	20	750	100	STCB	
IN430	8.0	8.8	10	15	10	250	150A	HSD & INT. RECT.	IN1354A	12.4	13.7	2.0	10	10W	155A	HSD	
IN430A	8.0	8.8	10	15	10	250	150A	HSD & INT. RECT.	SV136	12.4	13.7	70	5.0	250	150	TEC	
IN430B	8.0	8.8	10	15	10	250	150A	HSD & INT. RECT.	SV1018	12.4	13.7	70	5.0	750	150	TEC	
SV129	8.1	8.9	10	15	10	250	150	TEC	SV2018	12.4	13.7	2.0	500	10W	150	TEC	
SV1012	8.1	8.9	10	15	10	750	150	TEC	3Z15	13.0	16.0	7.5	40	3500		INT. RECT.	
SV2012	8.1	8.9	1000	.80	1000	10W	150	TEC	10Z15	13.0	16.0	4.0	140	10W		INT. RECT.	
654C9	8.5	9.5	5.0			150	150	TII	IZ15	13.0	16.0	15	13	1000		INT. RECT.	
SJDX9/9	8.5	9.5	10				250	BTHB	MZ15	13.0	16.0	23	6	500		INT. RECT.	
SV131	8.6	9.5	10	15	10	250	150	TEC	ZZ15d	13.0	16.0	60	5	350		INT. RECT.	
SV1013	8.6	9.5	10	15	10	750	150	TEC	SV137	13.3	14.7	70	5.0	250	150	TEC	
SV2013	8.6	9.5	1000	.80	1000	10W	150	TEC	SV1019	13.3	14.7	70	5.0	750	150	TEC	
SV132	9.0	10.0	10	15	10	250	150	TEC	SV2019	13.3	14.7	2.0	500	10W	150	TEC	
SV1014	9.0	10.0	10	15	10	750	150	TEC	IN1355	13.5	16.5	2.0	10	10W	155A	HSD	
SV2014	9.0	10.0	1000	.80	1000	10W	150	TEC	IN228d	13.5	18.0			150	150A	HSD	
IN1351	9.0	11.0	500	2.0	10	10W	155A	HSD	IN1316	13.5	18.0			150	150A	HSD	
IN226d	9.0	12.0	.20			150	150A	HSD	SV5	13.5	18.0	120			150	TEC	
IN1314	9.0	12.0				150	150A	HSD	SV815	13.5	18.0	120			150	TEC	
SV11	9.0	12.0	20	50			150	TEC	SV915	13.5	18.0	3.0			150	TEC	
SV810	9.0	12.0	60	50			150	TEC	GA52932r	14.0	16.0	7.0	10	1000	135	WEC	
SV910	9.0	12.0	800	1.5			150	TEC	IN1355A	14.3	-15.8	2.0	10	10W	155A	HSD	
ZZ10d	9.0	11.0		25	8	350		INT. RECT.	SV138	14.3	15.8	120	5.0	250	150	TEC	
10Z10	9.0	11.0		1.25	200	10W		INT. RECT.	SV1020	14.3	15.8	120	5.0	750	150	TEC	
3Z10	9.1	11.0		2.5	70	3500		INT. RECT.	SV2020	14.3	15.8	3.0	500	10W	150	TEC	
IZ10	9.1	11.0		4.5	20	1000		INT. RECT.	IN1356	14.4	17.6	3.0	10	10W	155A	HSD	
MZ10	9.1	11.0		6.8	10	500		INT. RECT.	IN1356A	15.2	16.8	3.0	10	10W	155A	HSD	
IN1351A	9.5	10.5	500	2.0	10	10W	155A	HSD	SV139	15.2	16.8	120	5.0	250	150	TEC	
655C9	9.5	10.5	5.0			150	150	TII	SV1021	15.2	16.8	120	5.0	750	150	TEC	
SV133	9.5	10.5	5.0	50	5.0	250	150	TEC	SV2021	15.2	16.8	3.0	500	10W	150	TEC	
SV1015	9.5	10.5	5.0	50	5.0	750	150	TEC	3Z18	16.0	20.0	15	35	3500		INT. RECT.	
SV2015	9.5	10.5	500	1.5	500	10W	150	TEC	10Z18	16.0	20.0	7.5	110	10W		INT. RECT.	
IN1352A	10.5	11.6	500	2.0	10	10W	155A	HSD	IZ18	16.0	20.0	30	10	1000		INT. RECT.	
SV134	10.5	11.6	5.0	50	5.0	250	150	TEC	MZ18	16.0	20.0	45	5	500		INT. RECT.	
SV1016	10.5	11.6	5.0	50	5.0	750	150	TEC	ZZ18d	16.0	20.0	80	4	350		INT. RECT.	
SV2016	10.5	11.6	500	1.5	500	10W	150	TEC	SV141	16.2	17.9	120	5.0	250	150	TEC	
IN1353	10.8	13.2	500	2.0	10	10W	155A	HSD	SV1022	16.2	17.9	120	5.0	750	150	TEC	

Following Type No.

r — Military use only

d — Double Anode Zener Types

Following Temp.

A — Ambient

B — Junction

S — Storage

ZENER REFERENCE DIODES

In order of Min. E_{b1} , Max. E_{b2} , and type no.

Type No.	Zener Voltage Range			Dynamic Impedance		Max. Diss. (mw)	Max. Temp. (°C)	Mfr.	Type No.	Zener Voltage Range			Dynamic Impedance		Max. Diss. (mw)	Max. Temp. (°C)	Mfr.
	Min. E_{b1} (volts)	Max. E_{b2} (volts)	@ I_z (ma)	Z (ohms)	@ I_z (ma)					Min. E_{b1} (volts)	Max. E_{b2} (volts)	@ I_z (ma)	Z (ohms)	@ I_z (ma)			
SV2022	16.2	17.9	500	3.0	500	10W	150	TEC	IN1319	25.0	32.0				150	150A	HSD
IN1357	16.2	19.8	500	3.0	10	10W	155A	HSD	IN1361A	25.7	28.4	150	3.0	10	10W	155A	HSD
GA52933 ^r	17.0	19.0	55	7.0	10	1000	135	WEC	IN1362	27.0	33.0	150	4.0	10	10W	155A	HSD
IN229 ^d	17.0	21.0	.20			150	150A	HSD	IN1362A	28.5	31.5	150	4.0	10	10W	155A	HSD
IN1317	17.0	21.0				150	150A	HSD	IN1363	29.7	36.3	150	4.0	10	10W	155A	HSD
GA52999 ^r	17.0	23.0	150	5.0	10	1000	135	WEC	HZ33	30.0	36.0		10	30	5000		INT. RECT.
IN1357A	17.1	18.9	500	3.0	10	10W	155A	HSD	IN232 ^d	30.0	39.0	.20			150	150A	HSD
SV142	17.1	18.9	5.0	200	5.0	250	150	TEC	IN1320	30.0	39.0				150	150A	HSD
SV1023	17.1	18.9	5.0	200	5.0	750	150	TEC	IN1363A	31.4	34.7	150	4.0	10	10W	155A	HSD
SV2023	17.1	18.9	500	3.0	500	10W	150	TEC	IN1364	32.4	39.6	150	5.0	10	10W	155A	HSD
IN1358	18.0	22.0	150	3.0	10	10W	155A	HSD	IN1364A	34.2	37.8	150	5.0	10	10W	155A	HSD
SV143	18.1	20.0	5.0	200	5.0	250	150	TEC	IN1365	35.1	42.9	150	5.0	10	10W	155A	HSD
SV1024	18.1	20.0	5.0	200	5.0	750	150	TEC	IN233 ^d	37.0	45.0	.20			150	150A	HSD
SV2024	18.1	20.0	500	3.0	500	10W	150	TEC	IN1321	37.0	45.0				150	150A	HSD
SV144	19.0	21.0	5.0	200	5.0	250	150	TEC	IN1365A	37.1	41.0	150	5.0	10	10W	155A	HSD
SV1025	19.0	21.0	5.0	200	5.0	750	150	TEC	IN1366	38.7	47.3	150	6.0	10	10W	155A	HSD
SV2025	19.0	21.0	500	3.0	500	10W	150	TEC	IN1366A	40.9	45.2	150	6.0	10	10W	155A	HSD
IN1358A	19.0	21.0	150	3.0	10	10W	155A	HSD	IN1367	42.3	51.7	150	7.0	10	10W	155A	HSD
GA52934 ^r	19.0	21.0	50	7.0	10	1000	135	WEC	HZ47	43.0	51.0		20	22	5000		INT. RECT.
IN1359	19.8	24.2	150	3.0	10	10W	155A	HSD	IN1322	43.0	54.0				150	150A	HSD
3Z22	20.0	24.0		22.5	30	3500		INT. RECT.	IN1367A	44.7	49.4	150	7.0	10	10W	155A	HSD
10Z22	20.0	24.0		12	90	10W		INT. RECT.	IN1368	45.9	56.1	150	8.0	10	10W	155A	HSD
IZ22	20.0	24.0		45	9	1000		INT. RECT.	IN1368A	48.5	53.6	150	8.0	10	10W	155A	HSD
MZ22	20.0	24.0		70	4.5	500		INT. RECT.	IN1369	50.4	61.6	150	9.0	10	10W	155A	HSD
ZZ22 ^d	20.0	24.0		125	3.5	350		INT. RECT.	IN1323	52.0	64.0				150	150A	HSD
IN230 ^d	20.0	27.0	.20			150	150A	HSD	IN1369A	53.2	58.8	150	9.0	10	10W	155A	HSD
IN1318	20.0	27.0				150	150A	HSD	IN1370	55.8	68.2	50	12	10	10W	155A	HSD
SV24	20.0	27.0	10	300		150	150	TEC	IN1370A	58.9	65.1	50	12	10	10W	155A	HSD
SV824	20.0	27.0	27	300		150	150	TEC	IN1371	61.2	74.8	50	14	10	10W	155A	HSD
SV924	20.0	27.0	400	8.0		150	150	TEC	HZ68	62.0	75.0		60	14	5000		INT. RECT.
IN1359A	20.9	23.1	150	3.0	10	10W	155A	HSD	IN1324	62.0	80.0				150	150A	HSD
SV168	20.9	23.1	5.0	300	5.0	250	150	TEC	IN1371A	64.6	71.4	50	14	10	10W	155A	HSD
SV1033	20.9	23.1	5.0	300	5.0	750	150	TEC	IN1372	67.5	82.5	50	20	10	10W	155A	HSD
SV2044	20.9	23.1	150	8.0	150	10W	150	TEC	IN1372A	71.3	78.8	50	20	10	10W	155A	HSD
IN1360	21.6	26.4	150	3.0	10	10W	155A	HSD	IN1373	73.8	90.2	50	22	10	10W	155A	HSD
IN1360A	22.8	25.2	150	3.0	10	10W	155A	HSD	IN1325	75.0	100				150	150A	HSD
SV169	22.8	25.2	5.0	300	5.0	250	150	TEC	IN1373A	77.9	86.1	50	22	10	10W	155A	HSD
SV1034	22.8	25.2	5.0	300	5.0	750	150	TEC	IN1374	81.9	100	50	35	10	10W	155A	DSH
SV2045	22.8	25.2	150	8.0	150	10W	150	TEC	IN1374A	86.5	95.6	50	35	10	10W	155A	HSD
3Z27	24.0	30.0		30	25	3500		INT. RECT.	IN1375	90.0	110	50	40	10	10W	155A	HSD
10Z27	24.0	30.0		15	70	10W		INT. RECT.	IN1326	90.0	120				150	150A	HSD
HZ27	24.0	30.0		7.0	40	5000		INT. RECT.	HZ100	91.0	110		180	10	5000		INT. RECT.
IZ27	24.0	30.0		60	7	1000		INT. RECT.	IN1327	110	145				150	150A	HSD
MZ27	24.0	30.0		90	3.5	500		INT. RECT.	HZ150	130	160		370	7	5000		INT. RECT.
ZZ27 ^d	24.0	30.0		200	3	350		INT. RECT.	GA52935 ^r	130	170	20	100	10	1000	135	WEC
IN1361	24.3	29.7	150	3.0	10	10W	155A	HSD									
SV171	24.7	27.3	5.0	300	5.0	250	150	TEC									
SV1035	24.7	27.3	5.0	300	5.0	750	150	TEC									
SV2046	24.7	27.3	150	8.0	150	10W	150	TEC									
IN231 ^d	25.0	32.0	.20			150	150A	HSD									

Following Type No.

r — Military use only

d — Double Anode Zener Types

Following Temp.

A — Ambient

B — Junction

S — Storage

energize the relay. When the grid is made more positive, it can be seen that the bias will remain constant even though the tube current increases. This is in contrast with conventional cathode resistor bias which would result in an ever increasing bias as tube current goes up. Fig. 4 illustrates how fixed bias

for two tubes or transistors in a single-ended push-pull servo-amplifier may be provided. This is a simple, highly efficient circuit with a minimum of components.

For more information on DATA's Service, circle Reader Service No. 25.

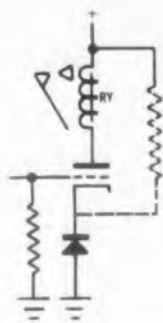


Fig. 3. Zener diode used as cathode bias element.

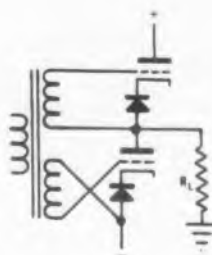


Fig. 4. Zener diode as fixed bias.

ZENER REFERENCE DIODES

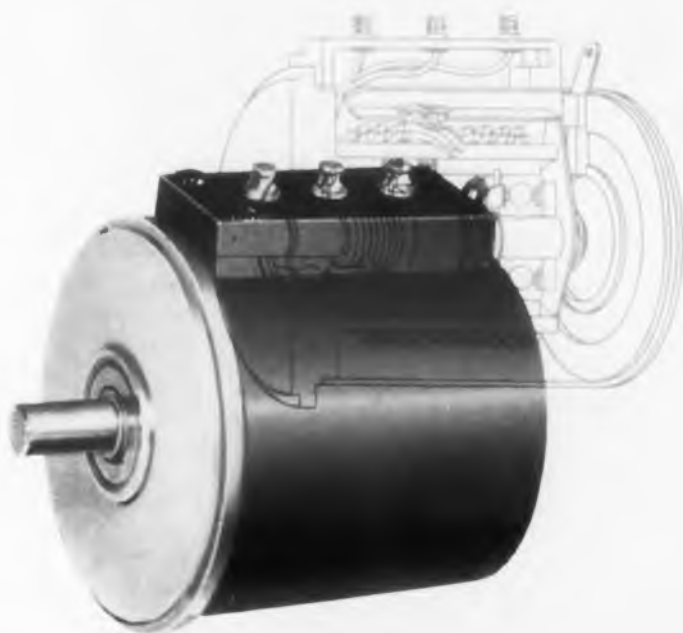
In order of Min. E_{b1} ' Max. E_{b2} ' and type no.

Editor's Note: The data in this table arrived late and was not incorporated in the overall tabulation. Western Electric also supplies various types of Zener Diodes to qualified military contractors.

Type No.	Zener Voltage Range			Dynamic Impedance		Max. Diss. (mw)	Max. Temp. (°C)	Mfr.
	Min. E_{b1} (volts)	Max. E_{b2} (volts)	@ I_z (ma)	Z (ohms)	@ I_z (ma)			
Z-3.9	3.6	4.3	5	30				SEM.
Z-4.7	4.3	5.1	5	25				SEM.
Z-5.6	5.1	6.2	5	10				SEM.
Z-6.8	6.2	7.5	5	10				SEM.
Z-8.2	7.5	9.1	5	25				SEM.
Z-10	9.1	11.0	5	50				SEM.
Z-12	11	13	1	70				SEM.
Z-15	13	16	1	100				SEM.
Z-18	16	20	1	150				SEM.
Z-22	20	24	1	200				SEM.
Z-27	24	30	1	300				SEM.
Z-33	30	36	.2	400				SEM.
Z-39	36	43	.2	600				SEM.
Z-47	43	51	.2	800				SEM.
Z-56	51	62	.2	1000				SEM.
Z-68	62	75	.2					SEM.
Z-82	75	91	.2					SEM.
Z-100	91	110	.2					SEM.
Z-120	110	130	.2					SEM.
Z-150	130	160	.1					SEM.
Z-180	160	200	.1					SEM.
Z-220	200	240	.1					SEM.
Z-270	240	300	.1					SEM.
Z-330	300	360	.1					SEM.
Z-390	360	430	.1					SEM.
Z-470	430	510	.1					SEM.
Z-560	510	620	.1					SEM.

Z types are rated at 150 mw. U.S. Semiconductor also makes a 400 mw LZ series and a 200 mw ZT series in E_{b1} ranges of 3.9 to 22v.

.01% Linearity in Production Potentiometers



LITTON'S MD20 CERAMIC CORE POTENTIOMETER SUSTAINED HIGH ACCURACY — PROVED

MD20 SPECIFICATIONS

- Up to .01% independent linearity • 1K to 100K standard resistances
- Up to .005% resolution depending upon resistance value • 3600° +1° -0° electrical angle • 5 watts power dissipation at 85° C, derates to 125° C
- Taps are welded and can be supplied in any location • 90° nominal overtravel
 - 1.0 oz. in. starting torque • 0.75 oz. in. running torque
 - 500 oz. in. static stop torque

*For 10 turn: Also available in dual 10 turn; 3 turn, dual 3 turn; 20 turn

The LITTON MD20 meets or exceeds all critical military specifications for potentiometers — and, up to .01% linearity is a LITTON production-standard specification in this 2" multiturn unit.

Here's how it's done.

■ Ceramic core provides a dimensionally stable, chemically inert and non-hygroscopic foundation.

■ Single-piece machined-aluminum hub furnishes a rugged support and accurate reference.

■ Modified Slope Control delivers a highly accurate servo-controlled winding.

Result — .01% linearity and .005% resolution, as a production standard.

Where your prime requirement is sustained high accuracy, Litton can help you. Please write to Litton Industries, Dept. 1, 215 South Fulton Avenue, Mount Vernon, New York, or to Litton Industries, Dept. 1, 5873 Rodeo Road, Los Angeles 16, California.

Visit our booth at N.Y. I.R.E. show.



LITTON INDUSTRIES Components Division

A DIVISION OF LITTON INDUSTRIES, INC.

LITTON PRECISION COMPONENTS: Potentiometers • Ferrite Isolators • Rotary Joints
USECO ELECTRONIC HARDWARE: Hardware & Terminals • Terminal Boards • Printed Circuits
VISIT OUR BOOTH AT N.Y.—I.R.E. SHOW

CIRCLE 26 ON READER-SERVICE CARD



Feedback Amplifier Design with the Nichols Chart

William D. Wade

The Magnavox Co.
Fort Wayne, Ind.

The Nichols chart, useful in servo and feedback amplifier design, provides advantages over more popular design aids. Unlike the Bode chart or phase-attenuation curves, it allows the designer to obtain closed loop data directly from open loop data.

THOUGH the Nichols Chart was derived for the design and stability analysis of servomechanisms, it is also a useful tool in solving stability problems of feedback amplifiers. It provides a convenient method of determining the gain of a complex closed loop directly from the gain of a complex open loop.

Derivation of the Nichols Chart

First, it is necessary to derive the open and closed loop gain. Fig. 1 shows a block arrangement of an amplifier without feedback. Here $Be_o = ABe_i$. If AB equals Y_1 then Be_o/e_i equals Y_1 , which may be defined as the open loop gain.

In Fig. 2, the feedback loop is closed. Here $e_o = (e_i - Be_o)A$. From this equation it follows that $e_o(I + AB) = e_iA$. The transfer function e_o/e_i equals $A/(I + AB)$. If, again, $AB = Y_1$, then $Be_o/e_i = Y_1/(I + Y_1)$ which is defined as the closed loop gain.

Note that the loop gain is the total gain through the loop. The amplifier gain, e_o/e_i , is the loop gain divided by B .

The Nicholas Chart ordinates are the magnitudes of the open loop gain in decibels; the abscissas are the phase shift angles of the open loop gain in degrees. Two families of curves are plotted. One is the constant phase shift curves of closed loop gain, the other, the constant magnitude curves. There is a point on the chart for

every value of the open loop gain, $Y_1 = |Y_1|/Y_1$. This point also locates the corresponding closed loop gain

$$\left| \frac{Y_1}{1 + Y_1} \right| \angle \frac{Y_1}{1 + Y_1}$$

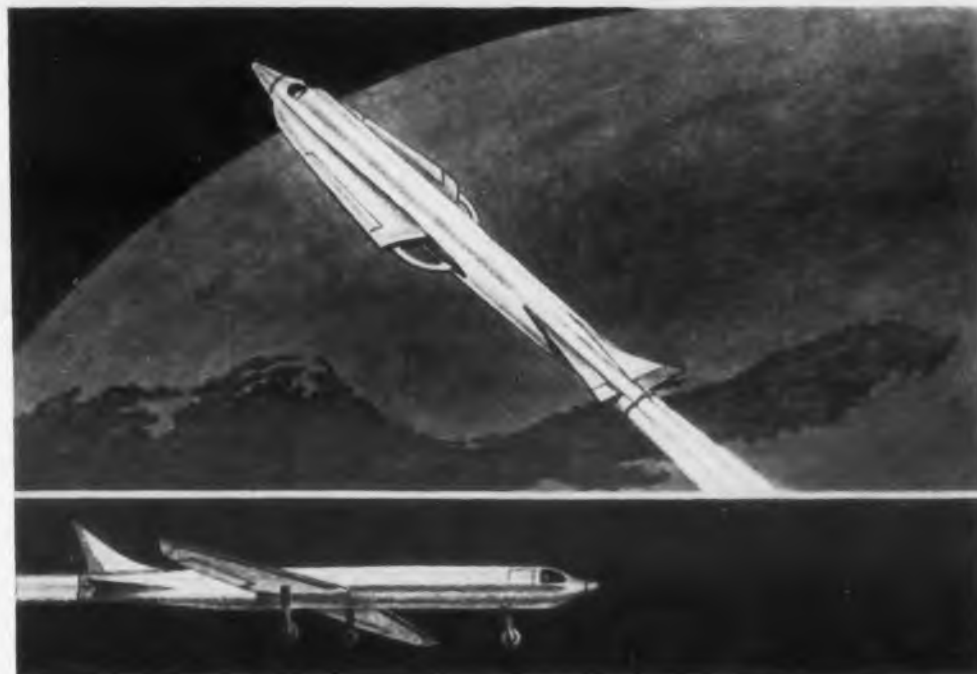
which can be read directly from the chart. For example, an open loop gain of $+9$ db $\angle -95$ deg corresponds to a closed loop gain of -0.5 db $\angle -20$ deg as shown in Fig. 5.

Nichols Chart—Advantages and Disadvantages

It is appropriate to compare the usefulness of the Nichols chart with the more familiar Nyquist diagram. One of the main Nichols chart advantages is that closed loop data may be read directly from open loop data. In most amplifiers, I/B is constant over the useful band, and the gain curve is easily obtained by adding B db to the closed loop gain. Amplifier gain is not determined easily from the Nyquist diagram.

Stability information (in the form of closed loop gain) is available directly from the Nichols chart, whereas, the Nyquist diagram requires additional graphical analysis.

Unfortunately, the Nicholas chart is not yet available from companies who print graph paper. However, a single Nichols chart can be used for many amplifier problems.



brings 'em back alive

Today's burning problem in space flight is how to ease a rocket safely back to earth, without being consumed by the metal-melting friction of our dense atmosphere. Design Engineer Carl J. Rauschenberger's ingenious suggestion is a pair of wings, locked forward at blast-off, later folded back into flying position (insert) by hydraulic cylinder controls for a slow, safe descent. Mr. Rauschenberger also envisions a retractable glass nose cone, heatproof to withstand the take-off, drawn back to admit air to a jet engine on the return flight.

This outstanding solution to a timely design problem may already exist in working drawings on somebody's drafting board, or even in mock-up form. But whether a project is developed today, tomorrow or the year after next, it will always be important to shape ideas into realities with the best of drafting tools.

In pencils, of course, that means Mars, long the standard of professionals. Some outstanding new products have recently been added to the famous line of Mars-Technico push-button holders and leads, Lumograph pencils, and Tradition-Aquarell painting pencils. These include the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman" pencil sharpener with the adjustable point-length feature; Mars Lumochrom, the color-drafting pencils and leads that make color-coding possible; the new Mars Non-Print pencils and leads that "drop out" your notes and sketches when drawings are reproduced.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXXB to 9H. The 1001 Mars-Technico push-button lead holder, 18 degrees, EXB to 9H. Mars-Lumochrom color-drafting pencil, 24 colors.



J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY

at all good engineering and drawing material suppliers

CIRCLE 27 ON READER-SERVICE CARD

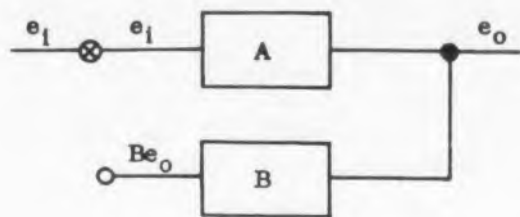


Fig. 1. Basic amplifier without feedback.

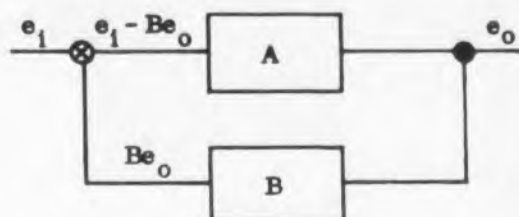


Fig. 2. Basic amplifier with feedback.

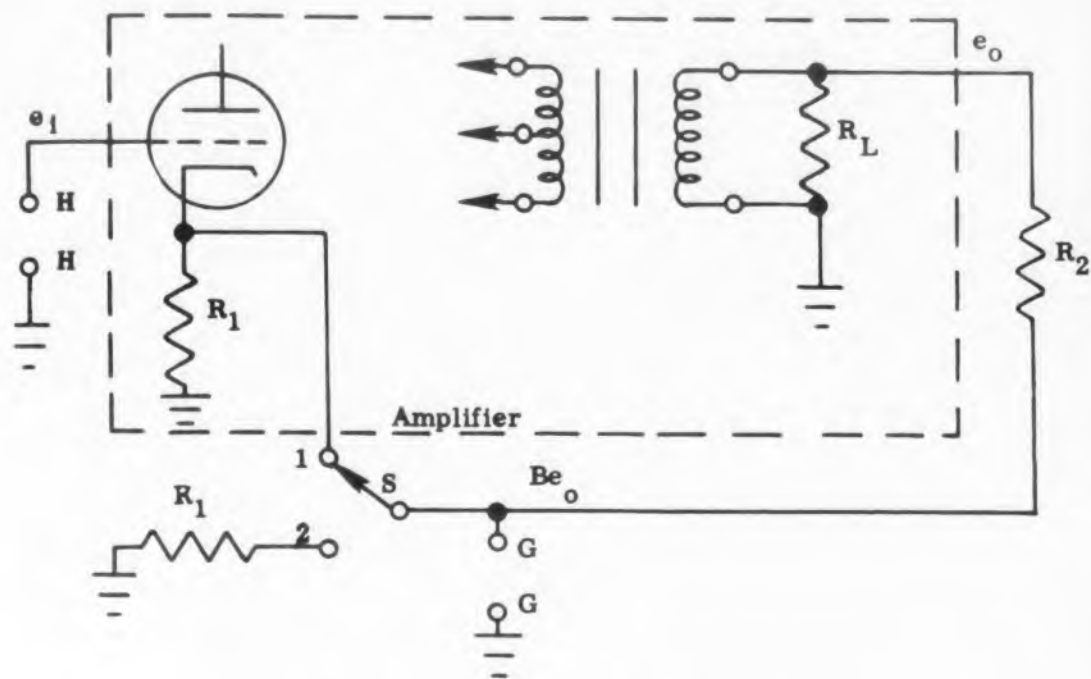


Fig. 3. Amplifier with 20 db of feedback.

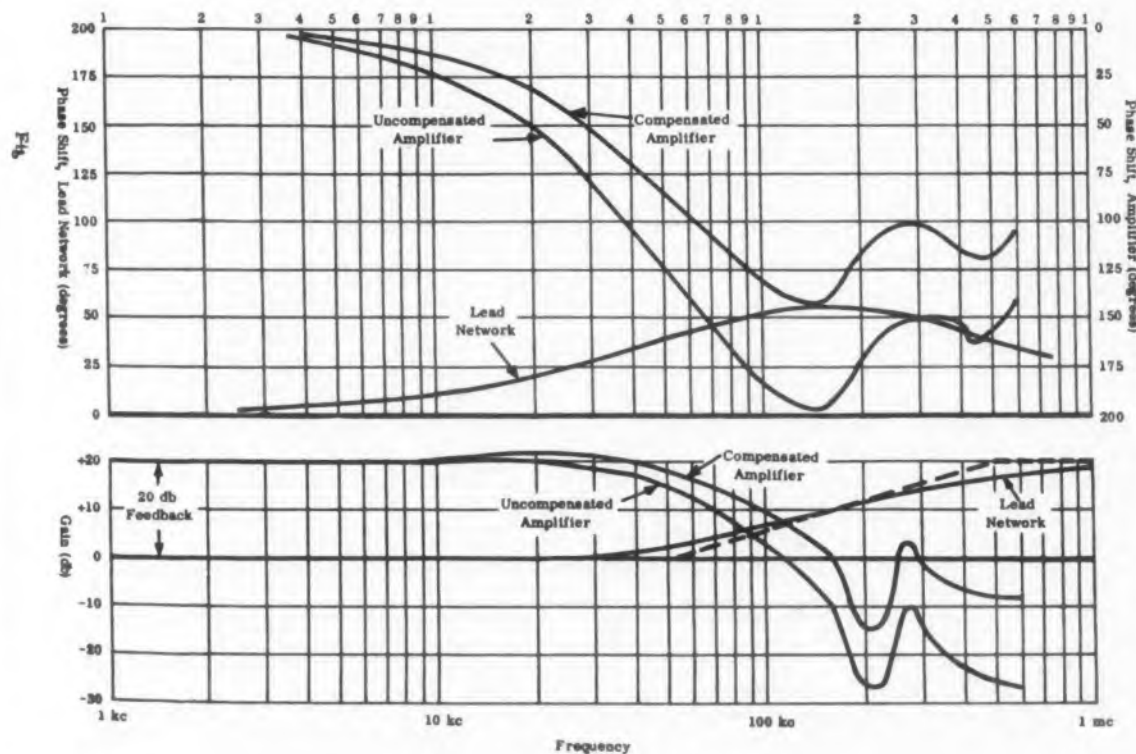


Fig. 4. Attenuation—Phase shift curves.

CLARE Type F RELAY

SPECIFICATIONS

Ambient Temperature	-65° C to +125° C.
Shock	50 Gs for 11 milliseconds.
Vibration	5-75 cps at maximum excursion of 1/8-inch. 75-2000 cps at 20 Gs acceleration.
Dielectric Strength	Sea level—1000 volts rms between terminals and frame, and between adjacent circuits; 750 volts rms between contacts of a set. At 80,000 ft., 350 volts rms.
Insulation Resistance	1000 megohms minimum at 125° C.
Coils	Coils up to 10,000 ohms available for a wide range of voltages or currents.
Nominal Operating Power	.250 milliwatts.
Pickup Time	3.5 milliseconds nominal.
Dropout Time	1.5 milliseconds nominal.
Contact Arrangement	2 pdt (2 form C).
Contact Rating	3 amps resistive at 28 volts d-c or 115 volts a-c; also for low-level applications.
Contact Resistance	0.050 ohm maximum.
Contact Life	500,000 operations minimum at 2 amps; 100,000 operations minimum at 3 amps.
Enclosure	Hermetically sealed, filled with dry nitrogen at 1 atmosphere pressure.
Mounting	All popular mounting arrangements available
Terminals	Printed circuit; solder, plug-in (matching socket available). Variations of printed-circuit terminal length on 1/10-inch grid spacing available.
Weight	17 grams.
Military Specifications	MIL-R-25018; MIL-R-5757C, except as to contact overload.

These could be the MOST IMPORTANT RELAY "SPECS" you ever read!

Here is a relay admirably geared to the needs of today's advanced circuit designers. Hermetically sealed—no bigger than a postage stamp—stalwart to withstand extremes of temperature, heavy shock and severe vibration—yet fast and more than moderately sensitive.

For complete information SEND FOR BULLETIN 124. Address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 2700 Jane Street, Toronto 15. Cable Address: CLARELAY.

CLARE RELAYS
FIRST in the industrial field

CIRCLE 29 ON READER-SERVICE CARD

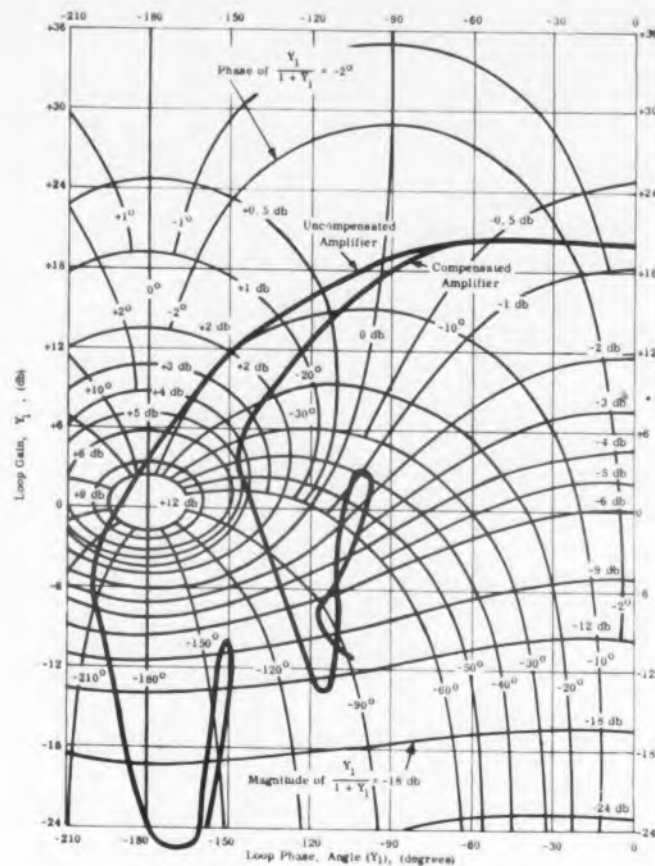


Fig. 5. Nichols chart with amplifier characteristics plotted.

A Practical Design Problem

Twenty db of feedback are to be applied to the amplifier of Fig. 3, i.e., at mid frequencies $|Y_1| = 20$ db. With the feedback loop connected, the amplifier oscillates at approximately 100 kc. Switch S is thrown to position 2 and the gain and phase shift between III and GG are measured and plotted against frequency as in the "uncompensated amplifier" curves in Fig. 4. These values are also plotted on the Nichols chart of Fig. 5. Since, on the Nichols chart, the curve passes to the left of $Y_1 = 0$ db / -180 deg, the amplifier will oscillate when the feedback loop is connected.

A lead network, having the response indicated in Fig. 4, may be added to the amplifier to move the plot to a stable region to the right of $Y_1 = 0$ db / -180 deg. The "compensated amplifier" curves in Figs. 4 and 5 show the response with the lead network connected.

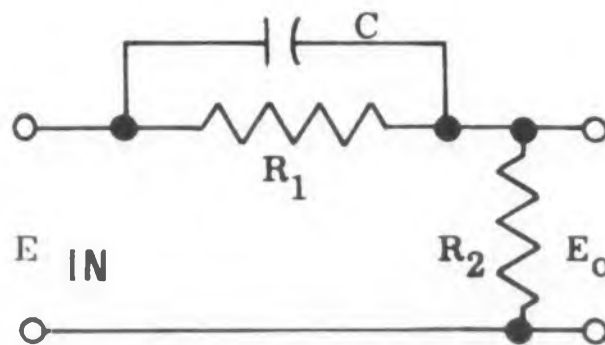


Fig. 6. A typical lead network.

Corrective Networks

Lead Network

A lead network gives phase shift correction at the expense of attenuation for high frequency correction and it provides attenuation at the expense of phase shift for low frequency correction. A typical lead network is shown in Fig. 6. Here

$$\begin{aligned} \frac{E_o}{E_{in}} &= \frac{R_2}{R_2 + \frac{-jX_c}{R_1 - jX_c}} \\ &= \frac{R_2}{R_1 + R_2} \cdot \frac{j\omega CR_1 + 1}{j\omega \frac{CR_1 R_2}{R_1 + R_2} + 1} \\ &= \frac{R_2}{R_1 + R_2} \cdot \frac{j\omega T_1 + 1}{j\omega T_2 + 1} \end{aligned}$$

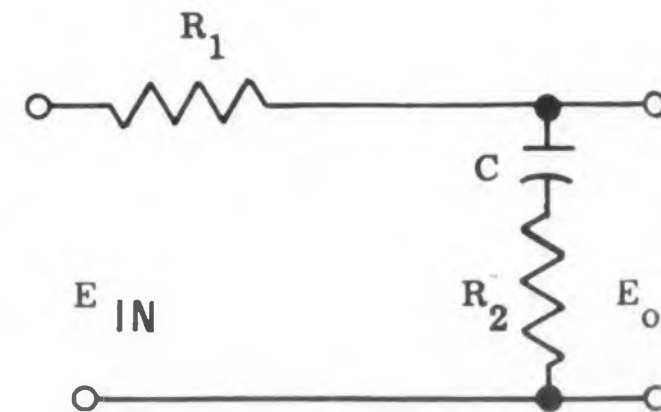


Fig. 7. A typical lag network.

$$T_1 = CR_1, \quad T_2 = \frac{CR_1R_2}{R_1 + R_2}$$

$$f_1 = \frac{1}{2\pi R_1 C}, \quad f_2 = \frac{R_1 + R_2}{2\pi R_1 R_2 C}$$

In the lead network required to stabilize the amplifier of Fig. 3, $f_1 = f_2/10 = 50$ kc and the maximum phase shift occurs at 160 kc. For any lead network where $f_2 = 10 f_1$, the maximum phase shift is 55 deg and the maximum attenuation is 20 db.

Lag Network

A lag network gives attenuation at the expense of phase shift for high frequency correction, and provides phase shift at the expense of attenuation for low frequency correction. Fig. 7 illustrates a lag network.

General Design Considerations

- The algebraic signs of the angles on the Nichols Chart are for the analysis of the high frequency characteristics of an amplifier. When the low frequency characteristics are examined, all angles that are negative on the chart should be considered positive, and all positive angles should be considered negative.

- In general, the maximum gain of the closed loop on the Nichols chart should not exceed 1.5 db. The amplifier used as an example can be improved by adding a second lead network. This would move the plot on the Nichols chart farther to the right.

- The schematics of the lead and lag networks shown in Figs. 6 and 7 are rather idealized. In general, E_{in} contains a series impedance, and E_{out} contains a parallel impedance. The effects of these should be minimized through proper circuit design. For example, R_2 in the lead network could be a grid resistor. In this case the impedance in the lead network should be high in comparison with the output impedance of the previous stage.

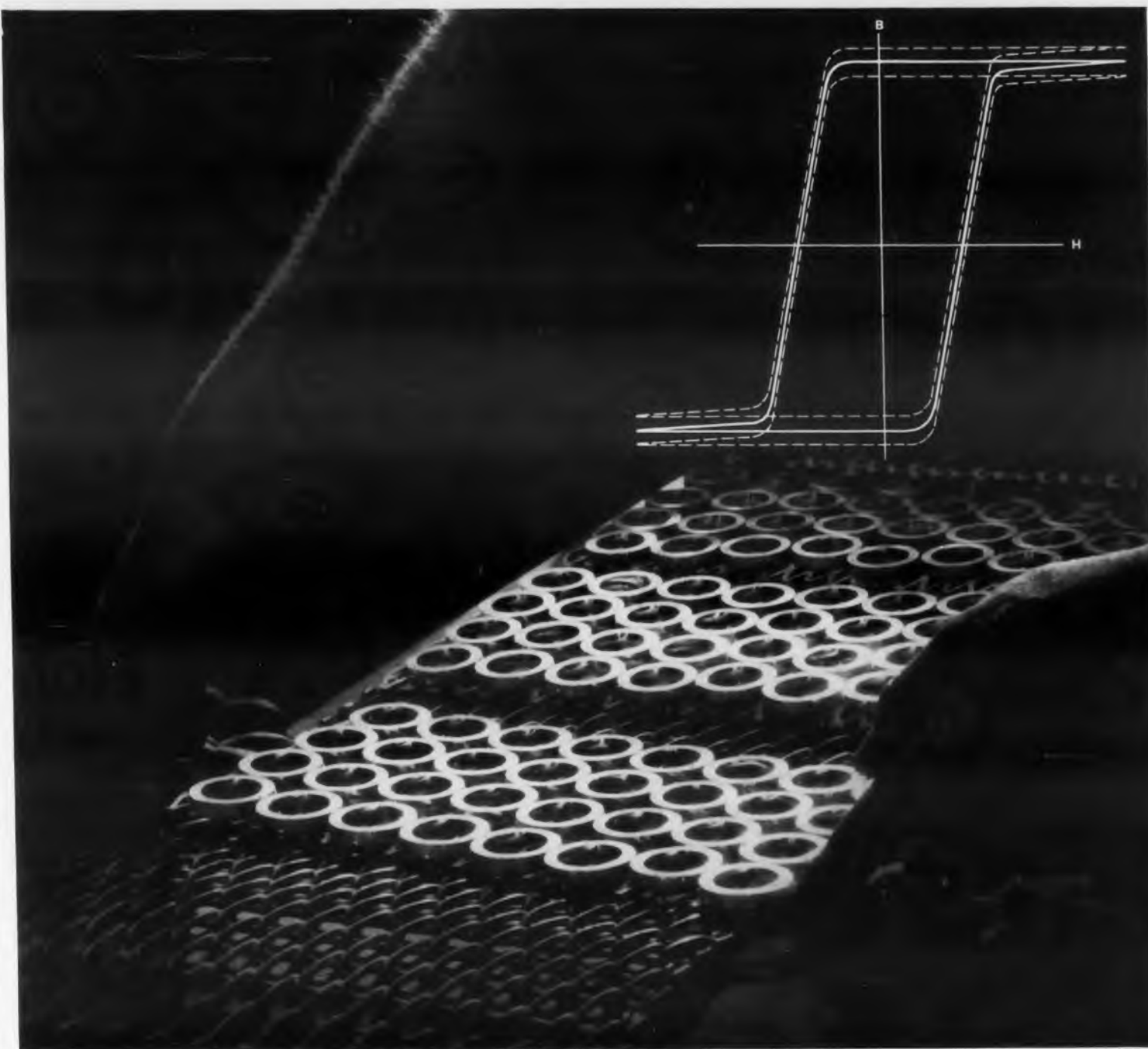
- The amplifier gain equals the loop gain multiplied by $1/B$. Although a corrective network can be made part of B , the network's gain variation should lie outside the audible frequency range.

For a reprint of this article turn to the Reader-Service card and circle 31.

References

1. James, H. M.; Nichols, N. B.; Phillips, R. S.; Theory of Servomechanisms; McGraw-Hill, 1947, pp. 179-186.
2. Bode, H. W.; Network Analysis and Feedback Amplifier Design; D. Van Nostrand Co., New York, 1945.
3. Langford-Smith, F.; Radiotron Designer's Handbook; 4th Edition, Amalgamated Wireless Valve Co. Pty., Ltd., Sydney, Australia, 1953, pp. 359-364.
4. Lynch, W. A.; The Stability Problem in Feedback Amplifiers; Proceedings of the IRE, Sept. 1951, p. 1000.

KEEP UP-TO-DATE ON MAGNETICS



Now—guaranteed maximum and minimum performance limits for tape wound cores!

For the first time you can order tape wound cores with guaranteed performance to published limits.

All tape wound cores coming from the hydrogen atmosphere annealing furnaces at Magnetics, Inc. are tested by flux reset as proposed by the AIEE Working Group on Core Matching and Grading*. Thus, standard cores are given a standard test to give engineer-designers a standard component whose performance is guaranteed within fixed limits.

Magnetics, Inc. has established the limits to provide maximum, minimum and nominal B_m , B_r/B_m , H_l and gain performance data. It is published for one, two, four and six mil tape thickness for Orthonol® and Hy Mu 80.

Now it is possible for you to select and order cores specifically suited to your design (just as with any other standardized

component). You'll save many hours of experimenting, and because the reliability of the data is guaranteed, you'll be sure at every stage of design and production.

The published limits for Magnetics, Inc. tape wound core performance are ready now. Write for your copy: Dept. ED-45, Magnetics, Inc., Butler, Pennsylvania.

MAGNETICS inc.

*Paper No. TWC-45, Winter General Meeting, AIEE, February, 1958. Flux Reset Test is one of two tests proposed for standardization.

CIRCLE 30 ON READER-SERVICE CARD

BOOST INSTRUMENT SENSITIVITY... with MIN-AMP



HIGH INPUT IMPEDANCE
LOW NOISE LEVEL
STABILIZED GAIN (x10, x100)
WIDE FREQUENCY RANGE
HI- and LO-PASS FILTERS
AC LINE OPERATION

Miniature, low-noise pre-amplifier (Model 201 illustrated) extends oscilloscope and voltmeter sensitivity by factors of 10 or 100. Two-stage amplifier readily removed from power unit and "plugged-in" to instrument input terminals without wiring, connecting links or other accessories. Compact assembly requires minimum bench space. Normal frequency range; 5 cycles to 1 mc. Switch-controlled filter circuits limit amplifier pass band; improve signal/noise ratio. Wide dynamic range; over 10 volts maximum output.

PRICE - \$125.00

Write for technical bulletin: MIN-AMP

ELECTRONICS, INC.
MOUNTAIN LAKES, NEW JERSEY

CIRCLE 32 ON READER-SERVICE CARD

Now you can read shaft positions
to one second of arc...directly...with

Gurley's new **UNISEC**

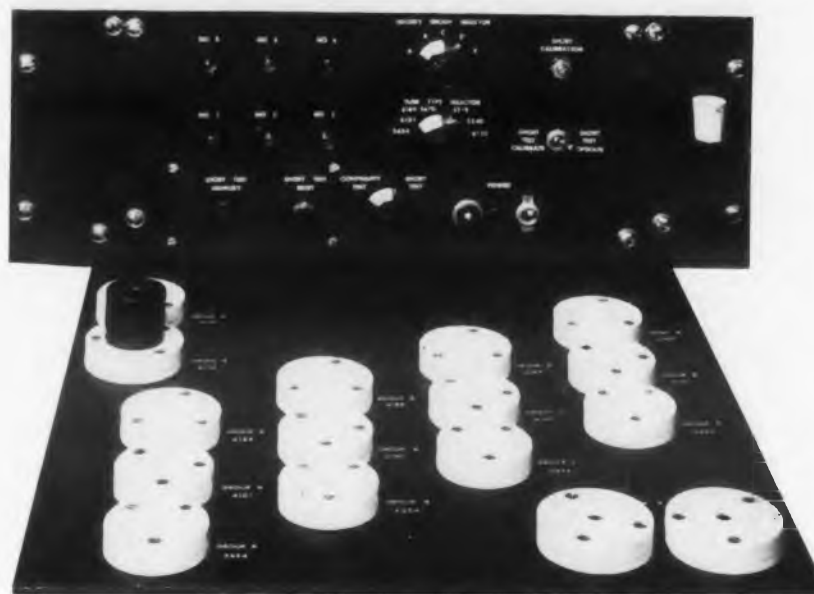
an optical Coincidence
Reading System
complete with a
precision glass
circle

A bulletin
illustrating
the how and
why of **UNISEC**
is yours for
the asking.

W. & L. E. GURLEY
525 Fulton Street
TROY, NEW YORK



CIRCLE 34 ON READER-SERVICE CARD



from one to another for testing. The cork mallet hanging at the right is for tapping tubes. The tester can readily be adapted to testing of other tube types than the seven types indicated above.

Short and Continuity Tester designed for rapid checking of seven tube types (5654/6AK5/6096, 6101/6J6WA, 6189/12AU7WA, 5670WA, 5718, 5840, and 6112). The first four types are 7 and 9-pin miniatures; the remaining three are subminiatures. Because testing of the first three types involved a great number of tubes in a large testing program, multiple positions were provided for these types for rapid short-continuity testing. Four tubes of a given type are plugged into the board. Then, while their heaters are being energized the operator switches a selector switch

Rapid Testing of Tube Shorts and Continuity

MOST general-purpose tube testers fail as convenient instruments for rapidly testing large numbers of vacuum tubes for shorts and discontinuities. This failure prompted the development of a short-continuity tester at Armour Research Foundation which is a high-sensitivity device for rapid tube checking and includes provisions for plugging-in and testing up to four tubes of a given type at a time. It also contains a "memory" feature for tap shorts. Although this unit was designed for seven particular tube types, other types could be accommodated with minor wiring changes.

The short-testing provision in the conventional tester usually consists of a four- or five-position switch utilized in conjunction with a single neon-lamp circuit. To locate the shorted elements, the switch positions for which a glow is obtained are noted and then a table is referred to for pin-pointing the short. There is no permanent indication for tap shorts. The G_m reading of the tester usually serves as the only continuity indication, and this is not always conclusive nor does it localize the discontinuity.

Short-Testing

The short-testing circuit of the newly developed tester has a "memory" characteristic whereby a permanent indication is given for an intermittent or "tap" short. In addition, the circuit will precisely localize all sustained shorts and those tap shorts in which the shorting time is sufficient for the human eye to sense the indication of the panel lamps. The precise localization is made by noting which lamp or lamps are ex-

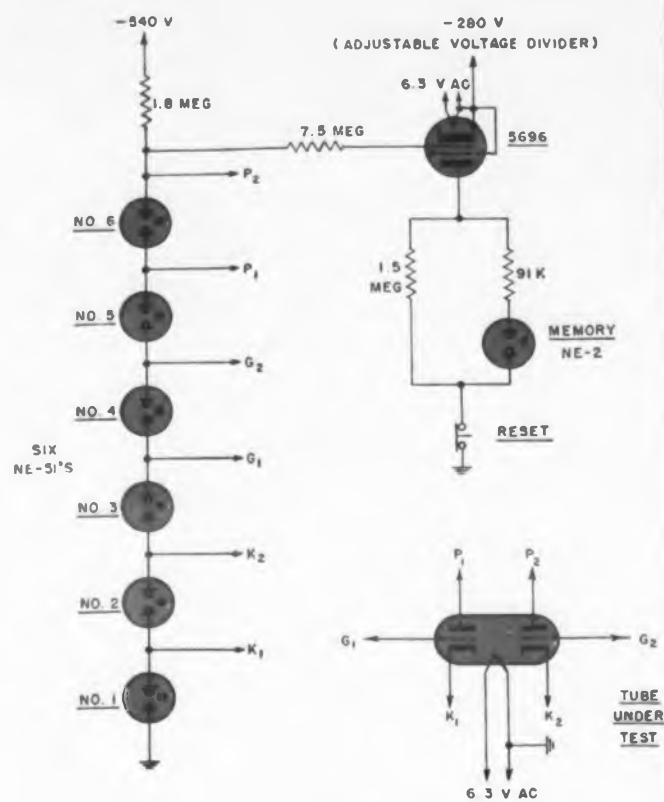


Fig. 1. Simplified short-testing circuit.

tinguished of six normally-glowing neon lamps. The "memory" indication is given by the glowing of a seventh, normally-extinguished lamp.

The sensitivity (maximum short resistance for indication) between any two elements of the tube under test is 220,000 ohms for the "memory" indication and approximately 400,000 ohms for the six-lamp localization display.

A simplified schematic diagram of the short-testing circuit (minus tube-type switching, tube-socket switching, etc.) is given in Fig. 1. The elements of the tube under test are connected to the junction points of the six series-connected

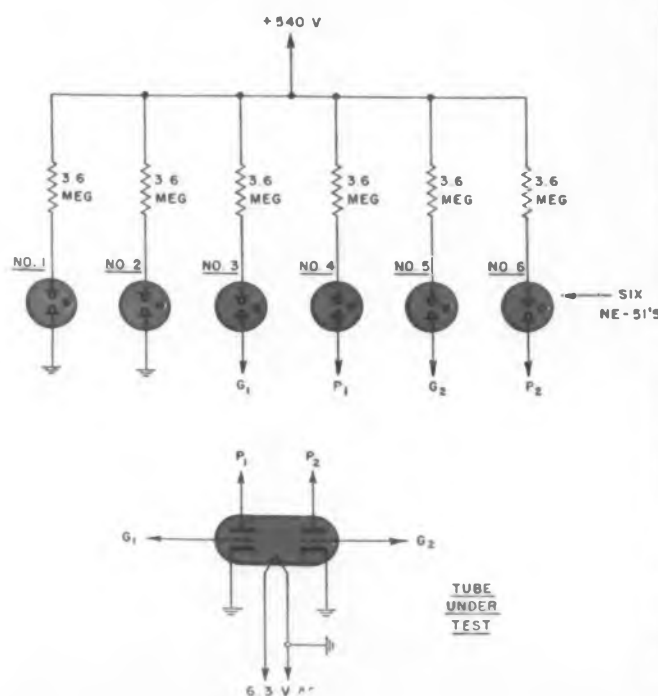


Fig. 2. Simplified continuity-testing circuit.

COMMUNICATION
ACCESSORIES COMPANY
LEE'S SUMMIT, MISSOURI



A Memorandum to the Electronic Industry

C-A-C has acquired the design and manufacturing facilities of a leading transformer manufacturer. The facility from conception has had responsibility for supplying components of greater reliability and higher performance than obtainable from existing suppliers.

Key personnel, assets, design and experience data have been moved to our new air-conditioned building in Lee's Summit, Missouri. Products now offered to general industry.

Watch for our advertisements announcing new developments in laminated transformers meeting MIL specs and future specifications yet to be written.

New catalogs available soon will describe components never before offered to the industry for airborne equipment and missile applications. Start your breadboards with transformers designed for tomorrow's environments.

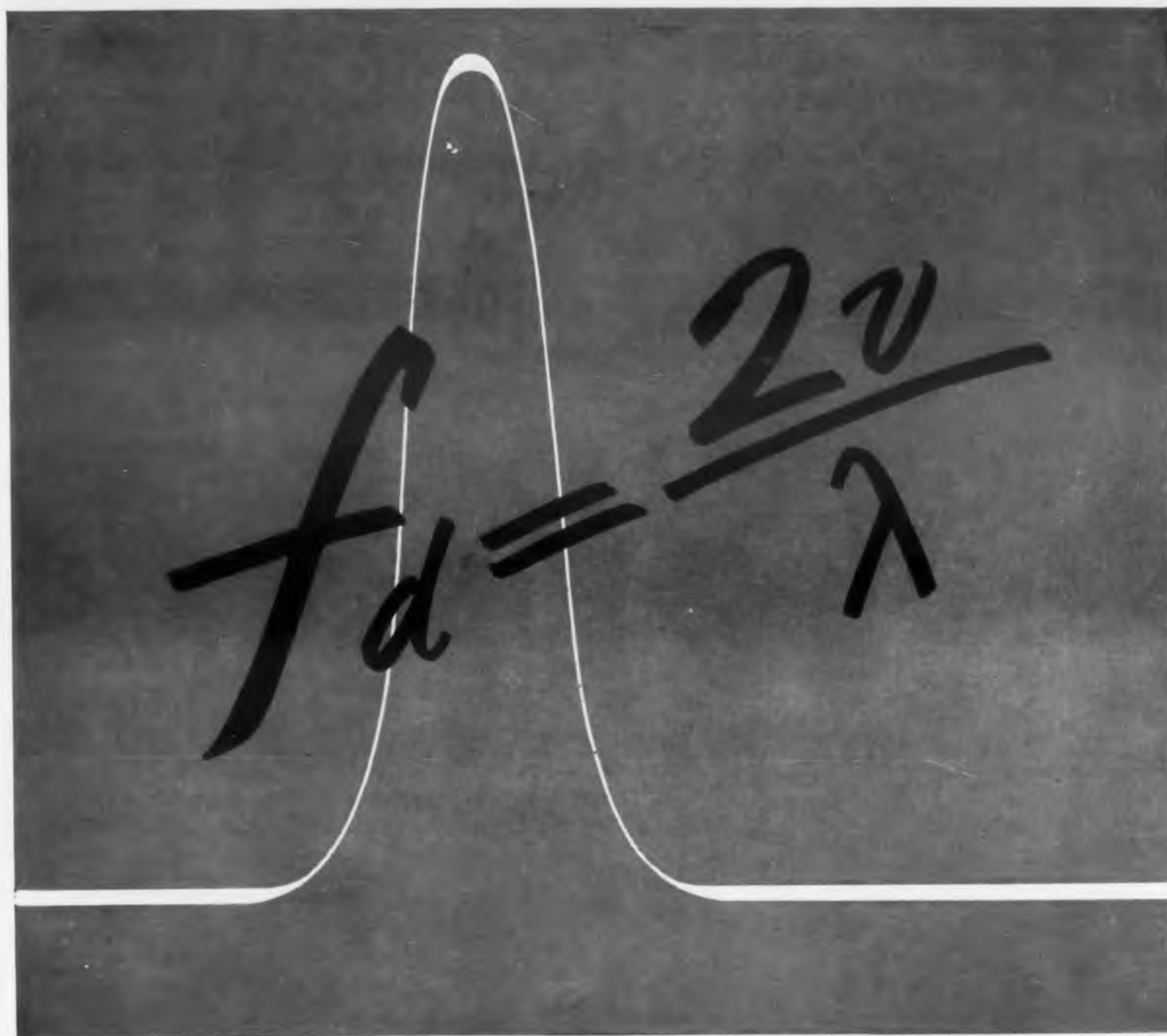
This acquisition precedes additional expansion plans at CAC. (Attention! Need more top notch transformer wizards—interested? Your choice: design application or sales.)

With toroidal components and the addition of the transformer division, CAC offers the country's broadest line of frequency selective, power and inductive components.

P.S. See
You at the
I.R.E.

George E. Guidi
George E. Guidi
Sales Manager

CIRCLE 33 ON READER-SERVICE CARD



DOPPLER NAVIGATION SPECIALISTS

Work on advanced doppler radar navigation and guidance projects at Raytheon.

Some of the most interesting and vital projects of the day are now in the works at Raytheon's Maynard Laboratory.

Challenging assignments are given to engineers with specialized radar experience in doppler navigation and guidance systems... and to others with backgrounds in radar interested in working with these new systems.

Are you a circuit design engineer, microwave design engineer, product design engineer, or systems engineer with radar experience?

PLEASE CALL COLLECT. Ask for John J. Oliver at TWin Oaks 7-2945, Ext. 246, or write him for details. He'll be glad to arrange an appointment at your convenience.

RAYTHEON MANUFACTURING COMPANY
Maynard Laboratory

P. O. Box 87D, Maynard, Massachusetts

CIRCLE 31 ON READER-SERVICE CARD



Excellence
in Electronics

Rapid Testing (cont.)

NE-51 lamps. The constant voltage drop of each of the neon lamps is approximately 50 v. The lamp current is fixed at approximately 0.133 ma by the -540 v source voltage and the 1.8 meg series-dropping resistor. If a resistance of approximately 400,000 ohms is placed between K_2 and G_1 , for example, all of the Lamp No. 3 current would be routed through the resistance and the lamp would extinguish. This value of resistance, which is the lamp voltage divided by the series current, is thus the basic localization sensitivity of the short tester. If the shorting elements are non-adjacently connected, such as K_2 and G_2 , Lamps Nos. 3 and 4 would extinguish and the sensitivity would be proportionately increased to 800,000 ohms. Since one side of the heater is grounded, a short between K_1 and heater, for example, would cause Lamp No. 1 to extinguish.

Memory Circuit. In connection with the "memory circuit," the grid of the Type 5696 thyratron is connected to the "top" of the No. 6 lamp (through the grid current-limiting resistor) which is at a constant potential without shorts; whereas the cathode is returned to a fixed voltage such as to bias the tube a certain amount beyond the negative critical voltage for firing. When a short of sufficient magnitude occurs between any of two elements of the tube under test, the thyratron grid becomes less negative, causing the tube to fire, which, in turn, causes the "memory" lamp to glow. The "memory" lamp continues to glow, of course, until the reset button is depressed, regardless of the voltage at the grid. The time-constant of the grid circuit (series resistance together with stray capacitance) is such that a short of duration of only about 100 μ sec is sufficient at maximum sensitivity to fire the tube. Thus, the circuit is fast enough for practically all tap short defects encountered.

The change in voltage at the grid, ΔE , resulting from an adjacent element short of 220,000 ohms (maximum design sensitivity) can be computed from the following equation:

$$\Delta E = \frac{E_L R_2 / R_1 + 6E_L - E_S}{1 + R_2 / R_1}$$

Where:

E_L = Lamp voltage (approximately 50 v)

E_S = Supply voltage (-540 v)

R_1 = Resistance of adjacent-element short (220,000 ohms)

R_2 = Series-dropping resistor (1,800,000 ohms)

The value of ΔE obtained from the above equa-

tion is approximately 18 v. To this value must be added the negative critical grid voltage of the thyatron to obtain the grid-to-cathode bias voltage necessary for this sensitivity. The critical grid voltage for the 5696 (with suppressor grid tied to cathode) with the working plate voltage of approximately 300 v is -2.5 v. Thus the required negative grid bias is approximately 20.5 v. Since the nominal NE-51 voltage drop is 50 v, the quiescent voltage at the grid is close to 50×6 or -300 v. The cathode must be returned, then, to approximately -280 v. The sensitivity of the instrument to tap shorts is calibrated by adjusting the cathode potential with a voltage divider. A 220 kilohm resistor is switched across one of the series lamps and the cathode voltage is varied in a negative direction until the thyatron fires as observed by the NE-2 "memory" lamp. The actual negative grid bias as set by calibration measures very close to the computed 20.5 v.

A regulated high voltage power supply is required because a 1 per cent change in cathode voltage gives roughly a 10 per cent change in "memory" sensitivity. The supply used in a recent application of the instrument was a Northeast Scientific Corporation (Cambridge, Mass.) Model RE-1602, a compact, relatively inexpensive supply having a regulation of about 0.01 per cent. This degree of regulation was actually better than required.

Continuity Testing

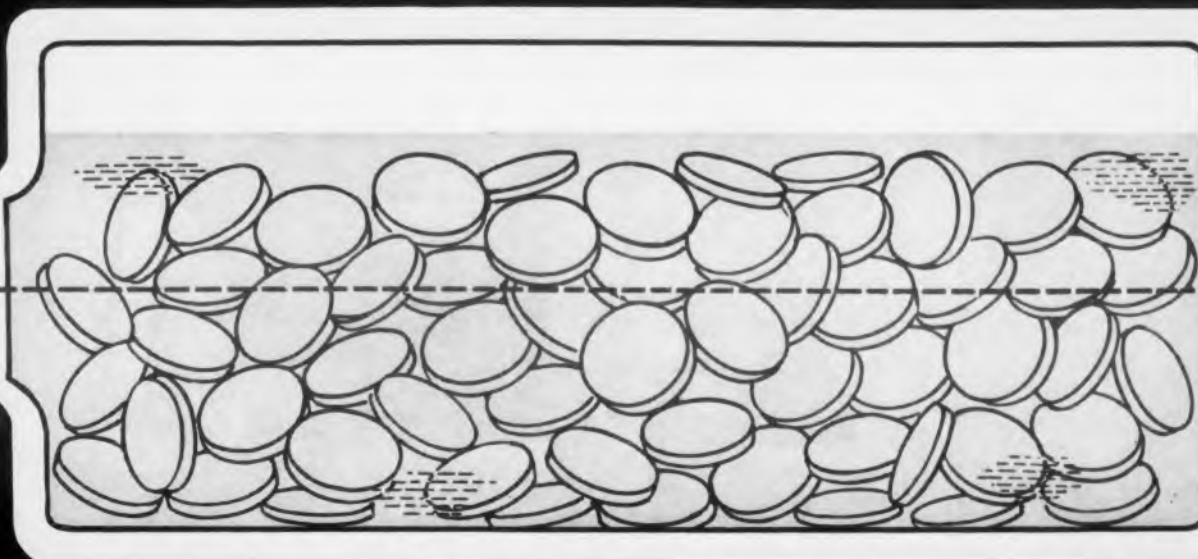
The continuity-testing circuit is quite simple. Emission from the hot cathode is utilized, all tube grids and plates being connected positively with respect to the cathodes. The same six NE-51 lamps are used with this circuit as with the short-testing circuit, and, as in the latter, all six lamps will glow with a non-defective tube under test.

A simplified schematic of the continuity-testing circuit is given in Fig. 2. The cathodes of the twin-triode under test are grounded and both grids and plates are connected to $+540$ v through an individual neon lamp and series-dropping resistor. If continuity is not present to a given element, its lamp will be out. For simplicity of operation, all neon lamps which are not utilized for the particular tube type under test, are energized by connection directly to ground. This is shown for lamps 1 and 2 in Fig. 2. Because of the large series-dropping resistors, the current through each element and lamp is fixed at approximately 0.13 ma, and all lamps glow equally.

The work described above was performed at Armour Research Foundation of Illinois Institute of Technology under sponsorship of the Air Materiel Command, and under technical direction of the Wright Air Development Center. It was reported by the engineer who developed the instrument, Mr. E. S. Gordon.

an outstanding RI achievement . . .

DIRECTLY OUT OF SOLUTION!



the new KEMETAL electro-less process of copperplating

large quantities plated in one low-cost operation

After five years of research and tests, RADIO INDUSTRIES has developed a process of plating low-cost, high conductivity copper on a ceramic (or any other) surface . . . DIRECTLY OUT OF SOLUTION . . . in large quantities.

Not only is the process low in cost, but it deposits copper uniformly on all surfaces of a body, regardless of how complex or irregular, and forms a close, tightly

adhering chemical bond. This tight bond is not lost in soldering, hence soldering temperatures are not critical as in the application of silver-coated parts.

Longer life for the product is assured because the copper, as this process applies it, has 100 times less migration activity between electrodes than silver in normal circuit applications.

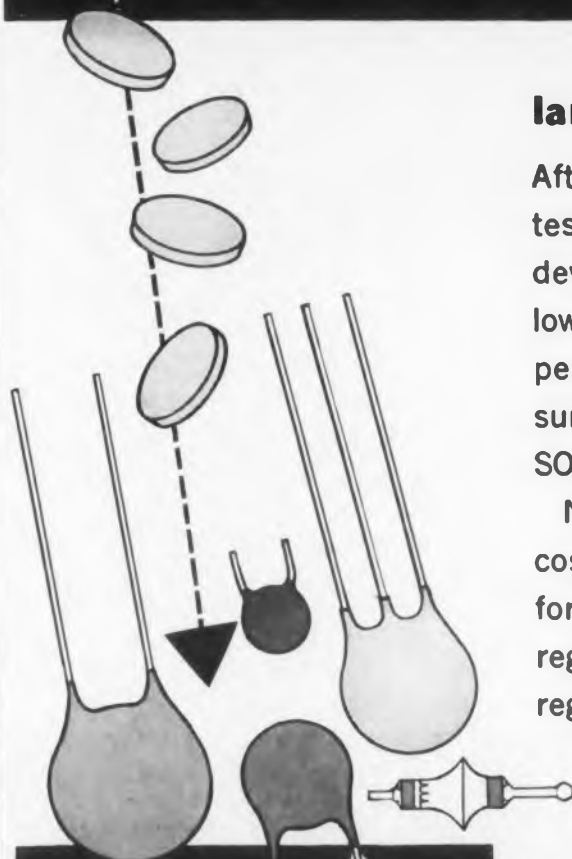
the KEMETAL process is now used in the manufacture of RI-caps . . . CERAMIC DISC CAPACITORS and FEED-THRUS.

RADIO INDUSTRIES, INC.

5225 n. ravenwood ave. • chicago 40, ill.

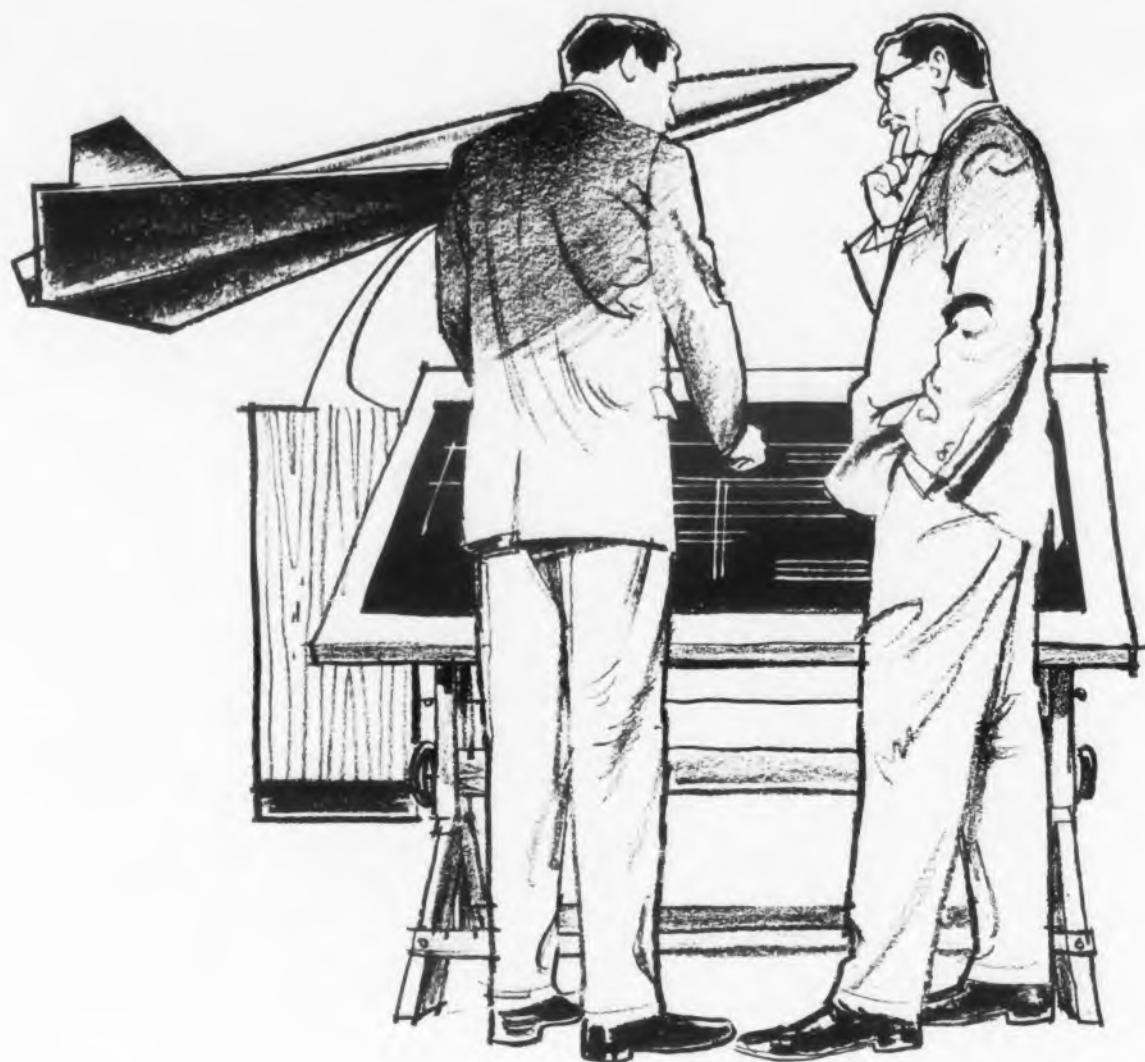


CIRCLE 35 ON READER-SERVICE CARD



NEW SWEDGE LEADS

held to accurate dimensions for printed circuit insertion.
Samples on request.



WHATEVER YOU REQUIRE IN SILVER

... HANDY & HARMAN IS YOUR BEST SOURCE OF SUPPLY

You can go no further for available knowledge of, and experience in, the manufacture of silver and silver alloys. In the ninety years Handy & Harman has been active in the research, manufacture and application of silver and silver alloys for all industry, it has gained the reputation of The Number One Source and Authority.

Among the many forms of silver and silver alloys manufactured by Handy & Harman are:

- Fine silver (wire, strip and foil)
- Silver anodes and grain for plating
- Silver contact alloys • Silver powders
- Silver flake, paints and paste • Silver brazing alloys • Silver electronic solders
- Silver sintered metals • Solder-flushed silver alloys • Silver chloride and oxide
- Coin silver (wire and strip) • Silver bi-metals

Our Technical Service and field application experience are at your disposal... we welcome inquiries on products and product problems involving any form of silver.

JOIN THE HANDY & HARMAN FREE LIBRARY

We have four Technical Bulletins giving engineering data on the properties and forms of Handy & Harman Silver Alloys. We would like you to have any or all of those that particularly interest you. Your request, by number, will receive prompt attention.

- Fine Silver Bulletin A-1
- Silver-Copper Alloys . . . Bulletin A-2
- Silver-Magnesium-Nickel . . . Bulletin A-3
- Silver Conductive Coatings . . . Bulletin A-4

Your No. **1** SOURCE OF SUPPLY AND AUTHORITY ON SILVER ALLOYS

HANDY & HARMAN
General Offices:
82 Fulton Street, New York 38, N. Y.

Offices and Plants: Atlanta, Georgia • Bridgeport, Connecticut • Providence, Rhode Island • Chicago, Illinois • Cleveland, Ohio • Detroit, Michigan • Los Angeles, California • Oakland, California • Toronto, Canada • Montreal, Canada

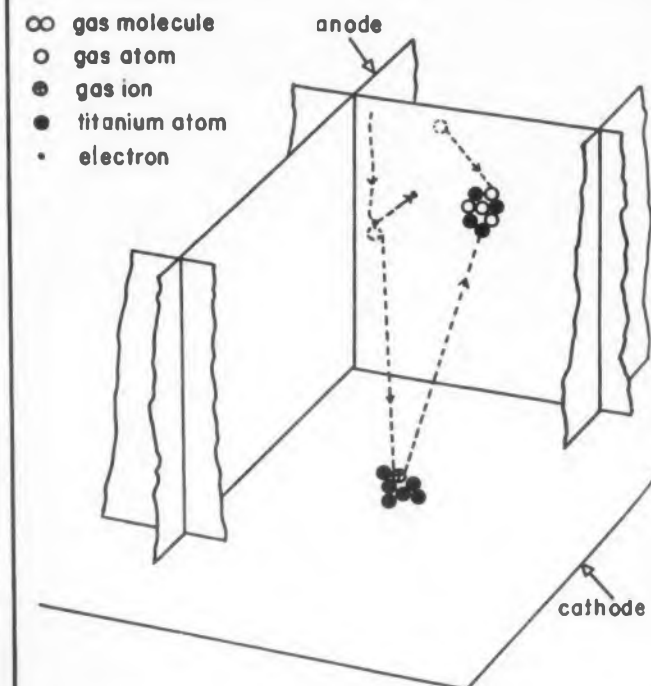
CIRCLE 37 ON READER-SERVICE CARD

Completely Electronic High Vacuum Pump

VACUUMS in excess of 1×10^{-9} mm are possible with this completely electronic high vacuum pump. The unit consisting of a permanent magnet and power supply has no movable parts.

Developed by Varian Associates, 611 Hansen Way, Palo Alto, Calif., the pump requires no oil vapor, cold traps, or vapor traps. Nor are additional pressure measuring devices needed for most applications, since pressure in the pump is calibrated in terms of pump current. If more than one pump is operated with a single supply, individual current meters must be provided to measure pressure.

Removal of the gas is achieved by the formation of a gettering layer of titanium atoms which combine with the gas atoms during the pumping



This cutaway view of the Vaclon high pressure pump depicts the action of the device. Electrons emitted from the cold-cathode are constrained by the magnetic field and collide with the gas atoms to produce a high density parallel ion current. Titanium atoms are emitted from the cathode after bombardment by the ion beam. A gettering layer is formed on the anode which unites with gas atoms.



No movable parts in this completely electronic ultra-vacuum pump.

process. Detailed operation of this process is illustrated in the cutaway diagram. Electrons emitted from the titanium cold-cathode plate are constrained by the magnetic field, increasing the electron path length. The ion current is therefore, greatly increased. High density, parallel ion beams defined by the cellular anodes bombard the cathode plates. Titanium atoms are ejected and these sputtered atoms are deposited on the anode cell walls. The gas atoms then combine with the titanium gettering layers.

Designated VacIon, the pump is started at a rough vacuum of 15 to 20 microns obtained with a conventional oil-sealed mechanical pump. The VacIon and system are valved off from the roughing pump after starting, making the system invulnerable in the event of a power failure. The starting pump may be shut off after the starting period.

The cellular anode construction offers greater effective sputtering area and cathode surface over a ring or simple cylinder design. The probability of trapping gas particles is increased, flaking is minimized, ion current density is increased, and a large number of field free regions are provided which increase sputtering.

In addition the total ion current is increased at any pressure and the discharge is permitted to persist to indefinitely low pressures at the applied voltage of 3 kv. This feature insures that the pumping speed will not fall to zero until extremely low pressures are reached. Pumping speeds of 10 liters per sec at pressures of 10^{-7} mm have been measured.

The ultra-high vacuum capabilities of the VacIon makes it particularly suitable for processing microwave tubes. Several large tubes have been constructed with the pump as an appendage. The pump is put through bakeout along with the tube and after pinchoff remains attached to it.

For more information on this device, turn to the Reader's Service Card and circle 38.

PZT-4[©]

NEW Piezoelectric* Material

Surpasses barium titanate... performs remarkably independent of temperature... Curie point above 572°F... suggests new fields of application—maybe yours

A newly-developed polycrystalline ceramic, Clevite PZT-4, can greatly increase the reliability and operating range of missile devices, sonar transducers, ultrasonic cleaning equipment and other systems now using "grown" crystals or barium titanate elements.

PZT-4's resonant frequency and piezoelectric coefficients are virtually independent of temperature... dielectric constant compatible with barium titanate—substitute PZT-4, extending your operating temperature range. PZT-4 substantially increases voltage output and power handling capacity of transducers.

Commercial quantities of PZT-4 are now available in electro-mechanical specifications to meet your needs. With skilled facilities, knowledge and experience in this highly specialized field, Clevite's Electronic Components Division is also prepared to manufacture complete assemblies—such as transducers—for your needs. Send for PZT-4 technical data, or discuss your application with one of our specialists.

*Piezoelectric—"pressure" electricity. Press or squeeze certain crystalline materials and they generate electricity. Conversely, charge them electrically and they change in width, in length or in thickness.

VISIT BOOTH NO. 2622, IRE SHOW, N.Y.C.—MARCH 24-27.

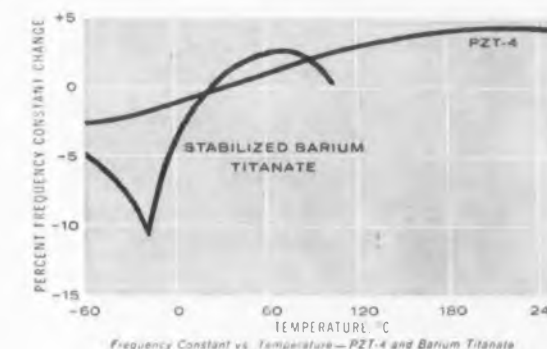
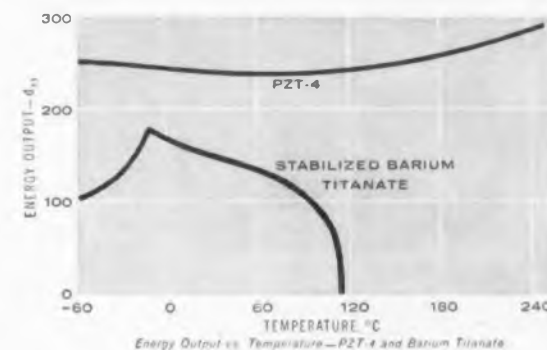
**CLEVITE
ELECTRONIC
COMPONENTS**

3311 Perkins Avenue, Cleveland 14, Ohio

DIVISION OF



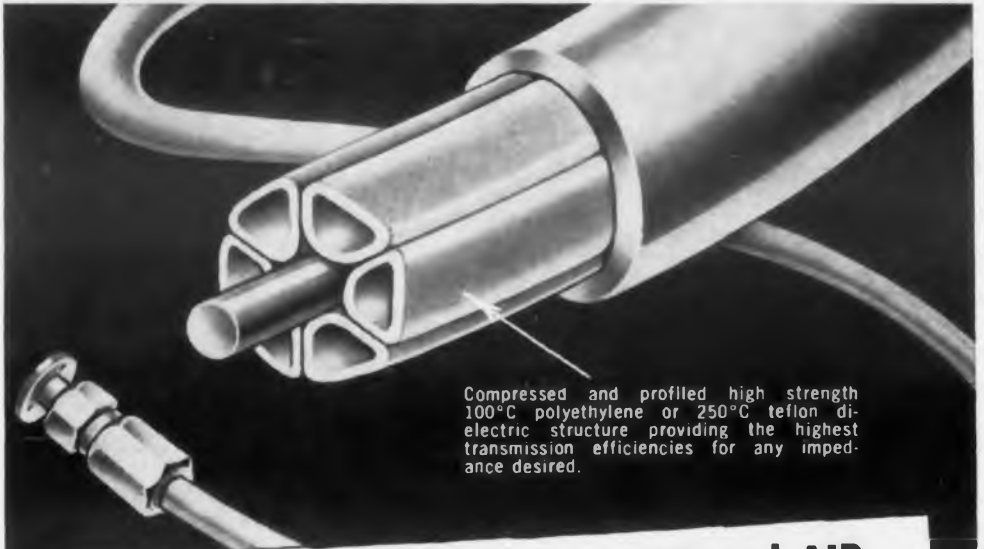
'BRUSH' MAGNETIC HEADS, TRANSDUCERS,
PIEZOELECTRIC CRYSTALS AND CERAMICS



NEW All-American!

Spir-O-line[®]

SEMI-FLEXIBLE ALUMINUM TRANSMISSION LINE



Compressed and profiled high strength 100°C polyethylene or 250°C teflon dielectric structure providing the highest transmission efficiencies for any impedance desired.

UNIQUE! ADVANTAGES of SOLID and AIR DIELECTRIC LINE COMBINED by *Prodelin* in revolutionary Cable and All-Aluminum Connector

Here's another Prodelin-pioneered contribution to air-dielectric transmission lines . . . *Spir-O-line*.^{*} It combines the low loss of air dielectric with the high power of solid dielectric lines by using dielectric tubes compressed and profiled into a symmetrical supporting structure. 50 ohm lines available in continuous lengths up to 1000' with reliably low VSWR and usable up to these cut-off frequencies: $\frac{3}{8}$ " to 15.0 Kmc; $\frac{1}{2}$ " to 10.0 Kmc; $\frac{7}{8}$ " to 5.0 Kmc; $1\frac{1}{8}$ " to 2.8 Kmc; $3\frac{1}{8}$ " to 1.5 Kmc.

FEATURES

- No special techniques or tools required to make up cable-conductor assembly
- No metallic welds or dielectric splices are used regardless of cable length
- Continuous high-conductivity aluminum sheath assures maximum pressure tightness and weather protection
- Uniform straight lay tubular support throughout keeps inner conductor smoothly centered on bends
- Pressure-tight and high tensile cable-conductor assembly can be made with only hand-tightening
- Dielectric structure makes continuous and intimate line contact with both conductors without spiraling — yielding best broadband performance, highest power handling capacity, lowest attenuations, and VSWR smoothness
- Both cable and connector available for -90 C to +250 C operation
- Terminates in standard EIA (RETMA) dimensions

PLUS



Spir-O-line Connector

Amazing Prodelin development! Adequately pressure-tight for lab use when hand-tightened . . . ready for field service when wrench-tightened. Specifically designed for use with soft aluminum tubing to provide highest tensile strengths without tube distortion. No special techniques, bulky fixtures, or non-standard tools required. *May be used again and again without redressing tubing or replacing connector parts!* Saves time and money! RETMA dimensioned.

Specify Spir-O-line HI-TEMP with Teflon for 250°C operation



Reconsider your cable requirements now and ask how Spir-O-line can provide new life with added economies in your service! WRITE FOR TECHNICAL BULLETIN TODAY

DEPT. ED-3 307 BERGEN AVE., KEARNY, N. J.

Spir-O-line! — the only All-American Semi-Flex Aluminum Cable and Connector Conceived, Engineered, and Manufactured in the U. S.!

CIRCLE 40 ON READER-SERVICE CARD

* PATENTS PENDING

Strain Gage Type

Miniature Accelerometer



Actual size of the accelerometer.

COMPACT design, using the strain gage principle of resistance wire in a balanced bridge configuration, has made possible the small size of this accelerometer. Measuring less than one inch overall length, the A52 accelerometer also exhibits notable characteristics: Ranges of ± 5 g to ± 100 g,

linearity of ± 1 per cent full scale, and a natural frequency of 200 cps for the ± 5 g type up to 650 cps for the ± 100 g range. The unit has an output of approximately ± 32 mv (64 mv representing a full scale excursion) using an excitation voltage of 8 v dc or ac rms. Viscous fluid damping is 0.7 (± 0.1) of critical at room temperature. The accelerometer's response to transverse acceleration is not more than 0.03 g per g within the rated range. The maximum allowable static acceleration is twice this rated range.

The A52 accelerometer, manufactured by Statham Instruments, Los Angeles, Calif., is based on the company's un-

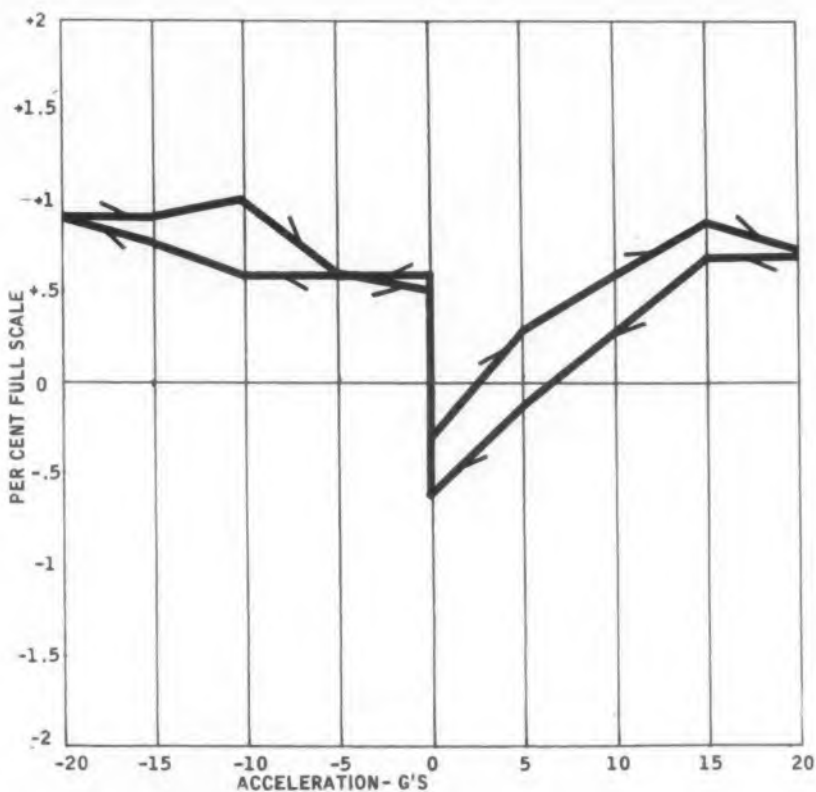


Fig. 1. Linearity tests on the A52-20-300 accelerometer show a variance of not more than ± 1 per cent. The unit has been cycled through its 40 g range, representing a total output excursion of 67.4 mv for an 8 v excitation.

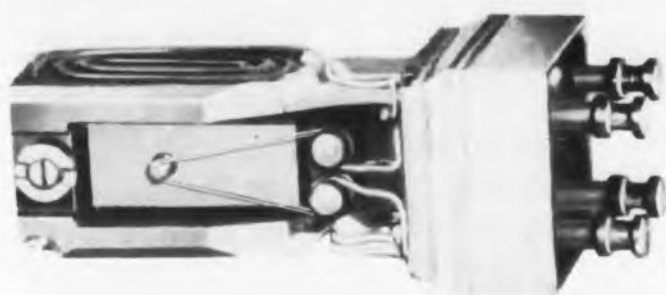


Fig. 2. The transducing element exposed, showing the resistance wire which makes up part of the balanced bridge circuit. The sensitive axis is at right angles to the exposed face. This is made possible by the cantilevered mounting of the central mass.

bounded strain gage construction. This consists essentially of four resistance wires arranged in a parallel fashion, and so attached to a moving element that displacement in either direction parallel with the wires will result in tension on two wires and relaxation of the other two. Since the resistance wires form a typical Wheatstone bridge, such displacement will result in an electrical unbalance.

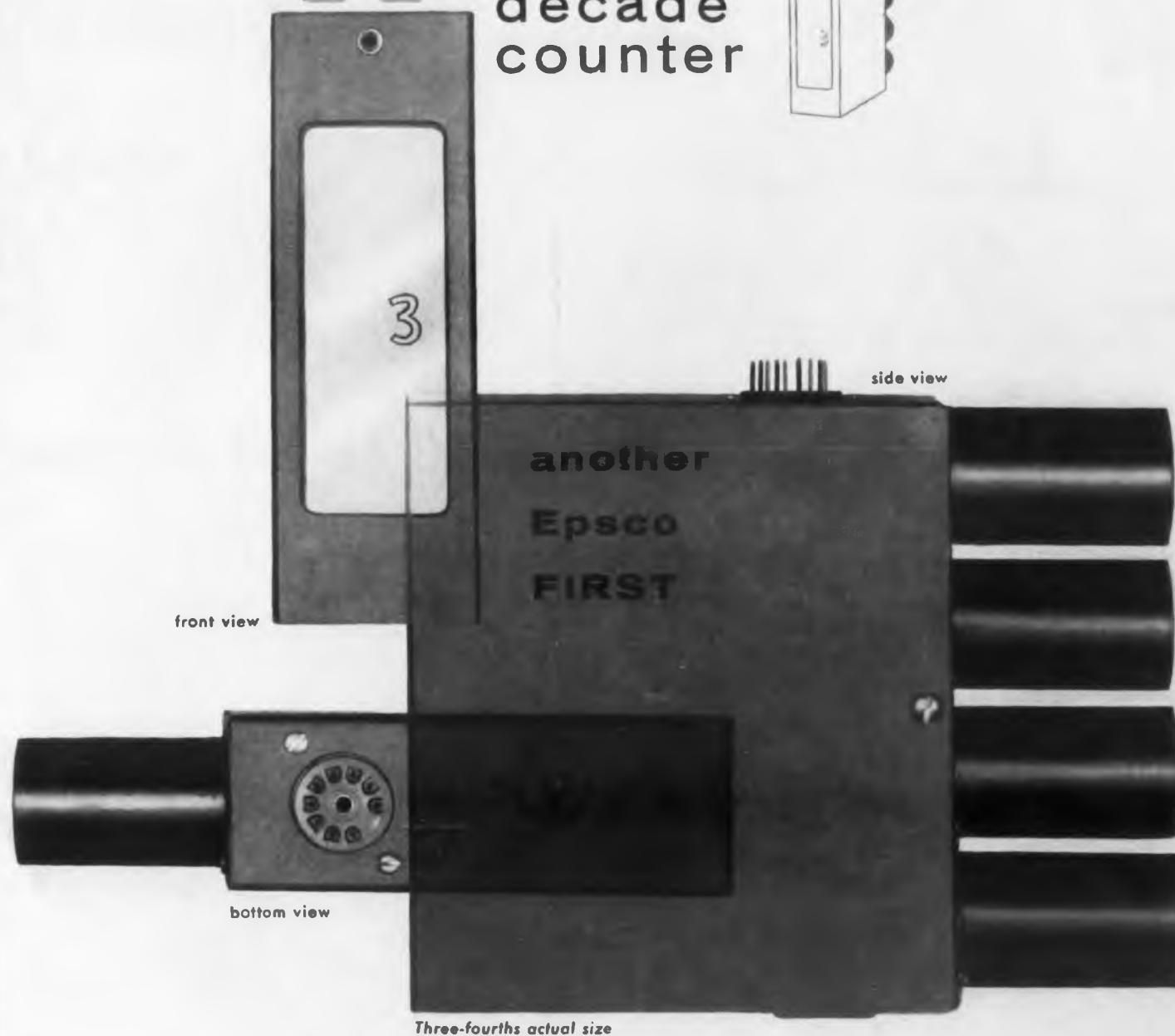
In this particular accelerometer, the construction is slightly different, providing a sensitive axis at right angles to the longitudinal axis. In effect, the moving element or mass is cantilevered to provide a mechanical advantage; this, in part, enables the small size of the instrument. As shown in Fig. 2, two of the resistance wires are here represented by the inverted V, attached to two terminals at the bottom and around the insulator on the mass. The mass is attached by means of a cantilevered construction at the bottom; this consists of a very thin strip of metal which is machined from the beryllium copper mass itself. A similar arrangement of the resistance wires on the other side provide the balanced circuit configuration.

In operation, a small movement of the mass around the cantilever axis suffices to set up an electrical unbalance. The linearity of the output is mostly due to the lack of any frictional devices, such as a pivot or sliding element. This linearity is described in Fig. 1 for model A52-20-300 accelerometer, which has a total range of 40 g and a output of 67.4 mv full scale with 8 v excitation.

For more information on the A52 accelerometer, Circle 41 on the Reader's Service Card.

now TRANSISTORIZED

decade
counter



Three-fourths actual size

Once again Epsco Components scores a first . . . a completely transistorized 150KC decimal counter unit that offers unique advantages in compactness, light weight, and low power input requirements. Read-out is indicated in highly legible $\frac{3}{8}$ " numerals on a translucent panel. The mating of inherent transistor stability with reliable circuit design guarantees dependability for an indefinite period. Epsco's Model CT-101 features plug-in, encapsulated flip-flops, and is fitted with a 9-pin miniature plug as

well as a 9-pin socket providing outputs for remote indication purposes.

Custom engineering-production of electronic components (shift registers, magnetic logic elements, delay lines, special pulse transformers, plug-in logic elements, etc.) is our specialty. Write for technical bulletin. See Decade Counter and other Epsco Components at IRE Booth 2120. Epsco Components, Dept. E-38 108 Cummington St., Boston 15, Mass.

START-TO-FINISH cooperation
an Epsco guarantee

Epsco 
COMPONENTS

CIRCLE 42 ON READER-SERVICE CARD

Galileo Galilei
1564-1642



"Wherever I am,
whatever my need,
They're delivered* to me
with blinding speed!"



BECKMAN/BREADBOARD PARTS

For the standard parts
to breadboard your system,
Send for catalog 35C,
where we show 'em and list 'em.

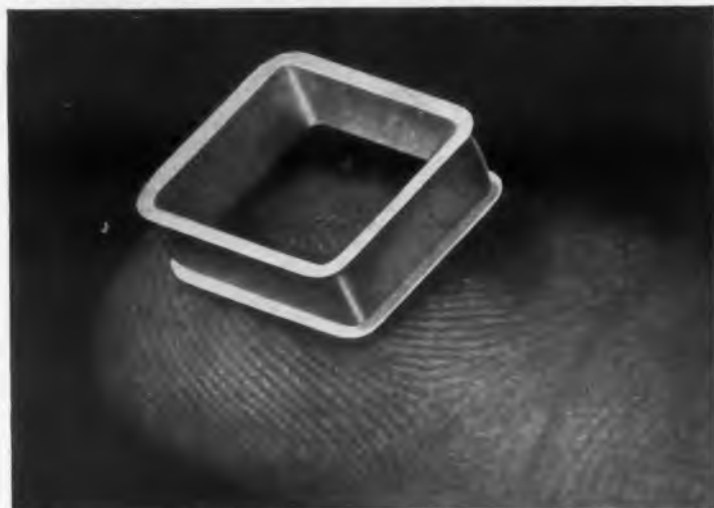
*Within 3 days of order!

Beckman*
Helipot Corporation, Newport Beach, Calif.
a division of Beckman Instruments, Inc.
Engineering representatives in principal cities.

1205

CIRCLE 43 ON READER-SERVICE CARD

VOLUME-PRODUCED TO TIGHT TOLERANCES



H&H close tolerance part—moving coil form, volume-produced for d'Arsonval galvanometers.
Width .362 ± .002 • Length .4219 ± .001 • Depth .160 ± .001 • Wall thickness .008 ± .0005

SPECIALIZED TUBULAR METAL PARTS

Want specialized metal tubular parts in extremely close tolerances? At lowest possible cost? H&H Machine Company volume produces an almost endless variety—to your specifications, in all commercial alloys, in sizes from .01 in. to ½ in. diameter. No production difficulties—we do the complete job from tooling up to rigid inspection. No design problems—we make our own tools and dies to meet specified tolerances precisely.

Write for literature, or send blueprint with quantities desired.



H & H MACHINE COMPANY, INC.
Noble & Jackson Sts. Norristown, Pa.
Phone BRoadway 2-6453 BRoadway 9-2327

CIRCLE 44 ON READER-SERVICE CARD

BACKGROUND FOR DESIGNERS

Here is the second part of Dr. Storm's article on non-linear magnetics. Part I, which appeared in the February 19th issue of *ELECTRONIC DESIGN*, discussed the basic nature of the saturable reactor (SR) and its applications without other circuit elements.

In this part, Dr. Storm discusses the SR used alone with a resistor (Section 3), and with an inductor (Section 4).

Applications of Non-Linear Magnetics

Herbert F. Storm

General Engineering Laboratory
General Electric Company
Schenectady, N. Y.

Part II

3 SR and Resistor R

Frequency Detector

Fig. 3-1A shows a saturable reactor primary winding connected across an ac bus. The resistance of winding 1 is lumped into R . Suppose the core flux ϕ is at negative saturation at $t = 0$ (points 1, Figs. 3-1 C and E). For t greater than 0, the instantaneous supply voltage e becomes positive (Fig. 3-1B), and the core leaves negative saturation. The core flux increases according to eq (2-1).

$$e_G = 10^{-8} N d\phi / dt \quad (2-1)$$

A magnetizing current flows, causing a voltage drop across the circuit resistance R . The instantaneous gate voltage e_G may be smaller than the supply voltage e . Hence,

$$\Delta \Phi = \frac{10^8}{N} \int e_G dt \quad (3-1)$$

The instantaneous output voltage e_o (Fig. 3-1D) follows from

$$e_o = e_G N_2 / N_1 \quad (3-2)$$

and the average output E_o for the first half-cycle is

$$E_o = \frac{2}{T} \int_0^{T/2} e_o dt \quad (3-3)$$

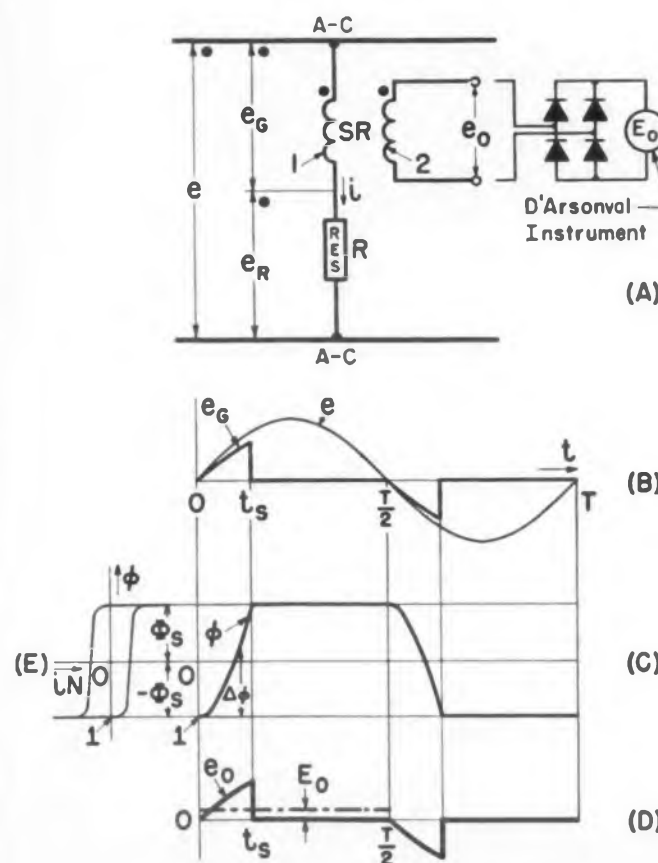


FIG. 3.1

Fig. 3-1. Voltage or Current Reference Circuit. (A) Circuit diagram, (B) Supply voltage e and gate voltage e_G , (C) Core flux, (D) Output voltage e_o , (E) Flux-current loop.

At $t = t_s$, the core saturates, ($\Delta\Phi = 2\Phi_s$, Fig. 3-1C), and it can be assumed that the core remains saturated for the duration of the half-cycle. Hence

$$E_o = \frac{2}{T} \frac{N_2}{N_1} \int_0^{t_s} e_G dt \quad (3-4)$$

Substituting from eq (3-1) into eq (3-4), and for $\Delta\Phi = 2\Phi_s$, one obtains

$$E_o = 4f \Phi_s N_2 10^{-8} \quad (3-5)$$

where the supply frequency f replaces the period T . The events during the second half-cycle produce similar results. A D'Arsonval instrument energized through a loss-free rectifier (Fig. 3-1A) would read E_o .

The output voltage E_o is proportional to the supply frequency and is not affected by the magnitude of the supply voltage as long as the core saturates at least once each half cycle. The magnitude of R does not affect E_o , but merely controls the maximum value of current i (eq 2-4). If a current flows in the output circuit, the output voltage E_o is reduced only by the voltage drop in winding 2 of the SR, but is not affected by the voltage drop in R . As long as the saturation branches of the flux-current loop (Fig. 3-1E) are horizontal in the first and third quadrants, the width of the loop, and the shape of its flanks are irrelevant to the circuit operation.

Practical applications of this circuit are in frequency regulators, frequency compensators, over- and under-frequency indicators and controllers.

Voltage or Current Reference

If the supply frequency f is constant, the output voltage E_o (eq 3-5) is also constant and the circuit of Fig. 3-1A can be used as the basis of a voltage or current reference circuit (Ref 3-1). If the supply frequency is variable, frequency compensation can be applied, for instance by the addition of linear reactors in the output circuit (Ref 3-2, 3-3). Reference 3-3 describes a circuit which holds the output current at $15 \pm .02$ ma dc with a 50 ohm load. The supply voltage varies from 100 to 140 v; the supply frequency varies from 360 to 440 cps; and the temperature from -55 to $+100$ C. In 15 cubic inches, the device weighs only 1.5 lb.

Firing Circuits for Thyratrons

For precise firing of grid-controlled mercury arc or gaseous rectifiers, a rapid rise of grid-cathode voltage is required. Such a voltage develops across R in Fig. 3-1 at the instant t_s of core saturation. This voltage e_R can be applied directly or by interposing a grid transformer to the grid-cathode circuitry (Ref 3-4).

T-42 In missiles, rockets, satellites

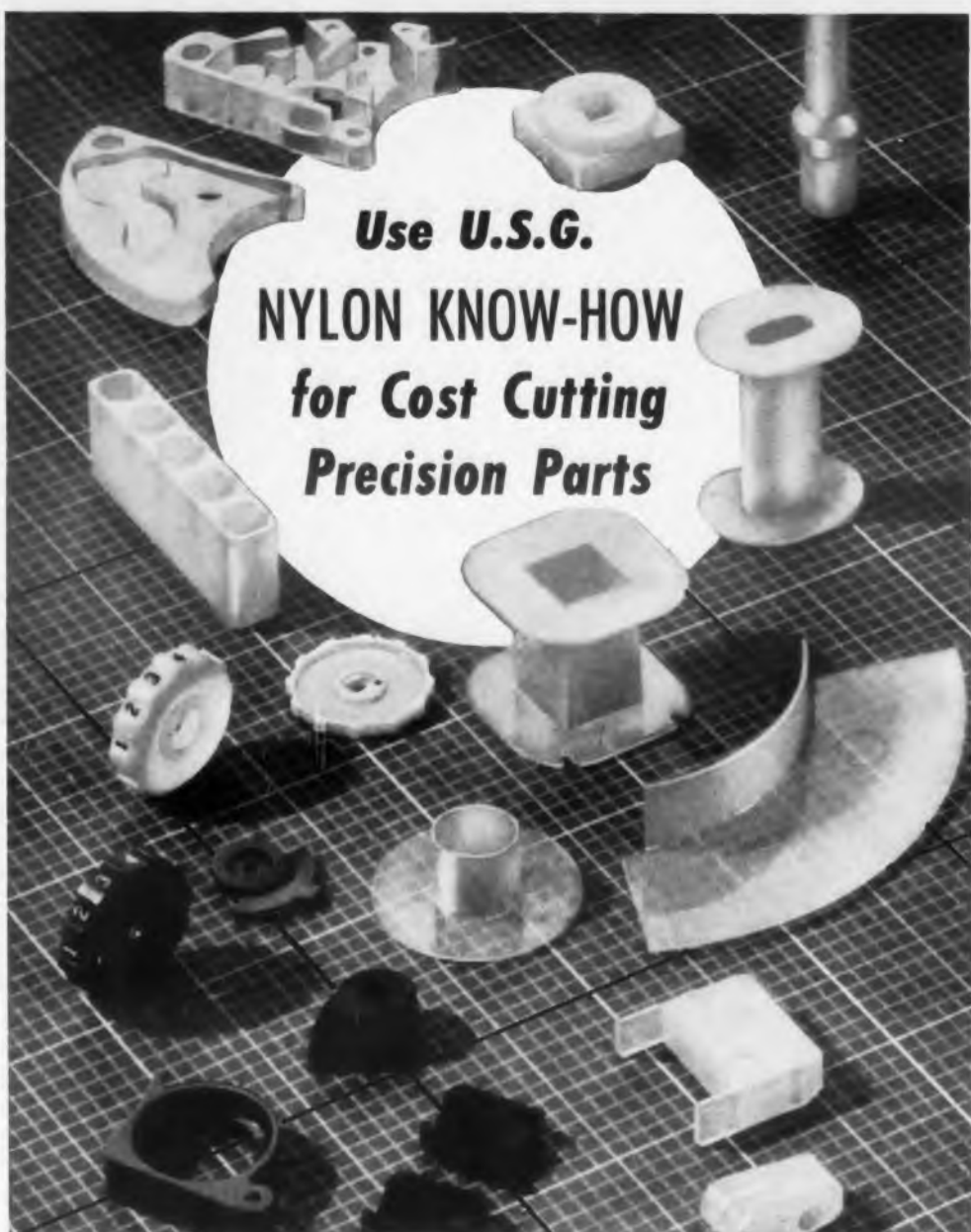
The T-42 looks like such a little thing. Hardly seems worth the name "Ionization Transducer." But the idea behind it is big . . . so big that in the few short years since it was introduced by Decker it has found itself a place in the instrumentation systems of every major U.S. rocket and missile. And there is space reserved for it in our satellite.

THE DECKER CORPORATION *Bala Cynwyd, Pa.*

whenever a new development takes place, it is based on ionization and electrical gas discharge



CIRCLE 45 ON READER-SERVICE CARD



For those mechanical and electro-mechanical parts that must be strong, durable, wear resistant, *design to use Chemiseal Nylon (du Pont ZYTEL)*. It has the highest compressive strength, is the most rigid, has the best resistance to heat, abrasion, chemicals, solvents, oils and greases—and is the lowest priced of the standard nylon compositions.

U.S.G. Nylon service goes all the way, offering STOCK (sheets, tape, rod, tubing, special shapes), for manufacture of parts in your own plant; MACHINING (precision fabrication on high speed automatics) to your specifications; and INJECTION MOLDING (volume production to close tolerances at lowest cost).

To be sure you are securing your parts at the lowest cost, consistent with your requirement at every stage from prototype to plant scale production—*check your costs with U.S.G. "know-how"*.

For prompt service, contact one of The Garlock Packing Company's 30 sales offices and warehouses throughout the U.S. and Canada, or write

United States Gasket Company
Camden 1, New Jersey

U
S
G **United States Gasket**

Plastics Division of
GARLOCK



CIRCLE 46 ON READER-SERVICE CARD

4 SR and Linear Inductor L

Peaking Circuit, Frequency Multiplier

The linear inductor L of Fig. 4-1A replaces the resistor R of Fig. 3-1A. Assuming zero resistance in the circuit, and an ideal, square flux-current loop for the core material (Fig. 4-1G), it can be seen, by inspecting the wave shapes in Fig. 4-1, that the supply voltage e appears as the gate voltage e_G . It produces the output voltage e_o at or near the crest value of the supply voltage, thus making this circuit far more effective for generating short pulses than the circuit of Fig. 3-1A.

The output voltage can be used for many applications such as where fixed input volt-seconds are needed (as in the counter and timer discussed in section 2). These pulses can also be used for the grid control of thyratrons. Furthermore, the substantial content of higher harmonics can be used for frequency multiplication.

Frequency Multiplier

By interposing a tuned filter between the SR and the load, as shown in Fig. 4-2, a current

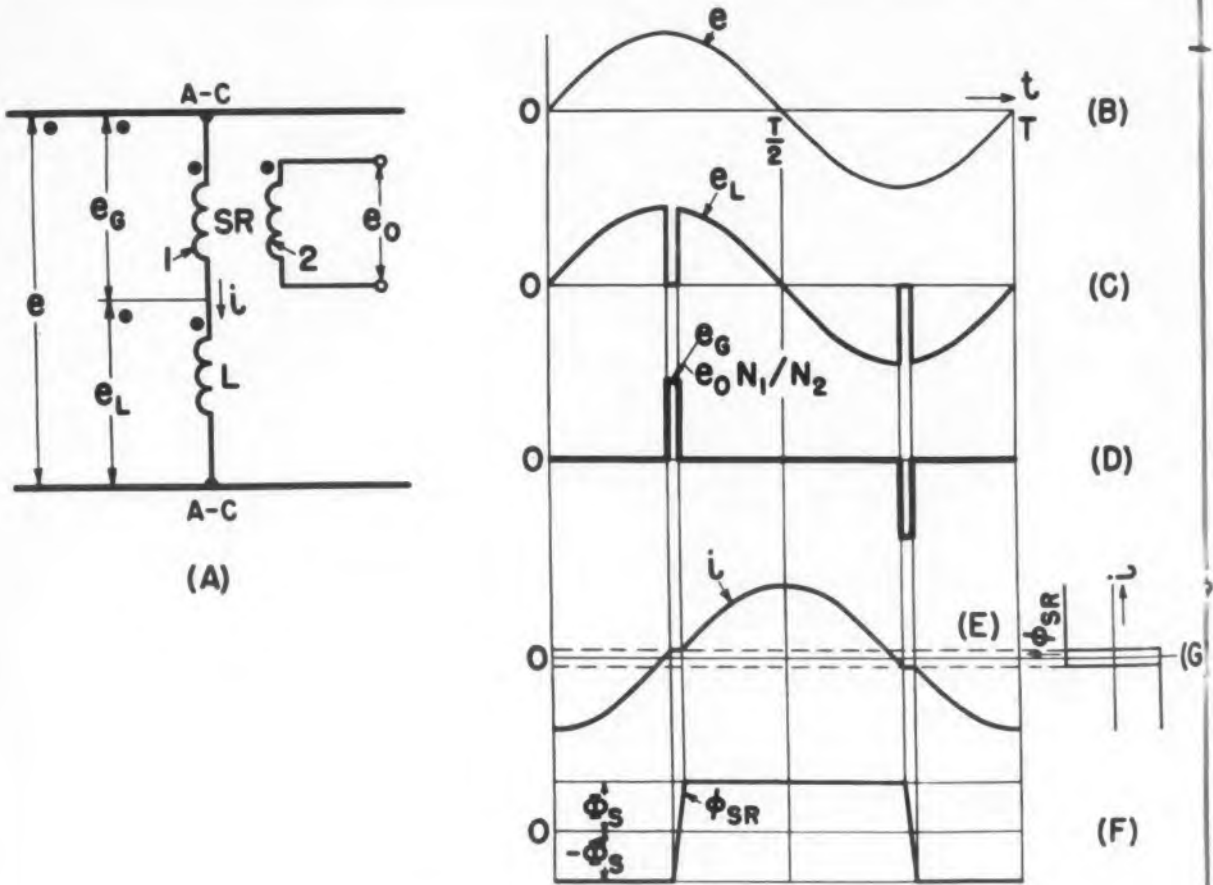
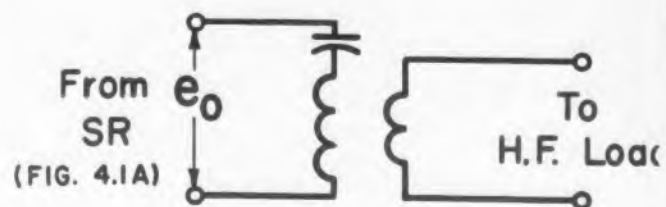


Fig. 4-1. Peaking Circuit. (A) Circuit diagram, (B) Supply voltage, (C) Voltage on inductor L , (D) Gate and output voltages, (E) Current in winding 1 of SR, (F) Flux in SR, (G) Flux-current loop for core of SR.

having the resonant frequency of the filter will flow in the load circuit. The filter is shock-excited so the high frequency voltage will be damped. This method of frequency multiplication was used in the early days of radio telegraphy where supply frequencies of 5 to 10 kc were available. These were stepped up by a factor of 15.

A linear capacitor in series with the inductor *L* of Fig. 4-1A increases the circuit efficiency to



Tuned Filter

Fig. 4-2. Shows frequency multiplication through tuned filter.

50 per cent when multiplying the supply frequency by a factor of 47. (Ref 4-1).

References 4-2 to 4-8 discuss frequency multipliers which use multiple magnetic cores.

References

3-1 Selbsttätige Strom- und Spannungs-Regler, W. Geyger, Arch. Tech. Messen., J062-7, Nov. 1934 and J062-8, Dec. 1934.

3-2 A Saturable-Core-Current Reference Circuit for Use with Magnetic Amplifiers, A. G. Milnes, T. V. Vernon, Tech. Note No. EL 46, Royal Aircraft Establishment, Farnborough, England, October 1952.

3-3 Saturating Transformer Reference Circuit, W. G. Evans, AIEE Trans., vol. 73, pt. 1, 1955, pp. 610-16.

3-4 Theory der Stromrichter, A. Glaser, K. Müller-Lübeck, J. Springer, Berlin, 1955, p. 237.

4-1 Ein neuer Hochfrequenz Maschine sender für drahtlose Telegraphie, K. Schmidt, E. T. Z., H. 40, Oct. 4, 1923, pp. 910-14.

4-2 An Introduction to the Theory of Magnetic Frequency Multipliers Using Biased Magnetic Cores, D. W. Leiby, Master's thesis, Union College, Schenectady, 1956.

4-3 Magnetic Frequency Conversion, L. C. Harriott, Proc. Nat'l. Electronics Conf., 1953.

4-4 Magnetic Frequency Multiplier for Fluorescent Lighting, E. G. Downie, Electronics, May 1955, p. 224.

4-5 Analysis and Design of a Magnetic Frequency Multiplier, O. J. M. Smith, J. T. Salihi, AIEE Trans., vol. 74, pt. 1, 1955, p. 99.

4-6 Design of the Resistively Loaded Static Frequency Doubler, P. P. Biringer, AIEE Trans., vol. 75, pt. 3, 1956, pp. 834-39.

4-7 Characteristic Properties of a Magnetic Frequency Multiplier, W. Leonard, AIEE Conf. Paper no. 56-716 (1956).

4-8 Magnetic Frequency Multipliers and their Rating, Pt. 1, Frequency Triplers, W. McMurray, AIEE Trans., vol. 75, pt. 1, 1956, pp. 384-90, pt. 2, Frequency Sextupler, W. McMurray, AIEE Trans. Paper no. 57-91 (1957).

From a paper which was presented at the AIEE Winter General Meeting in New York City, Feb. 2-7, 1958.

Use high-quality, dependable BROWN COMPONENTS in your measuring circuits and servo loops



CONVERTERS—Handle d-c signals as small as 10^{-8} volt. SPDT switching action. Sensitive, stable performance. Ideal for computers, servomechanisms, balancing circuits. Available with special features such as fungus proofing, grounded housing, mica-filled base, various contact percentages. Weight: 10 ounces.

Driving coils in 60, 40 and 25 cycle converters are energized by 6.3 volt a-c. 400 cycle uses 18 volts. Other coil ratings as follows:

Converter Type	Impedance	D-C Resistance	Power Consumption	Current Drain
60 cycle	125 ohm	110 ohm	.3 watts	.05 amps
25 and 40 cycle types	65 ohm	55 ohm	.60 watts	.10 amps
400 cycle	191 ohm	110 ohm	1.7 watts	.094 amps

Write for Specification S900-2.

INPUT TRANSFORMERS—Handle low-frequency a-c, or chopper-modulated d-c signals from .005 to 200 millivolts, such as generated by thermocouples or other transducers. Designed with highly efficient shielding. Measure $1\frac{5}{8}$ " in diameter, $2\frac{3}{32}$ " high.

Choose from three models		355567-1	356326	35567-2
Primary (center-tapped)	turns ($\frac{1}{2}$ primary)	600	1,094	3,400
	Resistance (approx.)	30 ohms	450 ohms	750 ohms
	60 cps impedance	1,300 ohms	7,500 ohms	30,000 ohms
Secondary	Impedance, full pri.	5,200 ohms	30,000 ohms	120,000 ohms
	turns	9,600	17,500	12,000
	Resistance (approx.)	2,500 ohms	5,800 ohms	3,400 ohms
Capacity to tune to 60 cycles		.015 mfd.	.001 mfd.	.003 mfd.
	Weight	5.7 oz.	7.1 oz.	6 oz.

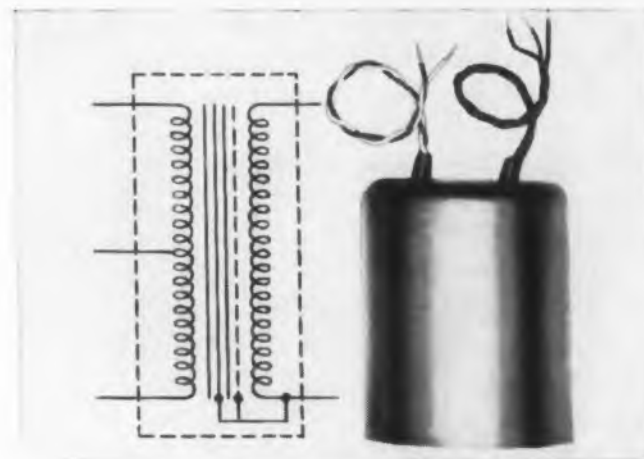
Write for Specification S900-1.

ELECTR-O-VANE CONTROL UNIT—A torque of 2 gram-inches or less actuates this precision switch. Use it as a limit switch to operate valves, lights or hopper openings, in response to motion of weighing beams or other members. Use it to sense other mechanical movements—to operate protective devices when a diaphragm is bulged or near rupture, for example.

Torque to move vane . 2 gram-inches max.
Vane motion for snap action . . . 0.003 in.
Precision within 0.002 in.
Switch action . SPDT, when vane center-line approx. 41° left of vertical
Load relay rating . 115 volts, 6 amp. a-c, non-inductive load
Operating power . 115 volts, 50-60 cycles; also 230 volt model

SPECIFICATIONS

Write for Specification S800-1.



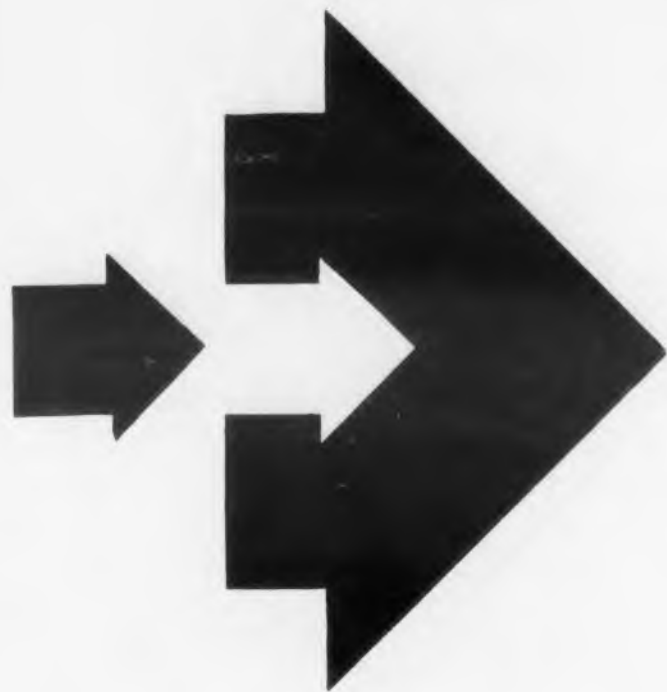
For additional details, call your nearby Honeywell sales engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR Co., Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell



First in Controls



THE THYRISTOR

Loy E. Barton
RCA Laboratories
Princeton, N. J.

The Thyristor is a new transistor that behaves much like a thyatron. It can be triggered "on" and "off" with low power and has a collector voltage drop of only about 0.5 volts during conduction. It is almost a perfect switch having a collector current rise and fall time of less than 0.1 microsecond. Characteristics and circuit applications are described.

THE POINT contact transistor is well known for its greater than unity alpha and for its negative resistance characteristics—it sometimes made a better electronic switch than an amplifier. The junction transistor, however, except for specialized units, is stable and is normally used as a linear amplifier.

The Thyristor is stable at low collector currents and unstable for collector currents above a critical value. These characteristics between those of the point contact transistor and the junction transistor make the Thyristor a bistable unit and a most useful device for electronic switching and pulse applications.

The Thyristor, in part, is a modified version of the high frequency diffused base transistor as described by Lee.¹ The RCA Laboratories modified version has been found to have a new and novel characteristic, as discovered by the writer. As the collector current was increased to a critical value the alpha of the experimental transistor increased to a value greater than unity resulting in a high speed triggering action. Because of this thyatron-like characteristic this transistor was named the Thyristor. The small emitter, the close spacing of the emitter and collector, and the manner in which the collector is connected, give rise to a second alpha due to electrons passing thru the collector "P" type junction. This second alpha due to electrons is emitter-current sensitive and contributes to a total alpha, hole alpha plus electron alpha,

¹C. A. Lee, "A High-Frequency Diffused Base Germanium Transistor" Bell System Technical Journal, Vol. 35, pg. 23-34: 1957.

greater than unity at critical collector currents.

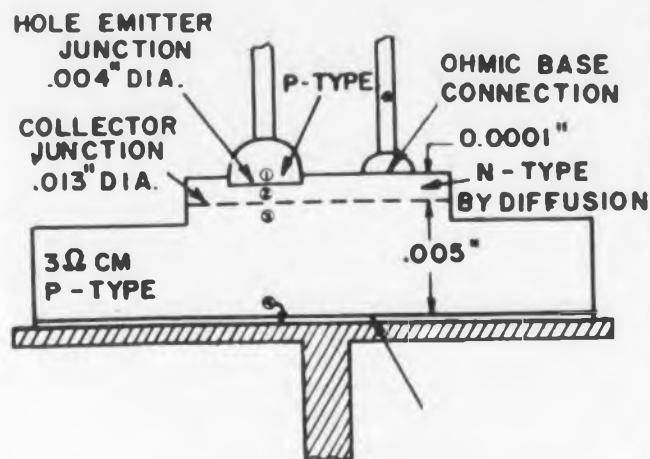
This greater-than-unity alpha in conjunction with the base resistance is used to trigger the collector current. The low power applied to the base to trigger the collector current "off" or "on" is a very desirable feature of the Thyristor. Other features are that the collector-to-emitter resistance is very low for current "on" condition and no sustaining power is needed on the base to maintain the collector current "on" or "off." The above features, coupled with high-speed rise and fall of the collector current, permits the use of the Thyristor in high-speed electronic switches or relays.

It is the purpose of this paper to describe the Thyristor, and its characteristics, and to present several circuits that make use of these characteristics.

Construction of the Thyristor

The construction of an experimental model of the Thyristor is shown in Fig. 1. The germanium wafer consists of a thin base layer of "N" type germanium and a thicker layer of "P" type germanium. The "N" type base region is formed by diffusing an "N" type material into one surface of the "P" type wafer. A "P" type junction with respect to the "N" type layer is within the wafer. This junction is the Thyristor collector junction electrically connected to the collector terminal through the "P" type germanium and the alloyed connection to the "P" type germanium.

The small emitter is an alloyed "P" type junction on the outer face of the "N" type germanium layer. The base connection is soldered to the



HOLE COLLECTOR FOR
LOW CURRENTS
ELECTRON INJECTOR FOR
HIGH CURRENTS

Fig. 1. Cross section showing construction.

outer face of the "N" type germanium at an appropriate distance from the emitter.

The sensitivity of the Thyristor as a triggering device depends upon several features of the transistor. Some of these features are, size of the emitter dot, thickness of the "N" type germanium layer, thickness of the "P" type germanium layer, and material, position, and size of the collector dot. The Thyristor used for the curves of Fig. 2 had an emitter junction about 0.004 inches in diameter. The "N" type layer was about 0.0001 inches thick. The "P" type germanium region was about 0.005 inches thick. A more complete and detailed description of the transistor may be found elsewhere.²

Characteristic Curves

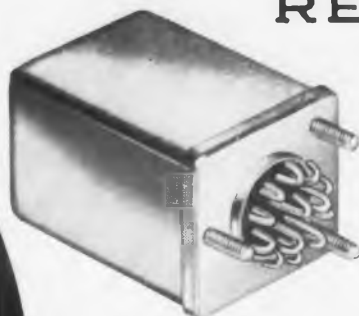
A set of curves representing the characteristics of a typical Thyristor are shown in Fig. 2. It should be noted that the particular Thyristor selected for the above characteristic curves had a fair sensitivity, that is, the triggering of the collector current occurred at a relatively low collector current.

The curves were taken by varying the base bias and reading the appropriate voltages and currents. It is necessary that a collector current limiting resistor always be in the collector circuit. In the case of the curves in Fig. 2, the collector resistor was chosen to obtain the approximate desired collector current upon triggering.

²C. W. Mueller and J. Hillibrand, "The 'Thyristor,' A New High-Speed Switching Transistor," to be published in the Transactions of the IRE Professional Group on Electronic Devices.

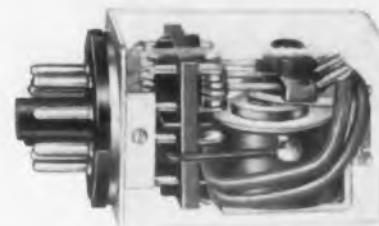
EVERYTHING UNDER CONTROL

GUARDIAN Series 3205 Hermetically Sealed RELAY



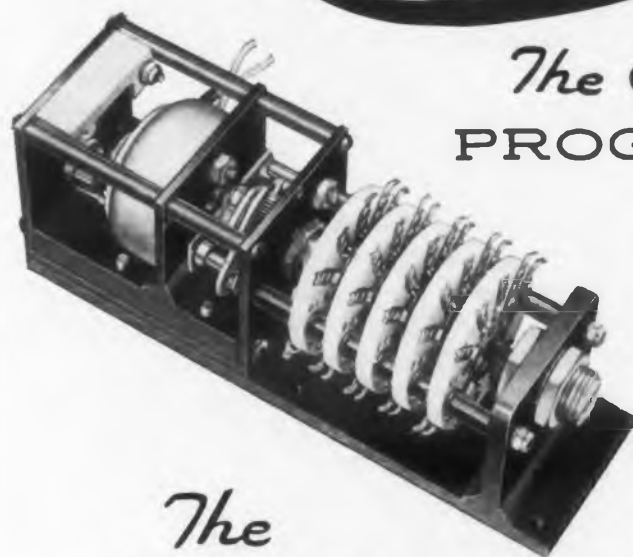
This 10-ampere Aircraft and Missile Relay is a newly developed hermetically sealed Guardian unit designed to meet and exceed all test requirements of Specification MIL-R-6106-B-Class B. Series 3205 10-ampere 4 P.D.T., uses same size envelope container as AN 3304 (4 PDT 3-ampere relay) and is essentially the same weight. Designed to meet minimum current requirements of military specifications.

GUARDIAN Series 1210 RELAY



Now . . . the popular Guardian Series 1200 Relay is available in a unique dust-tight enclosure of new lightweight transparent plastic that withstands heavy impacts. Unaffected by weather; resists temperatures up to +200°F. Contact rating: 8 amps., 115 v., 60 c., non-inductive. Series 1210 available any A.C. voltage 6 to 230; any D.C. voltage 6 to 110.

VISIT GUARDIAN BOOTHS, 2502-04 I. R. E. SHOW



The PROGRAMMER

• reliable • rugged • long-life

Approved and used to control guided missile and in-flight equipment this Programmer excels as the "heart" of automated production systems, machine tools and complete control assemblies, singly, or in combination with Guardian relay matrixes and control banks. Meets and exceeds MIL-S 25259 (Proposed). Open or sealed it withstands extreme temperatures, altitudes, vibration or shock; carries 8-12-18 or 24 points, up to 16 wafers and unlimited switching arrangements.

The GUARDIAN PROGRAMATION DIVISION FEATURES

these outstanding
CONTROLS
see them at
BOOTH 1911
I. R. E. SHOW



New incremental position Control

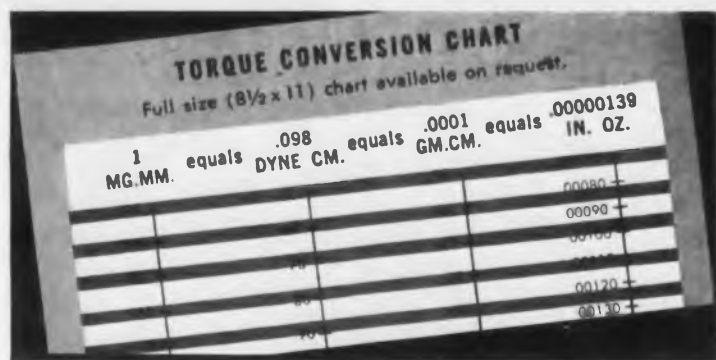
This new Guardian "Incremental Position" unit provides lower cost precision control for machine tools, position indicators, slave-master systems, remote indicators and automated machine drives. Excels as a complete multi-event sequence programmer to control predetermined selection of operations. Also as a single function sequence device to control potentiometer or valve incremental settings. Has many applications as a low cost servo type control.

write for detailed information

GUARDIAN  ELECTRIC
MANUFACTURING COMPANY

1622 - C W. WALNUT STREET, CHICAGO 12, ILLINOIS

CIRCLE 49 ON READER-SERVICE CARD



NEW CATALOG

Aid to successful Miniaturization

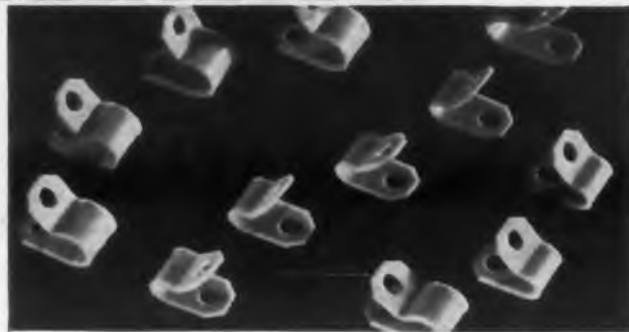
Read MPB's new catalog to learn how MPB miniature bearings heighten precision performance . . . how they reduce weight, space, friction. Nomograph, torque conversion, tolerance and clearance charts aid in selection.

Complete specifications for over 500 different kinds of bearings — radial retainer, radial retainer single or double shield, radial, high speed, all also available with flanged design—pivot, angular contact, thrust—new duplex bearings with specially ground inner and outer ring faces. Specials when necessary. For your copy of the new MPB catalog write Miniature Precision Bearings, 93 Precision Park, Keene, N. H.



CIRCLE 167 ON READER-SERVICE CARD

Weckesser



Cable Clamps of TEFLON*

Advantages:

- Excellent Dielectric Properties
- Chemical Inertness
- Heat Resistance
- Toughness and Flexibility
- Non-Adhesive Characteristics
- Low Coefficient of Friction
- Zero Moisture Absorption
- Weather Resistance

Write for size and price bulletin.

*Dupont T M

Weckesser COMPANY

5703-05 Northwest Highway • Chicago 30, Ill.

CIRCLE 50 ON READER-SERVICE CARD

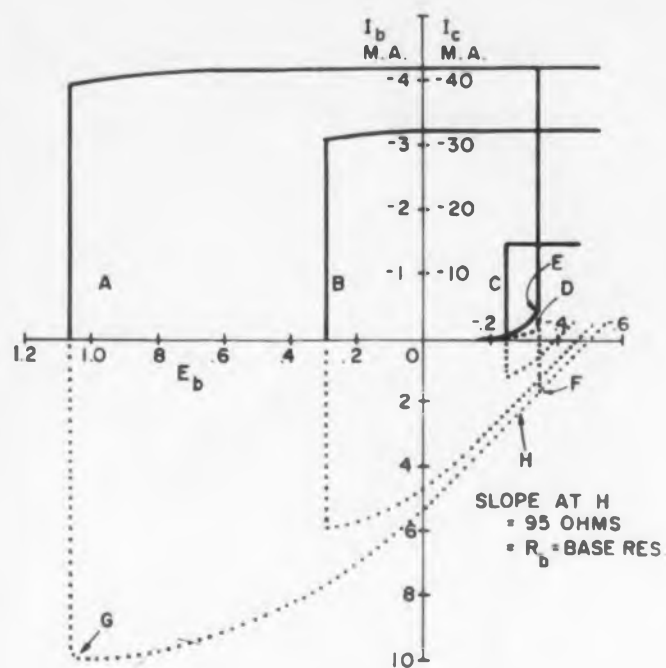


Fig. 2. Switching characteristics of the Thyristor.

This resistor is the load resistance when the Thyristor is used as a switch or relay. The base current curves are mostly below the zero current horizontal line and are broken lines. The collector current curves are above the zero current line and are shown by solid lines.

Beginning with a zero base bias (E_b) an increase of forward bias to the right causes the collector current to start at about -0.2 volts. Further increase in base bias causes the collector current to rise to point E or about 4.5 ma. The base current has risen to about 0.2 ma at a corresponding point D. At this point triggering takes place.

The source resistance of the base bias supply was low so that the base supply voltage at point D remained constant. However, the base current reversed to a value at F. The base bias was then increased until the base current was zero. The voltage at this point corresponds to the floating potential that the base assumes when the transistor is in the triggered condition. At this zero-current point the base circuit may be opened without affecting the triggered collector current. A decrease of the base voltage causes a rise in base current as indicated by the curve at H. The slope of this curve is the approximate internal base resistance of the "Thyristor," and in this case was about 95 ohms.

To cut the collector current "off" for curve A the base bias is reduced to a reverse polarity of about one volt before the collector current triggers "off."

The curve B, for a lower collector current of 32 ma indicates a final internal base voltage of 0.27 volts. In this case the alpha due to holes is not zero so that the electron maximum alpha was

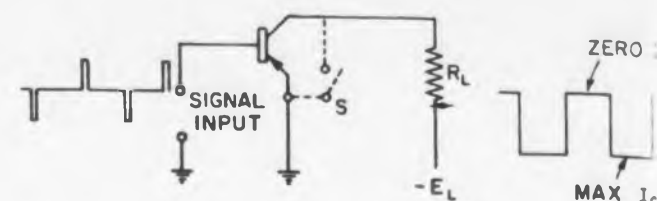


Fig. 3. The Thyristor as an electronic switch relay.

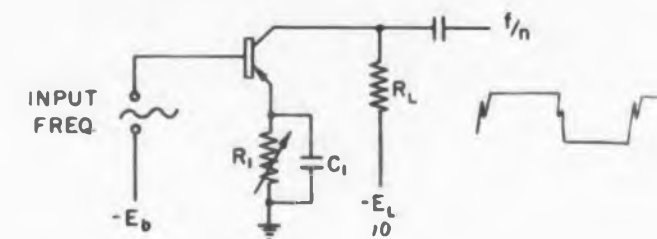


Fig. 4. The Thyristor as a frequency divider.

less than unity. At the point of collector current cutoff the sum of the hole alpha and electron alpha was less than unity. This is necessary for collector current cutoff.

Note that the point at which the collector current is triggered "on" is the same for all triggered currents. This is true because the electron alpha when added to the hole alpha has increased to a total alpha greater than unity at a given emitter current and is independent of the final triggered current. The total alpha is also essentially independent of the collector voltage.

Thus, in all cases an input power of about 0.6 mw for one to two microseconds is needed to trigger the collector current "on." In the case of the 43 ma collector current, 15 milliwatts for one to two microseconds was needed to trigger the current "off." For a supply voltage of 10.5 volts the power switched was about 400 mw.

A corresponding figure for 32 ma was an input power of 4.8 mw to trigger the collector current "off" for a switched power of 300 mw. A corresponding figure for the 14 ma current was an input power of 0.28 mw for a switched power of 140 mw.

From the above it is obvious that transistors designed for lower sensitivity would be more suitable for switching large collector currents. Conversely, if low currents are to be switched, transistors with high trigger sensitivities are needed.

Circuit Applications

The use of the Thyristor as a switch requires a very simple circuit as shown in Fig. 3. The input power to the base for a control of the

transistor as a switch may be very small if a Thyristor is selected for the particular current desired. Results to date indicate that a Thyristor of the size and type described above, except less sensitive, may switch upwards of one ampere for low duty cycles. At one ampere the collector to emitter voltage drop may be as low as 1 volt. At a collector supply voltage of 50 volts the switched power would be 50 watts.

The speed of switching is limited by the Thyristor design and the input and output capacities. Since the high frequency response is good the rise and fall times below one tenth micro-seconds are easy to obtain.

The use of the Thyristor for frequency division is shown in Fig. 4. The circuit provides a self-excited switch or blocking oscillator having an output frequency near the divided frequency. The time constant of R_1C_1 in Fig. 4 largely determines the output frequency as a blocking oscillator. Assume the Thyristor is nonconducting and the charge on C_1 is zero. A base bias, E_b , of about -1 volt causes the collector current to trigger. The duration of the "on" current depends upon the time required to charge C_1 to a value to reduce or reverse the value of the base bias to collector current cutoff. The collector current will remain "off" until C_1 loses enough of its charge to permit the base bias to again trigger the collector current "on." Now, if a frequency f is applied to the base in series with the bias the collector current will be switched "on" at the nearest negative rf half cycle to the time that the collector current would normally trigger "on." The collector current would then trigger "off" at the nearest positive rf half cycle to the normal time for triggering "off." The output frequency then becomes a submultiple of the input frequency.

In general, R_1 is comparatively small (200 ohms or less) and the switched currents are of the order of 10 ma. The power output from such a divider is relatively high and may easily drive another similar divider without additional amplification.

Frequencies as high as 4 mc have been divided by a factor of 15 in a single stage without critical adjustments of R_1 or the signal input amplitude. It is obvious that division by numbers lower than 15 will require even less critical adjustments.

Ring counters, shift registers, and similar type devices may be made by using the Thyristor collector current triggering characteristics.

Acknowledgment

The writer wishes to acknowledge the cooperation of C. W. Mueller of the RCA Laboratories, and his associates, for providing experimental Thyristors which had the trigger collector current characteristics.

PANEL INSTRUMENT VALUE...

ON A

Grand Scale

WESTON'S NEW, MAGNETICALLY-SHIELDED MODELS 1371 AND 1375 FEATURE 7.2-INCH SCALES

Here's a new series of panel instruments offering Weston's traditional craftsmanship with a bonus in readability . . . and at low cost, too! Look at these features:

CORMAG MECHANISM: means you can mount these rectangulars on magnetic or non-magnetic panels . . . in close proximity to other instruments . . . without special adjustments. They're immune to the effects of stray magnetic fields.

EXCEPTIONAL READABILITY: all-plastic fronts, with clear top and sides, provide excellent natural illumination of the oversize scales—without annoying shadows. Normally supplied with lance pointers, for distance reading, these instruments can be supplied with large pointer tips and heavy scale markings as illustrated . . . or with mirror scales and knife-edge pointers for more precise readings.

HIGH ACCURACIES: available in most d-c ranges with accuracies from $\frac{1}{2}\%$ to 2% . . . a-c rectifier types, 3%.

For more details, call your local Weston representative . . . or write to Weston Instruments, Division of Daystrom, Inc., Newark 12, N. J. In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 10, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.



LONG-SCALE READABILITY

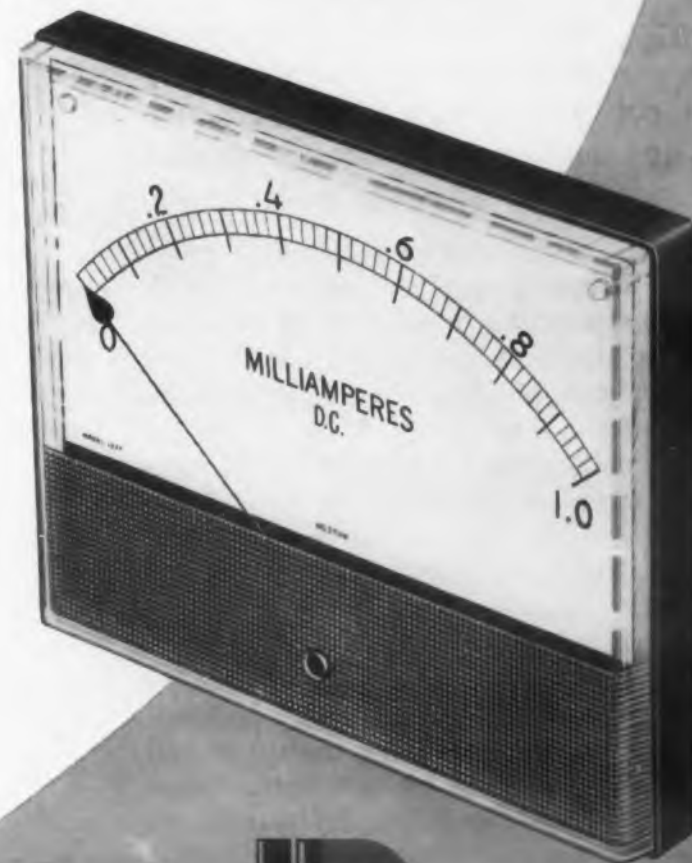


UNEQUALLED NATURAL ILLUMINATION



CORMAG® ACCURACY AND SHIELDING

Plus prices that'll surprise you



WESTON

Instruments



CIRCLE 51 ON READER-SERVICE CARD

How to Minimize

Radar Effects on Electronic Circuits

W. G. Egan

Ford Instrument Co.
Long Island City, N. Y.

High power radar transmitters have considerable effect on electronic circuits. Certain instruments, such as nuclear radiation survey equipment, are affected by pulse-type microwave radiation. When used near operating radar equipment they are subject to serious errors. Digital computers and nuclear scalers are also subject to triggering from radar pulses.

Many different types of circuits are affected:

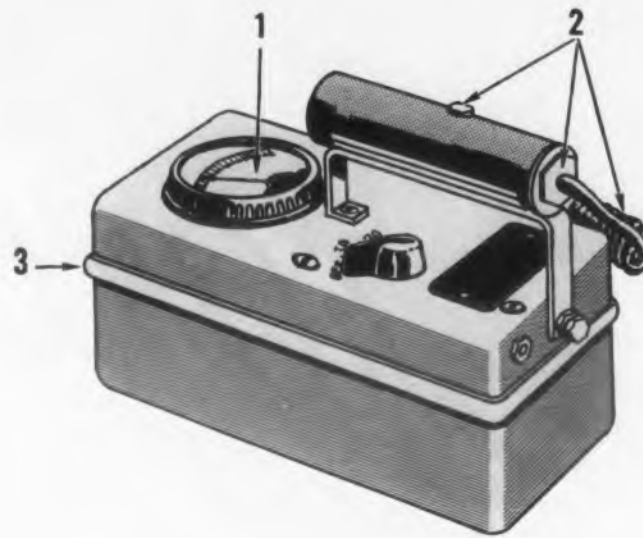
a. Multivibrator Type (used with an extension probe containing a Geiger-Mueller tube, as well as another Geiger-Mueller tube contained within the body of the instrument). As would be expected, the multivibrator is triggered at the repetition rate of the radar transmitter. The triggering is caused by the flow of grid current on the triggered half of a two tube multivibrator circuit. This yields an upscale meter deflection but only in the highest field (at 20 feet). The radar pulses entered the radiac set (1) through the indicating meter window on the set, (2) by the external probe wire, and (3) by exciting the upper and lower halves of the radiac set case (which were separated by a rubber gasket) to different electrical potentials. The size of the case and length of the mounting studs were such that a resonant cavity was created, and there was a sufficient electric field within the case near the sub-miniature multivibrator tube to cause triggering.

b. Dc amplifier (high impedance Wheatstone

bridge-photomultiplier type with two tubes as arms). At a distance of 20 feet, there was half scale deflection of the meter. This unit had no external probe, and radiation (1) entered the meter window and (2) caused the two halves of the case to be at different potentials. Rectification occurred when grid current flowed on the positive part of the microwave cycle. This voltage caused the bridge to unbalance. The phenomenon is complicated by the fact that the input leads to the tubes form, in some way, a distributed resonant circuit,

or the tube elements actually form the resonant circuit.

c. Transistorized dc amplifier (ionization chamber type detector). Large upscale or downscale deflections of the meter occurred at 20 feet in the X and S bands where the electric field is 505 and 15700 volts/cm., respectively, depending upon orientation of radiac set with respect to radiation. This unit did not have an external probe. At 300 feet when the X and S band electric field were 34 and 1240 v/cm, only X-band radiation



Three sources of radar interference: (1) through meter window, (2) through external probes or connections, (3) difference in potential between sections of the case.

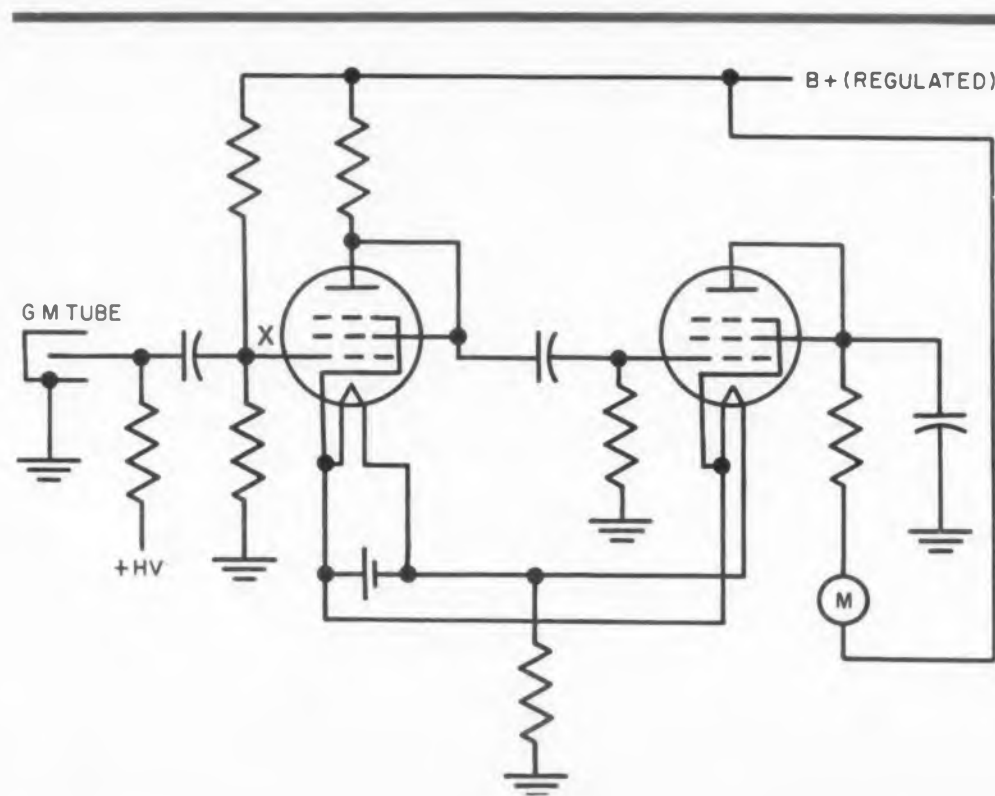


Fig. 1. Typical two-tube multivibrator circuit which may be triggered at the repetition rate of the radar transmitter. The triggering is caused by the flow of grid current at point x, due to rectification of the radar signal. This grid current flow causes a negative charge to accumulate on the grid (at point x) and trigger the circuit.

affected the instrument because it has a small case, and formed a resonant cavity only at this higher frequency. The radiation (1) entered this unit through the meter window and (2) caused the various sections of the four sectioned case to be at different potentials. The circuit effects are complicated by the relative effects of the rectification of the microwave fields within the unit by the emitter and collector circuits of the two transistors within.

d. Dc amplifier (very high impedance electrometer tube type connected to an ionization chamber). Large downscale deflections occurred (amounting to 65 per cent or full scale) at a distance of 20 feet, but only X-band radiation was effective at 300 feet, because of the small size of the unit as in c. The radiation (1) entered the set through the meter window and (2) caused the two sections of the set case to be at different potentials. Rectification occurred when grid current flowed on the positive part of the microwave cycle. This caused the downscale deflection, with the subminiature tube forming part of the distributed resonant circuit.

e. Pulsed Geiger-Mueller tube circuit. This circuit was unaffected by radar because it was active only for a short time (of the order of microseconds) a few hundred times a second, and since the circuit was not synchronized with the radar frequency, it was unaffected. In addition, the pulsing circuit within the set was low impedance, and not triggered by the radar.

Shielding the Meter Window

The effect of radar on circuits can be minimized by minimizing the radiations that enter the equipment. The amount of radiation that enters through the meter window may be decreased by the use of conducting glass for the meter window² or by using wire mesh across the meter window.^{2,3} A thin gold film is readily applied to the inside of the meter glass; however, it must form a good electrical contact with the case in order to be highly effective. For particular instrumental applications where visual acuity is less important, wire mesh or the Corning heating panel glass may be more suitable.

Good electrical conductivity is essential to microwave shielding, whereas this characteristic is not generally compatible with high light transmission. The microwave results are rather critically dependent on frequency and thickness of the material used. At the higher frequencies, the shielding effects of the film coatings are generally better. The greater the film thickness, the better the shielding because the film conductivity is greater. In general, thin films do not have the same volume resistivity as the bulk metal because of surface effects. It should be noted that the microwave attenuation is the result of both reflec-

Now 5-megawatt ferrite isolator for high-power radars

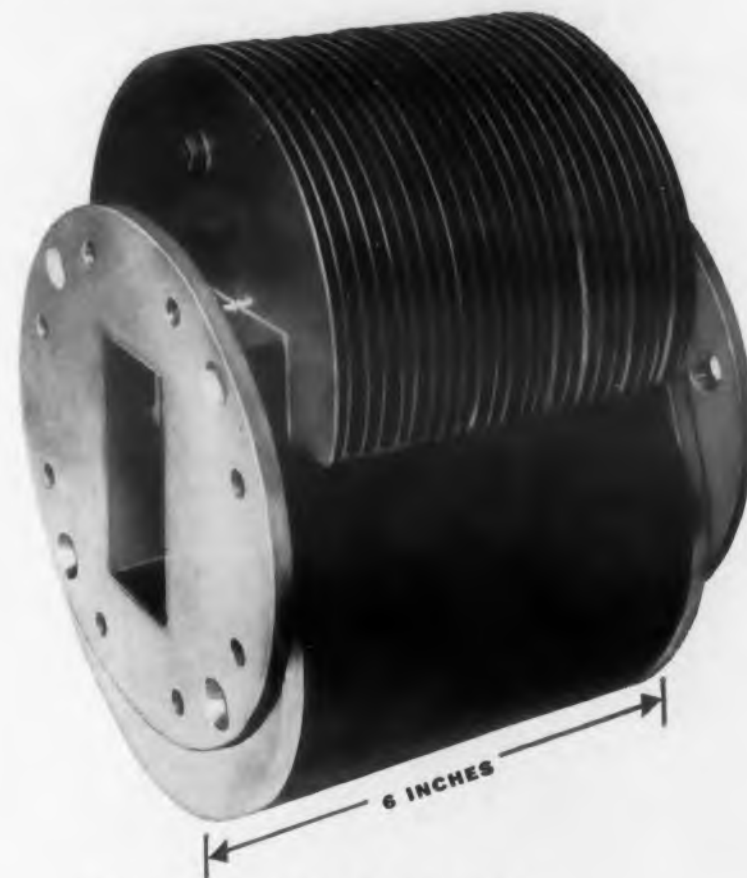
FORCED AIR COOLED!

Another Sperry contribution to improved performance of radar systems is this new Model D44S1 ferrite isolator. It boosts efficiency of S-band radars by allowing optimum operation of high-power tubes.

In addition, this isolator protects high-power tubes from load mismatches, and eliminates frequency and power variations due to changing load impedances. It is rated at 5 megawatts peak, 5 kilowatts average, and features insertion loss of less than 0.3 db. Compact and small, the Model D44S1 measures only 6 inches in length and 8 inches in diameter. And its air-cooled design eliminates the extra expense and weight of liquid-cooling accessories.

Currently Sperry has under development or in production a wide variety of ferrite devices in addition to those shown here. These include megawatt duplexers, coaxial duplexers, octave-plus bandwidth isolators and attenuators, high-speed switches, modulators and choppers.

Sample quantities of the listed units are available immediately from our stock for test and evaluation in your system, with a view to production tailored to your specific requirements. Contact our nearest district office for further information.



MODEL D44S1 SPECIFICATIONS

Power: 5 mw peak, 5 kw average
Frequency: 2700-2900 mc
Insertion loss: less than 0.3 db
Isolation: 10 db min.
Cooling: Forced air



COAXIAL FERRITE ISOLATORS

MODEL	USE	FREQ. RANGE	MAX. AV. POWER	INSERTION/ISOLATION	DIMENSIONS
A44L1	Radar	1250-1365 mc	400 w	1 db 10 db	3" dia. x 13.25"
A44S1	Radar	2700-3100 mc	10 w	1 db 10 db	1.5" dia. x 5"
D44L1	Relay	1700-2400 mc	30 w	1.5 db 21 db	3" dia. x 13.25"
A44S4	ECM	2000-4000 mc	400 w	1 db 10 db	3" dia. x 13.25"



X-BAND FERRITE COMPONENTS

MODEL	USE	FREQ. RANGE	MAX. AV. POWER	INSERTION/ISOLATION	DIMENSIONS
A44X1	Isolator	8200-12400 mc	400 w	1 db 10 db	1.5" dia. x 5"
A43X1	Variable Attenuator	8500-9600 mc	10 w	1 db 30 db var.	1.5" dia. x 2"

MICROWAVE ELECTRONICS DIVISION

SPERRY GYROSCOPE COMPANY

Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

Visit our booths 1416-1422 at 1958 Radio Engineering Show, March 24-27.

BROOKLYN • CLEVELAND • NEW ORLEANS • LOS ANGELES • SAN FRANCISCO • SEATTLE. IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC

CIRCLE 52 ON READER-SERVICE CARD

it's SHARP ... it's CLEAR
when you inspect with ...

PIKE 4½ power ACHROMATIC



FLASH-O-LENS illuminated magnifiers

4½x portable
battery model;
also electric
"plug-in" models

- sharp focus
- adjustable image
- built-in illumination
- quick conversion to 7, 20 or 40 power with interchangeable lenses



20x or 40x

WRITE TODAY
for literature showing
uses, types, prices

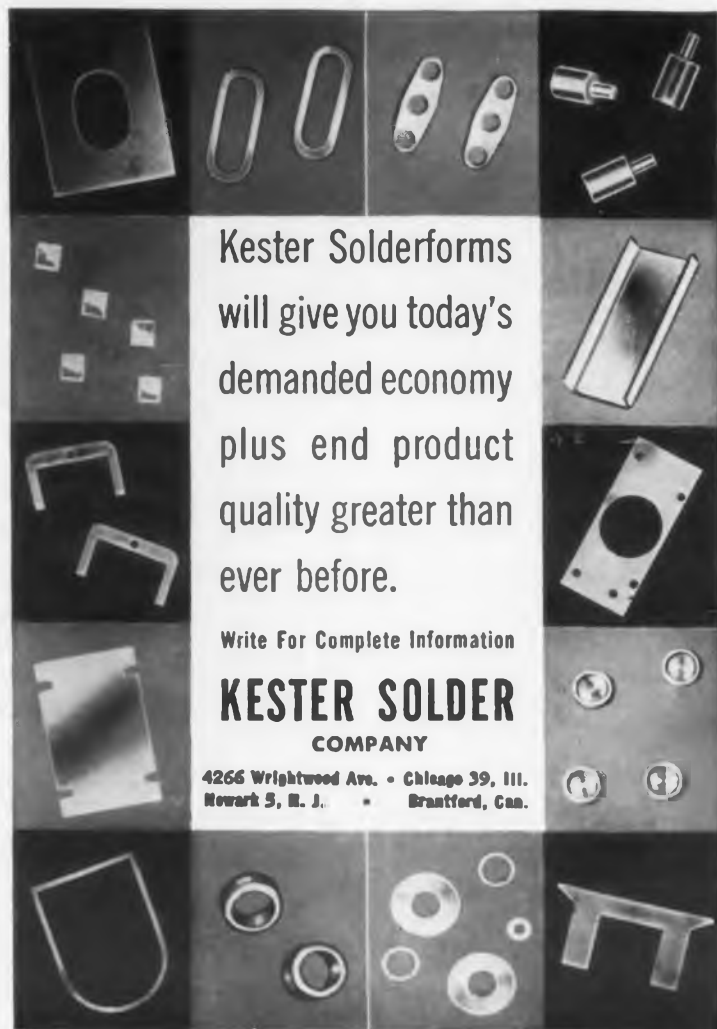


Since 1927 — manufactured in the U.S.A. by —

E. W. PIKE & CO., INC.

577 Penna. Ave., Elizabeth, N. J. • ELizabeth 2-0630

CIRCLE 53 ON READER-SERVICE CARD



Kester Solderforms
will give you today's
demanded economy
plus end product
quality greater than
ever before.

Write For Complete Information

**KESTER SOLDER
COMPANY**

4266 Wrightwood Ave. • Chicago 39, Ill.
Newark 5, N. J. • Brantford, Can.

CIRCLE 54 ON READER-SERVICE CARD

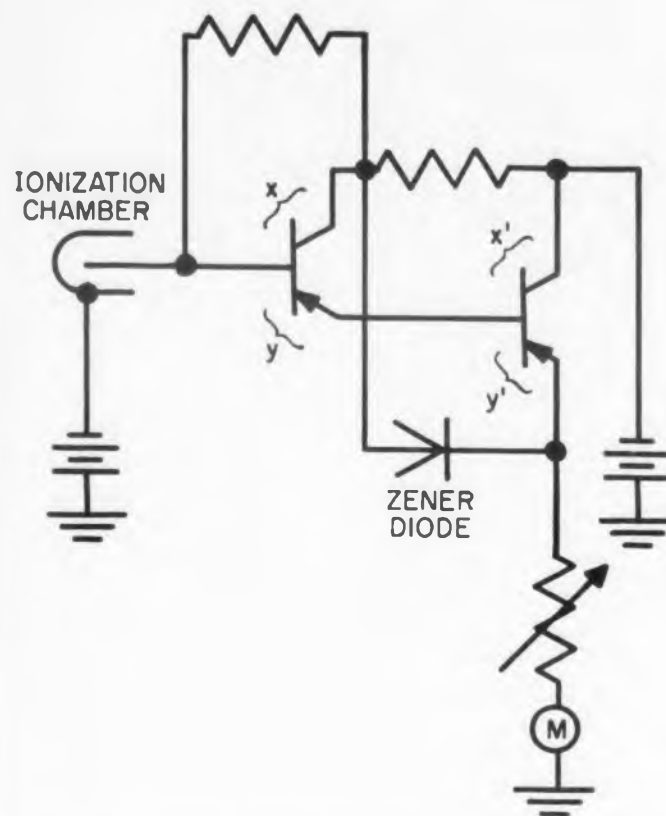


Fig. 2. Typical transistorized dc amplifier in which rectification of the microwave fields within the unit by the emitter (x,x') and collector (y,y') circuits of the transistors and diode circuit may occur. The rectification is similar to square law rectification.

tion and absorption of microwave energy by various materials. The measurements were made by determining the insertion loss by inserting the material being investigated between the coupling flanges of the two wave guide sections. Thus, the attenuation measured is, in part, a function of the mis-match between the impedance of the conducting film. The dc values of the surface film resistivity are specified as a guide to judging the relation to reflection properties.

The effect of radiation causing potential differences between sections of the case can be minimized by using case materials of adequate thickness and conductivity and establishing a good connection between them with a conducting gasket.^{4,5} Where watertightness is a consideration, a composite rubber and metallic gasket may

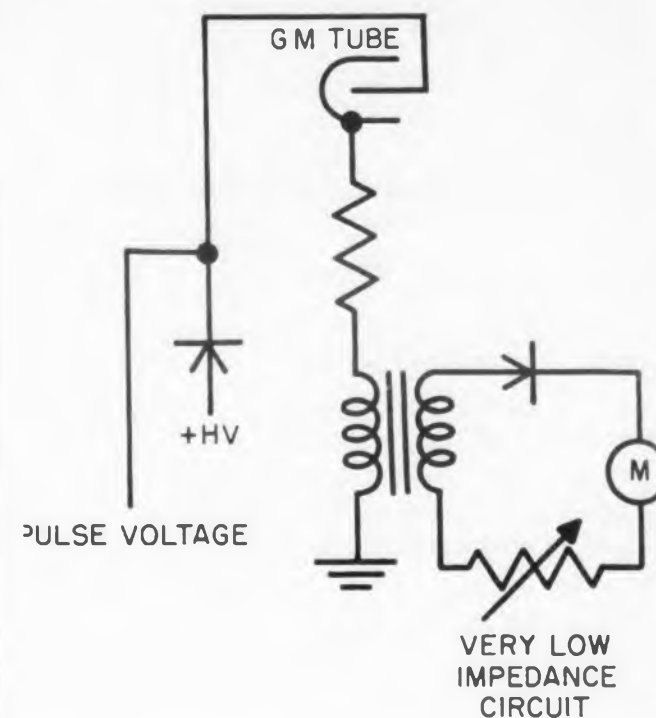


Fig. 3. Typical pulsed Geiger-Mueller tube circuit which is unaffected by radar because it is active for only a short time (of the order of microseconds). In addition, sensitive circuits are of low impedance, and comparatively insensitive to radar effects. The G-M tube was operated below threshold and responded to nuclear radiation only during the pulse voltage.

be used. The gasket must have a very low resistance. Thus conductive rubber or plastic gaskets are unsatisfactory.

By-pass condensers are, in general, ineffective at microwave frequencies. A button type condenser checked at 10 kmc appeared as nearly a pure resistance of about 100 ohms. Where extensions or probes are used on equipment, careful grounding of the shield is necessary.

It is sometimes possible to enclose the entire unit in a wire mesh container to minimize radiation pickup sufficiently.

Reducing Radar Effects

Circuits which are active during only a small portion of the time are not subject to interference from radar; the probability of the radar pulse

circuit action is small. However, it is possible that the pulsing circuit in the instrument be triggered at the radar repetition rate. This, in itself, is not objectionable, but if this occurs, other circuit elements such as diodes, transistors or vacuum tubes may be affected by the radar fields existing within the case during the radar pulse, and result in erroneous readings. This assumes negligible recovery time from the circuit action caused by a radar pulse, and, in general, depends upon the circuit time constants for a particular circuit.

Multivibrator, electrometer, dc amplifier or transistor circuits can be shielded with a copper screen carrying case. This presents a problem if knobs are to be adjusted on the instrument, but the meters can be easily read through the wire.

Screen wire shielding is most effective at lower radar frequencies, whereas a metallic film type of shielding is considerably more effective at higher radar frequencies.

At higher radar frequencies, a Corning heating panel (or equivalent) material for the meter window may be used, as well as a conducting resilient gasket between case sections.

Where the microwave radiation is of the continuous wave type, with amplitude or frequency modulation, the present maximum radiated power is relatively less than the peak power of radar pulses, and the associated circuit effects are correspondingly less. However, a multivibrator type circuit will not necessarily be triggered, but the circuit bias values may be affected because of rectification effects. Similar bias changes could affect the operation of pulse-type circuits. These rectification effects can occur with the other nonlinear devices (transistors, diodes, electrometer and vacuum tubes). Nevertheless, the same shielding considerations outlined above apply. It may be remarked that the shielding properties of the various materials described for continuous radiation are nearly the same as those for pulse modulation. Exceptionally thin shielding films have nonlinear, semiconducting properties which depend on the method of preparation, and the shielding properties would be better for pulse-type, high-power radiation.

References

1. Work performed at Naval Material Laboratory, New York Naval Shipyard, Brooklyn 1, New York.
2. Eye Protection in Radar Fields, W. G. Egan, *Electrical Engineering*, Vol. 76, No. 2, pp. 126-127, Feb., 1957.
3. How to Evaluate Shielded Rooms, E. A. Lindgren, *ELECTRONIC DESIGN*, pp. 36-37, Jan. 15, 1956.
4. Calculation of Effectiveness of Shielding Rooms, D. Shapiro (from Radiotekhnika) *ELECTRONIC DESIGN*, pp. 22-23, August, 1955.
5. R. F. Tightness Using Resilient Metallic Gaskets, O. P. Schreiber, *Electrical Manufacturing*, Vol. 58, No. 1, pp. 116-123, July, 1956.

PROBLEM:

Reduction of repair and replacement time for vital message switching center

SOLUTION:

Grant stock slides appreciably decrease servicing time, increase overall efficiency

Western Union has developed a fully automatic switching center which assists in unifying and improving the efficiency of the United States Air Force's domestic and global communications system. With this system, a message typed only once is automatically flashed to a desired air base, in any part of the world, in seconds. It checks out human, equipment and line failure and even determines the priority of a message. After the initial typing of the message, the entire process is automatic. Units such as these, with their precise and sensitive components, must undergo inspections, adjustments and maintenance and moments lost in dismantling might mean the delay of a vital message. The important operating sections of this equipment are mounted on Grant No. 306 slides. These afford instantaneous accessibility, permitting faster, more convenient and most efficient maintenance.

Grant No. 306 Slides
(one of a great variety
of stock slides)
recommended for loads
up to 50 lbs./pair

Courtesy The Western Union
Telegraph Company, N.Y.C.

Write for complete data on
this slide and the wide range of
heavy duty, 3 section slides.

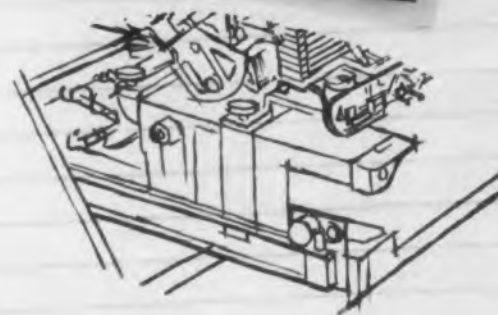
GRANT INDUSTRIAL SLIDES

If the question is Accessibility... the answer is Grant.

Grant Pulley and Hardware Corporation

21 High Street, West Nyack, New York
944 Long Beach Avenue, Los Angeles 21, California

See the amazing AL-THIN Slide, Booth 1118 IRE Show;
Booth 480, Design Engineering Show



NEW PRODUCTS

To provide a complete coverage of ALL new products generally specified when designing electronic original equipment, the New Product section has been extended. To include the largest number of items, products which are best suited to a brief description have been noted at the end of the section.

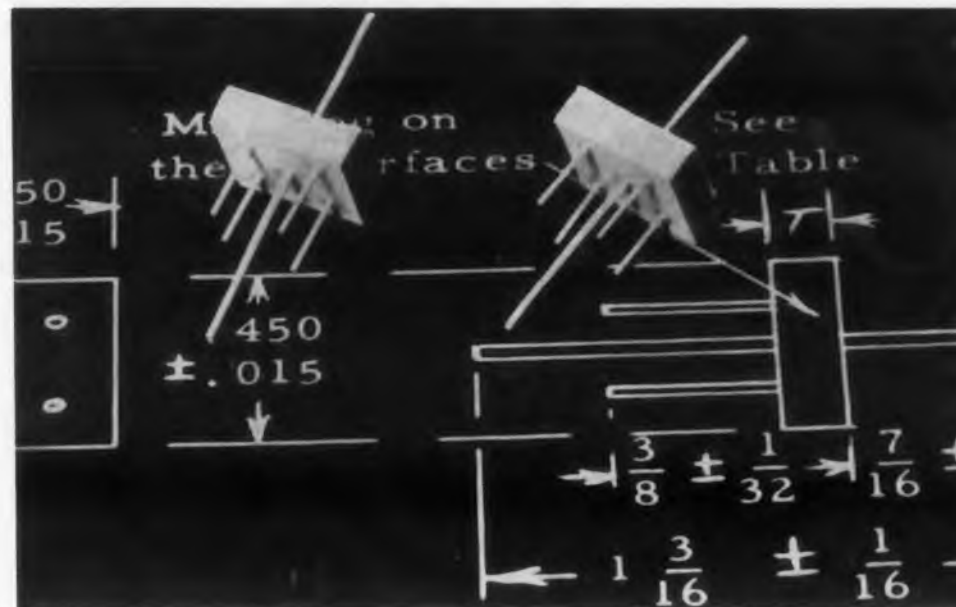


TRANSISTOR COLD PLATE

Used to dissipate heat generated in power resistors, the U-521330 cold plate provides good control of junction temperature. Heat generated by the power transistors is transferred across a pressure thermal contact to the cooling air ducted through the cold plate. The air flow is given as 7 lb per min, causing a pressure drop of 0.25 in. H₂O. The temperature drop is 1.5 C per watt. The aluminum cold plates are bonded by a dip braise method for light weight and maximum heat transfer. The cold plates can be used individually or assembled into manifolded banks.

United Aircraft Products, Inc., Dept. ED, 1116 Bolander Ave., Dayton, Ohio.

CIRCLE 56 ON
READER-SERVICE CARD



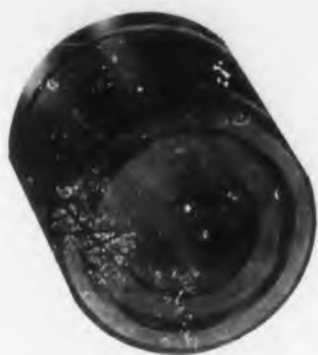
COAXIAL CAPACITOR

Axial design and use of rugged materials give this capacitor very stable, low inductance characteristics. The position of the four terminals, each attached to a separate electrode, allows a radial flow of current. This geometry results in a cancellation of magnetic fields and consequent low effective inductance.

The use of porcelain dielectrics and fine silver electrodes in a vitrified body enable a temperature coefficient rating of 115 ± 25 ppm per deg C, through a temperature range of -55 to $+125$ C. Capacitance drift is 0.05 per cent and Q is greater than 2500.

Vitramon, Inc., Dept. ED, Box 544, Bridgeport 1, Conn.

CIRCLE 57 ON READER-SERVICE CARD



INSTRUMENT BEARING

The extremely low friction of this ball bushing is made possible by a re-circulating ball principle, providing unlimited linear travel. Threshold sensitivity is such that the bearing will roll down a shaft at an angle of one minute or less. Outside diameter of the INST-4812 ball bushing is 1/2 in. The unit weighs 0.02 lb and takes a rolling load of 13 lb.

Thomson Industries Inc., Dept. ED, Manhasset, N.Y.

CIRCLE 58 ON READER-SERVICE CARD



POTENTIOMETER

Only one moving point of contact serves to greatly reduce noise in this molded composition potentiometer. The conventional wiper arm collector has been replaced by a beryllium copper spring, directly connecting the contact arm to the center terminal. Rotational life is given to be over one million cycles, with an overall resistance change of 6.3 per cent. The potentiometer meets the Y specifications of MIL R-94B, and is available in all tapers with either standard or locking bushings.

Reon Resistor Corp., Dept. ED, 117 Stanley Ave., Yonkers, N.Y.

CIRCLE 59 ON READER-SERVICE CARD

Get MORE circuit
in LESS space

model VC10G
actual size

TODAY'S TINIEST
TRIMMER CAPACITORS



VARIABLE TRIMMER PISTON CAPACITORS

for subminiaturization of printed or conventional circuitry

Are obsolescent oversized capacitors cramping your style? Let JFD Precision Trimmers help you save time and space... upgrade performance reliability in critical network design.

Miniature and subminiature JFD Piston Capacitors give you maximum tuning range in absolute minimum physical size... precise tuning resolution and stability... ultra low loss operation... rugged shock, vibration and corrosion resistance... approximately zero temperature coefficient. These are some of

the reasons why they are specified in almost all of today's missile and anti-missile systems.

If you're looking for new design freedom, new performance highs under severe environmental conditions, why not investigate the many advantages of JFD Trimmers? If your requirements can't be met from our 42 current models, we'll be glad to produce according to your specifications. Write for the new JFD Piston Capacitor File Folder for detailed electrical and mechanical data.



VC9G Trimmer series (lug & lead type for printed circuits)

Model	Capacitance Range (MMF)	
	Min.	Max.
VC9G	0.8	8.5
VC10G	0.8	4.5
VC31G	0.8	12
VC32G	0.8	18
VC42G	1	21
VC43G	0.8	30



VC9GW Trimmer series (4 wire type for printed wiring boards)

Model	Capacitance Range (MMF)	
	Min.	Max.
VC9GW	0.8	8.5
VC10GW	0.8	4.5
VC31GW	0.8	12
VC32GW	0.8	18
VC42GW	1	21
VC43GW	0.8	30



VC20G Trimmer series (panel type)

Model	Capacitance Range (MMF)	
	Min.	Max.
VC20G	0.8	8.5
VC21G	0.8	4.5
VC22G	0.7	12
VC23G	0.8	18
VC24G	1	30

Visit us at the IRE Show—Booth #2333

JFD Canada Ltd.
51 McCormack Street
Toronto, Ontario, Canada

JFD International
15 Moore Street
New York, New York



ELECTRONICS, INC.

PIONEERS IN ELECTRONICS SINCE 1929

1462 62nd Street, Brooklyn 19, New York

PHONE DEWEY 1-1000

CIRCLE 60 ON READER-SERVICE CARD



(Left to Right) Frank Marshall, Assistant Engineer, Arthur H. Wulfsberg, an Assistant Director of Research & Development, and John Sprengeler, Project Engineer, discuss the use of a General Electric GL-6442 in a power amplifier assembly which is part of the AN/ARN-46 receiver-transmitter unit shown in center foreground.



Disassembled power amplifier from AN/ARN-46. A G-E GL-6442 is used in each of 3 such amplifiers within the TACAN receiver-transmitter unit.

Collins Airborne TACAN Uses General Electric GL-6442 For Reliable Performance

EXCEPTIONAL performance characteristics of General Electric tube type GL-6442 are contributing significantly to the accurate and reliable performance of Collins TACAN equipment, which is capable of operation at altitudes over 70,000 feet.

TACAN provides the military or civil pilot with continuous, precise distance and bearing information for navigation at ranges up to about 200 miles.

The pressurized receiver-transmitter unit of the equipment employs five G-E GL-6442's—ceramic, disc-seal triodes of planar construction—in the frequency multiplier and power amplifier systems. Three of the tubes are used in the pulse-modulated final amplifier. These tubes are mounted in coaxial resonators, tunable over a 1025-1150 mc. range. More than 1 KW peak power output is obtained.

Designed primarily for use in grounded-grid cavity circuits as a plate pulsed oscillator or amplifier up to 4000 mcs., the tube is also useful as a continuous-wave RF power amplifier, oscillator, or frequency multiplier up to 2500 mcs. Typical operation in plate-pulsed oscillator service at 3500 mcs. produces 2 KW peak power output with an average power input of 7.5 watts and a duty cycle of 0.001.

Ratings for other classes of service available on request. For full information on Type GL-6442, call your regional G-E power tube representative. *Power Tube Dept., General Electric Co., Schenectady 5, N. Y.*

Progress Is Our Most Important Product

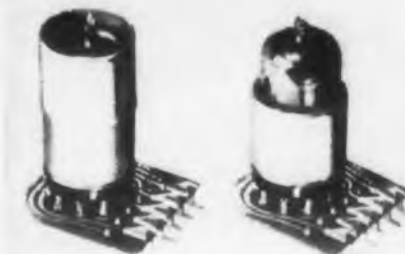
GENERAL  ELECTRIC

9545-8481-6

NEW PRODUCTS

Shielded Right-Angle Sockets

Shield is integral part of assembly



Being an integral part of 9 right angle sockets, this tube shield cannot be lost or misplaced when servicing the socket or installing a new tube. The tube shield is telescopic with a bayonet locking feature to maintain it in the raised position. The upper half is disengaged and lowered to remove the tube. The right angle shielded sockets are designated as the 7 PC-IS and 9 PC-IS series. Base material of the sockets is 1/16-in. XXP phenolic with 0.00135 copper capable of carrying 6-1/2 amp.

Cleveland Metal Specialties Co., Dept. ED, 1783 E. 21st St., Cleveland 14, Ohio.

CIRCLE 62 ON READER-SERVICE CARD

Blocking Oscillator Series

Rise and Fall Time of 0.04 μ Sec



These transistorized blocking oscillators have minimum pulse widths of 0.2 μ sec, with rise and fall times down to 0.04 μ sec. These oscillators work with up to 30 v power input, designs being easily altered for varying input voltages. Pulse repetition rates are up to 800 kc per sec. Amplitudes are approximately 40 per cent of the applied voltages.

Epsco Components, Dept. ED, 588 Commonwealth Ave., Boston 15, Mass.

CIRCLE 63 ON READER-SERVICE CARD

◀ CIRCLE 61 ON READER-SERVICE CARD

Microsyn Signal Generators

Linearity of 0.5 Per Cent



Different models of temperature compensated generators are available with 1/2 per cent linearity and allowable angular rotation up to ± 20 deg. Sensitivities are available up to 8 v per deg with a signal to noise ratio better than 0.01. They measure 1-3/8 in. od by 0.4 in. length, and are nominally supplied for 26 v input and a frequency range of 400 to 5000 cps.

Luther Mfg. Co., Dept. ED,
7312 Varna Ave., North Hollywood, Calif.

CIRCLE 64 ON READER-SERVICE CARD

Solenoid Ball Valve

Manual reset type with extreme temperature range



This 2-way, 2-position ball valve allows unrestricted straight-thru flow with an equivalent orifice of 1/4 in. diam and 3/8 in. tube size. It is available in pressures up to 4500 psi with a temperature range of -300 to $+300$ F. A momentary electrical surge of approximately 2-1/2 amp is required for actuation. A 24 v dc solenoid is furnished. Easy access to the manual reset lever arm is provided. The valve can be supplied either normally open or normally closed and may be used for most hydraulic or cryogenic applications.

Pneu-Hydro Valve Corp., Dept. ED, 364 Glenwood Ave., East Orange, N.J.

CIRCLE 65 ON READER-SERVICE CARD

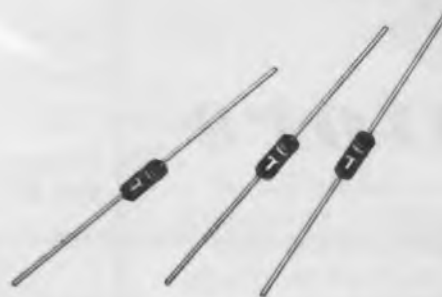
CIRCLE 66 ON READER-SERVICE CARD

Transitron

SILICON RECTIFIERS

HIGH VOLTAGE • 600 volts
HIGH CURRENT • 400 ma

combined with subminiature size



Type	Peak Recurrent Inverse Operating Voltage (volts)	Maximum Average Forward Current @ 150° C (ma)	Maximum Average Forward Current @ 25° C (ma)	Maximum Inverse Current @ 150° C Full Load (ma)
1N689(TG62)	600	150	400	.2
1N686(TG52)	500	150	400	.2
1N684(TG42)	400	150	400	.2
1N682(TG32)	300	150	400	.2
1N679(TG22)	200	150	400	.2
1N677(TG12)	100	150	400	.2

High ratings of 600 volts and 400 ma (150 ma at 150°C) are now yours in a tiny glass envelope only .1 inch by .3 inch in size. This versatile package is ideal for printed circuits, subminiature power supplies, D.C. blocking, high voltage series strings, and other applications where space is at a premium.

Rugged and reliable at temperatures to 175°C, these hermetically sealed rectifiers have been thoroughly tested under the most severe operating conditions. They offer the same high degree of dependability that characterizes Transitron silicon diodes and stud type rectifiers.

Send for Bulletin TE-1351

VISIT US AT IRE SHOW - BOOTH 3912-14

Transitron

electronic corporation • wakefield, massachusetts



Transistors



Diodes

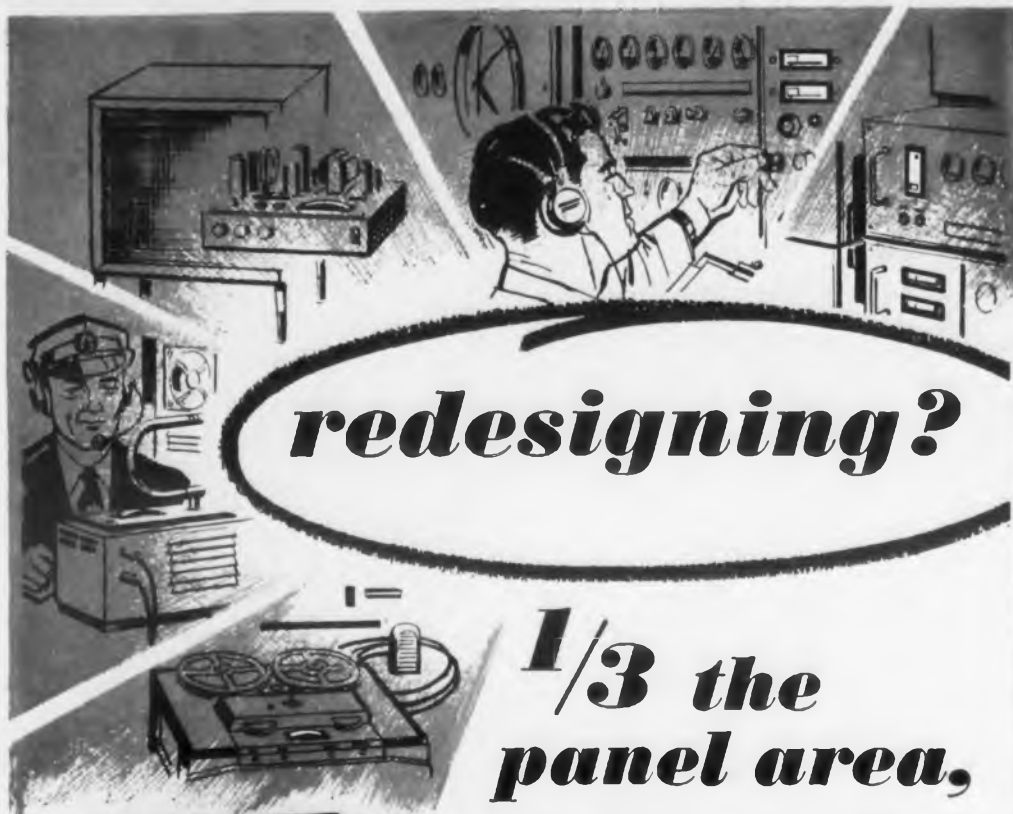


Regulators



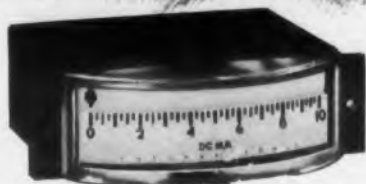
Rectifiers





redesigning?

***1/3 the
panel area,
same scale
length***



* MODEL 1145

side indicators



* MODEL 1135



* MODEL 1120



Save space on crowded, complex panels *without* sacrificing readability or accuracy. Model 1145 provides accuracy and scale length of conventional 4½" meters with ⅓ the panel area and far less weight . . .

Model 1135 compares with conventional 3½" meters. For horizontal or vertical mounting. Feature dust-proof cases with clear plastic covers. Center, top or bottom zero position and other variations so pointer movement will conform with "human engineering" principles. Side indicator panel meters are an original International Instruments development, and *only* International offers you a complete line with scale lengths of 2.7", 2.1" and 1.2"! Supplied in a wide variety of standard and special ranges.

**VISIT OUR BOOTH NO. 2814
AT THE I.R.E. SHOW**

WRITE NOW FOR ENGINEERING DATA SHEETS
... on Side Indicators and also on our 1½" Ruggedized Meters, 1" and 1½" Panel Meters, VU, DB and Illuminated Meters, and Miniature Multitesters. Sub-miniature Rotary and Lever Switches.
P.O. Box 2954, New Haven 15, Connecticut.
Cable: "INTERINST"

*PAT. PENDING

MINIATURIZATION HEADQUARTERS



***international
instruments inc.***

CIRCLE 67 ON READER-SERVICE CARD

NEW PRODUCTS



Output Transformers

Secondary winding brought out as separate sections

Eight models of the P5000 series of transformers are available with ratings of 35 and 50 w. The secondary winding of these transformers brought out as four separate sections which may be connected in series or parallel to match impedances of 0.95, 3.8, 8.5 and 15 ohms, thus ensuring that the complete secondary is utilized. At the full power rating, these units have 1 per cent distortion at 50 cps.

Swedgal Electronics, Dept. ED, 258 Broadway, N.Y. 7, N.Y.

CIRCLE 68 ON READER-SERVICE CARD

Frequency Transducer

Voltage output proportional to frequency input with 0.5 per cent accuracy



The Megacycler, a precision frequency and pulse rate transducer, produces a dc output current or voltage which is directly proportional to the input frequency. With temperature variations from -60 to +100 C, the Megacycler will maintain an output accuracy and linearity of better than $\pm 1/2$ per cent of full scale.

Four standard models cover the audio range to 4000 cps. Model MC125-A, as an example, has a range of 0 to 30 cps up to 0 to 125 cps (Frequency range is varied by an attenuator.) Full output of 5 v dc can be obtained at any desired full scale frequency between 30 and 125 cps. All models are assembled in a drawn steel can measuring 1-3/4 x 1-5/16 x 1-5/16 in.

Pioneer Magnetics Inc., Dept. ED, 5858 Wilshire Blvd., Los Angeles 36, Calif.

CIRCLE 69 ON READER-SERVICE CARD

Do you think of pressure transducers?



ATOMICS INTERNATIONAL
DIVISION OF NORTH AMERICAN AVIATION, INC.

does... and uses Statham pressure transducers as part of the control instrumentation in the construction of its nuclear reactors which open entirely new fields in industrial research and development by providing an on-the-spot source of high-energy gamma rays and neutrons.



WHEN THE NEED IS TO KNOW...FOR SURE SPECIFY STATHAM

*Accelerometers
Pressure Transducers
Load Cells*

Catalog, complete with prices, available upon request.

Statham

INSTRUMENTS, INC.
LOS ANGELES 64

CIRCLE 70 ON READER-SERVICE CARD

Cooling Unit

Integral part of equipment



Mounted on a lightweight, but structural 20 x 24 in. honeycomb base, this cooling unit is designed as part of a container that holds equipment sealed in a gaseous environment at a constant pressure of 20 psia. This particular unit provides a net cooling capacity of 1.5 kw at 50,000 ft. Two fans and a heat exchanger complete the cooling unit. One fan circulates non-toxic sulfur hexafluoride through the heat exchanger and over the electronic equipment within its pressurized container.

The Garrett Corp., Airesearch Mfg. Div., Dept. ED, 9851 Sepulveda Blvd., Los Angeles, Calif.

CIRCLE 71 ON READER-SERVICE CARD

Encapsulated Precision Resistors

In accuracies to 0.001 per cent



Previously available in a sealed oil-bath construction, these encapsulated resistors are available in resistance tolerances to 0.0025 per cent relative or 0.005 per cent absolute, with temperature coefficients of resistance of 2.5 ppm per deg C absolute or 0.7 ppm relative. Units can be furnished trimmed under specified ambient temperature and dissipation level and to track over MIL specification temperature ranges, such as to 0.01 per cent from -45 to +85 C.

Julie Research Labs., Inc., Dept. ED, 556 W. 168 St., New York 32, N.Y.

CIRCLE 72 ON READER-SERVICE CARD
CIRCLE 73 ON READER-SERVICE CARD

Transitron

SILICON

TRANSISTORS

*Now...
The widest
POWER RANGE
in the
industry!*

Two new high power transistors have just been added to the Transitron line, increasing power ratings to 80 watts. Now, whatever the application, you can choose from the broadest power range in the industry... with Transitron reliability built into every transistor.

HIGH POWER

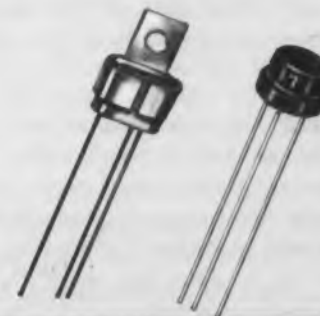
- Ratings to 80 watts
- Operation to 5 amps
- Low Rcs, 1.5 ohms typical
- Voltage Ratings to 60V



Type	Maximum Power Dissipation at 25°C case (watts)	Minimum D.C. Common Emitter Current Gain B	Typical Collector Saturation Resistance (ohms)	Maximum Collector Voltage Vc (volts)
ST400	80	15@5amps	1.5@5amps	60
2N389	37.5	10@2amps	3@1amp	60

MEDIUM POWER

- Operation to 500 ma
- Ratings to 5 watts
- Low Rcs, 6 ohms typical
- Voltage Ratings to 100V

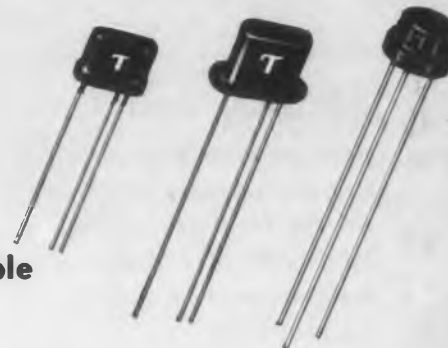


Type	Maximum Power Dissipation at 25°C case (watts)	Maximum Collector Voltage VcMax (volts)	Minimum D.C. Common Emitter Current Gain B	Typical Collector Saturation Voltage (volts)
2N545*	5	60	15@500 ma	3V@500 ma
2N547	5	60	20@500 ma	3V@500 ma
2N498	4	100	12@200 ma	4V@200 ma
2N497	4	60	12@200 ma	4V@200 ma
2N531	5	60	20@50 ma	1V@50 ma
2N243	.75	60	9@5 ma	3.5V@20 ma
2N244	.75	60	28@5 ma	3.5V@20 ma

*Fast Switching Type

SMALL SIGNAL

- Operation to 175°C
- Low Ico at Rated Vc max.
- High Current Gain
- Three package sizes available



Type	Minimum Common Emitter Current Gain, B	Maximum Collector Voltage Vcc Peak (Volts)	Typical Cut-off Frequency (MC)	Maximum Collector Cut-off Current at 25°C at Vc MAX (µa)
2N543	80	45	13	.5
2N480	40	45	11	.5
2N475	20	45	10	.5
2N336	78	45	13	50
2N334	18	45	11	50
2N118	18	30	4	10
2N119	36	30	4	10
ST904	18	30	4	10
ST905	36	30	4	10

Send for Bulletin TE-1353

Transitron

electronic corporation • wakefield, massachusetts

VISIT US AT IRE SHOW — BOOTH 3912-14



Transistors



Diodes



Regulators



Rectifiers





IRE SHOW
Booth 1807

What's under her hat?

It isn't an earring. It's an ACESET® . . . a micro-miniature, precision, wire-wound potentiometer featuring small pot size with big pot performance! Only 1/2" in diameter and 5/16" in body length, the ACESET excels in a combination of all around top performance characteristics. Heat dissipation, for example, is 2 watts at 60° C. Other specification information is listed below.

Improved performance at lower cost has been achieved in these micro-miniature units by mass producing to standard specifications. You can select from nine different resistance values between 100 and 25,000 Ohms. Shipments are guaranteed within 24 hours of receipt of order. Call, wire or teletype Dept. G, at Ace Electronics Associates, Inc., 99 Dover Street, Somerville, Mass. SOMerset 6-5130. TWX SMVL 181

MECHANICAL SPECIFICATIONS

One piece precision-machined metal case
Passivated stainless steel shaft
Self-contained locking device
Panel anti-rotation pin
Mechanical rotation: 330° nominal
Size: 1/2" diameter x 5/16" body length

ELECTRICAL SPECIFICATIONS

Heat Dissipation: 2 watts at 60° C.
Voltage breakdown: 1,000 VDC
Electrical Angle: 325° nominal
Temp. coefficient of resistance wire: 20 ppm
Resistance tolerance: ± 10 %
Linearity: ± 5 %

ACEPOT®
ACETRIM®
ACESET®
ACEOHM®

ACE

ELECTRONICS ASSOCIATES, INC.

CIRCLE 74 ON READER-SERVICE CARD

NEW PRODUCTS

200 C Capacitors

Insulation Resistance 10^{13} Ohms



The dielectric material used in the low voltage HT-4 capacitor offers high quality in a small unit. Insulation resistance of 10^{13} ohms at 25 C enables holding charge for long periods without derating. Operating temperature without derating is -55 to $+200$ C. Capacitance ratings are 0.001 to 0.1 μ fd, voltage rating up to 50 v dc, and tolerance is as low as ± 1 per cent.

Balco Research Labs, Inc., Capacitor Div., Dept. ED, 49 Edison Place, Newark, N.J.

CIRCLE 75 ON READER-SERVICE CARD



Accelerometer

Tests small component acceleration down to 0.01 g

Operating on the electrokinetic principle, type 4-242 accelerometer is designed to sense dynamic accelerations down to 0.01 g from 25 cps to 80 kc. The instrument produces flat response between 50 cps and 60 kc. It accurately senses vibratory acceleration and shock up to 1000 g, with reading not affected by 200 g steady acceleration. The pickup itself withstands overloads of 5000 g without damage. It will operate at temperatures from -10 to $+140$ F. Transverse response of the type 4-242 in the plane perpendicular to the sensitive axis is less than 1 per cent of response in the sensitive axis.

The unit operates by means of a polar fluid acting as a seismic mass, which is contained in a cylinder partitioned laterally by a porous-ceramic disc and closed at both ends by flexible diaphragms. As vibratory acceleration or shock occurs, a minute flow of the fluid is forced through the porous ceramic partition. This creates an electrical output equivalent to the instantaneous acceleration.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 76 ON READER-SERVICE CARD

ON THE SHELF!

SINGLE SPIDER GEAR DIFFERENTIALS

by FORD INSTRUMENT



AVAILABLE IN FOUR SIZES:
 $\frac{1}{8}$ ", $\frac{3}{16}$ ", $\frac{1}{4}$ ", and $\frac{5}{16}$ " Shaft Diameters

NOTE! Prices of $\frac{1}{8}$ " units have been drastically reduced.

GUARANTEED SHIPMENT WITHIN:

(WITHOUT END GEARS)	TYPE
1 WEEK for units with set shaft lengths*	A
3 WEEKS for units with shaft lengths to customer specs	B
(WITH END GEARS)	
4 WEEKS for units with stock end gears	C
8 WEEKS for units with end gears to customer specs	D

(SUBJECT TO PRIOR SALE)

*Note: $\frac{5}{16}$ " units are not stocked with set shaft lengths.

Ford Instrument produces single spider gear differentials to highest military and commercial standards, for extreme accuracy in addition and subtraction, and in servo loop applications. Seven ways superior. Call or wire W. Mohr, Component Sales Division (Stillwell 4-9000) for prices, or check and mail coupon below, stating quantity. Data bulletin with performance curves and characteristics will be sent with the prices.



Component Sales Division ED FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

Please send me prices on the following:

Circle size of unit desired:

$\frac{1}{8}$ " $\frac{3}{16}$ " $\frac{1}{4}$ " $\frac{5}{16}$ "

Circle category for type of units needed:
(Check two if both apply)

A **B** **C** **D**

I want _____ (number) units:

Name _____

Position _____

Company _____

Street _____

City _____ State _____

CIRCLE 77 ON READER-SERVICE CARD



Receiving System

Primarily for use in antenna pattern measurements, this receiver covers the range from 30 mc to 75 kmc. The system will be displayed at the coming IRE Show.

Designed for application in antenna pattern measurements, the series 402 receiver has a linear dynamic range exceeding 40 db and sensitivities greater than -90 dbm at 30 mc and -70 dbm at 75 kmc. A feature of the receiver system is that no waveguide connections from the antenna to the receiver are required. A receiving antenna may be located up to 75 ft from the receiver with negligible loss in sensitivity even at 75 kmc.

Operation is as follows: A Carcinotron oscillator, voltage-tunable over the frequency range of 2 to 4 kmc, serves as the local oscillator. For receiver operation between 2 and 75 kmc, the oscillator signal is fed through a coaxial cable to a simple crystal mixer at the terminals of the antenna under test. The local oscillator is tuned such that its frequency or one of its harmonics generated by the crystal heterodynes with the received signal to provide an intermediate frequency of 65 mc. This i-f signal, whose amplitude is proportional to that of the received signal, is returned through the same coaxial cable to the i-f amplifier.

The Carcinotron is swept in frequency at a 1000 cps rate over a range of several megacycles. The heterodyne mixer output is consequently swept through the pass-band of the i-f amplifier with a sweep width somewhat greater than the i-f bandwidth. The resulting audio modulation of the i-f signal is detected by a bolometer and the detected signal is fed to an antenna pattern recorder or other indicating device. A crystal detector is used to provide a signal for the cathode ray oscilloscope and the afc circuit.

Sweeping of the local oscillator makes the receiver insensitive to drifts of the transmitter and local oscillator frequencies so long as the received signal is included within the swept frequency interval. An afc system which operates over the full dynamic range of the receiver prevents detuning for larger frequency drifts.

Scientific-Atlanta Inc., Dept. ED, 2162 Piedmont Rd., N.E., Atlanta 9, Ga.

CIRCLE 79 ON READER-SERVICE CARD

new

Transistorized Power Supplies



Model Q28-1

Output: 18 to 36 (28 nominal) VDC,
0 to 1 amp.
Regulation: $\pm 0.25\%$ for line and load
change combined
Ripple: 0.01% maximum
Response time: 50 microseconds
\$195 in cabinet
\$400 in dual rack mount
(illustrated)

Model Q6-2

Output: 4.5 to 8 (6 nominal) VDC,
0 to 2 amps.
Regulation: $\pm 0.25\%$ for line and load
change combined
Ripple: 0.02% maximum
Response time: 50 microseconds
\$165 in cabinet

LOW-VOLTAGE HIGH-CURRENT DC POWER SUPPLIES

with the *PERFORMANCE* of ALL-TRANSISTOR CIRCUITRY

DC sources of utmost reliability, minimum ripple, and very fast response —with nominal voltages of 6, 12, 28 volts at 0 to 4 amp output—all in lighter, *smaller* packages. And these new, compact power packs are fitted with the Zener diode reference circuit that assures the $\pm 0.25\%$ regulation accuracy and high stability. The 2 to 1 output voltage range gives these supplies an application range that is unsurpassed. The all-transistor design provides the excellent ripple and response properties that rule out line and load transients. An exclusive protective circuit prevents short-circuit damage to the transistors. All models are low in cost, coming in single or dual rack mount, or in cabinets. Full information on this important advance in low voltage, high current technology is now in print. Ask your Sorensen representative for full data, or let us mail it to you directly.



See the *NEW Nobatrons* —
and all the new *Sorensen*
Power Supply developments
—both AC and DC
at our IRE exhibit.
Booths 2627-2629

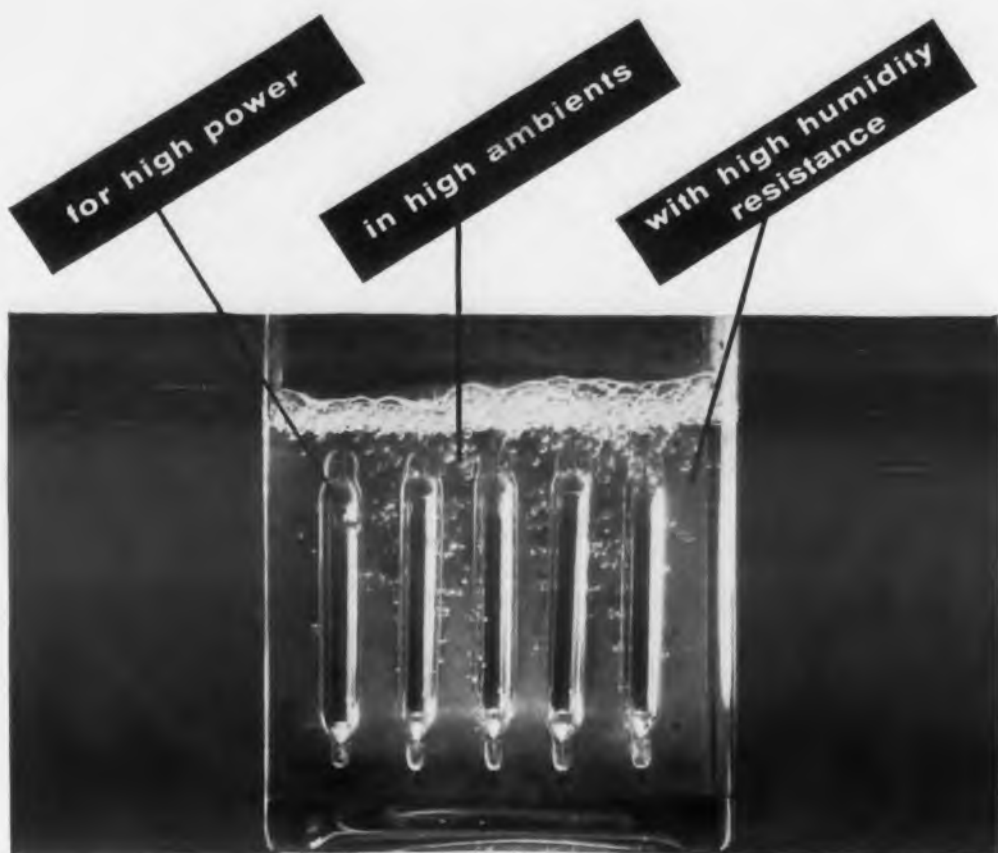


SORENSEN & COMPANY, Inc. Richards Avenue, South Norwalk, Connecticut

CONTROLLED POWER FOR
RESEARCH AND INDUSTRY

In Europe, contact Sorensen-Ardag, Eichstrasse 29, Zurich, Switzerland, for all products including 50 cycle, 220 volt equipment

CIRCLE 80 ON READER-SERVICE CARD



VICTOREEN ULTRA-STABLE FILM TYPE RESISTORS

Who ever heard of boiling water with resistors? Though they're obviously not designed for this purpose, Victoreen ultra-stable film type resistors *can* do it. What's more they stand up under this abuse.

The "boiling water test" does

prove *conclusively* the high power . . . high humidity resistance . . . stable operation in high ambients—of Victoreen resistors. And you get all these desirable qualities in Victoreen *precision* resistors—Victoreen models RX-4 and RX-5.

	MODEL RX-4	MODEL RX-5
Resistance	200 ohms to 50 megohms	200 ohms to 200 megohms
Tolerance	1, 2, 5, 10%	1, 2, 5, 10%
Size	.413 dia. x 2" long	.413 dia. x 3 1/8" long
Power	5W at 150°C 3W at 225°C	10W at 150°C 5W at 250°C

Stability—±4% for 1000 hours guaranteed life at rated power

If you have an application requiring precision resistors for operation at high power with high stability in severe ambients, it will pay you to check with Victoreen first.

AA-7093

Victoreen's Ultra-Stable Film Type Resistors will be on display at the
IRE SHOW BOOTH 2232



The Victoreen Instrument Company

Components Division

5806 Hough Avenue • Cleveland 3, Ohio

CIRCLE 81 ON READER-SERVICE CARD



Differential Meter Relay

Serves as Control Device

SIGNAL comparison and control are both provided simply and effectively by a new circuit using a differential contact meter relay. This relay has two moving coils instead of one. They are polarized so that the indicating pointer shows either the sum of, or the difference between the signals reaching the two coils. Two adjustable pointers are preset at high and low signal limits.

The circuit performs the same function as a closed loop pulse servo, but much more easily. Developed by Assembly Products Inc., of Chesterland, Ohio, it is probably the first control circuit to apply feedback directly to a meter relay to guide control action.

In the usual programming setup, the moving coils are wired so the indicating pointer shows the sum of their signals,

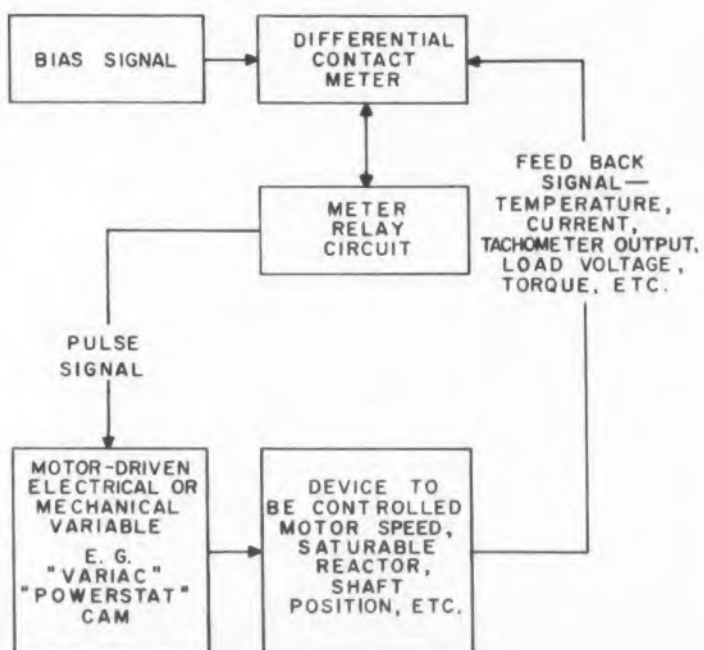
and the low adjustable pointer is set at the level of a bias signal.

The bias and the feedback from the controlled device comprise the total signal to the indicating pointer. The feedback directly reflects the control being exercised. If the bias is reduced, the indicating pointer meets the low adjustable pointer and their contacts lock. As the bias decreases, the meter relay tries to make up the difference by increasing the signal to the other moving coil. Since this latter signal is fed back from the controlled device, it indicates that a change corresponding to the signal increase has occurred in the action of the device.

For more information, turn to the Reader's Service Card and Circle 82.

IRE booths 3815-3817.

Block diagram of a typical programming circuit.



CIRCLE 310 ON READER-SERVICE CARD for Ohmite >

New Xenon-filled Westinghouse THYRATRON TUBES fit 90% of new equipment needs!



CHARACTERISTICS:

TUBE TYPE	FILAMENT		VOLTS PEAK		ANODE AMPS		HEIGHT	DIAMETER
	Volts	Amps	Inverse	Forward	Peak	Avg.		
WL5796	2.5	8.5	1500	1500	20	1.6	5½"	1 9/16"
WL5877	2.5	10.8	1500	1500	40	3.2	5¾"	1¾"
WL5878	2.5	21	1500	1500	80	6.4	6¾"	2 3/16"

Compact new design saves space, gives superior performance and uniform quality!

For motor controls, firing ignitrons, inverter service or any other new industrial or military equipment need—you'll find new Westinghouse Thyratrons the most advanced you can use. They meet NEMA and EIA specifications for control applications and have the following characteristics:

- 12 to 1 peak to average anode current rating.
- 1,500 volt forward and inverse voltage rating.
- 15 second averaging time.
- Operate in broad ambient temperature limits (—55° to 70°C)
- Fast cathode heating time.
- Small compact construction.

YOU CAN BE **SURE**...IF IT'S

Westinghouse
Electronic Tube Division Elmira, N. Y.

To see how Westinghouse Thyratrons can fill your design requirements, write today for detailed data. Westinghouse engineers will be glad to consult with you, if you wish. Sample orders available for immediate shipment.

CLIP AND MAIL COUPON NOW

COMMERCIAL ENG. DEPT., ELECTRONIC TUBE DIV.
WESTINGHOUSE ELECTRIC CORP. Elmira, N. Y.

Please send me full information on the following Thyatron
Tube (s):

—WL5877 —WL5878 —WL5796

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CIRCLE 312 ON READER-SERVICE CARD

VT Variable Transformers
Continuously adjustable auto-transformers. Unique Ohmite features for reliable service.

Relays
Compact relays in many types. For AC or DC. Power-handling and multiple circuit varieties.



The main ultramodern Ohmite plant contains 170,000 square feet and is one of the largest completely air conditioned plants in the Midwest. Manufacturing areas, laboratories, warehousing, and offices are housed in one efficiently integrated design, thus keeping all phases of production under direct control for service and quality.

Tap Switches
Ceramic insulated selector switches in many sizes for AC use up to 100 amperes. Single or tandem.

Resistors
Vitreous enameled power resistors in tremendous variety of types and sizes.



OHMITE®

R. F. Chokes

Radio-frequency chokes in many sizes for 3 to 520 megacycle applications. Single-layer wound.



Precision Resistors

Encapsulated and other wire-wound close tolerance resistors. Unique Ohmite Metal Film precision resistors.



Resistors

Rheostats

Tap Switches

Relays

Tantalum Capacitors

Variable Transformers

R. F. Chokes

NEW CATALOG and Engineering Manual

Here it is . . . The new, complete Ohmite Catalog 58! Contains detailed information on Ohmite Resistors, Rheostats, Relays, Tap Switches, Tantalum Capacitors, Variable Transformers, and R. F. Chokes. There are 190 pages of useful tables of ratings, graphs, dimensional drawings, illustrations, and engineering data. Catalog 58 is more than twice as large as the previous catalog. The wealth of information it contains will make it an authoritative reference in the electrical and electronic industries, and a valuable addition to your technical files.

Write on company letterhead for your personalized copy.

OHMITE MANUFACTURING COMPANY
3637 Howard Street, Skokie, Illinois



Rheostats

Complete range of vitreous-enameled close control power rheostat-potentiometers. Single or tandem. Many additional features.



Tantalum Capacitors

Sub-miniature wire-type in several styles. Several sizes of foil-type. High performance in minimum space.





STATISTICAL COMMUNICATION TECHNIQUES and SPACE TECHNOLOGY

The transmission of information to the earth from a ballistic missile or a space vehicle presents unusual problems in communications. With severe limitations on equipment size and power, the communication system must operate in the presence of receiver noise and interference from the radio environment, including terrestrial sources and, for longer ranges, sources in space. Statistical communication techniques are valuable tools in achieving reliable communications under these difficult conditions. These techniques, by providing means for coding and decoding information and for determining the amount of information which can be sent, make possible the use of low-strength signals which otherwise could not be sorted out from the background of interference and noise.

The statistical approach is also important in the development of systems with a high degree of immunity to electronic countermeasures. The less regular or predictable the nature of transmitted waveforms, the less likelihood there is that interference will prove effective against the communication system. However, it is necessary to design the system to take maximum advantage of the near-random waveform characteristics.

Future space vehicles inherently will impose greater demands on communication systems. Systems for guidance, tracking, and data transmission through space to the moon or the nearer planets are now real goals in space technology. In the development of such systems, statistical communication techniques can be expected to play a significant role.

At Space Technology Laboratories, both experimental and analytical work are proceeding in the application of statistical techniques to the problems of space vehicle electronics. This work illustrates the advanced research and development activities in STL's Electronics Laboratory and the emphasis upon the application of new techniques to the requirements of space technology.

Both in support of its over-all systems engineering responsibility for the Air Force Ballistic Missile programs, and in anticipation of future system requirements, STL is engaged in a wide variety of research and experimental effort. Projects are in progress in aerodynamics, propulsion, structures, and electronics.

The scope of activity at Space Technology Laboratories requires a staff of unusual technical breadth and competence. Inquiries regarding the many opportunities on the Technical Staff are invited.

SPACE TECHNOLOGY LABORATORIES

A Division of The Ramo-Wooldridge Corporation

5730 ARBOR VITAE STREET • LOS ANGELES 45, CALIFORNIA

Couplings

Handle 5 deg misalignment



These couplings will accommodate angular misalignment of driving and driven shafts up to 5 deg, parallel offset to 0.01 in. and axial end play up to 0.09 in. They can transmit torques up to 150 oz-in., permit speeds to 10,000 rpm, and provide high torsional rigidity. Couplings are bored to receive 3/16, 1/4, 5/16, or 3/8 in. shafts or combinations of these shaft sizes. Overall diameter of the coupling is 1.078 in.

Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.

CIRCLE 83 ON READER-SERVICE CARD

Screen Room Filters

100 db attenuation from 14 kc to 10,000 mc



This series of r-f interference suppression screen room filters, provides attenuation characteristics of 100 db and above at frequencies from 14 kc to 10,000 mc. Designated the FSR-1200 series, they are designed for use in circuits carrying 25 to 200 amp, for voltages to 250 v ac or 600 v dc, and power line frequencies of 0-400 cps. Assembled filters are completely tested for voltage breakdown, characteristic insertion loss, voltage drop, insulation resistance and hermetic seal.

Filtron Co., Inc., Dept. ED, Flushing, N.Y.

CIRCLE 84 ON READER-SERVICE CARD

CIRCLE 85 ON READER-SERVICE CARD

← For Ohmite CIRCLE 310 ON READER-SERVICE CARD

ALLIED'S CH RELAY

Miniature 10 Amp 4 PDT

Designed for Resistance to:

Shock—100 gravity units

Vibration—5 to 55 cps at 0.5 inch double amplitude
55 to 2000 cps at 30 gravity units

Temperature—from -65°C to $+125^{\circ}\text{C}$

Other Specifications:

Contact Rating: 10 amperes resistive, 8 amperes inductive, at 29 volts d-c or 115 volts a-c 400 cps

Weight: 5.3 ounces

Dielectric: 1500 volts rms at sea level

Contact Resistance: 0.10 ohm max. initial

Contact Arrangement: Four Pole Double Throw

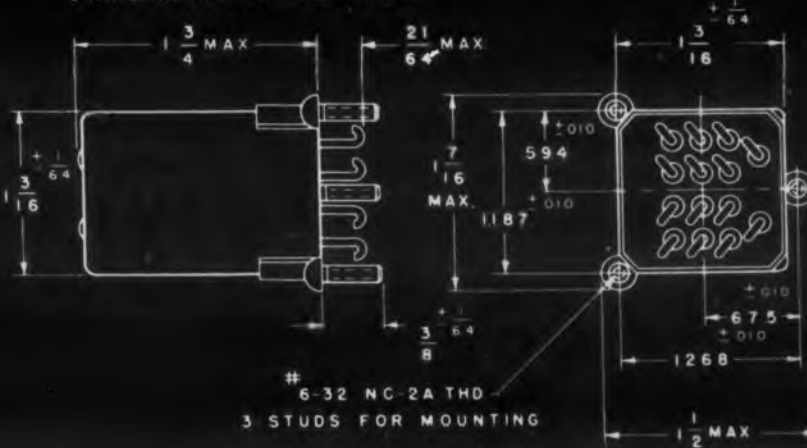
Now with Stabilized Construction*



TYPE CH-12D
ACTUAL SIZE

* Includes materials and processing necessary to minimize contact resistance variations and dielectric deterioration during life due to contact contamination, mechanical wear and shift of adjustments with temperature.

STANDARD 3 STUD MOUNTING



DIMENSIONAL TOLERANCES ON FRACTIONS $\pm \frac{1}{64}$ ON DECIMALS ± 0.010

The Allied CH-12D Relay was developed to meet the more rigid requirements of vibration, shock, temperature, rupture and overload conditions of the latest MIL spec. This relay is constructed with the latest improved materials and processes available. This relay is available with other mounting arrangements, such as 4 mounting studs, 2 mounting studs or holes with Allied MHY-12D mounting dimensions. For additional information write for Bulletin CH.



ALLIED CONTROL

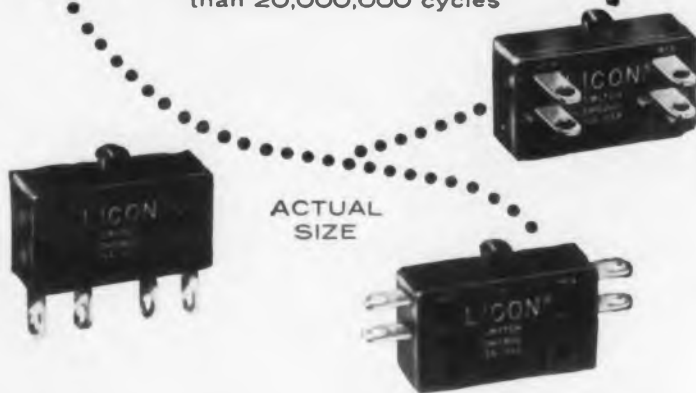


ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N. Y.

You've
never seen a
SUB-MINIATURE
switch
as mighty
as this

BIG switch performance in sub-miniature size

Rated 10 amps 30 V.d-c. inductive
(L/R-.026). Consistently more
than 20,000,000 cycles



ACTUAL
SIZE

NEW LICON® TYPE 16 SWITCH measures only 25/32" long and 1/4" thick but packs quality and dependability never before achieved in sub-miniatures. With characteristics found only in much larger precision switches, the Licon Type 16 is ideal for aircraft safety applications, has performance and size vital to guided missiles. Passes Navy 1300 G shock test . . . exceptionally shock and vibration resistant even near the trip point. Its new switch mechanism with stainless steel springs avoids early fatigue and provides the advantages of double break contacts with wiping action in a wide range of movement differentials and operating forces.



**WRITE FOR
FREE LICON TYPE 16
SWITCH BULLETIN**

Engineering data, characteristics,
modifications . . . write for
complete information on the new
Licon Type 16 Sub-miniature
Switch today.

L I C O N

Switches and Controls

Division of Illinois Tool Works
2501 North Keeler Ave., Chicago 39, Illinois



CIRCLE 86 ON READER-SERVICE CARD

NEW PRODUCTS

Variable Inductors

Range of 0.1 to 10,000 μ h



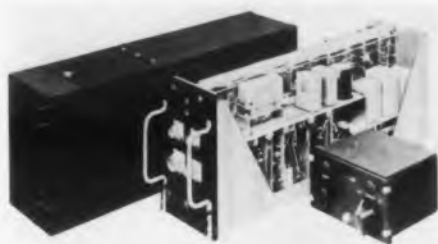
Three series of encapsulated variable inductors, built to meet MIL-C-15305A, Grade 1, Class B, cover the range of from 0.1 μ h to 10,000 μ h. Series 1, 01-22 μ h, measures 13/32 diam x 7/8 in. Series 2, 33-10,000 μ h, measures 17/32 x 1 in. Series 3, 0.1-15 μ h measures 11/32 x 5/8 in. Standard nominal inductance values are selected in steps of approximately 50 per cent. Inductance varies ± 25 per cent or more from nominal. The variable inductors are encapsulated under vacuum and are tuned by means of powdered iron cores.

Vanguard Electronics Co., Dept. ED, 3384 Motor Ave., Los Angeles 34, Calif.

CIRCLE 87 ON READER-SERVICE CARD

Digital Timing Generators

For airborne application



Models 206A, 206B, and 206C have been specifically designed for environmental conditions encountered in airborne applications. Model 206A employs the company's standard timing code format and a binary coded decimal tone burst system whose bit rate and tone burst frequencies are a function of magnetic tape speed. Model 206B is designed for an output to conform with the 20 pps, binary coded Patrick timing format. Model 206C is designed for the Parset timing code format in the forward or reverse form. This format is a 100 pps, pulse width, binary coded signal which modulates a 1000 cps carrier. The units are built to MIL-E-5400 specifications, weigh 15 lb, and consume 15 w.

Hycon Eastern, Inc., Dept. ED, 75 Cambridge Parkway, Cambridge 42, Mass.

CIRCLE 88 ON READER-SERVICE CARD

NEW NYLON PARTS from GRC

Economically mass produced on fully automatic, patented machines, these stock GRC nylon parts are available in many sizes and types. GRC uses single cavity techniques, molds in one automatic cycle, gets accurate, uniform parts, ready for immediate use

These advantages, these economies, apply too on parts made to exact specifications . . . in quantities of 50,000 to many millions. Write for bulletin describing GRC's unique methods for injection molding small plastic parts or send prints for quotation. Ask about our zinc alloy die castings, too!

Maximum size: 1 1/4" long, .03 oz. No size too small.

See GRC at the I.R.E.—Booth 4042



NYLON SCREWS



INSULATORS & BUSHINGS



COIL BOBBINS



WASHERS



GRC MOLDED NYLON SCREW INSULATORS

These insulators and bushings are designed with wide flanges—larger than the head size of all standard commercial screws—so that they will completely isolate the screw from its mounting surface.

Molded of nylon they have a low dielectric constant, relatively high dielectric strength . . . resist high voltages at commercial frequencies . . . are particularly suited for screw insulator applications, where high tensile and torque requirements call for non-insulating screws. Naturally elastic and resilient, they can also be used as light-load bearings.

Available from stock in 1/4" and 3/8" lengths for use with screw sizes #4 thru 1/4".

Write, wire, phone TODAY for catalogs and prices.



GRIES REPRODUCER CORP.

World's Foremost Producer of Small Die Castings

40 Second St., New Rochelle, N.Y.

• New Rochelle 3-8600

CIRCLE 89 ON READER-SERVICE CARD

HIGH Q 250



Plug-in

A NEW PRINCIPLE

IN TWIN-T

FEEDBACK AMPLIFIERS

FEATURES:

1. Q—quotations made on Q, 250 to 500 or greater.
2. Frequency range from 20 cycles to 2000 cycles.
3. Absolute stability.
4. Two outputs—high level and low level.
5. Two packages—plug-in or sub-chassis mount.
6. Quality components and workmanship.

SPECIFICATIONS:

Input impedance—approx. 11K
Output #1 impedance—approx. 12K
Output #2 impedance—approx. 18K
Gain-Input to Output #1 -7 db
Gain-Input to Output #2 +31 db
Frequency Tolerance \pm fo/2 Q
Dynamic Range-Output #1 0.5V (RMS)
Dynamic Range-Output #2 30V (RMS)
B+ 250V @ 18 ma.
Fila. 6.3V DC or AC @ 0.75A

FREDERICK TOOL & ENGINEERING CORP.

414 PINE AVENUE, FREDERICK, MD.

CIRCLE 48 ON READER-SERVICE CARD

Linear Differential Transformer

Directly Proportional Output



A linear variable differential transformer, type 3050XS-AT, has an output voltage which is a precise linear function of core displacement over a linear range of more than ± 3 in. A plot of output versus displacement will not deviate from a straight line drawn through the origin by more than ± 0.25 per cent of the output at 3 in. displacement. At this displacement, the output for a nominal 26 v 400 cps input into a 1/2 meg load is 6 v. When the core is at null position, residual voltage is less than 0.5 per cent of output at rated maximum displacement.

Schaevitz Engineering, Dept. ED, P. O. Box 505, Camden 1, N.J.

CIRCLE 90 ON READER-SERVICE CARD

Two-Speed Gearhead

Changes speed upon dc signal



For use with servo motors, the X-544 changes ratios internally when dc voltage is applied to, or removed from, an actuating solenoid. Primary applications are in positioning computing mechanisms which require fast approaches but slower zeroing or synchronizing action. Ratios in the size 14 unit pictured are on the order of 1800:1 de-energized and 36,000:1 energized. Similar two speed units are available in all ratios or combinations of ratios required. Units are furnished with housings to mount to servo motors.

Designed for integration with sizes 11, 14, or 18 motors, the X-544 requires 0.008 in.-oz of starting torque, and will operate 12 in.-oz of load torque. Operating at the higher ratio the assembly features a backlash maximum of 1 deg with a 5 in.-oz reversing load, and it introduces not more than 5 min of position change when it shifts speed.

Bowmar Instrument Corp., Dept. ED, 8031 Bluffton Rd., Fort Wayne, Ind.

CIRCLE 91 ON READER-SERVICE CARD

See how
the facts speak
for themselves



Standard
rectifier

RRco. Petti-Sel
rectifier

compare the size ...

compare the specs ...

STANDARD SELENIUM RECTIFIERS								
NOMINAL CELL SIZE (INCHES)		RRco. CELL CODE	Continuous DC Amperes at 35° C Ambient					
Vert.	Horiz.		SINGLE PHASE			THREE PHASE		
			Half Wave	Center Tap	Bridge	Half Wave	Center Tap	Bridge
1.0	1.0	M	.11	.22	.22	.29	.40	.33
1 3/8	1 3/8	P	.23	.45	.45	.60	.81	.67
1.5	1.5	Q	.45	.90	.90	1.2	1.6	1.3
2	2	S	.70	1.4	1.4	1.8	2.5	2.1
3	3	U	1.6	3.2	3.2	4.2	5.8	4.8
3 3/8	3 3/8	V	2.0	4.0	4.0	5.3	7.2	6.0
4	4	W	3.0	6.0	6.0	8.0	10.8	9.0
4.5	5	G	3.75	7.5	7.5	10.0	13.5	11.2
4 1/4	6	T	4.2	8.5	8.5	11.0	15.0	12.5
5	6	H	5.0	10.0	10.0	13.3	18.0	15.0
6	7 1/4	L	7.5	15.0	15.0	20.0	27.0	22.5

RRco. PETTI-SEL SELENIUM RECTIFIERS								
NOMINAL CELL SIZE (INCHES)		RRco. CELL CODE	Continuous DC Amperes at 35° C Ambient					
Vert.	Horiz.		SINGLE PHASE			THREE PHASE		
			Half Wave	Center Tap	Bridge	Half Wave	Center Tap	Bridge
1.0	1.0	6	0.2	0.4	0.4	0.6	1.0	0.6
1.3	1.3	11	0.5	1.0	1.0	1.5	2.5	1.5
1.6	1.6	16	0.75	1.5	1.5	2.25	3.75	2.25
2	2	25	1.25	2.5	2.5	3.75	6.25	3.75
2.6	2.6	44	2.25	4.5	4.5	6.75	11.25	6.75
4	4	100	4	8	8	12	20	12
4	8	200	8	16	16	24	40	24
4	12	300	12	24	24	36	60	36
8	8	402	16	32	32	48	80	48
8	12	600	22.5	45.0	45.0	67.5	112.5	67.5
8	16	800	30.0	60.0	60.0	90	150	90

In case you haven't noticed, the yellow and gray areas denote actual comparative sizes of the two rectifier types.

and compare the prices! HCD Petti-Sel rectifiers, developed in Western Germany by Siemens and now made in the U.S. by Radio Receptor, offer many important electrical advantages over standard types plus economic advantages.

See for yourself — We'll be glad to send you further information on this remarkable new rectifier line. Submit your requirements to Section D-3R

See us at our
Booths #2211-2213-
2215-2217 at
the I.R.E. Show.



Semiconductor Division
RADIO RECEPTOR COMPANY, INC.
Subsidiary of General Instrument Corporation

240 WYTHE AVENUE, BROOKLYN 11, N. Y. • EVergreen 8-6000

Radio Receptor products for Industry and Government:
Germanium and Silicon Diodes, Selenium Rectifiers, Thermatron Dielectric
Heating Generators and Presses, Communications, Radar and Navigation Equipment

CIRCLE 92 ON READER-SERVICE CARD

WILMAD PRECISION GLASS COMPONENTS



*... an economical approach
to accuracy*

When tubing and special precision parts are fashioned from glass by Wilmad, the result is extreme accuracy and uniformity . . . at a reasonable cost. For in addition to a lower initial cost, precision glass components may be designed to eliminate or reduce certain fabrication and assembly costs. It is for these reasons, plus the Wilmad ability to consistently work to tolerances of $\pm .0002''$, that design engineers are constantly finding new applications for Wilmad precision glass components.

Where necessary, Wilmad can grind the exterior of precision bore tubing concentric with the bore, thus assuring uniform wall thickness. The outside of the ground tubing can, in turn, be polished to restore transparency. Close O. D. tolerances can be maintained in both the standard precision bore tubing and the concentrically ground tubing.

Wilmad precision glass components have been used in many electronic assemblies and sub-assemblies, electrical and mechanical instruments, gauges and other devices requiring precise operation.

Why not apply the benefits of Wilmad precision glassware to your product. For more complete details, write to Wilmad Glass Company, Inc., Landisville, N. J.

WILMAD

CIRCLE 93 ON READER-SERVICE CARD

NEW PRODUCTS

Signal Simulator

Simulates PW signals for telemetering use



The MSS-3 is designed as a laboratory standard for simulating PW signals of 30 x 30, 45 x 20, 60 x 15, and 90 x 10 configurations for the checking and calibration of telemetering ground stations. The unit makes use of solid state devices throughout, with transistors operating in the switching mode exclusively. Both standard PW and a differentiated PW output to simulate PW/PM signals are provided. Pre-programming provisions permit the selection of simulated data inputs and channel assignments with complete flexibility.

Applied Science Corporation of Princeton, Dept. ED, P.O. Box 44, Princeton, N.J.

CIRCLE 94 ON READER-SERVICE CARD

Buffer Storage Unit

1000 bit capacity for high speed data



This magnetic core buffer storage unit, model CB-602/1000, has a total storage capacity of 1000 bits of information. The memory unit is particularly suitable for the storage of high-speed (above 20 kc) data. Since construction is modular, assemblies of lesser storage capacity are also available. The use of shift registers permits power to be consumed only during the times of read-in and read-out commands. Storage is retained indefinitely—even in the event of power failure. The shift registers may be connected to achieve combinations for special input and output capacities.

Epsco, Inc., Components Div., Dept. ED, 108 Commington St., Boston 15, Mass.

CIRCLE 95 ON READER-SERVICE CARD

HUNTER INSTANT LIGHTING TORCHES



for military
applications at
sub-zero temperatures



- developed in co-ordination with Engineer Research and Development Laboratories, Ft. Belvoir, Va.
 - unpowered, open flame burners — lighted instantly with a match at temperatures down to -90°F .
 - burn any type gasoline or JP-4 fuel.
 - for a wide range of sub-zero, spot heat applications: small engine starting; start-aid for bulldozers, snow plows, earthmovers, special-purpose equipment; de-icing bogie wheels, tracks, heavy-duty control equipment, etc.
 - capacities: 15,000 to 200,000 BTU/Hour at variable pressures.
- Other Hunter military equipment: space and personnel heaters; engine heaters; refrigeration units.*

GET
THESE
BROCHURES
TODAY!

for complete
specifications
and details

MH-167 "Hunter
Instant Lighting
Torches"

MH-166 "Hunter
Engine Heaters"

MH-162 "Hunter Space
and Personnel Heaters"



HUNTER MANUFACTURING CO.
30539 AURORA RD.
SOLON, OHIO
HEATING AND REFRIGERATION SYSTEMS
CIRCLE 96 ON READER-SERVICE CARD

Sweeping Oscillator

Latest model sweeps 100 kc to 150 mc range



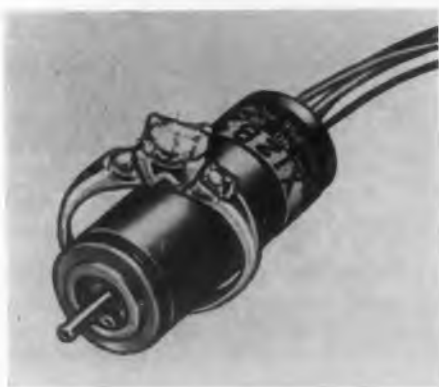
The Ligna-Sweep model CP has been added to this Company's series (Vara-Sweep, Rada-Sweep, etc.) of precision sweeping oscillators. This instrument provides continuously variable center frequencies calibrated on a direct reading dial from 100 kc to 150 mc with continuously variable sweep widths. The output is held constant over each band and the entire frequency range. The crystal markers are available in five groups of three and are controlled by a separate rotary switch. By decreasing its sweep width to a minimum, the model CP may be used as a cw signal generator. The output is held flat within ± 0.4 db over the widest sweep width. Sweep rate is variable around 60 cps and locks to line frequency.

Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N. J.

CIRCLE 97 ON READER-SERVICE CARD

Miniature Servo Motor

Measures 1/2 in. in diameter

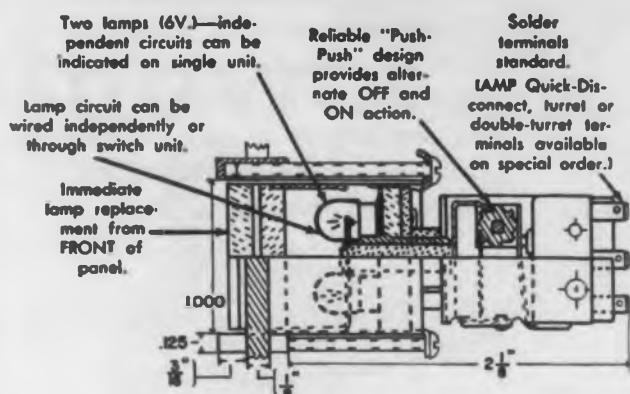


Measuring 1/2 in. diam by 1-19/64 in. long, this 400 cps servo motor consists of a squirrel-cage rotor on precision ball bearings, a two-phase stator and a stainless steel housing.

Characteristics include: size, number 5 frame; weight, 0.94 oz; fixed phase and control phase voltage, 26 v; current, 92 ma; impedance, $283 = 19.2 + j210$ ohms at stall; power input, 3.3 w; stall torque, 0.11 oz-in.; no load speed, 9500 rpm; torque-to-inertial ratio, 35,000 rad/sec²; and operating temperature range, -55 to +70 C.

Dendix Aviation Corp., Eclipse-Pioneer Div., Dept. ED, Teterboro, N.J.

CIRCLE 98 ON READER-SERVICE CARD



STANDARD MODELS (C6-Series)

Lighted Push-Button Panel Switches

Standard models furnished with two-piece colored button, two 6V. lamps, two basic switches (E4-103) with solder terminals.

C6-53—(shown above)—"Push-Push", alternate action.

C6-52—Momentary action with over-centering device, positive feel.

C6-51—Momentary action.

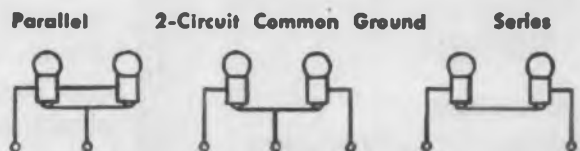
Model C6-50 — for pilot light duty only. Consists of 2-piece colored button and lamp unit with two 6V. lamps. (No switching mechanism).

- 2-piece color-coded button; 5 colors available.
- Barriers ordered separately — to meet panel requirements.
- 28V. lamps available on special order.

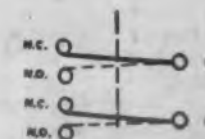
BASIC SWITCH OPERATING CHARACTERISTICS

Contact Arrangement	D.P.D.T.
Travel .....	.3/32 Approx.
Contact Pressure .....	.60 Grams
Contact Gap .....	.020 Max.
Temp. Range	-65° F to +180° F.
Current Rating .....	.5A @ 125/250 V.A.C.
	4A Res @ 30 V.D.C. 2.5A Ind @ 30 V.D.C.

• Complete push-button switch unit or pilot-light assembly can be supplied in any of the three following circuit arrangements. (solder terminals on lamp assembly).



• The double-pole, double-throw switching unit may be wired normally-open or normally-closed.



ELECTRO-SNAP SWITCH & MFG. CO.

4216 West Lake Street, Chicago 24, Illinois
VA 6-3100 TWX No. CG-1400

CIRCLE 99 ON READER-SERVICE CARD

"PUSH-ON, PUSH-OFF" ALTERNATE ACTION LIGHTED PANEL SWITCH

3 units in 1 compact mounting;

use singly or in "stacked" arrangement

The compact, modular design of this new Electro-Snap "Push-Push" alternate-action, panel-mounted switch combines a two-piece, color-coded button, pilot light and switching unit in one space-saving component. Two or more units may be "stacked" side-by-side in one panel slot. This eliminates congestion while achieving greater operating efficiency and quality appearance than where separate button, light and switch units are used.

Wide range of configurations permits almost unlimited application for control and indicating operations.

Almost unlimited operating and indicating conditions can be provided for sequencing, movement-limit, start-and-stop and similar applications on missile, electronic and industrial controls through variation of:

- circuit arrangements of switch and pilot lights
- colored lights for color monitoring
- colored push-buttons for color coding

For full application details and specifications contact your local representative or write for data on Standard (C6 Series) Electro-Snap "Push-Push" Panel Switches.

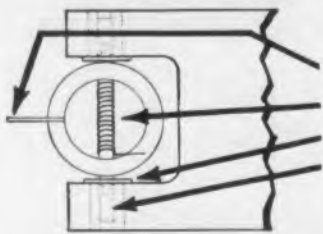
MOMENTARY-CONTACT PUSH-BUTTON PANEL SWITCH

This momentary-contact, lighted push-button panel switch (C6 Series) has the same space-and-cost-saving features as the "Push-on Push-off" switch above. It is available in various configurations to permit application to a wide range of indicating and switching operations.



For details, write for "Bulletin CB"

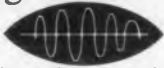
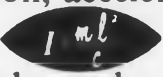

5,000,000 CYCLE LIFE!




Palladium alloy contact
Torque spring
Insulation bushing
Jewel pivot



another result of **dynamic** balance" * precision potentiometers

Long life is achieved by minimizing wear. Wear results from pressures or forces between contact assembly and winding. Total force consists of a dynamic force  due to vibration, acceleration and shock; an inertial force  acting on the contact assembly; and a static force resulting from contact pressure. For proper operation, contact force must exceed the vector sum of the dynamic forces .

The Kintronic contact assembly is *dynamically balanced* about a pivot  and therefore vibration, acceleration and shock forces cancel out. Inertial force on the contact assembly is minimized by making its mass and size small as possible. Reduction of these dynamic forces enable use of very low contact pressure.

Operational Results: total wear producing force is extremely small. 5,000,000 cycle life is achieved at maximum speeds of 3,425 r.p.m., under 2,000 cycle 30g vibration!

Incidentally, we know these are hot pots mechanically ... but they're also hot for temperature, too. Power derates to zero at 165°C standard — 225°C special.

* Patent Pending

Get complete engineering data on Kintronic "Dynamic Balance" precision potentiometers. Write today.

kintronic

Division of
Chicago Aerial Industries, Inc.

10265 Franklin Avenue • Franklin Park, Illinois
CIRCLE 100 ON READER-SERVICE CARD

NEW PRODUCTS

Servo Tester

Remote control of data frequency



Type 105-AR is a stable sine generator designed for the frequency response measurements of servo systems. The instrument covers a data frequency range from 0.3 to 30 cps, with different ranges available on special order. This data frequency can be set either by a front panel knob, or remotely controlled by some external dc voltage. Four suppressed carrier 400 cps output voltages are available in two quadrature pairs. The data phase of the first pair is fixed, while that of the second pair is set by a front panel dial. Controls are provided for output amplitude, data phase, and frequency.

Industrial Control Co., Dept. ED, 805 Albin Ave., Lindenhurst, L.I., N.Y.

CIRCLE 101 ON READER-SERVICE CARD

Relays

Switch high voltage in severe environments



The basic model of this relay, designated RL-1007, and a double deck version RL-906, are both designed to withstand severe shock, vibration, temperature range of -55 to $+95$ C and a minimum of 500,000 operations. Specifications include: Contact capacity under load of 1 amp ac at 10,000 v peak, 100 ma (res.) at 200 v dc; contact arrangement of spdt double-break, and dpdt double-break; dielectric strength of 17,000 v dc between mutually insulated contacts, and vibration of 10 g acceleration from 5 to 55 cps.

Joseph Pollak Corp., Dept. ED, 81 Freeport St., Boston 22, Mass.

CIRCLE 102 ON READER-SERVICE CARD

now —
for small
plastic parts

"DO IT YOURSELF"



cut costs . . .

avoid delays . . .

improve quality . . .

control production . . .

. . . with the Hull Standard Model 99A completely automatic transfer Molding Press for thermosetting plastics that literally "works while you sleep." Anyone, with minimum instruction, can supervise several presses.

Capacity up to 20,000 parts per week with 4-cavity mold. Utilizes conventional molding powders. No preforms or preheating required. Phenomenally low mold cost. Quick set-up and mold change-over.

Provides closer tolerances and greater strength in thin sections — facilitating miniaturization. Flash and finishing costs are minimized.

Write for information and technical paper "A new concept in Small Parts Molding."

HULL-STANDARD
CORPORATION

Hatboro, Pennsylvania • Phone: OSborne 5-5000
Export Division: 1505 Race St., Phila. 2, Pa., U.S.A.

Also for High-Vacuum Potting,
Drying, Impregnating, Metal-
lizing Equipment—write Hull
Corporation.

CIRCLE 103 ON READER-SERVICE CARD



Gain Measuring System

Measures up to 80 db of gain or loss

A complete system for making precise measurements of gain or loss of near-zero up to 80 db in. microwave components or systems has been announced. The system consists of four basic components: a preamplifier unit, an attenuator, an amplifier-detector, and a power supply. These components are placed on separate relay rack panels. When additional power supply and control facilities are required, a double klystron power supply may be added. All components are available either separately or as a complete system. The meter scale gives readings as small as 0.025 db.

Kay Electric Co., Dept. ED, Maple Ave., Pine Brook, N. J.

CIRCLE 104 ON READER-SERVICE CARD

Power Supply Regulation Analyzer

Measures applied dc, percentage change, and rms ripple on the applied dc



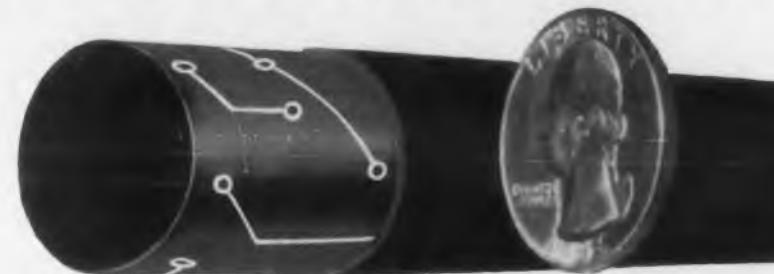
Model 901B power supply regulation analyzer is designed to measure applied dc voltage, the percentage change in applied dc voltage, and the rms ripple on the applied dc voltage of regulated and unregulated power sources. The unit measures characteristics of dc voltage in the test range 1 to 3000 v. The applied dc voltage can be measured to an accuracy of 0.1 per cent. The unit provides four ranges of sensitivity, measuring per cent regulation from 0.005 per cent each side of null position to 5 per cent each side of null position. Eleven ranges for measuring ripple voltage from 0 to 100 v are provided. This unit also provides for oscilloscope monitoring and external recording so that either a visual or permanent continuous record can be made.

Kepeco Labs., Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 105 ON READER-SERVICE CARD



new Formica® flexible copper clad...



fits larger circuits...into smaller spaces

The remarkable new Formica flexible copper clad laminated plastics save space like never before. Notice how a 40 square inch flat circuit above is contained in a space only 10 cubic inches!

Works fine, too. There's no shorting because of the insula-

tion the flexible sheet provides.

Flexible copper clad offers the product designer circuits in new shapes . . . plus increased miniaturization. For example, as shown above, an .008" sheet can be confined in a 3/8" diameter tube.

For complete information on

the design improvement possibilities Formica flexible copper clad holds for your products—civilian or military—write for new FF 89 data sheet. Formica Corporation, subsidiary of American Cyanamid, 4512 Spring Grove Ave., Cincinnati 32, Ohio.

FI 1417



**high IR,
cold punching
copper clad**

XXXP-36 for finest printed circuitry. Offers 1,000,000 megohms insulation resistance, cold punches to and including 1/16". It's the original translucent, watermarked sheet so widely copied but never duplicated.



**new
glass epoxy
high temperature
copper clad**

FF 91-1—retains mechanical strength and insulating properties at high temperatures and humidity. Cold punching and chemical resistant. Ideal for rockets and missiles.

Save your engineers — use Formica-4
the complete laminated plastics service



1. Application engineering 2. Research
3. Fabricating 4. Customer stock service

CIRCLE 106 ON READER-SERVICE CARD



If you need TEFLON* in any form R/M is the place to get it!

Raybestos-Manhattan pioneered in research and development in the use of "Teflon." R/M has had vast experience in fabricating this amazing substance . . . has accomplished things with it once thought impossible, such as molding highly complex valve diaphragms.

But R/M has more than the know-how—it has the facilities to produce "Teflon" in exactly the form you want it . . . can supply *all* your needs, from the usual types of tubes, tape, rods,

sheets and flexible wire braid covered hose to complicated molded and machined parts.

That is why R/M should be your headquarters for all your needs in products made of "Teflon," from simple standardized parts to intricate components painstakingly customized to your specifications. Call on your nearest R/M district office for the cooperation you need. Or write for detailed information.

*A Du Pont trademark



RAYBESTOS-MANHATTAN, INC.

PLASTIC PRODUCTS DIVISION FACTORIES: MANHEIM, PA.; PARAMOUNT, CALIF.

Contact your nearest R/M district office listed below for more information or write to Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

BIRMINGHAM 1 • CHICAGO 31 • CLEVELAND 16 • DALLAS 26 • DENVER 16 • DETROIT 2 • HOUSTON 1
LOS ANGELES 58 • MINNEAPOLIS 16 • NEW ORLEANS 17 • PASSAIC • PHILADELPHIA 3
PITTSBURGH 22 • SAN FRANCISCO 5 • SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber
Sintered Metal Products • Rubber Covered Equipment • Abrasive and Diamond Wheels • Brake Linings
Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls

CIRCLE 107 ON READER-SERVICE CARD

NEW PRODUCTS

Printed Circuit Connector

Dip Soldered or Wire Wrap



Printed circuit boards may be joined at right angles using type GPCW connectors with dip-solder terminals. The contacts are made of heat-treated beryllium copper in order to retain their contact force after repeated insertions and withdrawals. The same contacts are so designed that they may be also used for wire wrap techniques. The GPCW connector is available with 15 and 22 contacts, spaced $5/32$ in. apart for $1/16$ -in. boards, molded in fiber glass filled plaskon alkyd, or in melamine, or dyall-phalate.

Gorn Electric Co., Inc., Electronics Div., Dept. ED, 845 Main Street, Stamford, Conn.

CIRCLE 108 ON READER-SERVICE CARD

Temperature Transducers

Cemented or welded to surface



Type 1375 and 1376 surface temperature transducers are platinum resistance units that can be installed on any surface, flat or curved, metallic or non-metallic. The protective cover of the resistive element is cemented or welded directly to the thermal surface and forms an isothermal system which gives true skin temperature reading.

Units are available in various ranges from -400 to $+1550$ F. The resistance change over the operating interval of the instrument is 100 ohms. Outputs are up to 5 v without amplification. A 5-point resistance vs temperature calibration certificate is supplied with each transducer. Specifications include an accuracy of calibration of ± 1 per cent.

Trans-Sonics, Inc., Dept. ED, Burlington, Mass.

CIRCLE 109 ON READER-SERVICE CARD



TEST
INSTRUMENTS

for

LABORATORY/PRODUCTION

Measures Antenna Radiation Patterns



POLAR PATTERN RECORDING SYSTEM

AIL's Type 116R Polar Pattern recording system precisely records directional characteristics of electromagnetic, acoustic, thermal, atomic, and light radiation patterns. It traces, in polar coordinates, a continuous inked plot of input voltage vs angular position.

Precision performance is assured by low internal noise, high sensitivity, accurate turntable drive and exact pen response.

Available accessories include a new automatic relative power computer and a square root amplifier.

Write for details.



AIRBORNE
INSTRUMENTS
LABORATORY
INCORPORATED

1345 NEW YORK AVENUE
Huntington Station, L. I., N. Y.

CIRCLE 308 ON READER-SERVICE CARD

Cooling Units

Centrifugal blowers provide up to 1200 cfm



This series panel mounted centrifugal blowers provide from 600 to 1200 cfm of filtered air. Blowers mount in rack or cabinet as standard 8-3/4 x 19 in. panels. They measure 15 in. front-to-back exclusive of extensions. Radio interference requirements of MIL-I-16910A are met. Eight different models provide air discharge (through top, side, or rear outlets) to suit various applications.

Western Devices, Inc., Dept. ED, 600 W. Florence Ave., Inglewood, Calif.

CIRCLE 110 ON READER-SERVICE CARD

Quadrature Rejection Unit

Good operation at low temperature



Type SB-9505-04 hermetically sealed quadrature rejection unit can achieve 90 per cent or more of full speed when turned on at -60 C. The 22 rpm minimum speed at rated voltage will not vary more than ± 10 per cent over the entire operating range of -60 to $+80$ C. When properly excited the output will be an ascending saw tooth voltage. Motor voltage is 26 v, 400 cps, 2 phase. Motor input power is 3.2 w max per phase, potentiometer linearity, 1.5 per cent max.

John Oster Mfg. Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE 111 ON READER-SERVICE CARD

CIRCLE 112 ON READER-SERVICE CARD >

a Complete Line of...



MICROWAVE POWER SUPPLIES

- Important Voltages May Be Preset
- Important Voltages and Currents Are Metered
- Adjustable Current Overload Protection for Microwave Tube



Type Z817A

Type Z815B

Type Z819A

UNIVERSAL MICROWAVE POWER SUPPLY

Helix or Beam: 0-1800 V, 125 ma max., 1700-3500 V, 100 ma or 250 W max.

Collector: 0-300 V, 100 ma max.
Anode: 0-600 V, 60 ma max.

G-1: 0-300 V, 5 ma max.

G-2 or Reflector: 0 to ± 1200 , 1 ma max.

G-3: 0 to ± 750 , 1 ma max.

G-4: 0 to ± 500 , 1 ma max.

Regulation: 0.03%

Ripple: 3 MV max.

Heater: 0 to 15 V D.C., Regulated

Internal G-1 or G-2 Modulation: Square Wave, Pulse, Sawtooth, Sine Wave

UNIVERSAL KLYSTRON POWER SUPPLY

Beam: 200-2000 V, 125 ma max., 1800-3600 V, 100 ma or 250 W max.

Reflector: 0-1000 V

Control Grid: -300 to 0 to $+150$ V, 5 ma max.

Regulation: 0.03%

Ripple: 3 MV max.

Internal Reflector Modulation: Square Wave, Pulse, Sawtooth, Sine Wave

KLYSTRON POWER SUPPLY

Beam: 300-1000 V, 85 ma max.

Reflector: 0-900 V, 20 ma max.

Control Grid: -300 to 0 to $+150$ V, 5 ma max.

Regulation: 1%

Ripple: 7 MV max.

Internal Reflector Modulation: Square Wave, Pulse, Sawtooth

SEE THEM AT THE SHOW
Booth No. 3715-3717

Precision Microwave Equipment

F-R MACHINE WORKS, Inc.
WOODSIDE 77, N. Y. ASTORIA 8-2800

TEST
EQUIPMENT

RADAR
COMPONENTS

HIGH-POWER
MODULATORS

See the COMPLETE LINE of
FXR PRECISION MICROWAVE
TEST EQUIPMENT
at the I.R.E. SHOW

REPRESENTATIVES:

FLORIDA
GEORGIA
ALABAMA

J NEAL CO
1941 S W 33rd AVE
MIAMI FLA

WASHINGTON
OREGON

AMMCO
BOEING FIELD
KING CITY AIRPORT
SEATTLE 8 WASH.

WASHINGTON D. C.

A & M ASSOC.
1145 19th ST. N W
WASHINGTON D C

COLORADO
NEW MEXICO
UTAH
WYOMING

HYTRONIC
MEASUREMENTS INC
1295 S BANNOCK ST
DENVER 23. COLORADO

ILLINOIS
INDIANA
WISCONSIN

KADPELL SALES ASSOC
5875 N. LINCOLN ST
CHICAGO 45, ILLINOIS

CALIFORNIA
ARIZONA

VAN GROOS CO
21051 COSTANSO ST
WOODLAND HILLS, CALIF

EXPORT

SZUCS INT'L CORP
50 BROAD STREET
NEW YORK 4 N Y



NEW PRODUCTS

Silicon Rectifier Stacks

25 Amp, 245 V



Designed for high power rectification in a limited amount of space, these stack assemblies of silicon rectifiers have been made available. Illustrated is a single phase gull wave bridge assembly, rated at 25 amp average rectified current at an rms input of 245 v with forced air cooling, utilizing 2 x 2 in. fins. Over-all dimensions are 5 x 3 x 2 in. The assemblies have been successfully operated at ambient temperatures ranging from -50 to +165 C.

General Instrument Corp., Automatic Manufacturing Div., Dept. ED, 65 Gouverneur St., Newark 4, N.J.

CIRCLE 113 ON READER-SERVICE CARD

Silicon Rectifiers

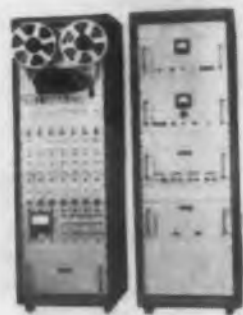
Current ratings to 750 ma



Featuring current ratings up to 750 ma, and voltage to 1000 v, the IN538, IN540, and IN547 are available as axial lead types. The forward conductance characteristics and low inverse current at high operating temperatures, make them useful for power supply, magnetic amplifier, and low frequency switching applications. The units are available for either 100 or 150 C operation.

Transitron Electronic Corp., Dept. ED, Wakefield, Mass.

CIRCLE 114 ON READER-SERVICE CARD



Recorder-Reproducer

14 Channel

Model TR-782 is a 14 channel two-speed data recorder-reproducer (7 track am and 7 track fm). The equipment is designed primarily for record-

INDUSTRY
Tung-Sol makes a wide range of tube types . . . tailored selenium rectifiers for diversified application throughout industrial and military electronic equipment.

Progress through increased service to the electronics industry! This spirit spearheaded Tung-Sol's dynamic growth over the years. Today, it shows in Tung-Sol's constant effort to diversify, to make new and better components. Underscoring Tung-Sol's steady diversification and product development, is rigid adherence to uniformly high standards of quality control. Tung-Sol has maintained these standards without compromise. They are your assurance of product performance . . . let you specify Tung-Sol, confident you specify the "best that can be made."

SEMICONDUCTORS
For reliability and long, efficient life of electronic equipment, specify Tung-Sol transistors! Eliminate interchangeability problems with the Tung-Sol JETEC 30 (TO-5 OUTLINE) package!

LAMPS
Neon glow and miniature incandescent lamps are two areas of Tung-Sol lamp leadership that dates from 1907 and development of the first successful electric automotive headlight.

ENTERTAINMENT

You can fill virtually every entertainment socket with Tung-Sol Blue Chip Quality tubes—cathode ray, series string, hybrid auto radio, TV, hi-fi and radio.

TUNG-SOL®

AT THE
IRE SHOW
BOOTHS
2833, 2835,
2837, 2839



AVIATION
Tung-Sol's hydrogen thyratrons and power supplies meet the aircraft industry's exacting demand for precision performance both in airborne and ground control.



TUNG-SOL ELECTRIC INC., NEWARK 4, NEW JERSEY

CIRCLE 115 ON READER-SERVICE CARD

ing and reproducing simultaneously dc to 100 kc information. One fm channel may be used for tape sync control and voice monitoring. The sync control unit, combined with the precision frequency controlled power supply permit the playback of recorded data to be reproduced at the exact rate of the recording.

Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N.Y.

CIRCLE 116 ON READER-SERVICE CARD

Regenerative Repeater High Reduction of Transient Noise



This regenerative telegraph repeater, model RTR-1, is a self-contained, one-way regenerative repeater designed for various teletypewriter speeds. Input circuits permit connection to telegraph lines grounded on either side of battery or floating. Transient noise spikes and signals distorted as much as 45 per cent are regenerated at the output with less than 5 per cent distortion. The unit occupies 3-1/2 in. of standard panel height. In conjunction with the telegraph repeater TR-2, the RTR-1, slightly modified, can be used in an electronic-hub system.

Stelma, Inc., Dept. ED, 190 Henry St., Stamford, Conn.

CIRCLE 117 ON READER-SERVICE CARD



Mag Amp Power Supply Remote Regulation

This transistorized power supply provides a fast response time to load changes, a reduced overshoot and undershoot of regulated voltages, and remote regulation at long distances.

It delivers a 27 V to 42 V output at 0 to 300 amp, regulated at the load. Surge capacity is 400 per cent overload for 2 sec. Regulation across the load is 1 per cent or better. Recovery time is less than 50 msec from initial load change. Overshoot and undershoot less than 25 per cent, with 30 per cent change in load. Ripple is 1 per cent of output voltage from no load to full load.

Packard-Bell Electronics, Dept. ED, 12333 West Olympic Blvd., Los Angeles 64, Calif.

CIRCLE 118 ON READER-SERVICE CARD

Now US

SEMCOR

assembles a Silicon Diode

ALL STAINLESS STEEL FUSITE TERMINAL



1.

Terminal as supplied by Fusite. V-24 glass and all stainless steel.



2.

Inside end of straight wire electrode is crimped to a hollow open top shell. (See photo A)



3.

Fraction of an inch of gold wire and aluminum wire are inserted and crimps folded over tight. (See photo B)



4.

Precision bit of silicon crystal is fused with heat to ends of wire inserts.



5.

Assembly is enclosed in miniature can and projection welded closed.



A



B

This application is typical of the hundreds of electronic components whose continuing operation is assured by the safety factor of a terminal with electrodes fused into the glass. The resulting rigidly fixed position of the electrode guards against damage to the finished assembly through movement of an electrode depending only on compression for its position in the glass.

Robert A. Rutherford, Vice President of U. S. Semiconductor Products, permits us this direct quotation.

"The Fusite header provides us with a very satisfactory solution to the problem of the lead wires turning in the header. The fused glass to steel has solved this very troublesome problem. The stainless steel material also provides excellent corrosion resistance. Aside from receiving a superior product from Fusite, we have also received very excellent service and a great deal of cooperation from both the company and their representative."

Test samples of any style terminal available on request. Stainless steel available on most Fusite Standard Headers.

Write Dept. C-2

THE FUSITE CORPORATION

6000 FERNVIEW AVE., CINCINNATI 13, OHIO

In Europe: FUSITE N.V. Königsweg 16, Aalen, Holland

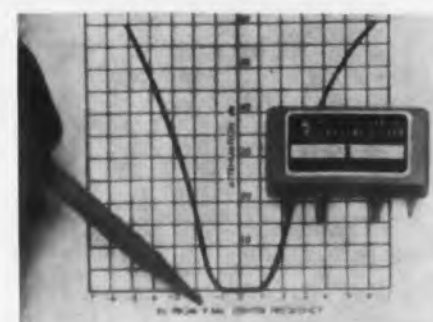
CIRCLE 119 ON READER-SERVICE CARD



NEW PRODUCTS

Crystal Filters

For Single Conversion Receivers



The model 9MA symmetrical bandpass crystal filter is designed for single conversion receivers used in mobile services. Specifications include a center frequency of 9 mc; passband ripple of less than $\pm 1/2$ db; bandwidth at 6 db attenuation of 3 kc; bandwidth at 60 db attenuation of 12 kc; insertion loss of less than 3 db; and impedance of 1 K nominal.

Hycon Eastern, Inc., Dept. ED, 75 Cambridge Pkwy., Cambridge 42, Mass.

CIRCLE 120 ON READER-SERVICE CARD



Frequency Converter

Portable 60 to 400 cps lab supply

Type PPS-101 converter takes 105-125 v 50/60 cps, and produces 115 v, 400 ± 0.5 cps. Voltage regulation is ± 5 v for full load and 10 per cent for no load. Load ratings are 100 va 3-phase and 70 va single-phase.

Eicor, Dept. ED, 4235 W. North Ave., Chicago 39, Ill.

CIRCLE 121 ON READER-SERVICE CARD



Servomotor

Features fast response to small signals

The fast response to minimum control signals of model 15 SM 460 servomotor is the result of a combination of low rotor inertial of 1 gm-cm² and a high stall torque of 1.45 oz-in. The torque-speed curve is linear from stall through no-load speed, demonstrating ideal viscous damping characteristics, particularly for small error signals. Teflon wire and insulating materials

enable the unit to operate continuously at total unit temperatures up to 200 C. The servomotor weighs 8 oz. Motor housing, shaft and ball bearings are stainless steel and all windings are fully encapsulated for protection against temperature, humidity and vibration

Beckman/Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 122 ON READER-SERVICE CARD

Spiral Harnessing

Wide overlap leaves no open joints



Although similar to the company's previously announced Spiral Wrap in many ways, Spiral Cover has the unique feature of overlapping itself 100 per cent forming a double cover over the wire and leaving no open joints. The insulating qualities are therefore almost equal to solid jacketing. Made only in non-inflammable Teflon, the wire harnessing has an 0.04-in. wall and is available in six different diameters from 1/4 in. to 1-1/2 in.

Illumitronic Engineering, Dept. ED, 680 E. Taylor, Sunnyvale, Calif.

CIRCLE 123 ON READER-SERVICE CARD

Terminal Blocks

Permit rapid, neat assembly



This terminal block is available for custom assembly or in factory assembled strips rated at 600 v ac or dc, 15, 25, and 50 amp ratings. Features include a snap in marking strip, and a snap on terminal block, both of which make modifications to a mounted terminal strip a fast operation. Standard 3/16 in. round cold rolled steel fits each molded piece and permits rapid assembly. All three current ratings can be assembled into one mounting strip.

Gemco Electric Co., Dept. ED, 25685 W. Eight Mile Rd., Detroit 40, Mich.

CIRCLE 124 ON READER-SERVICE CARD

New high-directivity bi-directional couplers

For continuous VSWR measurements

	GENERAL CHARACTERISTICS		
	Model 48 S-Band	Model 49 C-Band	Model 52 X-Band
Frequency Range (kmc)	2.60-3.95	3.95-6.00	8.2-12.4
Waveguide Type (AN)	RG-48 U	RG-49 U	RG-52 U
Waveguide Size	3" x 1 1/2"	2" x 1"	1" x 1/2"
Waveguide Flanges	UG-214 U	UG-149A U	UG-39 U
Weight	18 lbs	9.1 lbs	2 lbs
Dimensions	48 7/8" x 9 1/2" x 8 1/4"	31 1/2" x 7 1/2" x 5 1/2"	18 1/2" x 3 1/4" x 2 5/8"

Featuring two opposing couplers in a single waveguide unit, Sperry's new Microline® Bi-Directional Couplers provide complete coverage of waveguide frequency ranges. They are designed for VSWR measurements and continuous monitoring in combination with ratiometer, comparator, barretter mounts or other detectors.

Three models cover S, C and X bands, with uniform coupling (10db ± 0.5) and high directivity (40db) for accurate coupling calibration. If you'd like more information on the Sperry couplers shown here, write our Microwave Electronics Division for "latest data on directional couplers."

Visit our booths 1416-1422 at 1958 Radio Engineering Show, March 24-27.

MICROWAVE ELECTRONICS DIVISION

SPERRY *GYROSCOPE COMPANY*
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

BROOKLYN • CLEVELAND • NEW ORLEANS • LOS ANGELES • SEATTLE • SAN FRANCISCO. IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC



COAXIAL DIRECTIONAL COUPLERS

Used to monitor system power output and to provide local-oscillator or test-signal injection into receivers. Feature very low variation in coupling over 2-to-1 frequency range. Directivity is kept high by frequency-sensitive compensation.



BRANCH-GUIDE DIRECTIONAL COUPLERS

Serve as decoupling and isolating waveguide sections, with negligible effect on other system components. Offer high directivity and uniform coupling over full frequency range. Can be permanently installed in system transmission line.

CIRCLE 125 ON READER-SERVICE CARD



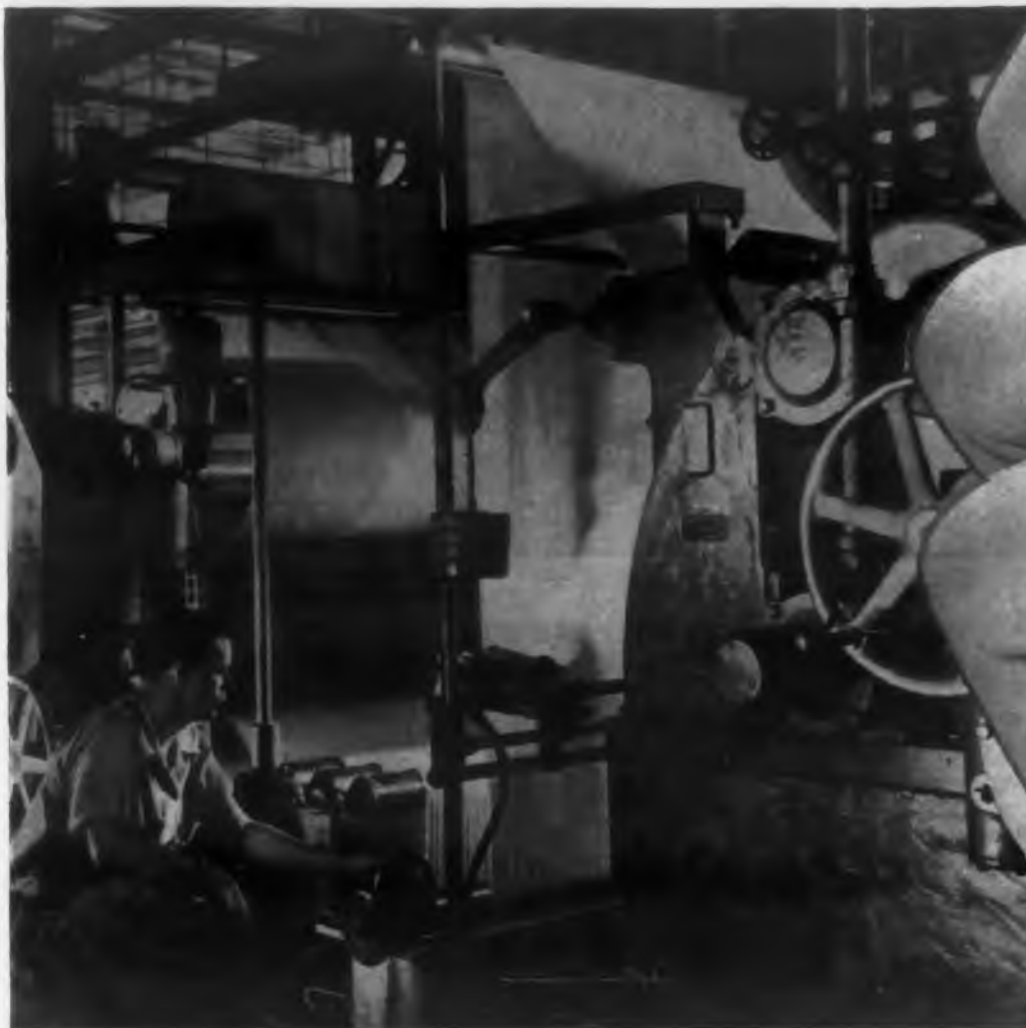
CROSS-GUIDE DIRECTIONAL COUPLERS

Designed to operate as space-saving one-way power monitors in waveguide transmission lines. For measuring power, VSWR and receiver sensitivity. Directivity is high and coupling is uniform over 40% frequency range.

THOMAS A.

EDISON

resistance temperature
detectors are
miniaturized for fast
response-sensitivity



The small dimensions of these temperature detectors give them their fast response characteristics. Minute temperature variations are registered within two seconds—a detection sensitivity which matches the performance of delicate laboratory thermocouples.

Edison research facilities have made possible the development of this and many other special purpose detectors to new engineering standards.

Designed to measure oil film temperatures, these units have been miniaturized to the point where they can be positioned in direct contact with bearing oil film in a wide variety of applications.

For complete information on Edison Resistance Temperature Detectors, write for Bulletin No. 3016.

Thomas A. Edison Industries INSTRUMENT DIVISION

55 LAKESIDE AVENUE, WEST ORANGE, N. J.

CIRCLE 126 ON READER-SERVICE CARD



NEW PRODUCTS



Environmental Test Chamber

Close humidity control
over wide range

Model SU-40-8-HC environmental test machine is adjustable from -50 to $+200$ F and will maintain a relative humidity of 95 per cent, ± 5 per cent between 80 and 160 F. The humidity element is supplied by a distilled water-air pressure reservoir, controlled by a solenoid valve. Clear working area is 24 in. high by 24 in. wide by 19 in. deep.

Cincinnati Sub-Zero Products, Dept. ED, 3932 Reading Rd., Cincinnati 29, Ohio.

CIRCLE 127 ON READER-SERVICE CARD



FHP Motors

Ratings up to 1/50 hp

A wide variety of fractional horsepower motors is available in ranges from 1 to 24 v and up to 1/50 hp. The motor shown is of the permanent magnet type; 1-6 v, 230-340 ma; 5000 rpm on 1-1/2 v.

Moen Trading Co., Dept. ED, 7 West 24th St., New York 10, N.Y.

CIRCLE 128 ON READER-SERVICE CARD



Power Supply

Silicon rectifier type supplies 32 v dc with 0.5 per cent ripple

Model KM93B silicon rectifier power supply with a continuous duty rating of 40 amp. Ripple is held to within 0.5 per cent throughout the range of the equipment. A safety factor allows for continuous operation at 125 per cent of rated current. Cooling is by convection. Voltage regulation from 1/10 load to full load does not exceed 12 percent at 32 v output.

Opad Electric Co., Dept. ED, 69 Murray St., New York 7, N.Y.

CIRCLE 129 ON READER-SERVICE CARD



DC Power Supplies

Two models offering 0.1 per cent regulation

Models RS-205 and RS-305 power supplies are of modular type mounting design, and are similar except for output voltage ranges. Outputs are 150-225 and 225-325 v dc, 50 ma for the respective models. Input is 105 to 125 v line with regulation is 0.1 per cent ripple and noise less than 7 mv peak to peak, and recovery time is less than 25 μ sec. Internal impedance is less than 1 ohm for both models.

Trans Electronics, Inc., Dept. ED, 7349 Canoga Ave., Canoga Park, Calif.

CIRCLE 130 ON READER-SERVICE CARD

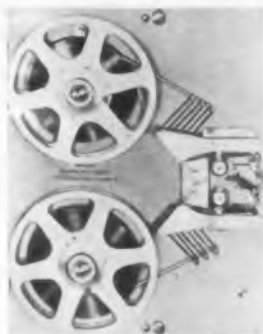
VHF Transmitter

Adjustable output from 10 to 50 w

Offering continuous operation in the 108 to 152 mc range, the 242F-5 transmitter features adjustable carrier output from 10 to 50 w. Linear power amplification is utilized to maintain low spurious output and to minimize intermodulation interference. Although a single channel transmitter, the unit offers additional service on up to four channels within a 500 kc spectrum as an optional feature. Over-all frequency stability is ± 0.005 per cent where standard CR-23/U crystals are used.

Collins Radio Co., Dept. ED, 855 35th St., N.W., Cedar Rapids, Iowa.

CIRCLE 131 ON READER-SERVICE CARD



Digital Tape Handler

Has fast stop time of 1.5 msec

Model 906 digital magnetic tape handler has ranges of four speeds forward and reverse, up to 150 in. per sec. The machine is capable of continuous cycling at any frequency from 0 to 200 cps without flutter. Start time is 3 msec and stop time is 1.5 msec. A vacuum loop device is used in the tensioning system to provide proper tape tension.

Potter Instrument Co., Inc., Dept. ED, Sunnyside Blvd., Plainview, Long Island, N.Y.

CIRCLE 132 ON READER-SERVICE CARD

NEWS ABOUT SILICON DEVICES



SILICON RECTIFIERS are finding increasing use at elevated temperatures in aircraft and missile applications by providing more power per pound.

Now...design improvements made possible with components of Du Pont Hyperpure Silicon

Today silicon rectifiers make possible a vast improvement in jet-age aircraft generators—the use of engine oil as a coolant instead of less-efficient ram air. Silicon rectifiers take the place of oil-sensitive brushes, commutator and slip rings... are completely unaffected by 150°C. engine oil. Result: a *brushless* generator of less weight and size than ordinary generators.

Silicon devices can similarly help you miniaturize—improve design and performance. Silicon rectifiers have excellent stability... can operate continuously at -65 to 200°C . They're up to 99% efficient—reverse leakages are only a fraction of those of other semiconductors. Both transistors and rectifiers of silicon can pack *more* capacity into *less* of your equipment space.

Note to device manufacturers: You can produce high-quality silicon transistors and rectifiers with Du Pont Hyperpure Silicon now available in three grades for maximum efficiency and ease of use... purity range of 3 to 11 atoms of boron per billion... available in 3 forms, needles, densified, cut-rod. Technical information is available on crystal growing from Du Pont... pioneer producer of semiconductor-grade silicon.



NEW BOOKLET ON DU PONT HYPERPURE SILICON

You'll find our new, illustrated booklet about Hyperpure Silicon helpful and interesting—it describes the manufacture, properties and uses of Du Pont Hyperpure Silicon. Just drop us a card for your copy. E. I. du Pont de Nemours & Co. (Inc.), Silicon N-2496-ED-3, Wilmington 98, Delaware.

CIRCLE 133 ON READER-SERVICE CARD

PIGMENTS DEPARTMENT



REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
... THROUGH CHEMISTRY

NEW PRODUCTS

Color Image Orthicon

Increased sensitivity permits reduced light levels



Type 7037 image orthicon for use in color TV cameras is stated to have more than twice the average sensitivity of previous tubes. Features include a higher effective sensitivity to red, green, and blue which permits reduction in lighting level or lens aperture, and a stabilized target which prevents picture sticking.

Radio Corporation of America, Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 471 ON READER-SERVICE CARD



Pulse Generator

Provides high power pulses from 28 v dc

Model 591-P pulse generator converts low-voltage dc to high-voltage dc or ac pulses. Operating from a 28 v dc line, the unit delivers a peak pulse power of 150 w at a 20 per cent duty cycle. Peak output voltage can be any value between 20 and 2000 v, with a rate of from 500 to 3000 pps. Rise and fall times are each approximately 100 μ sec. Amplitude and frequency of pulses are held within 2 per cent for variations in line input voltages from 24 to 30 v, and for load variations from half to full load.

Arnold Magnetics Corp., Dept. ED, 4613 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE 134 ON READER-SERVICE CARD



Pre-Set Counter

Designed for high speed counting and control

Model 4159 counter features high counting and recycling rates and has been designed for control of automatic operations. A panel switch-

SKY



WARRIOR WITH HIS F



T
h
n
c
s
i
d

t
t
t
F

c
t
s

3 FEET ON THE GROUND

The advent of complex jet warfare has created a new, highly respected type of engineer—the Hughes Field Engineer. Responsible for the modification and maintenance of complex Electronics Armament Systems and guided missiles, he keeps in the forefront of the newest electronics developments.

The Hughes Field Engineer, working with complete integrated systems, learns how each component contributes toward the working, fighting total. He is given the opportunity to work with electronics systems right where they prove themselves—in actual use.

The Hughes Field Engineer is the final link in a strong chain. The Research and Development Laboratories form the first link by initiating the basic designs for the new system. The Hughes manufacturing facilities produce the



Molten Ladle of silicon is watched during first step in the precise manufacture of Hughes semiconductors. Constant innovations in Research, Development and Manufacture have positioned Hughes Products as a commercial electronics leader.

Electronic Scanning Radar systems, a radically new concept in radar beam positioning, is currently being developed and manufactured by the Hughes Ground Systems Division.

Creating a new world with *ELECTRONICS*

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo,
Fullerton, Los Angeles, California
Tucson, Arizona

Visit our booths at the I.R.E. SHOW (Booths 2801-03-05) or visit the Hughes suite at the convention hotel.

CIRCLE 552 ON READER-SERVICE CARD

system, "building in reliability" with the most advanced techniques in testing. As the final link, the Field Engineer makes the system produce everything that was built into it.

The complete cycle of Research, Development, Manufacture, and Service is also evident in other Hughes activities. The commercial products activity performs all these phases in the areas of electron tubes, semiconductor devices, and industrial systems and controls. The Ground Systems Division performs all phases on protective radar systems. This diversity and wide scope of activity has made Hughes an ideal firm for present and prospective employees interested in career advancement.

Some of the highly rewarding positions now open include:

Computers	Solid State Physics
Microwaves	Semiconductor Sales
Reliability	Semiconductor Applications
Circuit Design	Systems Analysis

Write, briefly outlining your experience, to Mr. Phil N. Scheid, Hughes General Offices, Building 17 J, Culver City, California.



ing arrangement permits use either as a totalizing counter at rates up to 5000 counter per sec or as a pre-set counter adjustable from one to 9999 counts at rates up to 1000 counts per sec without error. An optional batch counter also totalizes batches at rates up to 600 per min. A rear panel test switch permits use of the instrument as a preset time interval generator adjustable to 1/60 sec increments for accurate cycle timing.

I-L-S Instrument Corp., Dept. ED, 4527 W. 160th St., Cleveland 11, Ohio.

CIRCLE 135 ON READER-SERVICE CARD

Microwave Regulator

Constant power source provides faster measurements



Model 301 microwave regulator is designed primarily for use with a traveling wave tube or in traveling wave tube manufacture. The unit serves as the connecting link for a 1 kc square wave modulated constant power source. The device itself operates at an audio frequency, and hence is completely independent of microwave power and frequency.

D. C. Broker Labs., Dept. ED, P. O. Box 967, Sunnyvale, Calif.

CIRCLE 136 ON READER-SERVICE CARD



Flight Simulator

Tests flight control system in three axes

Model 1806 flight simulator is capable of unlimited motion about any axis. Each gimbal is driven by a hydraulic servo system in response to signals from an analog computer. Synchros are used for error sensing in the closed servo loop, and a high gain amplifier drives a spool-type servo valve for hydraulic motor control. A maximum load can be accelerated up to 5 radians/sec² and a maximum velocity of 30 rpm may be attained with a velocity error of one per cent.

Aircraft Armaments, Inc., Dept. ED, Cockeysville, Md.

CIRCLE 137 ON READER-SERVICE CARD

NEW PRODUCTS



Pressure Gage

Records on 3-in. strip chart

Using a 3-in. strip chart for recording, these gages are offered in ranges from 0-3 psi up to 0-60 psi. Elements in various ranges are offered in Ni-Span C, beryllium copper, and phosphor bronze. The recording chassis is interchangeable. Several versions of the instrument are available for differing recording and indicating uses.

Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 138 ON READER-SERVICE CARD

Solenoid Valves

Plug-in units are ready-wired



This complete line of Speed King plug-in 1/4-in. 4-way control valves features fast, automatic connection of electrical circuits. Permanent wiring connections, made in the manifold or sub-base at the time of original machine assembly, need not be disturbed during in-service maintenance. The valves are designed for control of smaller devices, and are available in both single and double solenoid types.

Valvair Corp., Dept. ED, 454 Morgan Ave., Akron, Ohio.

CIRCLE 139 ON READER-SERVICE CARD

Printed Circuit Connectors

Available in one-piece construction



Printed circuit board receptacles in one-piece body construction are now available in either type GR and MFE mineral filled phenolic, MDG



A CONCEPT OF SCIENCE

Five years ago, The Martin Company conceived a unique undertaking in the field of pure science which grew out of a belief that our own and our country's resources in creative scientific research must be greatly enlarged and cultivated.

We believed that the country—and the Company—that concentrates on short-range material achievements, without a deep concern for the creative source of tomorrow's even greater achievements, will have no tomorrow.

It is now three years since that belief motivated management's action with the foundation of a program in pure research. Known as the Research Institute of Advanced Study, RIAS is now a substantial organization staffed by scientists who are working in many fields, including theoretical physics, biochemistry, metallurgy and mathematics, without short-range applied research requirements.

Today, the increasing appeals to industry and the nation for accelerated activities in basic research give the RIAS story a special significance. For creative research in pure science is the true life source of our technological security—the "seed bed" from which our national strength shall continue to grow.

MARTIN
BALTIMORE · DENVER · ORLANDO

diallyl phthalate or CFG general purpose phenolic. This board receptacle series has a new contact design to prevent board-to-contact damage. Standard terminations are solder eye, taper tab (AMP), solder dip and wire wrap, for either single- or double-sided board circuits. Minimum creep is 3/32 in., working volts are 550 ac, 770 dc; and test voltage is 1650 rms.

H. H. Buggie, Inc., Dept. ED, Box 817, Toledo 1, Ohio.

CIRCLE 140 ON READER-SERVICE CARD



Power Supply

Provides total receiver high voltage in mobile radio systems

A high-efficiency 25-w unit particularly suitable for existing two-way radio equipment has been developed with over 80 per cent efficiency. The supply can furnish total standby receiver high voltage, thereby decreasing the standby drain of a mobile unit's receiver section. Input voltage is 13.8 v dc nominal with a ± 20 per cent variation. Output voltage is 250 v dc ± 10 v at a 90 ma load.

Other specifications include a five per cent half to full load voltage regulation and a peak-to-peak ripple that does not exceed 0.1 per cent.

Allen B. DuMont Labs., Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N.J.

CIRCLE 141 ON READER-SERVICE CARD

Megohmmeter

Single range, easy-to-use meter



Model 500 self-calibrating megohmmeter measures from 10-10,000,000 megohms, and model 501 measures from 0.10-10,000 megohms. Basic features include six decades of resistance, logarithmic presentation with no scale compression. Accuracy is within 20 per cent of any reading. Test potentials of 8 v (model 500) and 1.5 v (model 501) are used.

Keithley Instruments, Inc., Dept. ED, 12415 Euclid Ave., Cleveland 6, Ohio.

CIRCLE 142 ON READER-SERVICE CARD

For brass and aluminum nuts...

you can't beat

Fischer
for

precision,
price and
delivery!



STANDARDS OR SPECIALS

... Fischer produces "turned" nuts to exacting specifications. Featuring uniform accuracy, these precision nuts save time in assembly operations.

RIGID QUALITY CONTROL

... is maintained throughout production and double-checked by final inspections.

MASS PRODUCTION FACILITIES...

... including unique high-speed machinery... assure prompt delivery and competitive prices.

FOR FULL DETAILS... and specifications on Fischer brass and aluminum nuts, send today for new CATALOG FS-1000.



there's no premium for precision at

Fischer
SPECIAL MFG. CO.



FISHER SPECIAL MFG. CO.
422 Morgan St., Cincinnati 7, Ohio
Please send me your new 20-page CATALOG FS-1000 describing Fischer precision nuts.

Name _____ Title _____
Company _____
Street _____
City _____ Zone _____ State _____

7880-PS

CIRCLE 143 ON READER-SERVICE CARD

NEW PRODUCTS

Delay Line

Has efficient use at 125 mc



Model V-215 has a practical operating frequency of 125 mc, a total delay of 50 μ sec, and impedance of 50 ohms. Designed for a continuous motor driven application, the unit is constructed with a printed circuit commutator-type switch having rhodium plated segments and a silver alloy wiper arm. Resolution is 1 part in 120. The delay line is also supplied as a manually operated unit and in other delays and impedances.

Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N.Y.

CIRCLE 144 ON READER-SERVICE CARD



Mag-Amp Power Supplies

Provide from 50 to 5000 amp

Known as Selenifiers, these magnetic amplifier controlled rectifiers provide regulation of 0.5 per cent with less than 1 per cent ripple factor in output. Output ratings are 22 to 32 v or higher; or 28 v constant with optional manual control. Units from 50 to 5000 amp can be furnished.

American Rectifier Corp., Dept. ED, 95 Lafayette St., New York, N.Y.

CIRCLE 145 ON READER-SERVICE CARD



Testing Bridge

Tests up to 99 circuits sequentially

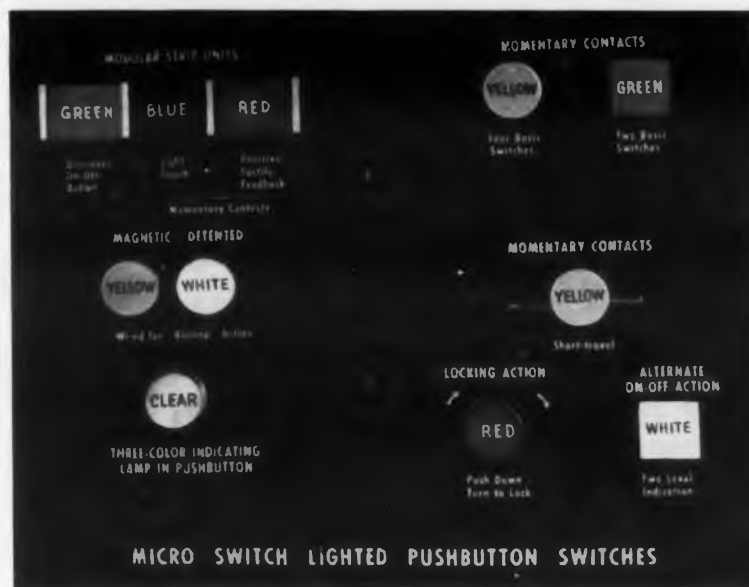
The CML 1020 Rotorbridge is an automatic, self-stepping comparison type bridge which will sequentially test up to a total of 99 circuits for continuity and resistance tolerance. It is designed



MICRO SWITCH Precision Switch

Highly Reliable MICRO SWITCH for Electronic Computer and

Here are six MICRO SWITCH Precision Switches, designed, produced and thoroughly tested for highly reliable performance in electronic computer consoles, aircraft instrument panels and other types of control panels. . . . The series "PB" illuminated pushbutton and the "AS" series of rotary selector switches typify the best in MICRO SWITCH design and the ultimate in MICRO SWITCH performance and reliability.



Eye Appeal and Positive "Feel" Within Minimum Panel Area

These are the Essentials in Console Design for Today and Tomorrow

Here are two of the many different designs available in Lighted Pushbutton Switches

The "50" series switch, shown at left, is a two position, alternate-action switch. The two level visual indication allows extra flexibility in complex control panels. The position of the button—up or down—indicates the condition of the circuit. An independent indicator lamp is free to give additional information, or it can be wired to go "on" and "off" with the switch.

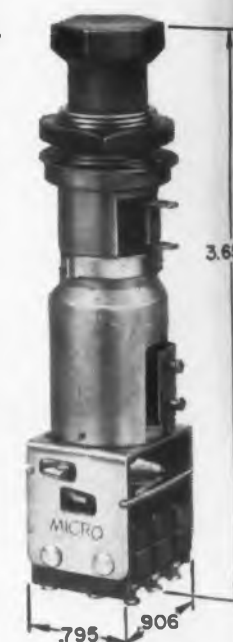
The "50" series switch, at right, is a unique magnetically held pushbutton. This extremely versatile switch combines multi-circuit switching, indicator light and d-c holding solenoid in one compact unit. When the button is pushed, the switch contacts are held actuated until electrically released. This permits one-by-one "bailing" operation with remote electrical release, allowing complete freedom of panel layout.

These switches are available with two, three or four SPDT contact structures. All lamp and button options may be used. They are rated at 5 amps., 125-250 vac. 3 amps., 30 vdc.

Request Data Sheet No. 133.



54PB67-T2
with 52PA5 Button

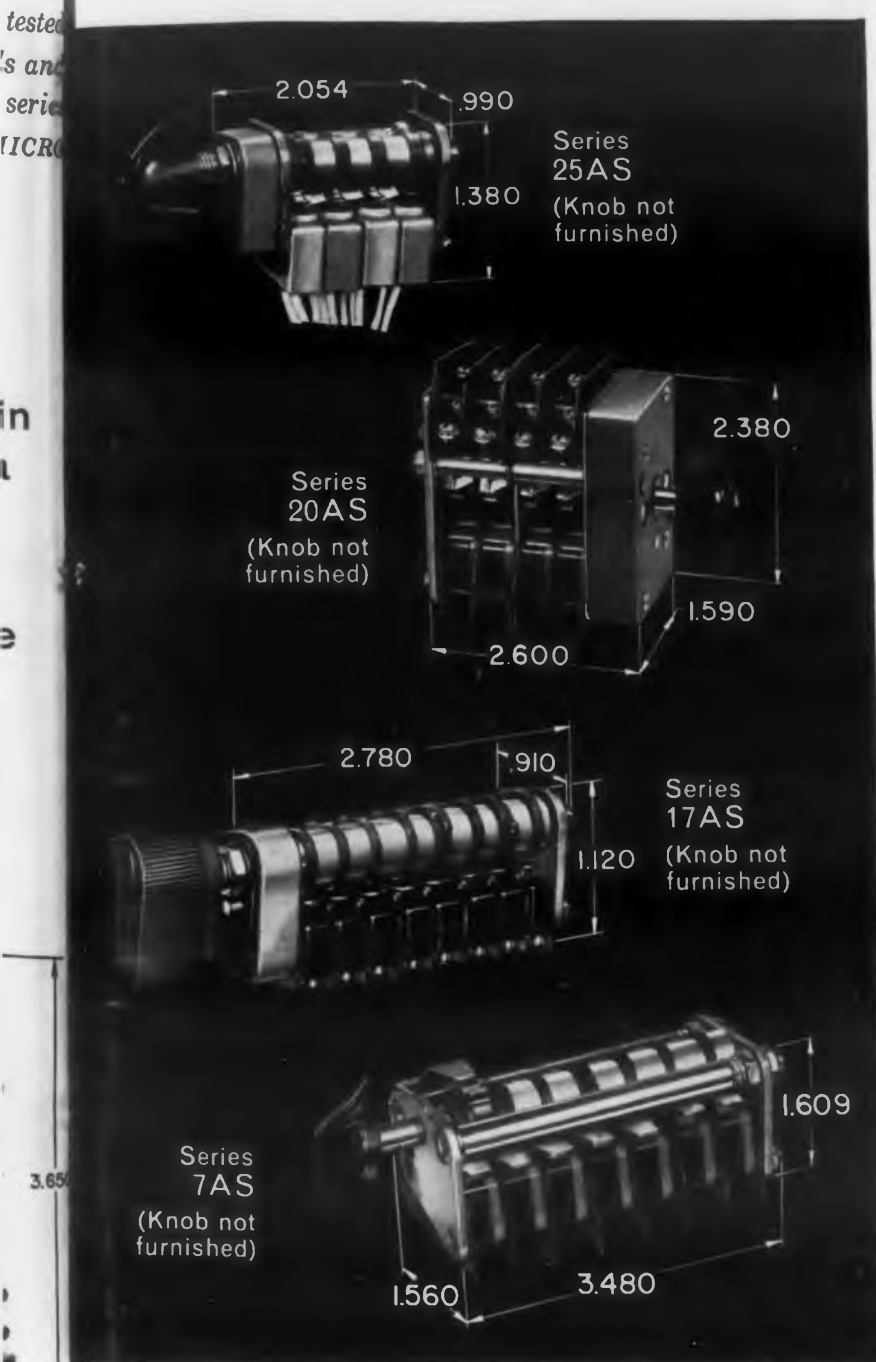


53PB8-T2
with 52PA8 Button

Switches have uses unlimited



MICRO SWITCH Precision Switches and Aircraft Instrument Panels



Smallest Rotary Selector Switch Assemblies Available ... Provide up to 20 Switching Units.

"25AS" series rotary selector switch assemblies are the smallest available with environment-proof sealed subminiature basic switching units. Assemblies are available with from two to eight SPDT sealed subminiature switches. Optional positive detent positions from 2 to 8. Rated 5 amps., 125-250 vac. 3 amps., 28 vdc.

"20AS" series rotary selector switch assemblies are extremely versatile. Available with 4 to 20 "V3" type switching units. They are compact, sturdily constructed, and highly reliable. Panel sealing and detent positions are optional. Rated 10 amps., 125-250 vac. 10 amps., 30 vdc.

"17AS" series rotary selector switches are small compact assemblies, available with up to ten SPDT subminiature basic switches. 45 degree angle detents are available in 2 to 8 positions. The use of these assemblies reduces instrument panel space. Rated 5 amps., 125-250 vac. 2½ amps., 30 vdc.

"7AS" series rotary selector switches are compact and sturdy assemblies of two to eight SPDT "V3" type switches, ideal for applications requiring multi-circuit control of 10 amp. circuits. Available in 2 to 8 detent positions. Rated 10 amps., 125-250 vac. 10 amps., 30 vdc.

For complete details on these assemblies ask for Data Sheet 86a.

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



First in Precision Switching

CIRCLE 146 ON READER-SERVICE CARD

for the production testing of errors in wiring, defective components and improper installation of components. The unit permits rapid change-over from the testing of one device to another. The bridge range is from 200 ohms to 2 meg with an accuracy of 10 per cent of the selected tolerance figure (ie: 10 per cent of 5, 10 or 20 per cent for instance) or from 47 ohms to 5 meg if an error of 12 per cent of the selected tolerance figure is acceptable.

Communication Measurements Lab., Inc., Dept. ED, 350 Leland Ave., Plainfield, N.J.

CIRCLE 147 ON READER-SERVICE CARD



Standard Cell Oven

Provides 0.05 C
regulation

The SCO-106 standard cell oven provides short-turn regulation of 0.01 C and long-term regulation of 0.05 C. The thermal resistance bridge permits measurement of enclosure temperature to 0.005 C. The enclosure provides space for 3 cells of the type used by the National Bureau of Standards. Enclosure volume measures 6-1/2 x 3 in. Heater supply is 24 to 28 v dc.

Julie Research Labs., Inc., Dept. ED, 556 W. 168 St., New York 32, N.Y.

CIRCLE 148 ON READER-SERVICE CARD

Ammeters

A thermocouple type withstanding large overloads



This line of thermocouple type rf ammeters is described as having thermocouple characteristics of unusual sensitivity. A double wire construction makes possible greater overload and less power consumption. Meters are ruggedized and conforming to specification MIL-M-10304. They are available for panel mounting in 1-1/2, 2-1/2, 3-1/2 and 4-1/2 in. diam in ranges up to 0 to 15 amp rf.

Sun Electric Corp., Meter Div., Dept. ED, Harlem and Avondale, Chicago 31, Ill.

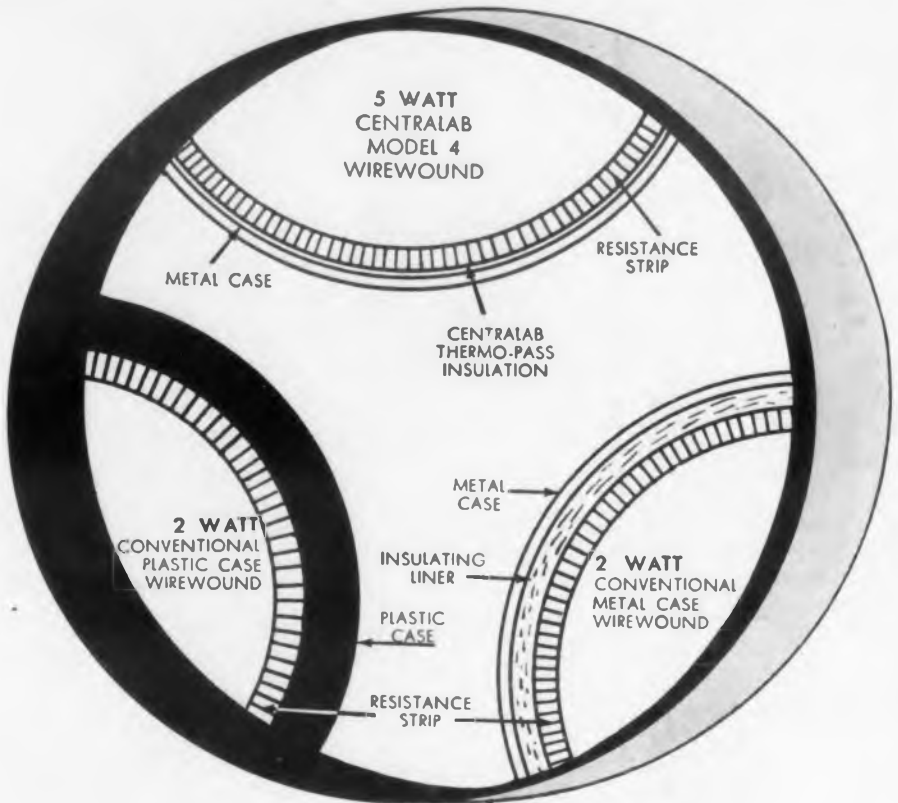
CIRCLE 149 ON READER-SERVICE CARD

The two-word name "MICRO SWITCH" is NOT a generic term. It is the name of a division of Minneapolis-Honeywell Regulator Company.

**5 watt capacity -
2 watt size**

Centralab MODEL 4

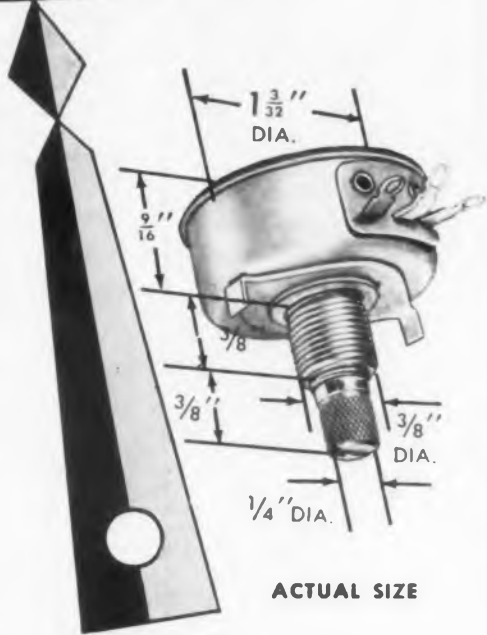
Miniature Wirewound Radiohms®



As you know, the rating and size of a variable resistor depends upon the speed with which heat can be transferred from the resistance element to the atmosphere. Centralab "thermo-pass" insulation combines exceptional heat transfer with a dielectric strength of 4500 volts per mil at 25° C. Result: Model 4 Radiohm, a conservatively rated 5 watt wirewound variable resistor smaller than a conventional 2 watt unit.

- Only 1 3/32" diameter by 9/16" deep.
- Resistance range, 1 ohm to 15K ohms; linear taper.
- 295° rotation, stop strength 15 inch pounds
- Minimum life, 25,000 complete cycles.
- Totally enclosed elements.

For detailed information write for Centralab Engineering Bulletin EP-493 or contact your Centralab sales representative. Ask your local distributor about the many values he carries in stock in the WW and WN series (listed in Catalog 30).



ACTUAL SIZE

Centralab®
B-5810

A DIVISION OF GLOBE-UNION, INC
960C E. KEEFE AVE. • MILWAUKEE 1, WIS.
In Canada: 804 Mt. Pleasant Rd. • Toronto, Ontario

VARIABLE RESISTORS • PACKAGED ELECTRONIC CIRCUITS • ELECTRONIC SWITCHES
CERAMIC CAPACITORS • ENGINEERED CERAMICS • SEMI-CONDUCTOR PRODUCTS
CIRCLE 150 ON READER-SERVICE CARD

NEW PRODUCTS



Dielectric Test Set

Supplies potentials called for in MIL-C-13294A

Type no. 50 breakdown tester is designed to furnish the potentials required for dielectric tests conducted under MIL-C-13294A. Output is 5 kw at 1000 v or 5000 v rms, and is continuously adjustable from zero to max by panel mounted control driving a variable auto-transformer, within the console. The test set operates from 220 v rms, 60 cps single phase. Voltage and current are simultaneously metered. The test set measures 22 in. deep, 24 in. wide, and 42 in. high and weighs approximately 400 lb.

Industrial Transformer Corp., Dept. ED, Gouldsboro, Pa.

CIRCLE 151 ON READER-SERVICE CARD



Limit Stop

20 lb-in. capacity

The NM-217 multi-turn limit stop is designed for direct mounting on an instrument gearbox in the manner of a Mark 8 servomotor. It is continuously adjustable from 0 to 50 turns, and has a torque capacity of 20 lb-in. The device is constructed to conform to applicable sections of MIL-E-5400.

Normac Tools and Engineering, Dept. ED, 7120 Canby, Reseda, Calif.

CIRCLE 152 ON READER-SERVICE CARD

Scaler-Ratemeter

Features plug-in units



Pulse amplifier or linear amplifier and single channel analyzer are available as plug-in units for the input section of the model PFA-100 scaler-



***CUSTOM BUILDERS AND DESIGNERS OF:**

CAVITIES

**MIXERS • DETECTOR MOUNTS
DUPLXERS • MULTIPLIERS
ROTARY JOINTS • BENDS
TWISTS • OTHER COMPLEX
COMPONENTS & ASSEMBLIES**

Application-engineered microwave parts and complex assemblies are our specialized field. We'll manufacture components to your prints ... or we will design and integrate them into your application.

You can depend on J-V-M for close coordination, guaranteed electrical performance and "know how" that is attested by innumerable assemblies ranging from dc. to 40,000 mc. now in industrial and military use.

FOR EXAMPLE:



1. Variable vane directional coupler ... sliding vane type ... high directivity—low VSWR.



2. Pre-selector-mixer ... S band ... 50 ohm input impedance ... high Q double-tuned ganged cavities ... detector output ... frequency stable from -55° to $+85^{\circ}$ C.

CUSTOM-ENGINEERED
MICROWAVE
PARTS

Get full information on J-V-M standard or custom-engineered microwave parts and components, also complex mechanical assemblies. Request catalog today.

J-V-M

J-V-M MICROWAVE COMPANY

4635 LAWNDALE AVENUE, LYONS, ILLINOIS
Phone: Lyons 3-7990—TWX: Lyons, Ill. 2796

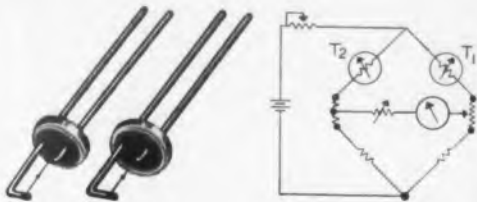
CIRCLE 153 ON READER-SERVICE CARD

Using Thermistors

Edited by
FENWAL ELECTRONICS

MATCHED THERMISTORS FOR GAS ANALYSIS

Now Fenwal Electronics offers resistance and voltage-current matched thermistor assemblies which are particularly useful for gas chromatography and other gas analyses.



The matched thermistor assemblies above are used in a balanced bridge circuit. One assembly is in each arm of the bridge and equal current is applied to each. The thermistors, self-heated by the passage of current, will dissipate heat at equal rates if the medium surrounding each thermistor is identical. The meter will show an equilibrium reading.

If the thermal conductivity of the gas surrounding either one of the thermistors should change, the rate of heat dissipation will also change, altering the resistance of the thermistor and unbalancing the bridge, thus causing a reading on the meter. The meter can, therefore, be calibrated to give an accurate indication of the percentage of a foreign element in the gas being analyzed, as related to a known reference gas.

It's all based on the unique characteristic of thermistors — when temperature rises, resistance falls. This relationship occurs whether the thermistor is self-heated, as in the example above, or externally heated through a liquid, gas or solid.

Write FENWAL ELECTRONICS, INC., 38 Mellen Street, Framingham, Mass., for complete information on matched thermistors (Bulletin EM-14), and for many other thermistor applications (Catalog EMC-1).



Design — Engineering — Production
of Precision Thermistors

CIRCLE 154 ON READER-SERVICE CARD

ratemeter. The counting unit can be either a high-speed decade scaler (either 100 kc or 1 mc) or a ratemeter with aural monitor. The instrument includes built-in timer, continuously variable voltage for probe with 1/2 per cent regulation, calibrator, and connection for 1 ma pen recorder.

Nuclear Electronics Corp., Dept. ED, 2632 W. Cumberland St., Philadelphia 32, Pa.

CIRCLE 155 ON READER-SERVICE CARD



Care Testers

Provides complete display of magnetic toroid characteristics

Model 123 core tester provides a display of coercive force, saturation flux density, $B_r:B_m$ ratio, differential permeability and shows the shape of the hysteresis loop. The display is made on an oscilloscope. This display permits a quick evaluation of basic core characteristics in relation to a specific circuit application. The test probe is a single solid rod which permits manual testing rate up to 400 cores per hr.

Mack Trucks, Electronics Div., Dept. ED, 40 Leon St., Boston 15, Mass.

CIRCLE 156 ON READER-SERVICE CARD



Pulsed Oscillator

A flexible source of high power in the uhf range

Model 105 Series of high-power tunable pulsed oscillators provides high peak powers for the laboratory testing of components and systems in the uhf range. The units provide peak power outputs of at least 75 kw for duty cycles up to 0.03. Model 105A tunes from 17 to 52 mc. Other basically similar models provide complete coverage from 10 to 120 mc. A 10 kv plate supply and grid pulser unit provides pulse rates variable from 100 to 400 pps with pulse widths from 10 to 100 μ sec.

Granger Associates, Dept. ED, 966 Commercial St., Palo Alto, Calif.

CIRCLE 157 ON READER-SERVICE CARD



rule out the bottleneck



You'll have time to pause and refresh if, unlike friend Sherman here, you've specified our Vibrotron Transducers for your flight testing. In case you're wondering, that's an F-106 Sherm is so ably piloting. We use it to illustrate that the people at Convair have found a way to simplify monitoring of *their* flight tests.

They mount two of our Vibrotron Absolute Pressure Transducers and matched amplifiers aft of the nose boom. One set measures total pressure, the other static pressure (altitude). As pressure variations occur, wire tension changes are fed into an FM/FM telemetering system. At the monitor, total pressure minus static pressure is *digitally* read out as airspeed. By this unquestionably advanced means, analog to digital conversion is bypassed, photo panel instrument hysteresis overcome, intelligence transmitted a good long way without accuracy drop.

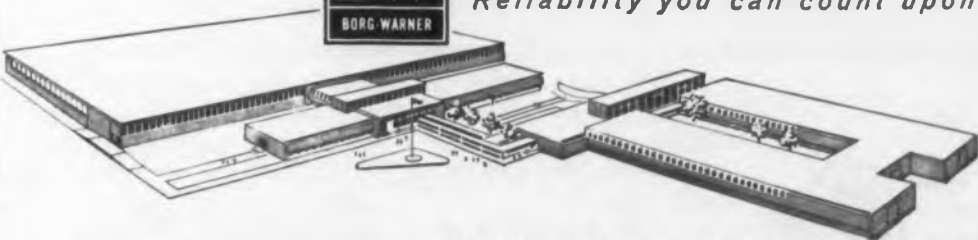
Whatever your remote sensing application, if direct digital data, miniaturization, accuracy and dependability are considerations, talk to us about Vibrotron® Transducers. Available in combinations of a wide range of pressures from 10 to 2000 psi, RDB Channels 8-14, temperature environment ranges from -65° to 350° F. General purpose, corrosion resistant and temperature controlled models are laboriously explained in current technical bulletins. Please write for yours.



BJ ELECTRONICS

BORG-WARNER CORPORATION

Reliability you can count upon



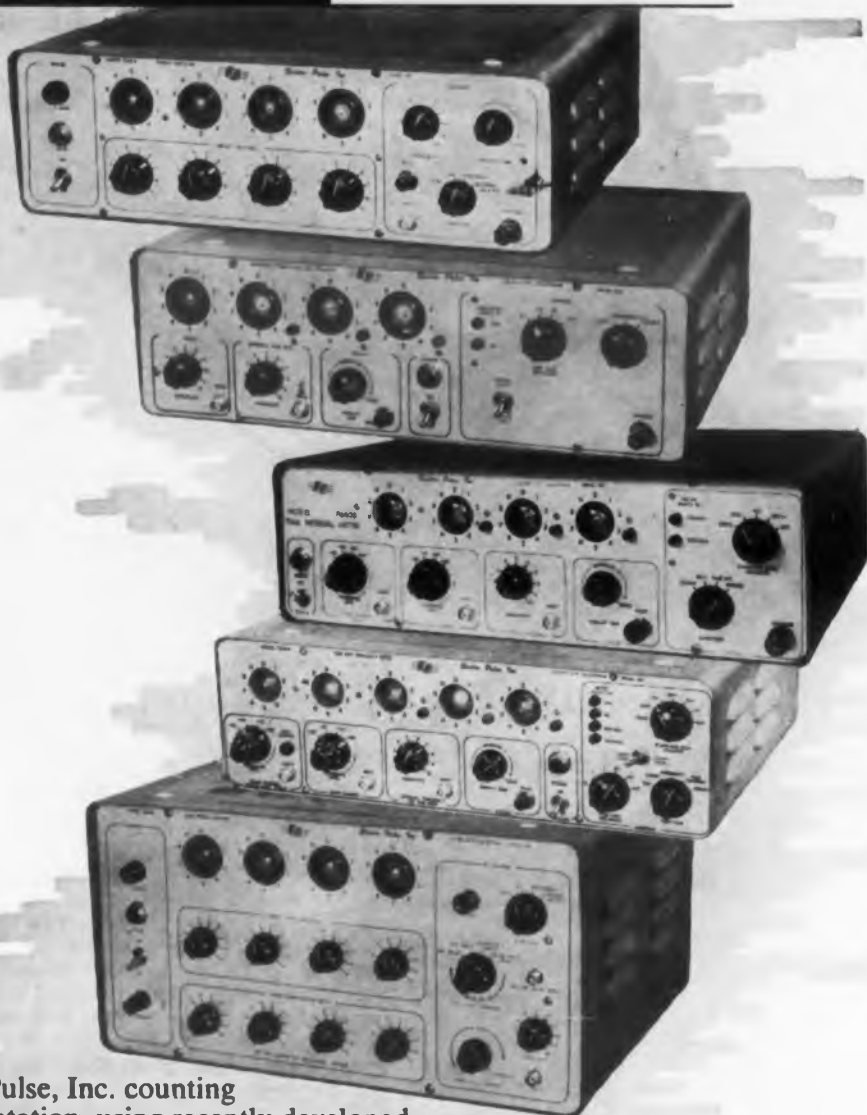
3300 NEWPORT BOULEVARD, P. O. BOX 1679, SANTA ANA, CALIFORNIA
 EXPORT SALES: BORG-WARNER INTERNATIONAL CORP., CHICAGO, ILLINOIS
 CIRCLE 158 ON READER-SERVICE CARD

a New Concept in

See our complete instrumentation
Display—IRE Show—BOOTH 3611-13

ELECTRONIC COUNTING EQUIPMENT

- Printed Wiring & Modular Construction
- Simplified Circuitry, Low Maintenance
- Self-testing, Self-indication
- Low Power Requirement
- Counter Tube Life: 10,000 hours
- Competitively Priced



Electro-Pulse, Inc. counting instrumentation, using recently developed self-indicating glow transfer tube counters, offers significant advantages in a wide range of measurement and control applications. Simplified circuitry and advanced design provide laboratory accuracy and industrial reliability.

Packaging features include snap-off top and bottom cabinet plates—for easy maintenance access and conversion to bench or relay rack mounting. Standard printed circuit modules utilized in this equipment may also readily be combined for OEM and other special test and control requirements.

Instruments available include single and dual preset counters, frequency indicators with and without print-out, time interval meters, totalizers, combination frequency and time interval indicators.

Contact local Representative for further information—or . . .

Write for Complete Data: Catalog IC-58/ED

Electro-Pulse, Inc. also offers a broad line of precision pulse instrumentation:

Pulse Generators, Time Delay Generators, Magnetic Core Testing Equipment, Pulse Code Generators, etc.

Write for Catalog 1P-58/ED

EP *Electro-Pulse, Inc.*

11861 TEALE ST., CULVER CITY, CALIF. • Phone: EXmont 8-6764 or TEXas 0-8006
CIRCLE 159 ON READER-SERVICE CARD

NEW PRODUCTS

Variable Autoformers

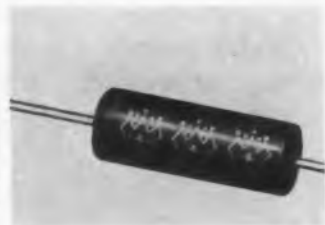
Explosion-proof types



Designed for controlling power line voltage in hazardous areas, these autoformers feature light-weight cast aluminum housings and compact construction. Model 6240 illustrated has a power input of 120 w, 60 cps and output of 0-140 v, 7.5 amps, 1 kva max. Weight is 29 lb. Other models with smaller capacities are also available.

I-L-S Instrument Corp., Dept. ED, 4543 160th St., Cleveland 11, Ohio.

CIRCLE 160 ON READER-SERVICE CARD



Film Resistors

Costs little more than carbon types

The primary feature of these film type resistors is given as low cost. Characteristics are stated, to be comparable to wirewound properties. Seven types are available: 1/2 w, 350 v; 1 w, 500 v; 2 w, 750 v. The 3, 4, 5, and 7 w units can be used at their full wattage ratings at 40 C ambient temperature.

Union Resistor Corp., Dept. ED, 1001 W Weed St., Chicago 22, Ill.

CIRCLE 161 ON READER-SERVICE CARD

Caution Switch

Lighted bar gives warning



A caution switch assembly with a lighted bar containing any desired warning nomenclature is available. The unit is lighted by three AN3140-



**GUDEBROD
BROTHERS
ARE
PIONEERS
IN FLAT
& BRAIDED
TAPES OF
NYLON,
DACRON,
TEFLON.
WAX-COATED,
FUNGUS-PROOF,
HEAT-RESISTANT.**

Gudebrod flat braided lacing tapes hold harness securely—no bite-through or slip, yet are easy on the hands. Some resist high temperature, some are color-coded . . . and they come wax-coated or wax-free . . . rubber-coated . . . or with special coating. Gudebrod makes many tapes for many purposes, including defense work. Send us your lacing problems or your specifications . . . we can supply the answer to both.

**GUDELACE • GUDE-NYLACE
GUDELACE H • TEFLACE**

GUDEBROD BROS. SILK CO., INC.

ELECTRONICS DIVISION

225 W. 34th St., New York 1, N. Y.

EXECUTIVE OFFICES

12 South 12th St., Philadelphia 7, Pa.

CIRCLE 162 ON READER-SERVICE CARD

For easily-installed, reliable line voltage regulation, use Sola



Five constant voltage transformer types answer most stabilizing needs

1. The AC Solavolt, as shown above, provides adjustable output from 0-130 volts ac, regulated within $\pm 1\%$, with less than 3% harmonic content. Ideal for testing, instrument calibration, lab work . . . any use where supply-voltage regulation and wave-form harmonic content are critical. For rack mount or bench use.



2. Standard*

Static-magnetic stabilizers for line voltage regulation. Output voltage is constant within $\pm 1\%$ with input variations up to $\pm 15\%$.



3. Harmonic-Free*

Line-voltage regulation $\pm 1\%$, with less than 3% harmonic content for conditions where harmonic-free voltages are required.



4. Plate-Filament*

Regulated $\pm 3\%$. Plate and filament windings are combined on a single, compact core for chassis mounting. Typical ratings.



5. Filament*

Regulated $\pm 1\%$, 6.3 volt output for operating large numbers of electron tube filaments. Stock units for outputs up to 25a.

*Stock or custom designs

Send for circular 31C, CVL-274.

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.



CIRCLE 163 ON READER-SERVICE CARD

327 lamps in parallel. Nomenclature is never visible unless the lamps are energized. Pressing the lighted strip actuates a switch inside the unit which can be used for re-setting in an annunciator system, or for any other desired control. The assembly has been qualified for extremes of vibration, shock, and temperature, and life of 50,000 operations.

Radar Relay, Inc., Dept. ED, 2120 Pontius St., Los Angeles 25, Calif.

CIRCLE 164 ON READER-SERVICE CARD

Microwave System Slide Rule

Simplifies communication calculations



Designed to simplify calculations used in planning a microwave communications system, this slide rule contains 28 scales and is used on both sides. One side is used to rapidly calculate propagation characteristics from 1000 mc to 30,000 mc. Included are Fresnel zone clearance, path loss, antenna and reflector gain, beam width and other path parameter needed for system design. On the reverse side are scales for multiplex calculations including signal-to-noise ratio, carrier loading and all other related factors for both fm and single sideband multiplex system performance calculation.

Motorola Communications and Electronics, Inc., Microwave & Industrial Control Dept., Dept. ED, 1400 N. Cicero Ave., Chicago 51, Ill.

CIRCLE 165 ON READER-SERVICE CARD



Reset Counter

Count is independent of input direction

Designed for speeds up to 1000 rpm or 1000 strokes per minute, these counters have capacities of 4 and 5 figures. A ratchet action is available which will record oscillations of the driveshaft through an arc as small as 45 deg.

The counter registers in one direction, regardless of the direction of driveshaft input. It may be obtained to add but not subtract or to subtract but not add.

Technicraft, Dept. ED, 6222 Ridge Ave., Philadelphia 28, Pa.

CIRCLE 166 ON READER-SERVICE CARD



**THE
ELEMENT
OF
GROWTH**

and the Circuit Design Engineer

Technical growth thrives when two basic conditions are combined: (1) a complex program that explores new areas of science and engineering and (2) engineers and scientists whose personalities demand that their work extend them to the utmost.

Both conditions exist at System Development Corporation. Now, with significant expansion in progress, several new positions for Circuit Design Engineers have been created.

To qualify, at least three years' experience in general circuitry design in both tubes and transistors is required. Experience should encompass areas such as video and pulse circuits, cathode ray tube displays and analog and/or digital computer techniques.

You are invited to write for more information or phone collect. Address R. W. Frost, System Development Corporation, 2432 Colorado Avenue, Santa Monica, Calif.; phone EXbrook 3-9411.

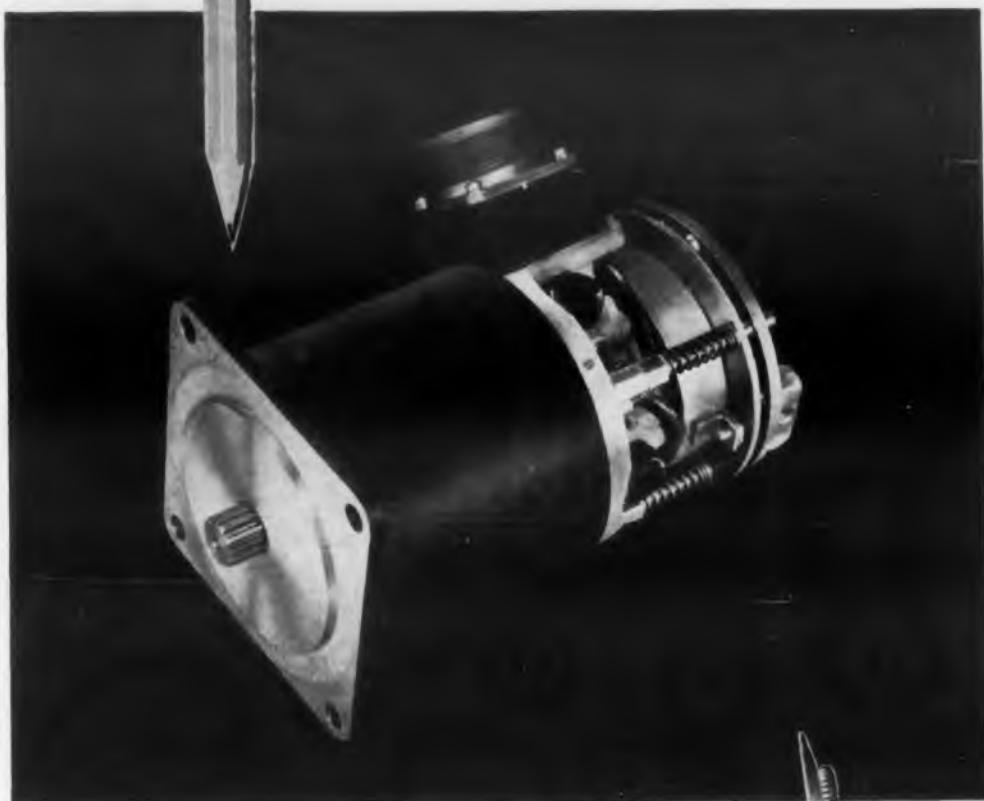
SYSTEM DEVELOPMENT CORPORATION

An independent nonprofit organization, formerly a division of the Rand Corporation

CIRCLE 553 ON READER-SERVICE CARD



DC MOTORS



**Elcor rotary electric
and electronic components**

precisely engineered to rigid government
specifications

produced in the widest range of output ratings
in the most compact sizes and weights

also manufactured for many commercial requirements

Inverters • Converters • Power Supplies • Generators
DC Motors • Dynamotors • Transistorized Power Supplies



EICOR

4233 WEST NORTH AVE., CHICAGO 39

Another F. L. Jacobs Division

CIRCLE 168 ON READER-SERVICE CARD

NEW PRODUCTS

Exciter-Demodulator

Supplies ac excitation and dc output in transducer circuits



Model 200 exciter-demodulator supplies current regulated ac excitation to a transducer, demodulates and filters the resulting signal and supplies a linear dc output signal proportional to transducer input. Direct operation is provided with standard strip chart recorders X-Y plotters and digitizing equipment. A magnetically regulated, tubeless circuit allows reliability for critical applications and freedom from drift. Model 200 is designed for operation with instruments having input impedances of 3000 ohms or greater. Model 200L is designed for 400 to 3000 ohm instruments.

Daytronic Corp., Dept. ED, 216 S. Main St., Dayton 2, Ohio.

CIRCLE 169 ON READER-SERVICE CARD



Magnetic Head Stacks

All-metal construction protects tape

Offered in a number of standard and special sizes, these magnetic head stacks present an all-metal surface to the magnetic tape, thus eliminating oxide and dirt deposits. Exceptional stability of all dimensions and track alignment has been achieved by eliminating plastics and resins as binding agents for aligning individual heads within the stack. Precision lapping, possible because of the all-metal design, provides long-time conformity of tape to heads. Head gaps are aligned to $\pm 50 \mu\text{in}$ and the line of gaps in each stack is perpendicular to the stack base plane within 0.02 deg. Heads for magnetic-drum applications are also available on special order.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 170 ON READER-SERVICE CARD

TAPPING SCREWS

MACHINE SCREWS
& NUTS

DRIVE SCREWS
STOVE BOLTS

CARRIAGE BOLTS
WOOD SCREWS

DOWEL SCREWS
HANGER BOLTS



IN FASTENERS
SOUTHERN IS

quality

If quality is an important element in your assembly operations, it will pay you to see how Southern Screw's Quality and Service has worked wonders for many industries. Southern Screws can do the same for you.

There are no better fasteners than USA-made Southern Screws. Over a billion in stock, available from our warehouses in New York, Chicago, Dallas and Los Angeles . . . Let us quote Southern quality screw prices on your requirements. Compare with the cost of conventional screws. Address: Southern Screw Company, P. O. Box 1360, Statesville, N.C.

Q-57



CIRCLE 171 ON READER-SERVICE CARD

at I.R.E. Booth 3515-3517

NOW AVAILABLE

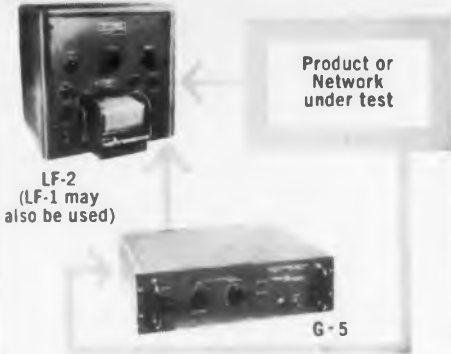
in the

SUBSONIC RANGE

0.5 - 2,250 cps

Panoramic's
unique

RESPONSE TRACING SYSTEM



for

- analyzing frequency response characteristics of
 - servo amplifiers
 - filters
 - acoustic reproducers
 - transformers
 - hearing aids
 - shaker tables
- locating resonant frequencies in mechanical structures

Serving as a frequency sweep source and synchronous selective indicator, the G-5 and LF-2 or LF-1 form a frequency response tracing system in the SUBSONIC range . . . are invaluable in testing networks and devices which tend to produce distortion products, where hum and noise are present, or where measurements through large dynamic ranges are necessary.

Shows single line response to fundamental frequency only, discriminates against noise and hum, has virtually unlimited dynamic range. 3 sweep widths which may be centered at any point in the range from 0.5—2000 cps. Scan rate of 10 sec., 2 mins. or 16 mins. Analyzer I. F. bandwidth variable from 0.25 to 12 cps.

Write, wire, phone TODAY for more information or help on your specific problem.

Send for our new CATALOG DIGEST and ask to

be put on the mailing list for The PANORAMIC ANALYZER featuring application data.



PANORAMIC RADIO PRODUCTS, Inc.
524 So. Fulton Ave., Mount Vernon, N. Y.
Phone: OWens 9-4600
Cables: Panoramic, Mount Vernon, N. Y. State

CIRCLE 172 ON READER-SERVICE CARD

DENSITY PROBE.—The P-625 measures the density of liquids wherever liquid processing of any kind is involved. The unit will indicate liquid density change of 0.01 gram per cc in about one second.

General Communication Co., Dept. ED, 681 Beacon St., Boston 15, Mass.

IRE Booth No. 3063

CIRCLE 173 ON READER-SERVICE CARD

R-F CONNECTORS.—Added to the Company's line of Subminax components, these connectors have a nominal impedance of 50 ohms, and are for use with miniature RG-196/U Teflon coaxial cable.

Amphenol Electronics Corp., Dept. ED, 1830 S. 54 Ave., Chicago 50, Ill.

CIRCLE 174 ON READER-SERVICE CARD

MICROMETER HEADS.—Micrometer heads for wave-meters and other electronic equipment requiring micrometric adjustment are available to meet exact specifications as to length, head diameter, range, graduation, finish, or material.

L. S. Starrett Co., Dept. ED, Athol, Mass.

CIRCLE 175 ON READER-SERVICE CARD

ALARM-CONTROL UNIT.—Additional alarm sequences are being offered with the Electro-Pane annunciator. Mercury switches combined with mechanical tripping latch action allow alarm units to be used directly for control.

Electro Devices, Inc., Dept. ED, 116 S. Michigan Ave., Chicago 3, Ill.

CIRCLE 176 ON READER-SERVICE CARD

POWER TRANSISTORS.—Germanium types electrically matched to provide low distortion in audio and servo applications requiring push-pull amplification. Designated 2N399 and 2N401, and rated 8 w undistorted Class B push-pull output, each unit can dissipate to 25 w.

Bendix Aviation Corp., Dept. ED, Long Branch, N.J.

CIRCLE 177 ON READER-SERVICE CARD

SOCKET SCREWS.—A complete range of self-locking screws in all diameters from microsize no. 0 to 1-1/2 in. fasteners supplement the self-locking hexagon head screws introduced by the company last year. The socket screws are made self-locking by a nylon pellet inserted in the threaded section of the screws.

The Cleveland Cap Screw Co., Dept. ED, 4444 Lee Rd., Cleveland 28, Ohio.

CIRCLE 178 ON READER-SERVICE CARD

SEARCH RADAR SIMULATOR.—May be used in place of an operational radar to supply inputs to tracking devices and other data processors. Effects of antenna radiation pattern, target scintillation, and receiver thermal noise may be simulated with validity.

Federal Scientific Corp., Dept. ED, 615 W. 131st Street, New York 27, N.Y.

CIRCLE 179 ON READER-SERVICE CARD

See us at Booth 2237
Radio Engineering Show
New York Coliseum
March 24-27, 1958



DIEHL*

**SIZE 11 RESOLVER
REACHES NEW STANDARD
OF ACCURACY**

0.03% TOTAL FUNCTIONAL ERROR

Missile guidance today requires more accurate Function Generators, Data Transmitters and Phase Shifters.

The DIEHL Size 11 Resolver is an answer to these problems.

DIEHL engineering and exceptional manufacturing methods insure a *uniformity* of product with a great percentage of the total production well within the 0.03% Total Functional Error. DIEHL defines percentage of Total Functional Error (T.F.E.) as: theoretical sine minus Actual Reading divided by sine 90° multiplied by 100.

A recent statistical check of one standard DIEHL resolver shows:

- 74% with T.F.E. less than 0.020%
- 22% with T.F.E. from 0.020% to 0.025%
- 4% with T.F.E. from 0.025% to 0.03%

This kind of quality eliminates the risk of culling special units from regular production.

All DIEHL standard units are available within 10 days. We invite your inquiries.



*** DIEHL MANUFACTURING COMPANY**
Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, SOMERVILLE, N. J.

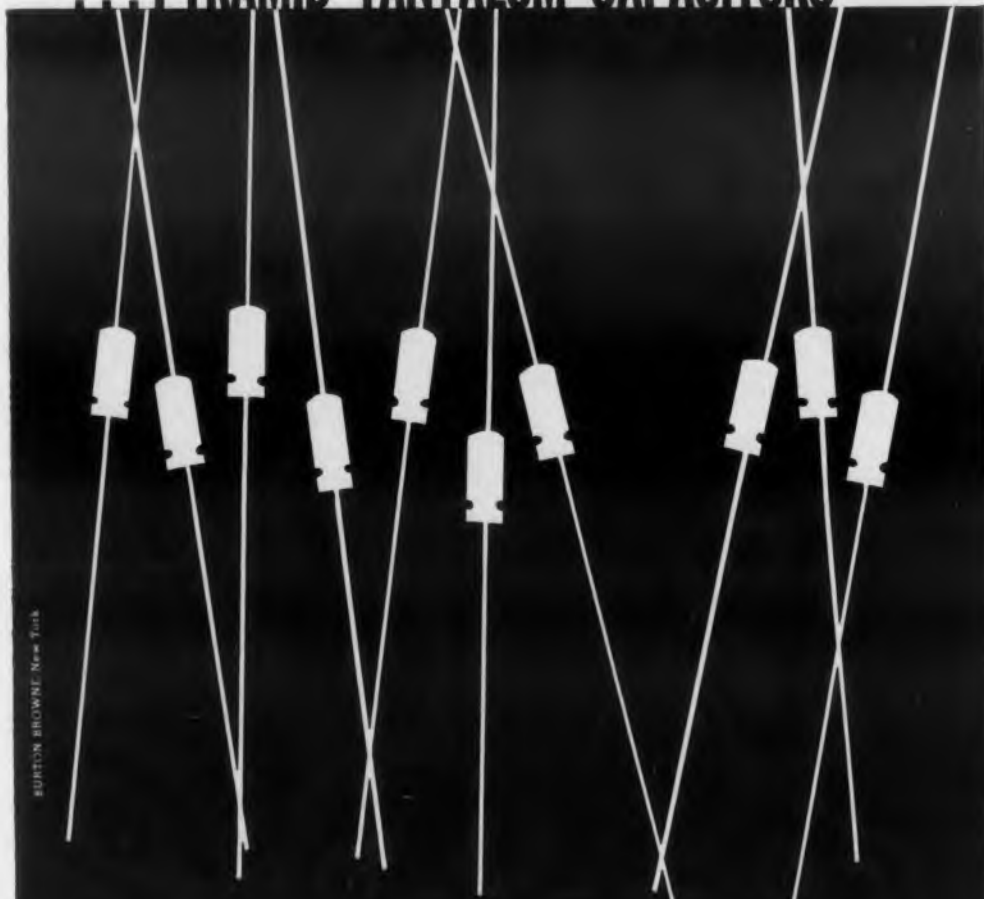
Other available components:
A.C. SERVOMOTORS • A.C. SERVOMOTORS WITH A.C. TACHOMETERS
A.C. SERVOMOTORS WITH D.C. TACHOMETERS • A.C. AND D.C. TACHOMETERS
D.C. SERVO SETS • RESOLVERS

* A Trademark of DIEHL MANUFACTURING COMPANY

CIRCLE 180 ON READER-SERVICE CARD

UP TO 1000 MFD-VOLTS IN LESS THAN 2/100 OF A CUBIC INCH

... PYRAMID TANTALUM CAPACITORS



BURTON BROWNE, New York

Pyramid Tantalum slug capacitors are miniaturized to provide maximum space economy.

New Pyramid Tantalum slug capacitors have cylindrical cases and contain a non-corrosive electrolyte. Due to the special construction of materials used in the manufacture of Pyramid Tantalum slug capacitors, these units are both seep and vibration proof. In addition, this type of capacitor assures long service life and corrosion resistance — made to meet MIL-C-3965 Specifications.

Commercially available immediately, these new Pyramid Tantalum capacitor units have an operating range between -55°C to 100°C for most units without any de-rating at the higher temperature.

To obtain complete engineering data and prices for Pyramid Tantalum slug capacitors, write to: Pyramid Research and Development Dept., Pyramid Electric Company, 1445 Hudson Boulevard, North Bergen, New Jersey.

CAPACITORS — RECTIFIERS
FOR ORIGINAL EQUIPMENT —
FOR REPLACEMENT

PYRAMID
ELECTRIC COMPANY

NORTH BERGEN, N. J.



CIRCLE 181 ON READER-SERVICE CARD

NEW PRODUCTS

CONNECTORS.—Four no. 12 size contacts, each carrying 40 amp have been arranged in a 19-pin shell. Designation is DM9700-194 and DM9601-194.

The Deutsch Co., Dept. ED, 7000 Avalon Blvd., Los Angeles, Calif.

CIRCLE 182 ON READER-SERVICE CARD

SWEEP GENERATORS.—The line of Transitron signal and sweep generators is now available for mounting on standard size racks. Included are the SG-161 (900-2100 mc), SG-132 (15-400 mc), SG-109 (400-1000 mc), and the SG-153 (1800-4000 mc) types.

Van Norman Industries, Inc., Electronic Div., Dept. ED, 186 Granite St., Manchester, N.H.

CIRCLE 183 ON READER-SERVICE CARD

WATER LOAD.—Rated to dissipate 75 kw, type 517 load is available for 50, 75 or 230 ohms impedance on any specified frequency within the range of 3000 kc to 3000 kc.

Continental Electronics Mfg. Co., Dept. ED, 4212 S. Buckner Blvd., Dallas 27, Texas.

CIRCLE 184 ON READER-SERVICE CARD

PACKAGING.—Sus-Rap is a preformed fibre board wrap-around material designed to block, space, and cushion fragile products. The manufacturer also offers design facilities to provide custom packaging.

Vanant Co., Inc., Dept. ED, 952 S. Water St., Milwaukee 4, Wis.

CIRCLE 185 ON READER-SERVICE CARD

3-WAY VALVE.—Second in a series produced by Eckel, type BF42C weighs three ounces and provides inherent minimum internal leakage. Power consumption is 9 w at 28 v dc.

Eckel Valve Co., Dept. ED, 1425 First St., San Fernando, Calif.

CIRCLE 186 ON READER-SERVICE CARD

POWER SUPPLY.—A low-voltage type has been added to the Nelson line for purposes such as production testing of semi-conductor products. Output is 1.5 to 15 v, 0 to 1 amp with 0.5 per cent ripple and regulation.

Nelson Instrument Co., Dept. ED, 607 Howard St., Evanston, Ill.

CIRCLE 187 ON READER-SERVICE CARD

SOLENOIDS.—Type C-8 measures 5/8 x 3/4 x 1-1/4 in. and is available for ac-dc service. Type C-8 is a miniature version for lower force requirements.

Anderson Controls, Inc., Dept. ED, 2777 Mannheim Rd., Des Plaines, Ill.

CIRCLE 188 ON READER-SERVICE CARD

INSTRUMENT CABINETS.—Counter-height equipment cabinets have been designed for instrumentation purposes where operators are required to be on the move or standing. The enclosures can be mounted on casters for mobility.

Elgin Metalformers Corp., Dept. ED, 630 Congdon Ave., Elgin, Ill.

CIRCLE 189 ON READER-SERVICE CARD



True Hermetic Sealing.

GASEAL®
Pressurized metal hermetic seals for easy installation anywhere without special tools. Withstand more than 850 degrees F., high pressures and altitudes. For any sealing configuration.

Best Insurance for Component and Systems Reliability!

Corrosion...dust...fungus...altitude...humidity...pressures. *True* hermetic sealing completely eliminates their usually disastrous effects on electronic and mechanical apparatus.

GHS offers uniquely qualified techniques and specially developed facilities in the field of hermetic sealing. They are guaranteed to add a *permanent plus* to your product reliability.

For inert gas filling, 100% mass spectrometer leak testing of any assembly, and every phase of *true* hermetic sealing to meet military or industrial specs, GHS in-plant services are unequalled.

The GHS Megpot®



Quickly, efficiently tests your components, insulation. Features 10 million megohms, 100, 200 or 500V DC, automatic "charge" and safety controls, non-destructive (as high as 5000V AC) high-potential test set with current limiting and automatic shut-off circuit. Portable.

Write for Specific Information... and use the GHS Advisory Services without obligation.



**GENERAL
HERMETIC
SEALING**

ELECTRONICS FOR
LAND, SEA AND SPACE CORPORATION

Valley Stream, N. Y. • VALLEY STREAM 5-6363

CIRCLE 190 ON READER-SERVICE CARD

THIS IS ZIPPERTUBING

... a method of making custom
electronic cables in seconds...
at a fraction of the cost!



MEETS
MIL
SPECS.

Now available in Vinyl, New Stretch
Vinyl, Teflon, Nylon, Mylar, Neoprene.

Major Advantages

1. Cables are made by you, on the spot, as needed, without machinery. Production delays eliminated.
2. New stretch compound provides tighter jacketing.
3. Highly abrasion-resistant. Temperature range, -90°F to 450°F .
4. Eliminates expensive lacing or tying of conductors.
5. Provides re-accessibility to conductors, or can be permanently sealed.
6. New method permits cable termination with any type of connector.
7. Sizes from $\frac{1}{4}$ " ID — continuous lengths to 1000 ft.
8. New metal laminations for shielded or co-axial cable construction.
9. Perforated type or molded "Ys" and "Ts" simplify branchouts.

Important

If you design or work with electronic cables, it will pay you to try ZIPPERTUBING. Field representatives are nearby — or send for free sample and technical literature.

Offices & Warehouses in All Principal Cities

THE ZIPPERTUBING CO.

752 So. San Pedro St • Los Angeles 14, Calif.

TWX LA 840

CIRCLE 191 ON READER-SERVICE CARD

CAPACITANCE PROBE TESTER.—The MD-2A measures electrostatic capacitance and electrical insulation resistance directly. Capacitance range is from 0 to 5000 μf . Accuracy of the unit is 0.25 per cent of full scale.

Consolidated Airborne Systems, Inc., Dept. ED, 321 Willis Ave., Mineola, N.Y.

CIRCLE 192 ON READER-SERVICE CARD

GLASS-ENCLOSED CRYSTALS.—Similar to type RH-8DP released last year, the RHG-DP has an increased frequency range from 1 to 15 kc. Components are hermetically sealed in glass bulbs (T5 1/2 with noval base). Temperature range is -55 to 100°C with a stability of ± 0.02 per cent.

Dynamics Corp. of America, Reeves-Hoffman Div., Dept. ED, Carlisle, Pa.

CIRCLE 193 ON READER-SERVICE CARD

TRANSISTORS.—Three types added to the Philco line include type 2N534, a 50-v version of the basic low level audio transistor; type 2N535 for 85 C operation with 20-v collector voltage rating; and type 2N536 for switching applications.

Philco Corp., Dept. ED, 4700 Wissahickon Ave., Philadelphia 44, Pa.

CIRCLE 194 ON READER-SERVICE CARD

DOUBLE-ENDED CRYSTAL DIODES.—Eliminating the need to specify reverse diodes, these units are designated 1N416B, C, D, and E for 1N21 types, and 1N415B, C, D, and E for the 1N23 series.

Sylvania Electric Products, Inc., Dept. ED, Woburn, Mass.

CIRCLE 195 ON READER-SERVICE CARD

CAPPED CLINCH NUTS.—Self-locking type LHC-FKM has an integral metal cap to prevent potting compound from flowing inside the nut threads when used inside miniature transformers.

Elastic Stop Nut Corporation of America, Dept. ED, 2330 Vaux Hill Rd., Union, N.J.

CIRCLE 196 ON READER-SERVICE CARD

THERMOSTAT.—For use in ranges up to 700 F, this unit has three separate heating phases, one of which is on continuously when desired. Two other phases are controlled thermostatically.

Robertshaw-Fulton Controls Co., Thermostat Div., Dept. ED, Youngwood, Pa.

CIRCLE 197 ON READER-SERVICE CARD

MIXER CRYSTAL.—The MA-423A, for C and X bands requires no dc bias. It is mechanically interchangeable with the 1N23 series but provides improved receiver noise figures of 7 db or better when used with a 1.5 db r-f strip at 30 mc.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.

CIRCLE 198 ON READER-SERVICE CARD

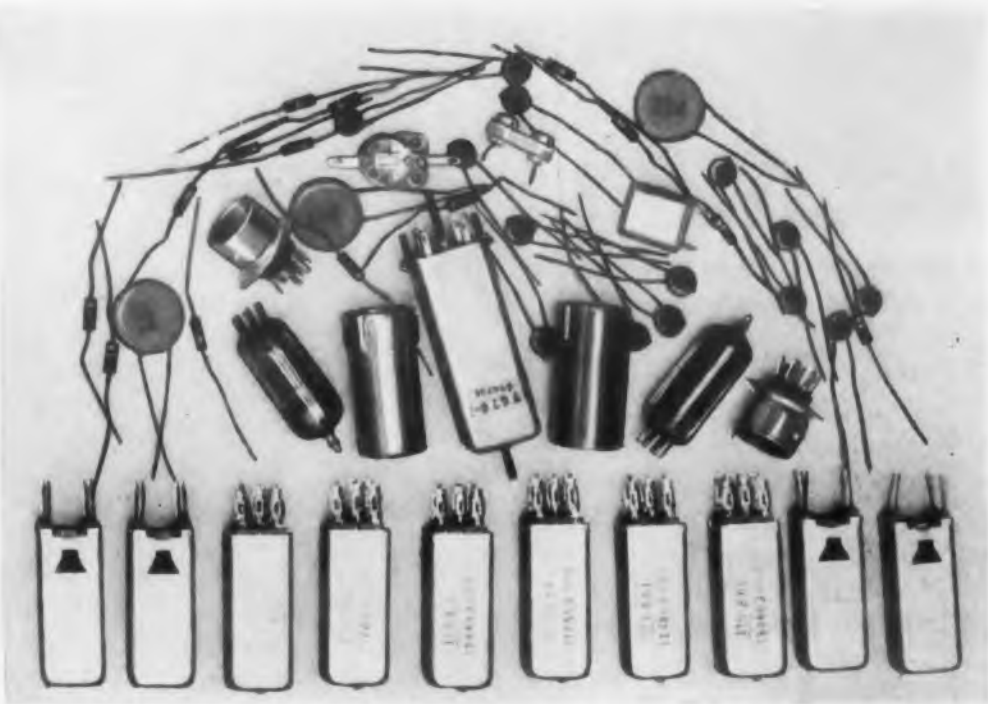
PUMP AND MOTOR.—Model 1203-152D is a pump and motor combination designed to supply oil under pressure to hydraulic actuators on the ground-based radar antennae. The equipment features three-phase thermal protection with automatic reset.

Eastern Industries, Inc., Dept. ED, Hamden, Conn.

CIRCLE 199 ON READER-SERVICE CARD

CRYSTAL FILTERS

NOW YOU CAN REPLACE ALL OF THESE COMPONENTS



Shown approx. 1/3 size

WITH A SINGLE HYCON EASTERN CRYSTAL FILTER



Shown approx. 1/3 size

IRE SHOW
Booth Nos.
3038 & 3039

**AND REDUCE WEIGHT, SAVE SPACE,
IMPROVE PERFORMANCE AND RELIABILITY**

It will pay you to investigate how this unique component can improve performance and reduce costs of your communications equipment. Hycon Crystal Filters make possible single conversions in AM and FM receivers while retaining the important advantages of double and triple conversions. These units permit excellent reception in the presence of strong jamming or interfering signals. Center frequencies are accurate to .001%. Insertion loss is 1/10 of other filtering methods. Aircraft and guided missile environmental requirements are exceeded. Write for Crystal Filter Bulletin.



HYCON EASTERN, INC.

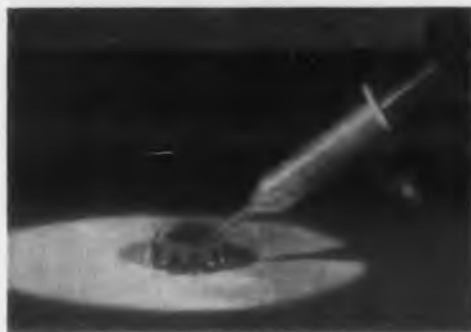
75 Cambridge Parkway Dept. B, Cambridge 42, Mass.

CIRCLE 200 ON READER-SERVICE CARD

NEW MATERIALS

Disposable Syringes

For applying potting compounds



The Helix disposable syringe, made of molded polyethylene, can be used for applying bonding agents and potting compounds easily and quickly. Each syringe has a tapered tip so that orifice diameters may be enlarged by cutting back the tip. Also available with steel hollow needle tips.

Carl H. Biggs Co., Inc., Dept. ED, 2255 Barry Ave., Los Angeles 64, Calif.

CIRCLE 201 ON READER-SERVICE CARD

Copper Clad Laminate

Has highly resistant bond



This material, Textolite 11558, is characterized by a copper to laminate bond which is as resistant to cyanide plating solutions, solvents and thermal aging as the base laminate itself. It will easily pass dip solder specifications. Illustrated is a solder pot test at 500 F.

General Electric Co., Dept. ED, Coshocton, Ohio.

CIRCLE 202 ON READER-SERVICE CARD

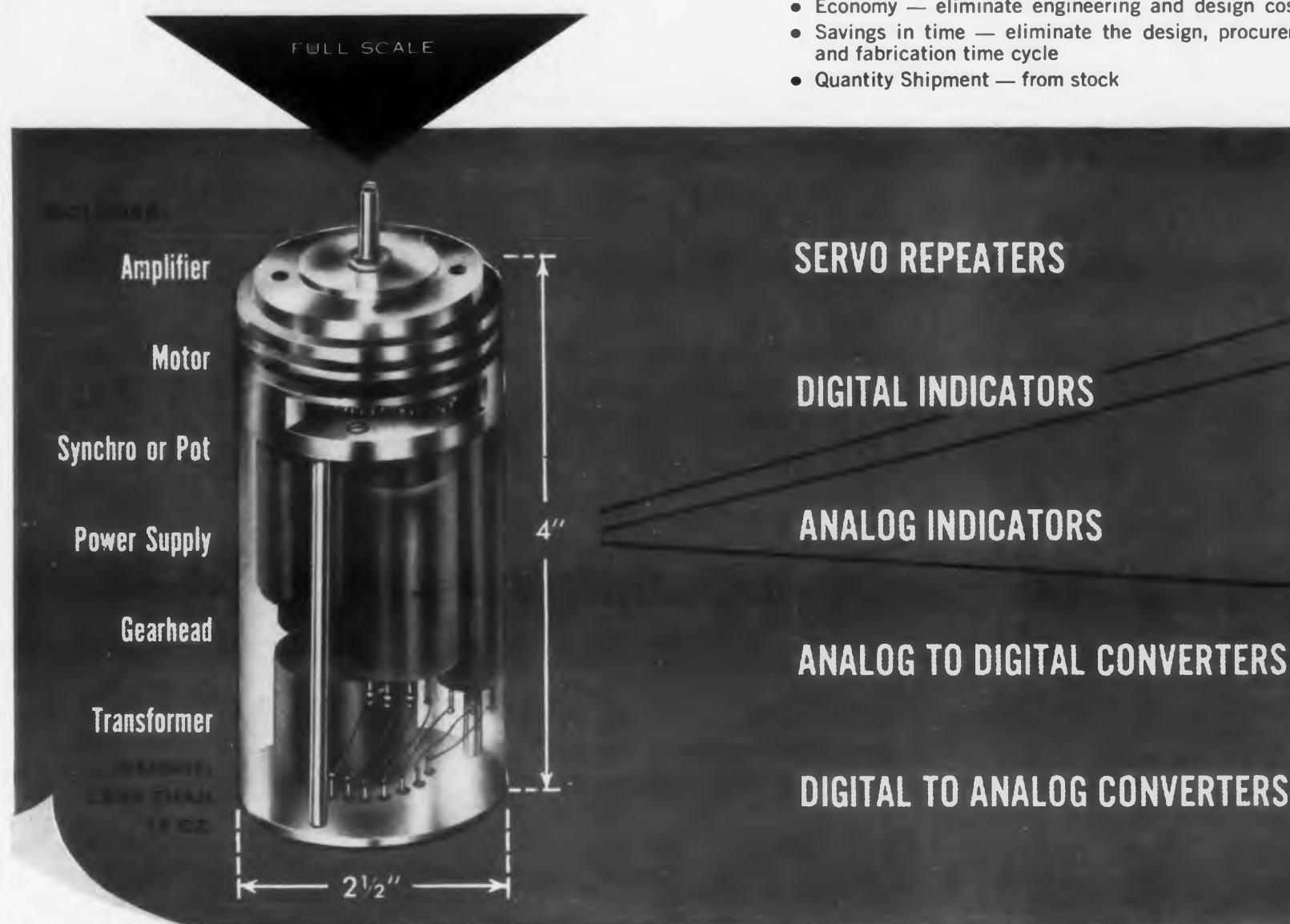
CIRCLE 203 ON READER-SERVICE CARD ➤

THIS IS A COMPLETE SERVO SYSTEM

"off-the-shelf" micromation*

TINY, PLUG-IN SUB-SYSTEMS
HAVE UNLIMITED
APPLICATIONS AND OFFER...

- Input Flexibility — models repeat voltage, shaft position, or digital data
- System Accuracy — up to .05% of full scale
- Operating Efficiency — require 7 watts maximum for full operation
- Reliability — meet MIL Spec E-5272A and E-5400
- Economy — eliminate engineering and design costs
- Savings in time — eliminate the design, procurement and fabrication time cycle
- Quantity Shipment — from stock



Why waste valuable design and procurement time: phone or wire your sub-system requirements to Waldorf today!

*COORDINATED
MINIATURIZED
SYSTEMS AND
COMPONENTS

MICROMATION

waldorf

A DIVISION OF
F. C. HUYCK AND SONS.

**WALDORF
INSTRUMENT COMPANY**

ELECTRONICS DIVISION

HUNTINGTON STATION, LONG ISLAND, NEW YORK
HAMILTON 7-7500

servo systems, converters and instruments



ANALOG INDICATORS

Accept either synchro or voltage input and remotely indicate.

Accuracy up to .05% of full scale



DIGITAL INDICATORS

Accept AC or DC voltages from computers, thermocouples, strain gage bridges, etc., indicate remotely to 3 or more significant figures.

CONVERTERS

DIGITAL TO ANALOG

Accepts digital input, converts, stores, generates a function (sine, exponential, etc.) and positions shaft or indicator.

ANALOG TO DIGITAL

Accurately positions standard encoders to any function of shaft position or voltage input.

SEE OUR EXHIBIT AT BOOTH #2219, IRE SHOW.

Just clip out this coupon
and mail to:
Electronics Division,
Waldorf Instrument Company
Huntington Station,
Long Island, N. Y.

Please send information on:

- Servo Repeater System
- Potentiometer Followup Servo System
- Digital to Analog Converters
- Analog to Digital Converters
- Digital Indicators
- Servo Voltage Indicators
- Servo Amplifiers

Rush For Immediate Project

ED-3-58

NAME _____

TITLE _____

COMPANY _____

STREET _____

CITY _____

Colored Insulator Stock

Color-coded Teflon rod

This colored Teflon rod stock is intended for use in the machining of such parts as feed-through and stand-off insulators. Available in eleven colors, it meets the requirements of specification MIL-STD-104. Supplied in diameters from 1/32 to 2 in.

Chemplast, Inc., Dept. ED, 3 Central Ave., E. Newark, N.J.

CIRCLE 204 ON READER-SERVICE CARD

Conductive Adhesive

For use where solder is impractical



These conductive adhesives are epoxide based materials which are supplied in paste form and can be cured rapidly at moderate temperatures to produce rigid, low electrical resistance solids. They are of use where soldering is impractical due to heat or because solder will not wet and adhere to conductive plastics or nichrome wire. Adhesion is excellent to metals, plastics, glass and ceramics. Bond strength is about 2000 psi. Conductivity of resultant compositions compares with that of metals. No solvent is present. Once cured, they can be used from -65 to $+500$ F.

The adhesives, trademarked Ecobond, are as follows: Type 56 C is two component paste cured at 120 F with a volume resistivity of 0.1 ohm-cm. Type 58 C is one component, cured at 300 F, with same resistance. Type 60 L is a two component paste, cured at room temperature, with resistance of about 300 ohm-cm.

Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE 205 ON READER-SERVICE CARD

◀ CIRCLE 203 ON READER-SERVICE CARD

STATE _____



DISTINCTIVE FEATURES:

- SNAP ACTION to eliminate chatter
- Single pole, double throw or either normally open or normally closed contacts
- Wide temperature range (-65° + 125°C)
- Pre-set time delay periods from 3 seconds to 5 minutes
- Available in metal or glass envelope or dust tight cover

TIME DELAY RELAYS

For Every Requirement

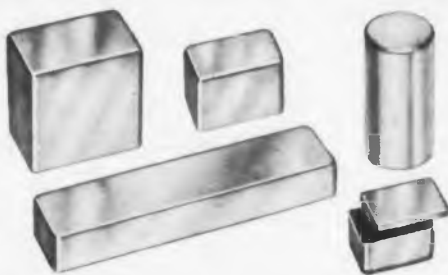
(Industrial or Military)

Whether it's a standard Curtiss-Wright thermal relay ready for immediate delivery or one that requires *special custom design* for your application, our engineers can provide it. Our design and production experience is at your disposal to solve any problem in time delay relays.

Write Component Sales Department



CIRCLE 206 ON READER-SERVICE CARD



*deep drawn
aluminum
boxes and
cases*

**1400 STANDARD SIZES
TO CHOOSE FROM**

with no tooling cost!

Choose from more than 1400 standard sizes and save tooling cost. All can be trimmed and modified to your specification by secondary operations...brackets and fasteners installed, holes and louvers punched, welding, painting, etc. Choose from rectangular, round, square boxes and covers. Custom deep drawn parts at nominal cost using exclusive ZERO-method tooling—send your print or contact your local ZERO representative for a quotation.



Write for complete new ZERO catalog



ZERO MANUFACTURING COMPANY

1121 CHESTNUT, BURBANK, CALIFORNIA

CIRCLE 207 ON READER-SERVICE CARD

NEW MATERIALS

Flattened Aluminum Wire

Has rounded edges

Round edge flattened wire in thickness ranging from 0.02 to 0.187 in., and in widths from 0.063 to 1 in. is available in E. C. grade and in alloys 1100, 3003, 5052, and 5056. Numerous other flattened wire sizes and alloys are also available upon special request by customers. Round edge flattened aluminum wire is being used for primary and secondary transformers, dc generator commutator windings, armor for electrical cable, and for electro magnets.

Kaiser Aluminum & Chemical Sales, Inc., Dept. ED, 919 No. Michigan Ave., Chicago 11, Ill.

CIRCLE 208 ON READER-SERVICE CARD

Glass Domes

For Transmitting Infrared Radiation



Called Servofrax, this arsenic trisulphide glass may be molded, ground and polished to produce one-piece domes. Used in transmitting infrared radiation to infrared detection equipment, this shape is available in sizes from 4 to 12 in. diam and may be ordered in any spherical section up to 180 deg. The dome has a slight negative lens effect which sometimes can be used effectively as a Maksutov corrector for concentric optical systems.

Servo Corp. of America, Dept. ED, 20-20 Jericho Turnpike, New Hyde Park, N.Y.

CIRCLE 209 ON READER-SERVICE CARD

Encapsulating Compound

High flow properties

The flow properties of this compound called Chem-o-sol permit it to conform to complex-mold cavities. It may also be employed in dipping operations, such as in coating capacitors, wire ends, and complex wire constructions. Chem-o-sol is also applicable to spaghetti tubing and to other types of vinyl constructions.

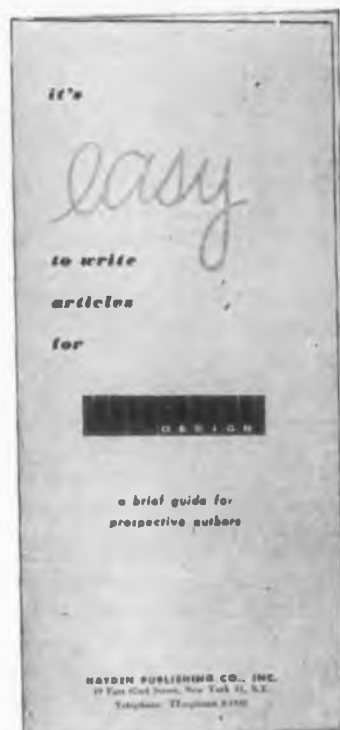
attention

idea men



Because an electronic design engineer must have hundreds of ideas to draw upon for each individual design decision, the editorial staff of *ELECTRONIC DESIGN* is continually trying to add to this storehouse of ideas. We are, therefore always interested in material based on your own experience which would be of immediate practical use to electronic design, development and research engineers. It is not difficult to write an article for *ELECTRONIC DESIGN* if you know what to write about and how we like to have our stories written. To simplify the preparation of an article, we have drawn up a brief guide for authors. Send for your copy today.

Edward E. Grazda, Editor.



ELECTRONIC DESIGN

830 Third Avenue
New York 22, New York

The conversion of Chem-o-sol from a liquid to a solid is accomplished by exposing it to heat in the order of 375 F. No pressures are required in the conversion process. Electrical resistance is 800 v per mil when deposited in thicknesses of 10 mils, and short-term heat resistance is 450 F.

Chemical Products Corp., Dept. ED, King Philip Rd., East Providence, R.I.

CIRCLE 211 ON READER-SERVICE CARD

Ceramoplastics

Molding techniques make thinner sections possible



Sections as thin as 0.018 in. to tolerances of ± 0.001 in. have been precision-molded of Supramica 555 ceramoplastic offering added possibilities for designers of miniature components for high-temperature applications. Illustrated is a field coil bobbin in which the flanges are 0.018 in. thick, with the entire piece measuring $3/8 \times 7/16$ in. overall. The molding technique used makes possible the use of Supramica for parts which have previously been moldable only by injection molding of organic plastics materials. Supramica ceramoplastic is a standard product of the company made from synthetic mica.

Mycalex Corp. of America, Dept. ED, 125 Clifton Blvd, Clifton, N.J.

CIRCLE 212 ON READER-SERVICE CARD



Precision Pins

Tapered and other shapes

Small precision pins and shaft are being offered in diameters from 0.03 to 0.1875 in. and lengths from 0.125 to 2 in. Precision taper pins are also available with tolerances of 0.0001 in. through length of pin. Shapes include dowel, straight, countersunk, or angle ends.

Commercial Centerless Grinding Co., Dept. ED, 6609 Cedar Ave., Cleveland 3, Ohio.

CIRCLE 213 ON READER-SERVICE CARD

NEW!! COPPER CLAD REXOLITE FOR PRINTED CIRCUITS

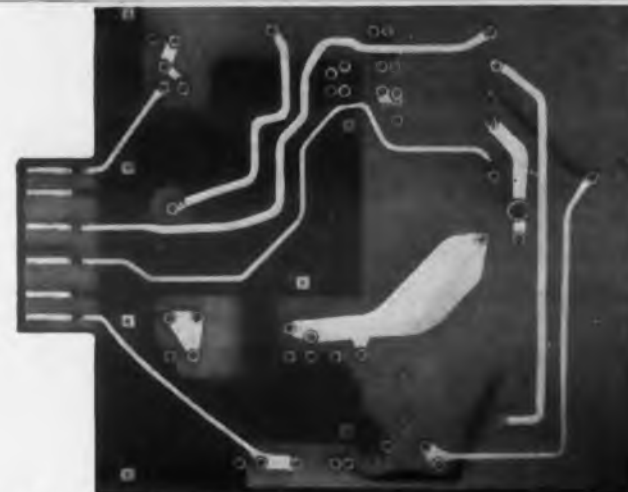
COMBINES THE EXCELLENT ELECTRICAL AND CHEMICAL PROPERTIES OF REXOLITE 2200 IN AN EASILY ETCHED MATERIAL

Copper Clad Rexolite features--

- Easily etched using conventional methods
- Can be cold or hot punched
- Readily soldered with low melt alloys
- Offers high impact strength and good tensile strength
- Especially suited for applications requiring strain and excessive abuse.
- Bonding of copper to Rexolite is strong to withstand mechanical abuse in fabrication and usage

Availability--

1 or 2 ounce copper on one or two sides
Standard Sheet: 34" x 34"
Thickness: .031" to .125"



Write for Complete Technical Data

ELECTRONICS DIVISION

THE REX CORPORATION

210 HAYWARD ROAD, WEST ACTON, MASS.

CIRCLE 214 ON READER-SERVICE CARD



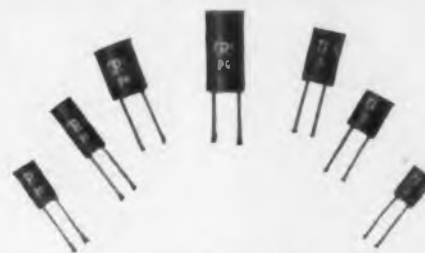
RESISTORS

PRECISION WIRE WOUND • HIGH VOLTAGE • HIGH MEGOHM • HIGH FREQUENCY



High Megohm Resistors

Type H Resistors are used in electrometer circuits, radiation equipment and as high resistance standards. Resistance available to 100 million megohms, (10^{14} ohms). For utmost stability under adverse conditions Type HSD and HSK Hermetically Sealed are recommended. Eight sizes from $1/8$ inch to 3 inches long are available. Voltage rating to 15,000 volts. Low temperature and voltage coefficients. Standard resistance tolerance 10%. Tolerance of 5% and 3% available. Also matched pairs 2% tolerance.



Printed Circuit Precision Resistors

To meet the requirements for printed circuitry, RPC has developed Type P Encapsulated Wire Wound Precision Resistors. Miniature, single ended units designed for easy rapid mounting on printed circuit panels with no support other than the wire leads. Many newly developed techniques are employed in the manufacture of Type P Resistors. These units can be operated in ambient temperatures up to 125°C. and will withstand all applicable tests of MIL-R-93A, Amdt. 3. Available in 6 sizes, rated from 1/10 watt to .4 watt. $1/4$ " diameter by $3/16$ " long to $3/8$ " diameter by $1/4$ " long. Resistance values to 3 megohms. Tolerances from 1% to 0.05%.



High Frequency Resistors

Used where requirements call for very low inductance, capacitance and skin effect in circuits involving pulses and steep wave fronts. Depending on size and resistance value, these resistors are usable at frequencies to over 400 mc. Resistance values range from 20 ohms to 100 megohms with tolerance of 20% to 5%. 2 types available. TYPE G resistors (shown) are tubular, in 6 sizes from $4 1/2$ " long x $3/4$ " diameter to $18 1/2$ " long x 2" diameter. With band terminals or ferrules. Power rating 10 to 100 watts. TYPE F resistors (not shown) in 8 sizes from $9/16$ " long x 0.10" diameter to $6 1/2$ " long x $9/16$ " diameter. Lugs or wire leads. Power rating $1/4$ to 10 watts.

RESISTANCE PRODUCTS COMPANY

914 SOUTH 13TH STREET, HARRISBURG, PENNA.

SPECIALIZING IN THE MANUFACTURE OF QUALITY RESISTORS IN ANY AMOUNT

CIRCLE 215 ON READER-SERVICE CARD



where
can you
use this simple fastener?

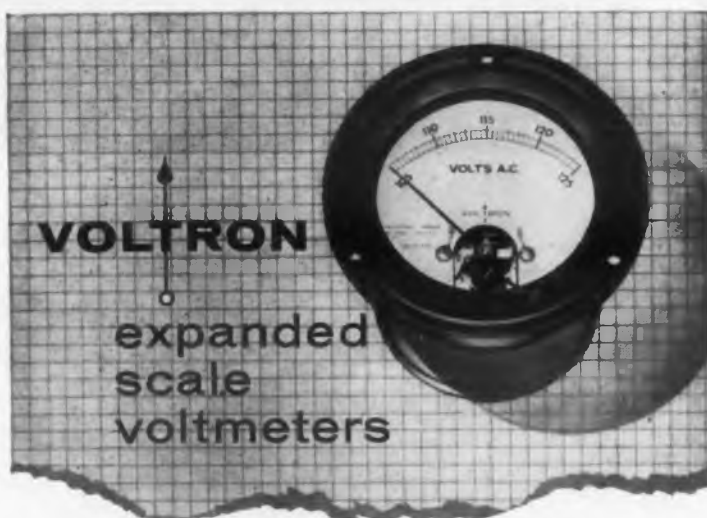
If you use locating dowels, hinge pins, rivets, set screws—or straight, knurled, tapered or cotter type pins—consider ROLLPIN® to reduce your costs. This modern fastener drives easily into standard drilled holes, compressing as driven to provide a precise fit without precision reaming. Its spring action locks it in place—regardless of impact loading, stress reversals or severe vibration. No threading, peening or precision drilling needed. Can be removed and reused in the same hole. For design information, write Elastic Stop Nut Corporation, 2330 Vauxhall Road, Union, N. J., Dept. R43-357.



**ELASTIC STOP NUT CORPORATION
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

CIRCLE 216 ON READER-SERVICE CARD



...1/2% accuracy!

Accuracy maintained over entire military temperature range of -55° to $+65^{\circ}$ C. No oven or heater needed.

Time-stable—negligible drift over long periods of time.

Small size—the expansion network projects only $1\frac{1}{4}$ ". AC or DC units for military or industrial applications. Military units meet all requirements of MIL-M-10304. Off-shelf deliveries. 30 to 45 days on specials. WRITE FOR LITERATURE.

VOLTRON products

1010 Mission St., South Pasadena, Calif.

CIRCLE 217 ON READER-SERVICE CARD

NEW MATERIALS

Silicon Glass Tubing

Precision Coil Form



Precision bore 96 per cent silica glass tubing has been made available with inside diam tolerance of up to ± 0.0005 in. The Vycor brand tubing can be manufactured with diameters from $1/8$ to 3 in., with special slots or indentations made to precision tolerances. Having a very low coefficient of expansion, the tubing has uses as a precision coil form, or as an enclosure for high frequency, high temperature transmitters, and precision resistors.

Corning Glass Works, Dept. ED, Corning, N.Y.

CIRCLE 218 ON READER-SERVICE CARD

(ADVERTISEMENT)

New Quick Connectors

CTC jack and plug excellent for panel patch work



Shown $1/4$ over-size

New products recently developed by CTC include jack and plug terminals designed for quick, tight patch work on panel boards.

The CTC jack, designated as X2200, is available in shank lengths for panel thicknesses vary-

ing from $1/32$ " to $3/16$ ". Diameter of the jack is $5/32$ " and it is .210" high when mounted.

The plug, designated as X2201, has a pin length of $3/16$ " and a body length of $5/8$ ". It will take up to #20 AWG size wire, which can be crimped over the insulation to prevent fraying, and then soldered.

Steadily maintained gripping power is an important advantage of the connector. This results from the unique design of the jack, embodying a specially designed compression spring that assures a perfect electrical connection every time. Write for complete details, including prices. Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Massachusetts.

CIRCLE 219 ON READER-SERVICE CARD

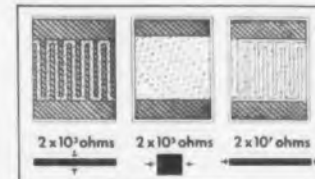
This is a
photosensitive
resistor...



actual size

It's called a Kodak Ektron Detector, the photosensitive substance is lead sulfide, and it can be laid down in any pattern.

- Signal response extends from 0.25 microns in the ultra-violet to 3.5 microns in the infrared with maximum sensitivity at 2.2 microns in the infrared.



- They are available in complex and exact arrays and mosaics.

- Signal-to-noise ratio is excellent, particularly in the infrared.

- Vibration doesn't affect them.

- Elements can be extremely small in size.

To get the details on Kodak Ektron Detectors, write for a free booklet to: Military and Special Products Sales,

EASTMAN KODAK COMPANY

Rocheater 4, N. Y.

Kodak
TRADE MARK

CIRCLE 220 ON READER-SERVICE CARD

62

*years of superior optical
design qualifies us to
offer special services in
these fields*

Photographic Reconnaissance and Mapping, Extreme Wide-Angle, Telephoto and Plotting Lenses, Radar Recording, Data Recording, Infra-Red and Ultraviolet Optical Systems, Light Relay Systems, Components from Synthetic Crystals, Closed Circuit Television Lenses, Aspherics and Anamorphics.

Quotations to your specifications.



C. P. GOERZ

American Optical Company

Inwood 96, L. I., N. Y.

CIRCLE 221 ON READER-SERVICE CARD



Ultrathin Precious Metal

Clad to Inexpensive Base

Precious metals permanently clad to inexpensive base metals are available in precision-rolled strip. Precious metals include silver, gold, platinum and palladium. Cladding is accomplished by direct bonding by means of heat and pressure. As an example, gold clad nickel can be manufactured with a layer of gold 0.00006 in. thick.

American Silver Co. Inc., Dept. ED, 36-07 Prince St., Flushing 54, N.Y.

CIRCLE 224 ON READER-SERVICE CARD

High Temperature Cement

Capable of sealing glass to metal at temperatures as high as 450 C



Presently being used to seal the face panel to the funnel of color TV tubes, this cement has a service temperature as high as its sealing range, from 400 to 450 C. The new cement can be used to seal most glasses, including lead, lime and barium-flint types, ceramics to glass, ceramics and metal to glass and metal to metal. A short heat treatment transforms the cement into an extremely strong glass-ceramic. In most glass-to-glass seals, this bond is stronger and harder than the parts, even at elevated temperatures.

Corning Glass Works, Dept. ED, Corning, N.Y.

CIRCLE 225 ON READER-SERVICE CARD

Class F Insulating Varnish

Cured at 125 C

Designed to meet temperature requirements of 155 C, this insulating varnish may be cured at temperatures as low as 125 C. The polyester-type varnish cures to a tough, flexible film with good adhesive and electrical properties and resistance to oil, moisture and acid. Typical applications include treating of transformers, magnet coils, stators, fields, and low-speed armatures.

General Electric, Dept. ED, Schenectady 5, N.Y.

CIRCLE 226 ON READER-SERVICE CARD

More KVA Per Dollar Less Pounds Per KVA

★ New Designs ★ Lower Losses

★ Ratings from 5.75 KVA to 104 KVA

★ Duratrak Brush Track

★ Cased/Uncased Models ★ Motor Drives

★ Single Units or
up to SIX Gangs

Sleeve or Ball Bearing
Models

★ Prices Start
at \$120

**type W50
Variacs**



Write for the VARIAC Bulletin

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 1000 N. Seward St. LOS ANGELES 38
8055 13th St. Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA
1182 Los Altos Ave., Los Altos, Calif. SAN FRANCISCO 6605 W. North Ave., Oak Park, Ill. CHICAGO

In CANADA: 99 Floral Parkway, TORONTO 15

CIRCLE 222 ON READER-SERVICE CARD



Model G-625



Model G-627

AERO-POT

miniature trimming

potentiometers

featuring extreme reliability!

All-metal case gives maximum rigidity, ruggedness and long life, plus high resistance to impact and torque. Settings are stable under vibration of 30 G's from zero to 2000 cps...under acceleration, shock and ambient temperature changes. Excellent heat dissipation and protection against high humidity, splashing and dust. Zero end resistance.

The Aero-Pot is adjustable throughout 32 turns by means of a slotted leadscrew. Resistance range: 100 to 100,000 ohms in one case size. Can be supplied completely sealed. Write for literature.

*PATENT APPLIED FOR

AERO ELECTRONICS CORP.

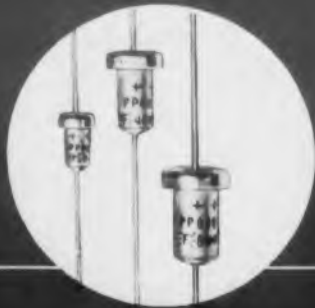
Sales Office: 2311 W. Burbank Blvd. • Burbank, Calif.

CIRCLE 223 ON READER-SERVICE CARD

For Highest Reliability

FANSTEEL

Tantalum Capacitors



PP Type, for normal temperature ranges

Ask for Bulletin A-106

VP Type, for excessive vibration or shock requirements

Ask for Bulletin B-112



HP Type, for high ambient temperatures (to 125°C) and for vibration resistance

Ask for Bulletin B-111

PP, VP and HP Types are also available with insulated cases

STA Solid Tantalum. Voltage ranges up to 35 volts, D-C. Unusual stability over a wide temperature range

Ask for Bulletin B-113



STOCK DELIVERIES

Fansteel's capacitor expansion program now nearly complete — most tantalum capacitors can be shipped from our stock — we will be able to ship any size or rating within 30 days.

VISIT US AT
BOOTHS 4021
— 4022
I. R. E. SHOW

CAPACITORS
FANSTEEL[®]
RECTIFIERS

FANSTEEL METALLURGICAL CORPORATION

North Chicago, Illinois, U. S. A.

RELIABLE TANTALUM CAPACITORS SINCE 1930

CIRCLE 228 ON READER-SERVICE CARD

NEW LITERATURE

Instrument Catalog

229

This 4-color, 132 page catalog contains the manufacturer's entire line of 200 items, ranging from Geiger Mueller detectors to transistorized multi-channel analyzers. For reading ease, the catalog is divided into four sections, with a special section of applications. Each section has its own table of contents. The applications section shows how the detectors, instruments and accessories can be combined to form various detecting, counting and analyzing systems. The catalog contains colored charts, graphs, and other illustrations. Radiation Counter Labs., Inc., 5121 W. Grove St., Skokie, Ill.

Centrifugal Fans

230

Catalog 1121 presents a line of centrifugal fans with airfoil blading. It depicts and describes a number of fan arrangements, bearings, wheels, and accessories. The 10-page booklet also contains selection charts and dimensional drawings. Westinghouse Electric Corp., Sturtevant Div., 200 Readville St., Hyde Park, Boston 36, Mass.

Motor Generator Sets

231

Bulletin MG957 covers 400 cps motor generator sets. The 4-page folder presents specifications and pictures for synchronous and induction type units from 500 w to 250 kw. Kato Engineering Co., 1415 First Ave., Mankato, Minn.

Insulating Materials

232

Electrical insulating materials are featured in catalog 23. Containing photos, prices, and ordering data, the 32-page catalog describes over 36 different insulating materials. Several pages are devoted to Mylar and Rag paper combination and dispenser packaged cuffed paper and Mylar combination insulations. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill.

Motor Generators

233

An illustrated catalog describes a recent addition to a line of motor generators. The dc unit has removable inspection covers and is fan cooled. Carter Motor Co., 2711A W. George St., Chicago, Ill.

NEW, LOW FREQUENCY RELIABILITY IN GLASS-ENCLOSED CRYSTAL



Precision components of the new RHG-DP crystals are enclosed and hermetically sealed in glass holders to assure maximum internal cleanliness and most reliable evacuation. The result is a series of sturdy, miniature, low frequency units having excellent long-term stability and higher Q.

TYPICAL VALUES FOR 2 KC UNIT*

Frequency range	1 to 15 kc
Holder	T5 1/2 glass bulb —Noval Base
Temperature range	-55 to +100°C
Frequency tolerance	±.015%
Effective resistance	75,000 ohms max.
Aging 8 hours—100°C	±.001% max.
Meets MIL specifications for vibration stability	

*Reeves-Hoffman manufactures a broad line of crystals in the range from 1 to 1000 kc.

**REEVES-
HOFFMAN**

WRITE FOR BULLETIN RHG-DP

DIVISION OF
DYNAMICS CORPORATION OF AMERICA
CARLISLE, PENNSYLVANIA

CIRCLE 234 ON READER-SERVICE CARD

Safety Cleaning Solvent 235

Specifications of a safe cleaning solvent are given in a 1-page sheet. The cleaner is compared with carbon tetrachloride and other chlorinated solvents which it can replace. Harco Chemical Co., Cranford, N. J.

Ultrasonic Welding 236

Ultrasonic welding and equipment to effect it are discussed in Bulletin SW-87. The 4-page illustrated brochure points out advantages of the system and the strength of spot-type welds in various materials. Sonobound Corp., Subsidiary of Aeroprojects, Inc., West Chester, Pa.

Overheat Detection 237

"Continuous Fire and Overheat Detection for Aircraft Safety" is the title of this 8-page brochure. The brochure, illustrated with graphs, charts and photographs, contains a description of the operating principal behind the detector and gives general specifications. Uses in general industry as well as aircraft are also included. Fenwal, Inc., Pleasant Street, Ashland, Mass.

Wire Processing Film

"Modern Wire Processing," a 15-minute 16mm color motion picture on an automatic wire cutter and stripper is available on a loan basis. The color film shows in detail the action and operation of the machine, which will cut and strip 12 ga. to 32 ga. insulated wire in lengths from 1 in. to 300 ft at speeds up to 8,000 pieces an hour. *It may be obtained from Eubanks Engineering Co., 260 N. Allen Ave., Pasadena, Calif.*

Pulse Transformers 238

Specifications on a full line of pulse transformers are listed in Catalog TR-57. Twenty-five new items have been added to this latest edition. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Time Interval Meter 239

A 1-page catalog sheet presents illustrations and complete specifications for a time interval meter. The unit measures periods and period ratio as well as intervals. Electro-Pulse, Inc., 11861 Teale St., Culver City, Calif.

AUGAT'S NEW TRANSISTOR CLIPS



Augat Brothers have developed a new line of clips for the retention of transistors, crystals, diodes, etc.

Now available in all standard sizes, they are the answer to the engineers' layout problems in regards to shock and vibration. Made of either 1065 spring steel or 25 alloy beryllium copper to retain shape, a minimum of clamping action is lost in use.

If your requirements are not listed in our catalog, write us for information on clips made to your specifications.

AUGAT BROS. INC.

31 PERRY AVENUE • ATTLEBORO, MASS.

CIRCLE 240 ON READER-SERVICE CARD

For Highest Dependability

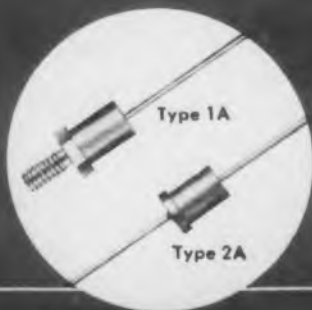
FANSTEEL RECTIFIERS

SILICON RECTIFIERS

Type 1A—Rated at 300 ma without heat sink

Type 2A—Rated at 300 ma

Ask for Bulletin 6.301

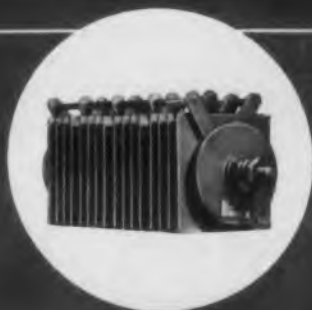


SELENIUM INDUSTRIAL POWER RECTIFIERS

Ask for Bulletin 6.400

SELENIUM HIGH TEMPERATURE POWER RECTIFIERS (to 130°C)

Ask for Bulletin 6.411



Get in touch with your nearest representative . . . he can help you with your specific requirements.

ATLANTA, GEORGIA	W. J. Jones 4-2000	Ray Adams
BOSTON, MASS.	W. J. Jones 2-7888	C. F. Sweeney
CHICAGO, ILLINOIS	T. J. O'Connell 9-3300	E. R. Yarns 2-1-8000
CLEARWATER, FLORIDA	W. J. Jones 3-7072	Dr. Sam Winberry
CLEVELAND, OHIO	W. J. Jones 3-4175	C. E. Jones
CLIFTON, NEW JERSEY	G. R. Gregory 1-2400	Robert Kelly (Executive) Selling Division
DALLAS, TEXAS	W. J. Jones 2-4000	Sam Yarns
HUNTINGTON, TEXAS	W. J. Jones 2-8800	Gene Cox
MILWAUKEE, WIS.	W. J. Jones 3-4001	T. J. Jones
NEW YORK, NEW YORK	W. J. Jones 3-4000	W. E. Sullivan, J. E. Day
PHILADELPHIA, PA.	W. J. Jones 3-4000	E. P. Williams
SAN CARLOS, CALIF.	L. J. O'Connell 3-4000	Sam Y. Yarns
SEATTLE, WASH.	L. J. O'Connell 7-0000	Henry Lister
SOUTH PASADENA, CALIF.	W. J. Jones 3-4000	E. E. Yarns, G. E. Yarns
TUCSON, ARIZONA	W. J. Jones 3-7000	Gene Lister
TORONTO, ONTARIO	W. J. Jones 2-7487	J. E. Yarns

VISIT US AT
BOOTH 4021
—4022
L. E. SHOW

CAPACITORS
FANSTEEL[®]
RECTIFIERS

FANSTEEL METALLURGICAL CORPORATION

North Chicago, Illinois, U.S.A.

1964

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 241 ON READER-SERVICE CARD

one reliable source for all your



CLIP, BLOCK and HARNESS STRAP needs!

ADEL offers the widest variety of LINE SUPPORTS in the World . . . 19,000 different types and sizes for safe, vibration-free, positive support in all types of aircraft, missiles, rockets, ordnance, automotive and original equipment of all kinds.

SAFETY . . . FLEXIBILITY . . . DURABILITY . . . ECONOMY . . . SERVICE FITTED . . . SERVICE TESTED . . . SERVICE APPROVED

Illustrated are but a few of the World's most complete line of Line Supports that meet or exceed all applicable specifications and/or requirements. Whatever the application—STANDARDIZE ON ADEL—the leader in completeness of line, service and reliability.



Reliability

ADEL PRECISION PRODUCTS

A DIVISION OF GENERAL METALS CORPORATION

SPECIFICATIONS ARE AVAILABLE TO AIRCRAFT, MISSILE AND ORIGINAL EQUIPMENT MANUFACTURERS . . . WHAT ARE YOUR REQUIREMENTS?

Direct inquiries to Huntington Division
1444 Washington Ave., Huntington 4, W. Virginia
DISTRICT OFFICES: Burbank • Mineola
Dayton • Wichita • Dallas • Toronto

CIRCLE 259 ON READER-SERVICE CARD

Celco
TRANSISTORIZED

YOKES

¾" ★ 1" ★ 1¼" ★ 2" ★ 2½" CRT NECK DIA.

for **MILITARY** and **COMMERCIAL PRECISION DISPLAYS**



**HIGH RESOLUTION
FAST RECOVERY
HIGH SENSITIVITY
LOW LI²
CONTROLLED
MAGNETIC FIELDS**

Write for CELCO DEFLECTION YOKE Catalogue & Design Sheets or for immediate engineering assistance Call your nearest CELCO Plant:

Mahwah, N. J.
Davis 7-1123

Miami, Fla.
Plaza 1-9083

Cucamonga, Calif.
Yukon 2-2688

Celco *Constantine Engineering Laboratories Co.*

CIRCLE 242 ON READER-SERVICE CARD

NEW LITERATURE

Axial Flow Fans 243

Attractively illustrated, the 4-page bulletin, No. 5703, includes a detailed enumeration of aircraft, electronic, commercial and marine applications for a line of axial flow fans. Illustrations show the self-contained "package" design. Specifications in table form are also given. The fans described have a range or rating from 16 to 5000 cfm. Borg-Warner Corp., Pesco Products Div., 24700 N. Miles Rd., Bedford, Ohio.

Carbon Pile Elements 244

Bulletin 6 AE discusses carbon discs, plates, and pile assemblies for all types of carbon pile rheostats and similar control units. Its 5 illustrated pages point out carbon properties, size ranges, and methods for determining the resistance of a specific pile. Two graphs plot resistance and elongation versus force for a typical large and small carbon rheostat element. Speer Carbon Co., St., Marys, Pa.

Electronic Parts Catalog 245

A 200-page electronic parts catalog has been announced. It lists, with details, components and equipment for service, industrial, communications, public address, and amateur applications. Electronic Publishing Co., Inc., 180 N. Wacker Dr., Chicago 6, Ill.

Stainless Fasteners 246

A 12-page catalog of stainless steel AN fasteners is offered. With pictures, it describes government specification aircraft bolts, slotted and Phillips machine screws, flat and round rivets, and washers. Stock sizes and dimensions are given. Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, N. Y.

Crystal Filters 247

A 4-page catalog outlines the major characteristics of some standard crystal filters. Specifications, outline drawings, a typical characteristic curve, and a circuit diagram are shown. Hycon Eastern, Inc., 75 Cambridge Pkwy., Cambridge 42, Mass.

not just miniature, but . . .

Time Tested Quality

SUB-MINIATURE

Actual Size

"Smaller than a postage stamp"

SMT ELECTROLYTIC CAPACITORS

Tubular and Upright for Regular and Printed Circuits

Available in wide temperature ranges -40°C to $+65^{\circ}\text{C}$ and -20°C to $+85^{\circ}\text{C}$

A complete line with exclusive patented construction in a variety of miniaturized sizes. Features: hermetically-sealed; stabilized for high and low temperature operation; excellent life characteristics; immersion-proof; resistant shock and vibration leakage currents extremely low.

Write for technical information and illustrated literature.

Telephone: EVerglade 4-1300

ILLINOIS CONDENSER COMPANY

1616 N. Throop Street • Chicago 22, Illinois

CIRCLE 248 ON READER-SERVICE CARD

Wide Range Pulse Generator 249

A wide range pulse generator, Type 1006, is illustrated and described in a technical bulletin just released. The unit produces a stable source of pulses in eight overlapping frequency ranges up to 4.5 mc. Its output may be a continuous train of pulses controlled by selecting one of the eight frequency ranges or a single pulse controlled by pressing a pushbutton on the front panel. The output pulse is either a positive or negative half sine-wave of 0.1 μ sec duration. Amplitude is variable from 8 to 30 v. Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa.

Pulse-Height X-Ray Technique 250

In a 4-page article David C. Miller discusses problems related to pulse height analyzers used in X-ray work. The article outlines the construction, application, and limitations of pulse-height analyzers and devotes separate sections to window and base line settings, detector operation, and interference. Illustrated with graphs and tables, the text explains how to operate pulse-height units with scintillation, propor-

tional, and flow counters to obtain best results. It also tells how to handle two energies which are quite well resolved and two overlapping distributions where one is much stronger than the other. Reprinted from Norelco News, "Some Considerations in the Use of Pulse Height Analysis with X-Rays" is free to those who request it. Philips Electronics, Inc., Instruments Div., 750 S. Fulton Ave., Mt. Vernon, N.Y.

Precision Fasteners 251

A broad range of precision industrial fasteners—for a wide variety of production assembly and maintenance applications—is reviewed in a bulletin now available. The four-page bulletin covers the complete line of standard industrial fasteners including socket screw products, self-locking nuts, spring pins and steel collars.

The illustrated literature gives range of sizes, materials, finish, and other specifications for socket, head, cap, and set screws, shoulder screws, both regular height and thin self-locking nuts, clinch nuts, dowel pins and collars. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

DIMCO-GRAY

SNAPSLIDE FASTENERS

**PROVIDE VIBRATION-PROOF HOLDING
AND QUICK, FOOL-PROOF RELEASE!**

APPROVED UNDER ARMY-NAVY STANDARDS

Here's a simple, easy means of securely fastening assemblies to withstand shock or vibration, and yet allow quick removal for inspection or repair. Instant snap action engages or releases fastener . . . no tools are required! After installation, fasteners never need adjustment . . . even with repeated use.

Three sizes available for different load requirements. Large and medium sizes are made of corrosion-resistant stainless steel. Small size is made of nickel-plated brass. Stock parts fit various thicknesses of flanges and mounting plates . . . special parts can also be supplied.

WRITE FOR FULL DETAILS TODAY!

DIMCO-GRAY COMPANY

201 E. SIXTH STREET DAYTON, OHIO
CIRCLE 252 ON READER-SERVICE CARD



WE'RE MEETING
THE DEMAND WITH
INCREASED PRODUCTION



now available
for immediate delivery

Waterman

3XP1

RAYONIC CATHODE RAY TUBE

3XP1 IS 33 VDC/INCH—2ND ANODE AT 2000 VOLTS

FOUR TIMES THE SENSITIVITY
FOUR TIMES THE LIGHT OUTPUT
OCCUPIES 1/2 PANEL SPACE } AS AGAINST
3" ROUND TUBE

ALSO AVAILABLE:

3AHP, 3JP, 3MP, 3RP, 3RP□A, 3SP

All Tubes Available in P1, P2, P7 and P11 Phosphors,
JAN TUBES—3JP1, 3JP2, 3JP7, 3RP1, 3RP1A, 3SP1, 3XP1

**SEE WATERMAN
AT THE IRE SHOW**

Booth # 1902-1904

MANUFACTURERS OF

PANELSCOPE* PANELPACK* POCKETSCOPE*
PULSESCOPE* RAKSCOPE* SYSTEMAT*

... And Other Associated Equipment

*Registered Trademarks



WATERMAN PRODUCTS CO., Inc.
PHILADELPHIA 25, PA. • GARfield 6-8600

CIRCLE 253 ON READER-SERVICE CARD

You get **MORE** than
accurate counting with

SODECO Electric Impulse Counters

SODECO just starts with counting accuracy. With SODECO Electric Impulse Counters you get many additional built-in advantages which enable you to use them for your toughest counting problems. For example:



SODECO TYPE T Ce Z
Instantaneous Mechanical Reset

• Just touch the toggle—Counter resets to zero.

- Fast—counts up to 25 impulses/sec.
- Compact—suitable for flush mounting.
- Low power demand—used in electronic circuits.

Both types are available with auxiliary contacts which allow you to connect them to other counters for applications such as batch counting, recycling, etc.

No matter what your counting problem, you can count on SODECO for the answer. Write for complete information.

LANDIS & GYR, INC.

45 West 45th Street • New York 36, N. Y.

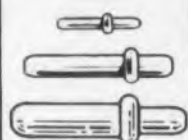
CIRCLE 254 ON READER-SERVICE CARD

50% SAVINGS

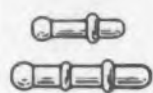
with

BEAD CHAIN® Multi-Swage Parts

CONTACT
PINS



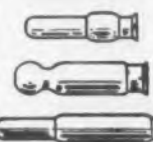
TERMINALS



JACKS



FRICION
CONTACTS



also PRINTED CIRCUIT
MINIATURE PARTS

Contact pins, terminals, jacks or any small tubular parts. Maximum 1/4" diameter x 1 1/4" length.

Send sketch for quotations.

BEAD CHAIN DRIVES

Low-speed positive drives or motion transfer
... at far less cost!



Send for Multi-Swage or
Bead Chain Drive Catalogs!

THE BEAD CHAIN MFG. CO.

58 Mountain Grove St., Bridgeport 5, Conn.

CIRCLE 255 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Get \$10.00 plus a by-line for the time it takes you to jot down your clever design idea. Payment is made when the idea is accepted for publication.

Rapid Design of Transistorized Regulated Power Supplies

A RAPID, simplified design of practical transistorized regulated power supplies can be accomplished using the following procedure. A set of basic rules is a prerequisite. They are:

1. The power source for the reference should be taken from the regulated output of the supply in order to maintain the reference current independent of power supply input variation;

2. The maximum current drawn from the reference should be as small as possible in order to reduce the reference voltage variation and drift, due to heating;

3. Automatic compensation must be provided to further reduce output variations. (The alternative method of increasing regulator gain by cascading several transistors increases cost, complexity, and transistor leakage problems);

4. The design must be based upon transistor types in plentiful supply. This dictates pnp types, if germanium transistors of reasonable voltage and power ratings are desired.

Circuit And Operation

The simple one-transistor schematic in Fig. 1 fulfills the above requirements. It is capable of reducing input voltage variation by a factor which can exceed 1000.

The transistor is in shunt with load resistor R_L . Rising output voltage causes the zener reference to pass more current into the transistor base. The transistor then passes beta times the base current, giving rise to an increased voltage drop across R_C . This tends to maintain the output constant. R_C , if properly chosen, will greatly reduce any remaining variations in output voltage.

The action of R_C is as follows: Since the transistor collector current flows thru R_C , an increase in collector current causes an increased voltage drop across R_C . This voltage drop is additive with the drop across R_S as far as the output voltage is concerned, but does not affect the zener reference element. Hence, it compensates for input voltage variation. Increasing R_C will give the supply a negative resistance characteristic, i.e., an increase in input voltage will result in a decrease in output voltage.

Design Example

Assume a required regulator delivering 10 ma at 7 v, from an input of 24 to 28 v. R_L is therefore 700 ohms.

Step 1. Determining R_s .

$$R_s \cong \left(\frac{\text{minimum } E_{in} - E_{out}}{E_{out}} \right) R_L$$

$$= \frac{24 - 7}{7} (700) = 1700 \text{ ohms.}$$

This approximation is not quite correct, due to the fact that at the lowest input voltage the zener reference must remain in conduction. The transistor is thus caused to pass a small current, to which must be added the transistor leakage. This necessitates decreasing the value of R_s somewhat; however, the above formula furnishes a quick guide to the selection of R_s . (Transistor leakage and minimum zener currents vary with type and quality of units, and are not predictable).

Step 2. Choosing the transistor.

$$I_{\text{collector max}} = \left(\frac{\text{maximum } E_{in} - E_{out}}{R_s} \right) - \frac{E_{out}}{R_L}$$

$$= \frac{28 - 7}{1500} - \frac{7}{700} = 0.004 \text{ ampere}$$

(R_s is assumed to be 1500 ohms here, instead of 1700, in accordance with the notes in Step 1. The next lowest stock value of resistance was 1500 ohms).

Since $E_{\text{collector}} = -7$ v, maximum dissipation

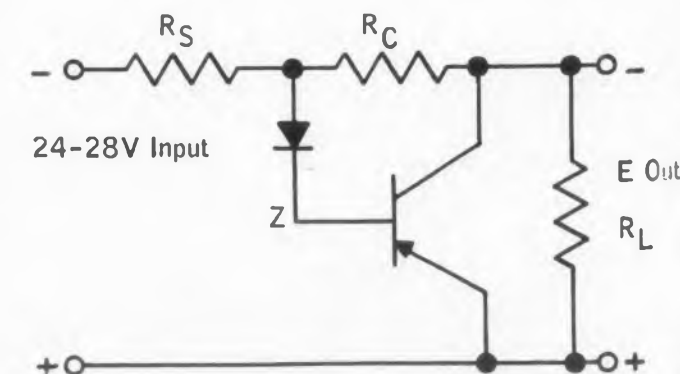


Fig. 1. Basic transistorized shunt regulator.

is 28 mw. Suitable is any low base-resistance, pnp medium beta transistor, with collector voltage rating above 7 v, and dissipation exceeding 28 mw at the desired ambient temperature. A typical choice might be a Tung Sol 2N382 which has a wide margin of safety factor, and beta of $\cong 50$.

Step 3. Choice of a zener.

$$\begin{aligned} \text{Maximum } I_{\text{zener}} &\cong \frac{I_{\text{collector maximum}}}{\text{Beta}} \\ &= \frac{0.004}{50} = 80 \text{ microamperes} \end{aligned}$$

The zener must have a voltage rating equal to the maximum desired output voltage of the regulator—7.0 v.

Dissipation = 7.0 v (80 x 10⁻⁶) = 0.56 mw. Any 7 v zener will meet this requirement power-wise; however, zeners are available with various temperature coefficients and dynamic impedances. This zener should be selected for the desired temperature coefficient and low dynamic impedance at the working current of 80 μ a.

Step 4. Selection of compensating resistor R_c .

$$R_c \cong \frac{\Delta E_{\text{out}}}{I_{\text{collector maximum}}}$$

With R_c shorted out and load connected, vary the input voltage from minimum to maximum and note change in output setting. R_c can then be calculated as above. Sure R_c compensates for variations of both zener and transistor, it cannot be calculated accurately till ΔE_{out} is known. It is practical to substitute a rheostat for R_c where extremely close compensation is required.

Filter Considerations

A regulated supply, designed as above, gave a variation of ± 2 mv from nominal with an input variation of 4 v, or ± 0.05 per cent. The ripple reduction factor inherent in this supply, reduces the necessity for elaborate input filtering, hence a simple resistance capacitance filter suffices for many applications. This was achieved economi-

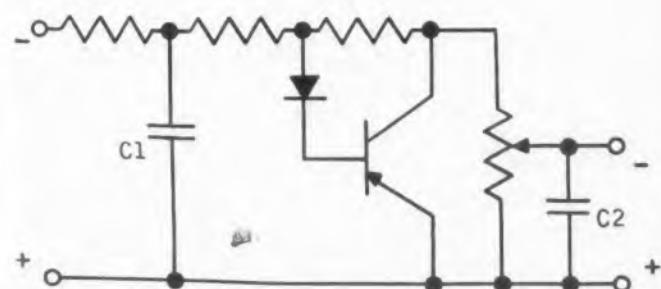


Fig. 2. Shunt regulator with filter and variable output control. Note simplicity.



The 33 megawatt hydrogen thyatron shown above is just one of the many special purpose electronic tubes manufactured by Chatham Electronics, a Division of Tung-Sol Electric, Inc. The precision glass components shown in both photos are typical of those supplied by F & P for use in thyratrons and other tube products manufactured by Chatham.



New precision in glass:

precision glass puts giant thyatron on target

Here's a job in precision glass fabricating that wasn't easy — not even for the experienced production staff of Chatham Electronics, Division of Tung-Sol Electric, Inc.

This giant hydrogen thyatron just had to have its anode stem precisely centered at the top of the tube. The slightest lack of uniformity in the glass components used to make up the stem assembly would throw the anode off-center, resulting in spurious discharges, arcs, and misfires. Such behavior could hardly be tolerated in the high power radar pulse modulator service for which the tube was designed. Glass components made to conventional tolerances were not good enough!

That's when F & P was called in. Recommended by 20 years of experience in the field of precision glass forming and fabricating, F & P was the company chosen most likely to meet the strict ID-wall thickness-concentricity requirements of this critical application. F & P not only succeeded in furnishing components to the required tolerances, but also worked with Chatham in solving related glass design and fabricating problems. How's that for service?

This is just a sample of what F & P can do for you in precision glass. F & P has met tolerances as low as $\pm .0001$ in. . . . in special types of glass tube enclosures, glass switch components, miniature glass battery enclosures, and precision molds.

If you would like to explore the possibilities of using precision glass in your designs, contact the Glass Products Division, Fischer & Porter Company, 5738 County Line Rd., Hatboro, Penna.



FISCHER & PORTER CO.
Glass Products Division

CIRCLE 256 ON READER-SERVICE CARD

RELIABILITY HIGHEST EVER

DOWN-TIME reduced to MINUTES

CUBIC'S NEW DIGITAL SYSTEMS with built-in rely/ance*

Cubic's Digital Systems reflect the extreme reliability and ease of maintenance present in Cubic's Electronic Tracking Equipment, currently in use by the United States Air Force in the IRBM and ICBM programs. They have

been designed to accommodate the widest possible range of customer applications. A demonstration of these systems and individual units will prove that they are the most reliable, practical and versatile available.



EASE OF MAINTENANCE CUTS DOWN-TIME

SPECIAL FEATURES INSURE RELIABILITY

Careful attention has been given to even the smallest components. For example, wire-wound resistors are wound on bobbins of encapsulating material in which the coefficient of thermal expansion closely matches that of the resistance wire. Thus resistor stability is assured.

Another reliability feature is *controlled drive*. Transistors drive the stepping switches, and these, in operating, turn off the transistor drive circuit. Since the switches control their own drive, circuit adjustments are neither frequent nor critical.

Cubic Digital Systems provide easy and rapid access to replaceable parts and adjustments, an indispensable requirement in any system.

When rack-mounted, simply releasing the front panel locking knob allows the unit to slide out. No other operation is required.

The switch assemblies, mounted on horizontal bars, swing up and out, giving easy access to wire-wound resistors and/or switch assemblies.

***rely/ance**

is Cubic's engineering philosophy which regards reliability and ease of maintenance as inseparable features of a truly functional system.



For a free illustrated brochure, write

CUBIC CORPORATION

5575 Kearny Villa Road, San Diego 11, California

CIRCLE 257 ON READER-SERVICE CARD

IDEAS FOR DESIGN

cally by splitting R_s into two 750 ohm resistors in series, and adding a filter capacitor, $C1$, as in Fig. 2. This resulted in 500 μ v of output ripple.

An output capacitor $C2$ was also added to maintain low output impedance at frequencies above the transistor cut off frequency, and eliminate any noise generated by the zener diode. In this design, the 10 ma current drain of the load resistor chosen was much greater than the small output current delivered to another circuit by the reference supply. A potentiometer was therefore substituted for R_L , delivering any required voltage from 0 to 7 v, with exceptional freedom from line and load variations. The total power consumed by this basic supply was less than 1/3 w. The reduction in circuit complexity enabled packaging in 10 cu in. without crowding, using conventional components and techniques.

Bernard B. Daien, Chief Engineer, Transistor Devices Inc., Kenilworth, N.J.

New Ground Strip for Electron Tubes



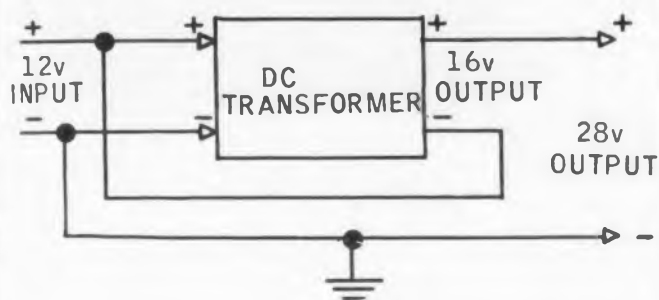
Left, the old ground strip; possibility of poor ground connections prompted new design. **Right**, the new ground strip; contact pressure provides good ground connections, and tubes are easily inserted.

The new ground strip, shown at right, eliminates poor ground connections often experienced with the design shown at left. This ground strip is made of two identical semicircular, tin-plated phosphor-bronze pieces curved to fit around the base of the tube socket. When assembled as shown, the pieces form a four-section ground strip mounted in the same manner as, and interchangeable with, the older one. The sections are designed to minimize the possibility of tube pins

catching on the top or in the openings, unless there is a misdirection to the extent that one or more tube pins are outside the ground strip. The tubes and shields cannot be put in at an angle because the four sections act as guides, and the sections also allow the tube and shields to be rotated to locate the pins in their contact holes without snagging. Such features are particularly advantageous when a person must reach to insert a tube in a location where he cannot see the socket. Because the individual sections are rugged and are not easily damaged, they insure a reliable ground connection.

From *Bell Laboratories Record*, Volume XXXVI, No. 1, January, 1958.

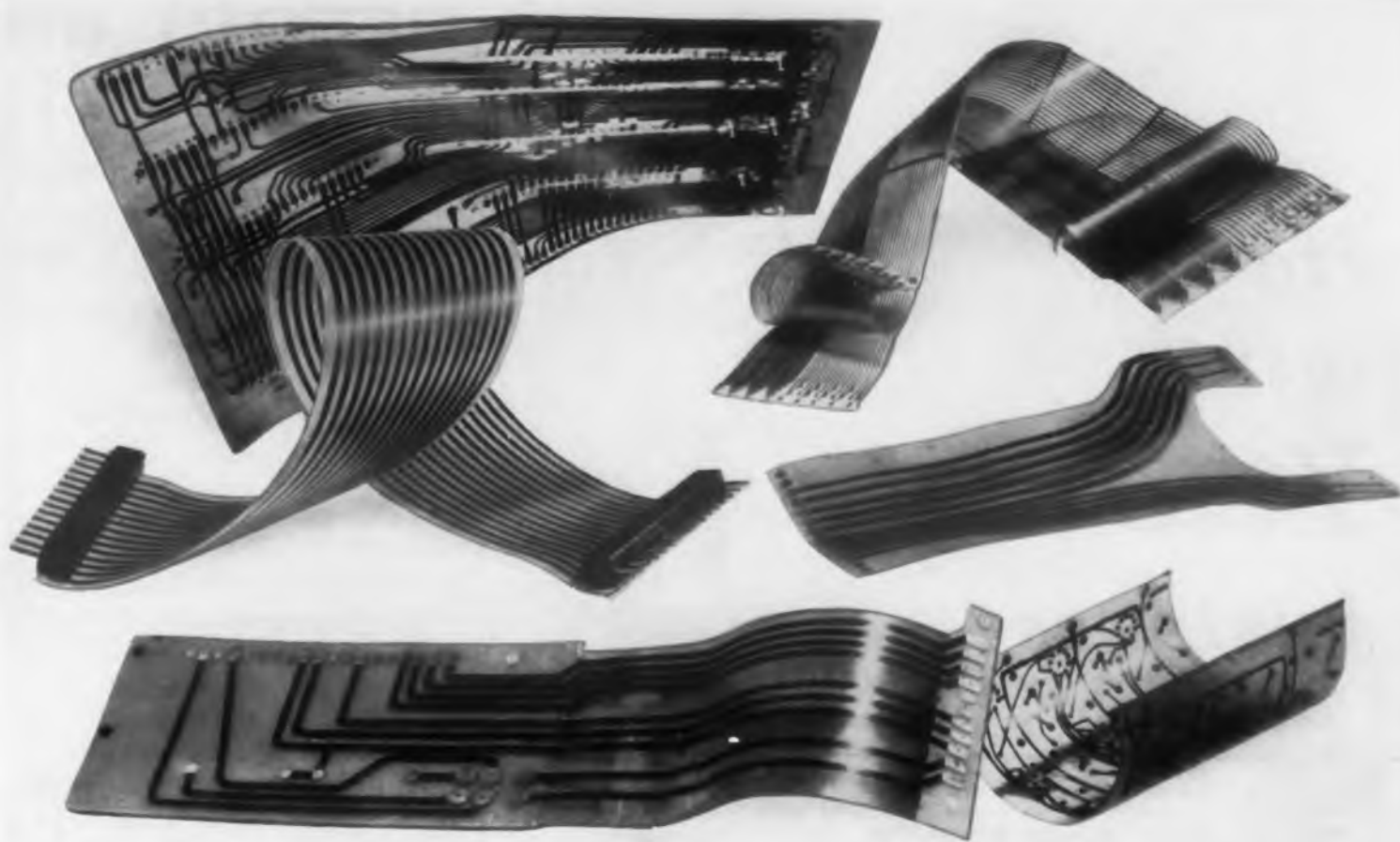
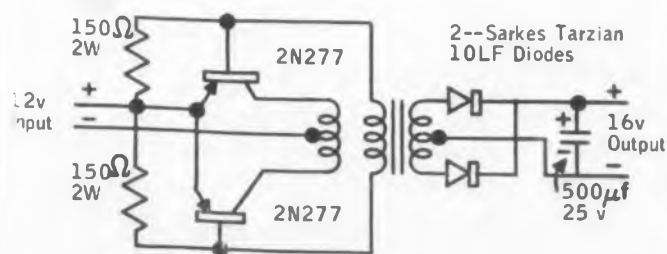
Transistorized Audio Amplifiers From 12-volt Supply



It was desired to design a transistorized audio amplifier to operate from a 12 v supply and deliver 50 w output. This problem is made difficult by the fact that there are no transistors currently available that will deliver this amount of power without a higher voltage supply. A supply voltage of 28 v would be ideal for this application.

A dc transformer (sometimes called a dc power converter, dc-to-dc transformer and dc voltage changer) which delivers 16 v output with a 12 v input can be connected as shown in Fig. 1 to provide about 100 w at 28 v from a 12 v line. The overall efficiency of the device when used in this manner is about 82 per cent. Ground continuity is maintained. A schematic of the dc transformer is shown in Fig. 2.

Thomas P. Prouty, Engineering Section Chief, Hallamore Electronics Co., 8352 Brookhurst Ave., Anaheim, Calif.



SANDERS FLEXPRINT [®] CABLES AND HARNESSES offer designers unlimited opportunities to take advantage of flat, flexible wiring in a wide variety of permanently bonded insulating plastics from low cost vinyls and polyethylenes to fluorocarbons.

Flexible Printed Wiring in all lengths for all layouts

Reliability-proved Sanders development sharply reduces weight, bulk, and cost of electronic and electrical assemblies.

Sanders Flexprint Wiring brings to commercial and military applications a combination of field-tested advantages unmatched by conventional wiring and ordinary printed circuits.

Check these features! Flat copper is etched to the conductor length, pattern and current carrying capacity that fits your application. The conductors are bonded between thin sheets of flexible insulating plastics that meet your environmental requirements. The bond is permanent . . . insulation can't peel. The result: reliable, printed wiring that often weighs less than half as much as conventional wiring . . . can occupy less than 1/3 the space.

Check these benefits! Flexprint Wiring conforms to any housing shape or layout . . . withstands effects of vibration

and flexing . . . allows interconnected assemblies to move independently. Completely encapsulated conductors provide maximum environmental protection . . . increase equipment reliability. Flexprint Multi-Conductor Cable can be cut . . . stripped (with a simple stripping tool) . . . connected to printed circuit connectors or boards or to itself. Accurately reproduced Flexprint Wiring Harnesses speed up assembly . . . permit automatic production . . . eliminate error. The result: better wiring at lower cost.

Check these options! Flexprint Wiring can be designed and produced in straight cables or complex harnesses . . . in any length . . . in single or multiple layers or bonded to rigid materials as a replacement for printed

board . . . with or without a cover coat . . . with vinyls, polyethylenes, polyesters, silicones, Kel-F, Teflon, or other insulations.

Check all the facts! Write today for complete data about capabilities, prices and deliveries.

EXPERIMENTERS AND DESIGNERS

Flexprint is available in the form of unetched copper-plastic laminate, without cover coat, together with complete instructions for etching your own circuits. Details on request.

[®] TRADEMARK — SANDERS ASSOCIATES, INC.

Visit Booth 3933, I.R.E. Show

SANDERS FLEXPRINT WIRING

Flat . . . Flowless . . . Flexible



SANDERS ASSOCIATES, INC.

NASHUA, NEW HAMPSHIRE • Dayton, Ohio • Inglewood, California • Washington, D. C.

CIRCLE 258 ON READER-SERVICE CARD

*He's
minding
YOUR
business*



YOUR HEART IS HIS BUSINESS. He's a research scientist—one of thousands supported by the Heart Fund. His life is dedicated to finding the unknown causes of the heart diseases, and new methods of treating and preventing them. He and your Heart Association have made *your* heart their business.

YOUR HEART IS YOUR BUSINESS. Whatever your way of life, your future depends on your heart. Heart disease causes personal suffering and undermines the happiness and economic welfare of the family. No one—no child or adult—is immune.

THE HEART FUND IS EVERYBODY'S BUSINESS. When you support the Heart Fund, you help all hearts. You support heart research—and you make it possible for your Heart Association to bring the latest advances in heart research to you and your family through your doctor.

Give Generously for Every Heart You Love

HELP YOUR HEART FUND  HELP YOUR HEART

REPORT BRIEFS

Metallurgy, Ceramics Studies

Thirteen studies for the Atomic Energy Commission in metallurgy and ceramics were released. The reports are:

ANL-5635 *A shielded metallograph for remote metallography*, Oct. 1957, 32 pp, \$1.00.

ANL-5678 *Manufacture of the ThO_2UO_2 ceramic fuel pellets for borax-IV*, Aug. 1957, 20 pp, \$.75.

ANL-5752 *A study of mechanical-electrolytic polishing on uranium metallographic specimens*, Jan. 1957, 19 pp, \$.75.

BMI-1048 *The characteristics of the bond interface formed between zircaloy 2 and uranium-12 w/o molybdenum*, Oct. 1955, 44 pp, \$1.25.

BMI-1184 *Fabrication of dispersed uranium fuel elements using powder-metallurgy techniques*, May 1957, 46 pp, \$1.25.

BMI-1224 *High-strength materials for pressurized-water-in-pile tubes*, Sept. 1957, 56 pp, \$1.75.

BMI-T-16 *Control of particle size in aluminum-uranium alloys*, Nov. 1949, 19 pp, \$.50.

HW-51998 *Fabrication of a titanium tube heat exchanger*, Aug. 1957, 31 pp, \$.75.

ISC-906 *Tabulation, bibliography, and structure of binary intermetallic compounds, III—Compounds of copper, silver and gold*, Sept. 1957, 48 pp, \$1.25.

LA-1846 *Casting of magnesium oxide in aqueous slips*, Mar. 1957, 47 pp, \$1.25.

WAPD-127 *Development and properties of uranium-base alloys corrosion resistant in high temperature water, Part II—Alloys with protective cladding*, Sept. 1955, 152 pp, \$4.00.

WAPD-184 *Properties of UO_2* , Sept. 1957, 140 pp, \$3.75.

WAPD-TM-86 *Weigh-shape conversion tables for zircaloy-2*, May 1956, 12 pp, \$.50.

Order from OTS, U. S. Department of Commerce, Washington, D. C.

Fault Protections Device

Fault diverters, or "crowbars," have proven very effective in protecting against transient-induced power arcs in oscillator tubes used at the University of California's Radiation Laboratory. The protective device short circuits the oscillator-plate power supply in the event of an over-current, thus removing the power flow from the fault within a few microseconds. Ignitrons, thyatrons, and triggered spark gaps are used for short circuiting. The power supply is pro-

How SMALL do you want your Shift Registers?



- low power consumption
- highly reliable
- only 1/8 cubic inch per binary digit
- Engineered for printed circuits
- Designed for severe service conditions

See "MINIBIT" shift registers and other
Epsco Components at IRE Booth 2120

Chances are Epsco's new line of "MINIBIT" miniaturized shift registers can meet your specifications to a T. Operating rates up to 500 KC and above . . . fully encapsulated . . . substantial savings in weight and space.

Whatever your requirements relating to buffer storage, pulse distribution or other pulse, digital and logic functions, we would like to talk to you about them. Epsco designs and manufactures a wide variety of transistorized, transistor-driven and tube-driven shift registers and magnetic logic elements, featuring high reliability, low-power consumption and compactness.

Custom engineering-production of electronic components (shift registers, magnetic logic elements, delay lines, special pulse transformers, plug-in logic elements, etc.) is our specialty. Write for Technical Bulletin #58-1. **Epsco Components, Dept. E-308, 108 Cummington St., Boston 15, Mass.**

START-TO-FINISH cooperation
. . . an Epsco guarantee

Epsco 
COMPONENTS
CIRCLE 261 ON READER-SERVICE CARD

HOW TO MEASURE ATTENUATION UP TO 30db

INSERTION LOSS

TEST SET

Measure Attenuation
Up to 30db
Maximum Error .1db
Resolution about .02db

BA-1B \$400
Bolometer Preamplifier

CF-1 \$525
Audio Frequency
Substitution Attenuator
for R.F. Square Law
Detector

IN-1 \$400
Audio Level Indicator
for R.F. Square Law
Detector



Write for detailed performance specifications to:



CIRCLE 262 ON READER-SERVICE CARD



SOLENOID REFERENCE MATERIAL

Yours for the asking!

New reference data covering PSP Miniature and Sub-Miniature DC Solenoids are now available to aid you in solenoid selection for valves, computers, memory units, data processing—and avionics applications. Solenoid type, size, voltage range, temperature range, force, weight and similar characteristics of nine units are given. All are produced in accordance with MIL-S-4040A specifications.

Send for this helpful reference material today. And ask also for information about high voltage and high temperature solenoids, high pressure types, co-axial valves and standard PSP Solenoids!



PSP ENGINEERING COMPANY

DIVISION OF INDUCTION MOTORS CORP.
6058 Walker Avenue • Maywood, California

Send for the Informative PSP Catalog

PRECISION SCIENTIFIC PRODUCTS
CIRCLE 263 ON READER-SERVICE CARD

tected from the short circuit either by a current-limiting device or a high-speed contactor which removes the system from the power lines. *Fault Diverter—A Protective Device for High-Power Electron Tubes*, B. H. Smith, Radiation Laboratory, University of California for U. S. Atomic Energy Commission, Aug. 1957, 21 pp, \$.75. Order UCRL-3701 from OTS, U. S. Department of Commerce, Washington 25, D. C.

Radiated Energy Power Supply

This report describes the principle and circuitry for powering electronic devices entirely from electromagnetic energy radiated from distant sources. The energy sources may be transmitters operated specifically for powering the devices, or ordinary commercial radio or television stations in urban areas. In most applications of the system, dc power derived from received rf energy is used to power transistors in various circuits. The report emphasizes the use of a transistor amplifier in the system to provide remote switching of power to a load. Complete instructions are given for construction of a standard broadcast radio receiver operating on this principle. Circuit arrangements are described for storing dc power, withdrawing the stored power at selected rates and amplitudes, changing dc power to ac power, and applying the required power to various devices. *Powering Transistorized Electronic Devices with Radiated Energy*, by Lloyd R. Crump, U.S. Ordnance Corp, Diamond Ordnance Fuze Labs., Washington 25, D.C. Feb., 1956, 13 pp, \$.50. Order PB 131264 from OTS, U.S. Department of Commerce, Washington 25, D.C.

Communication Theory, Antenna Design

Contents: Introduction, by Roy C. Gunter; Mathematical Introduction I, by Charles Bumer; Mathematical Introduction II, by F. Sheppard Holt; Application to Electronics I, by Arthur Kohlenberg; Application to Electronics II, by Peter Elias; Application to Optics I, by Edward O'Neill; Application to Optics II, by George B. Parrent, Jr.; Electro-Optical Systems in Cascade, by Otto Schade; Antennas I, by John Rize; Antennas II, by W. H. Steel; Antennas III, by Charles Drane; Summary Comments, by Francis J. Zucker; Bibliography; Attendance List. *Proceedings of Symposium on Communication Theory and Antenna Design.*, U.S. Air Force, Air Research and Development Command. Nov., 1957. 229 pp, microfilm \$9.90, photocopy \$34.80. Order PB 128075 from Library of Congress, Washington 25, D.C.



DESIGN SECRETS EXPOSED

Over 15,000 engineers have chuckled their way through "Murder in the Model Shop". Now in its second big printing, this free 48-page pocket book tells in true Mickey Spillane style how an "engineer-private eye" solves actual servosystem and instrument design problems with SERVOBOARD® Electromechanical Assembly Kits. Appendix includes descriptions of servo components and kits, Servoscope® servosystem analyzer, and Servomation® building blocks. For your copy write to:



SERVO CORPORATION OF AMERICA

20-28 Jericho Turnpike, New Hyde Park, L. I., N. Y.

CIRCLE 264 ON READER-SERVICE CARD



FOR FASTER ASSEMBLY WORK...

LOOP-TYPE

PLASTIC CLAMPS

52 SIZES
1/8" to 3"

Perfect insulators for mounting single or group wires, tubing, etc. . . unaffected by age, moisture, corrosion, shock, vibration. Use as a clamp, strain relief, clip, hanger, fastener, strap, etc.

MILLIONS IN USE!



Women Assemblers Like 'Em



Easy To Open . . . Snap Back in Shape!

ASK FOR FREE SAMPLES! Specify Type and Sizes

- **NYLON CLAMPS** Strong, tough, durable and pliable. Do not support combustion. Temperature ranges, -60° to +250° F. Thirteen loop diameters, 1/8" to 1". Larger sizes coming!
- **ETHYL CELLULOSE CLAMPS** For general use. Tough, lightweight, durable and pliable. Temperature ranges, -40° to +175° F. Twenty-two loop diameters, 1/8" through 3".
- **SARAN CLAMPS** Very pliable and non-burning material . . . Temperature ranges, -40° to +150° F. Seventeen loop diameters, 1/8" through 1-1/4".

MAIL TODAY FOR 1958 "Hi" CATALOG

NAME _____
FIRM _____
ADDRESS _____
CITY _____ STATE _____



HOLUB INDUSTRIES, Inc.

468 ELM STREET • SYCAMORE, ILLINOIS

CIRCLE 265 ON READER-SERVICE CARD



Specialists
IN STAMPING AND DRAWING

- KOVAR • RODAR
- FERNICO

• Other IRON-NICKEL-COBALT Alloys

**COMPLETE FACILITIES FOR PRECISION
 PRODUCTION OF ELECTRONIC COMPONENTS**

Our facilities are geared to meet your production and engineering needs for components of any description. Unusually Complete Tool Room • Press Shop • Hydrogen Annealing, Machining and Polishing Operations • Glass-to-Metal Hermetic Sealing. Production of completed parts ready for assembly in your own plant.

CUT TOOLING COSTS!

Over 3,000 high precision tools and dies available to reduce your initial tooling time and costs.

A complete service in our plant means prompt service to your plant.

Call on us for free consultation and quotations.

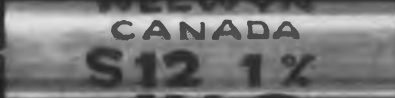


ZELL PRODUCTS CORP.
 282 Main Street, Norwalk, Conn.

CIRCLE 266 ON READER-SERVICE CARD

 **WELWYN**

*Hermetically Sealed
 Deposited Carbon Resistors*



High stability resistors bonded into glazed and vitrified ceramic shells for complete protection against ambient humidity changes.

Silicone oil filled — acts as efficient convective medium for improved heat dissipation. Also serves as infallible quality control for detecting seal leakage defects.

As part of quality control, each resistor is subjected to sustained pre-load test at $1\frac{1}{2}$ times rated wattage. Insures against catastrophic failures under normal operating conditions.

**Designed to meet military specifications.
 MIL-R-10509 (current issue)**

for complete data, write to:

WELWYN INTERNATIONAL, INC.

3355 Edgecliff Terrace, Cleveland 11, Ohio

CIRCLE 267 ON READER-SERVICE CARD

PATENTS

Transistor-Magnetic Amplifier Bistable Devices

Patent No. 2,798,169. J. P. Eckert, Jr. (Assigned to Sperry Rand Corporation)

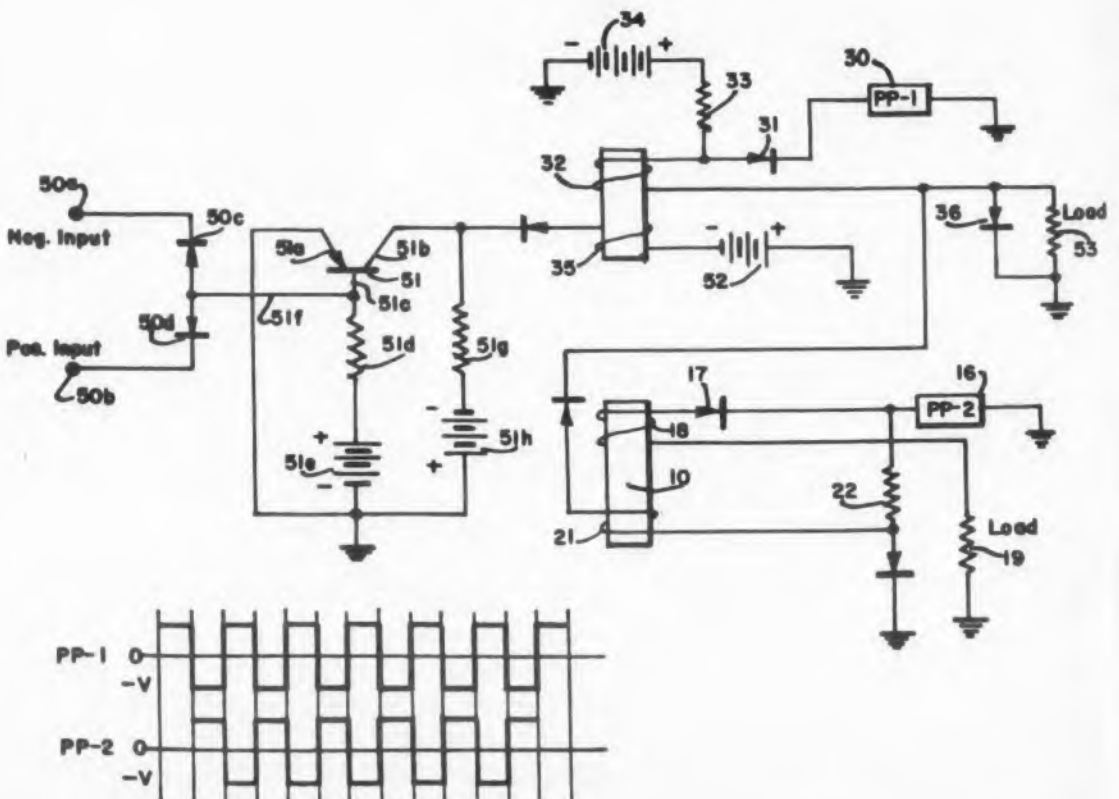
By combining a transistor and a magnetic amplifier into a bistable device, both high current and voltage gains are achieved. Both of these devices also have the virtue that the components will not burn out.

The circuit illustrated in the figure, has a transistor 51 to the base electrode of which are applied negative and positive control signals from the input source or terminals 50a and 50b. The collector 51b of the transistor is connected with the control winding 35 of a magnetic amplifier. Power pulses are applied through the winding 32 from source 30 to the load 53 as long as there is no current flowing through the control winding 35. When there is no current in this winding, the battery 34 resets the core between power pulses by current flow through resistor 33, winding 32, and diode 36. If, however, negative input pulses are applied at input terminal 50a of the transistor, the current flow through the collector and winding 35 sets up a magnetizing force which equalizes that

set up by the battery 34 and the core of the magnetic amplifier is not reset. The power pulses are now fed to a low impedance winding 32 and these pulses, therefore, pass through to the load. Upon application of positive pulses at the input terminal 50b of the transistor, current will not flow in the collector circuit and winding 35 and hence the core is reset. The impedance of the winding 32 becomes high and the power pulses from the source 30 are not applied to the load.

The basic combination covered by the patent includes a transistor and a single magnetic amplifier. In the figure, a more complex circuit is illustrated in which a second magnetic amplifier is used in conjunction with the first with power pulses fed to the second magnetic amplifier from the source 16. However, when power pulses of the first amplifier are being applied to the load 53, current flows through control winding 21 of the second amplifier and biases the second amplifier to cut off. Power pulses are fed to the load 19 of the second amplifier only when the first amplifier is not transmitting power pulses to its load.

The patent also discloses numerous other modifications of the circuit for accomplishing more complex results.



Magnetic Transformer Apparatus

Patent No. 2,811,689. Anthony T. Balint.

The voltage regulator uses a pair of magnetic cores of dissimilar core material so that their hysteresis loops are substantially different for low levels of magnetization and more similar hysteresis loops for high levels of magnetization. An input circuit receives alternating signals from a signal source having magnetic intensity application means which magnetizes the cores in accordance with the signal. An output circuit applies energy to a load the circuit of which is responsive to the magnetic and hysteresis response of the cores.

Superheterodyne Receiver

Patent No. 2,812,429. Johan van Baarda. (Assigned to North American Philips Company, Inc.)

The receiver is designed particularly for use in frequency-shift telegraphy and includes a local oscillator having a frequency control circuit. A detector circuit detects the received telegraphy signals and produces a signal having given amplitudes representing respectively the work-frequency and the rest-frequency of the received signals when the oscillator is correctly tuned. The detected signal has differing amplitudes when the oscillator is detuned in the direction of a frequency higher or lower than the correct tuning frequency. A first and a second threshold tube are provided which are normally biased to cutoff. The detected signal is coupled to the control electrode of both tubes so that the given amplitude representing the work-frequency of the received signal adjoins the threshold level of the first tube when the oscillator is correctly tuned and exceeds this threshold level, to render the first tube conductive, when the oscillator is detuned in one of the directions. Hence the given amplitude representing the rest-frequency of the received signal adjoins the threshold level of the second tube when the oscillator is correctly tuned and exceeds the last-mentioned threshold level to render the second tube conductive when the oscillator is detuned in the other direction. The output electrodes of the tubes are in push-pull relation to the frequency control circuit.

Transistor Oscillator Circuit

Patent No. 2,811,646. Huo-Bing Yin. (Assigned to Radio Corporation of America)

The circuit produces a very high frequency oscillation using a semiconductor having a normal base electrode and an auxiliary base electrode. The semiconductor has predetermined interelectrode capacitance. Energizing potentials are applied to the collector, emitter, and auxiliary base electrode. An oscillator signal is generated by a first frequency-determining circuit connected with the normal base electrode and this circuit is tuned to a fundamental oscillator frequency. The interelectrode capacitance of the semiconductor provides regenerative internal feedback between the normal base and the emitter. A second frequency-determining circuit is connected with the collector and is tuned to a harmonic frequency of the fundamental oscillator frequency. An output circuit derives from this second circuit a sinusoidal output wave at a frequency determined by the resonant frequency of the second circuit.

Time Discriminator

Patent No. 2,814,725. Jerome E. Jacobs and Ercell E. St. John. (Assigned to Hughes Aircraft Company)

The time discriminator circuit includes first and second thermionic tubes with an impedance element providing a dc path between the anode of the first tube and the cathode of the second tube. Control signals are impressed upon the control grids of the tubes through suitable circuitry. An input circuit which receives signal pulses is connected between the anode of the second tube and the cathode of the first tube and is operable to apply the received pulses to the tubes with proper polarity so as to establish anode-cathode supply voltages for the tubes. The tubes are conductive only when the signal pulses are coincident with the control signals. An output circuit is coupled to the impedance element so as to develop an error signal at the impedance element which represents the difference in the conductive periods of the tubes.



Compression and Kovar Type
HERMETIC SEALS
 "The Seal of Excellence"

Meeting the ever-increasing standards of perfection established by the electronics industry is a challenge admirably met by Zell's highly skilled engineers. They are able to exercise unusually rigid quality controls because all production operations are carried out in Zell's own completely equipped, ultra modern plant.

SPECIALISTS IN STAMPING AND DRAWING KOVAR — RODAR — THERLO — FERNICO AND OTHER ALLOYS
 Write us for **FREE Technical Consultation and Information**

Seal Engineers: excellent position open, write:

ZELL Hermetic Seals Enjoy These Desirable Characteristics:

- ★ A stable finish that protects seals against corrosive atmospheres. ZELL'S GOLD PLATE WITHSTANDS THE MOST STRINGENT TRANSISTOR ETCH TESTS DEvised.
- ★ High resistance to mechanical and thermal shock.
- ★ Excellent electrical properties.
- ★ Tight dimensional tolerances.
- ★ Easy weldability and solderability.

ALL FACILITIES UNDER ONE ROOF

- Complete tool room facilities.
 - 85 Power Presses (to 50 tons).
 - Double stage annealing-fusing furnaces.
 - Advanced plating facilities for Nickel, Gold, Tin, Cadmium, Copper, Silver, etc.
 - Complete glass facilities.
 - Mass Spectrometer leak testing.
- ZELL engineers control every process every step of the way, assuring uniform quality and performance.

REPRESENTATIVES: Your Inquiries invited!

ZELL PRODUCTS CORP.
 282 Main Street, Norwalk, Conn

The completeness of our facilities assures the completeness of your satisfaction!

CIRCLE 270 ON READER-SERVICE CARD



KAY
Attenuators

- Fast Switching to Check Points (1/2 Power, etc.) at Any Pre-Set Reference Level
- 0-101 db in 1 db Steps from Single Unit
- Choice of 50, 70, or 90 Ohm Impedance

- Ruggedized High Frequency Switches—Solid Silver Contacts in Teflon for Low Insertion Loss
- 1% Carbon Film Resistors—Highly Accurate and Stable

SPECIFICATIONS

Model	20	21	22	20-0	21-0	22-0	30-0	31-0	32-0
Cat. No.	430-A	440-A	450-A	431-A	441-A	451-A	432-B	442-B	452-B
Zin Zout	50 ohms nom.	70 ohms nom.	90 ohms nom.	50 ohms nom.	70 ohms nom.	90 ohms nom.	50 ohms nom.	70 ohms nom.	90 ohms nom.
Max. Power	1/2 watt								
Insertion Loss	10 db			zero db at low freq. approx. 0.3 db at 200 mc			zero db at low freq. approx. 0.5 db at 200 mc		
DB Switched	41 db in 6 steps						101 db in 9 steps		
Steps	20 db, 10 db, 5 db, 3 db, 2 db, 1 db						20 db, 20 db, 20 db, 20 db, 10 db, 5 db, 3 db, 2 db, 1 db		
Frequency Range	DC to 500 mc								
Accuracy of Attenuation	Within 0.1 db db to 500 mc Better accuracy at lower frequencies								
Connectors	BNC type UG-185 U								
Dimensions	2 1/4" x 8 1/4" x 2 1/4"						2 1/4" x 11 1/2" x 2 1/4"		
Weight	2 1/2 lbs.						4 lbs.		
Price	\$65			\$60			\$95		

All prices f.o.b. factory.

ON SPECIAL ORDER:

0.5 db steps and your choice of insertion loss, attenuation range, and impedance rating.

Write for 1958 Kay Catalog

KAY ELECTRIC COMPANY

Dept. ED • MAPLE AVE. • PINE BROOK, N. J. • CALDWELL 6-4000
 See us at the IRE Show—Booths 2608-09-10.

CIRCLE 271 ON READER-SERVICE CARD



AT THE I R E SHOW Visit Electronic Design Booth No. 4101 - 4102

Editorial Headquarters for Electronic Design, Electronic Week, and Electronic Daily, will be located at Booth No. 2401 at the Coliseum. Stop in to see our editors . . . bring us your suggestions for future articles . . . tell us about your plans . . . or, request an editor to meet your engineers to discuss your new programs and developments. Copies of all three Hayden publications will be available at the booth.

HAYDEN PUBLISHING COMPANY, INC.
New York • Chicago • Los Angeles



Books

Glossary of Terms in Nuclear Science and Technology

American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y. 188 Pages, \$5.00.

This glossary was approved by the American Standards Association as the American standard.

It was prepared to include terms:

1. peculiar to the field of nuclear energy;
 2. used in this field in a different sense or with different emphasis from what is commonly understood in other connections;
 3. used elsewhere in the same way, but so infrequently as to be unfamiliar.
- It is well organized and complete.

Elements of Tape Recorder Circuits

Herman Burstein and Henry C. Pollak, Gernsback Library, Inc., 154 West 14th St., New York 11, N.Y. 223 Pages, \$2.90 soft cover, \$5.00 hard cover.

The latest in the Gernsback Library series, this book is an excellent compilation of information on tape recorders and their circuitry. With a minimum of mathematics, basic design principles are presented for the audio enthusiast and the technician.

Engineering readers can derive a great deal of useful information on circuits which can find application outside of tape recorders. Of the book's ten chapters, the last three, on oscillators, record-level indicators, and on minimizing

FALSTROM metal fabrication

• cabinets • consoles • cubicles • panelboards

At FALSTROM—under one roof—you will find all the precision facilities and trained manpower to produce the equipment enclosures you need . . . rapidly and economically. In many ways it may pay you to call your FALSTROM man—for design assistance or a quotation.

FALSTROM COMPANY
107 Falstrom Court
Passaic, New Jersey
PRescott 7-0013

WHERE SKILLED HANDS MAKE THE DIFFERENCE

FREE GUIDE to Consoles and Cabinets
gives informative details. Write for it today!

See us at Booth 1116—I.R.E. Show—March 24-27—N. Y. Coliseum

CIRCLE 272 ON READER-SERVICE CARD

noise and hum, can be most useful to those with only a secondary interest in tape recorders.

Elsevier's Dictionary of Electronics and Waveguides

Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J., 628 pp, \$17.50.

This six-language volume, the third in a planned series of polyglot technical dictionaries relating to special fields in science and industry, contains over 2000 words in its basic list. The words are arranged on an English alphabetical base and clear distinction is made between American and British usages. Corresponding terms in French, Spanish, Italian, Dutch, and German then appear. A thumb-indexing system has also been incorporated which permits one to find words in any of the languages at once with numerical keys to the basic English list. Certain principles proposed by UNESCO have been utilized in planning the dictionary so that it may fit into a pattern which will cover all interrelated fields and all necessary languages.

Electrical Discharges in Gases

F. M. Penning, Macmillan Co., 60 Fifth Ave., New York 11, N.Y., 75 pp, \$3.00.

This collection of essays, published posthumously, is a masterly synopsis of the field reflecting much of the investigations which were begun by the author in 1924 at the Phillips Company Research Laboratories, in Eindhoven, Holland. The simplicity of description and the completeness of treatment indicate the reason that the volume, which was published originally in Holland in 1955, requires a wider circulation than would be found in Dutch-speaking countries alone. Particularly lucid discussions are offered with regard to Townsend discharge and breakdown, the positive column, and non-self sustaining and self-sustaining arc discharges.

Wrong Book Price

Price of the book, Handbook of Tri-Plate Microwave Components (ED, Feb. 5, p 100) is \$3.50—not \$3.00 as originally reported. Tri-plate is a registered trademark of Sanders Associates, Inc.

When ordinary gold plate won't do...



EARTH SATELLITES PLATED WITH SEL-REX BRIGHT GOLD

... to provide maximum heat reflectivity and emissivity. This patented formulation was also used to plate most internal parts and instrument housings in the U.S. IGY Earth Satellites.

When the unique properties of precious metals are required—without the shortcomings of conventional electroplate—missile, electronic manufacturers, and government agencies specify SEL-REX. Learn why from our technical literature, free on request.



PRECIOUS METALS DIVISION
SEL-REX CORPORATION

NUTLEY 10, NEW JERSEY

Offices: Detroit, Chicago, Los Angeles

Manufacturers of Exclusive Precious Metals Processes, Metallic Power Rectifiers, Airborne Power Equipment, Liquid Clarification Filters, Metal Finishing Equipment and Supplies.

CIRCLE 275 ON READER-SERVICE CARD

Gertsch

FREQUENCY METER MODEL FM-6

To meet new FCC regulations effective on some new communication installations in 1958, and on all installations in 1963, Gertsch is proud to announce the development of a new concept in frequency measurement—the all new Model FM-6 Frequency Meter.



FEATURES

- ★ Measures and generates frequencies from 20 to 1000 mc with better than 0.0001% accuracy!
- ★ Direct reading—No charts or curves!
- ★ Portable.
- ★ Contains internal standard producing a 1 megacycle output with accuracy and stability of better than 0.00001%.
- ★ May be used with a 1 mc counter to provide measurement and generation from 20 to 1000 mc with 0.00001% accuracy!
- ★ Spurious free output—may be used with auxiliary amplifier and calibrated attenuator to form a true "tight" signal generator!
- ★ Rugged cast aluminum sectionalized construction.

Gertsch PRODUCTS, INC.

3211 South La Cienega Boulevard
Los Angeles 16, California
Texas 0 2761 Vermont 9 2201

CIRCLE 276 ON READER-SERVICE CARD

Where You Use

"TEFLON"* WIRE & CABLE

Hook-Up Wire (Type E and EE)—AWG 10 through 32 per MIL-W-16878B. Extruded or fused wrapped. Striped and solid colors.

Lead Wire—AWG 32 and larger. "Teflon" insulation, outer jacket glass fiber braid w/"Teflon" impregnate.

Miniature Cable—AWG 10 through 32. Extruded or fused wrapped primary insulation. "Teflon", Nylon, Glass or Vinyl jacket.

Multi-Conductor Cable—AWG 10 through 32. "Teflon", Nylon, Glass, or Vinyl jacket, optional.

Air Frame Wire—AWG 10 through 32 per MIL-W-7139A. Striped and solid colors.

Miniature Coaxial Cable—AWG 22 through 32. Insulation thickness .004" to .007" for 300V service. Striped and solid colors.



**SPECIFY
HAVEG
"TEFLON"
WIRE & CABLE**

H-801

HAVEG INDUSTRIES, INC.

HALOCARBON DIVISION
900 Greenbank Road
Wilmington, Delaware

*Trade name for du Pont's Tetrafluoroethylene Resin.

VISIT BOOTH #4216 • I.R.E. SHOW • MARCH 24-27 • COLISEUM • N.Y.C.

CIRCLE 277 ON READER-SERVICE CARD



**NOW Available . . .
Computer-Measurements'
SHORT FORM CATALOG**

Containing Condensed Information on:

Frequency and Period Counters
Decade Counting Units
Preset Decade Counting Units
Frequency Deviation Meters
Time-Function Translators
Digital Printers
Preset Controllers
Totalizing Counters
Time Interval Meters
Universal Counter-Timers

write for your copy today

**Computer-
Measurements
Corporation**

5528 Vineland Ave.
No. Hollywood, Calif. Dept. 193A
CIRCLE 292 ON READER-SERVICE CARD



**SEALED
Subminiature
Unimax
SWITCH**

Sealed against
oil, water, dirt, cold,
dampness, fuels,
and solvents.

The Type EA1
environment-free
switch
is contained in a
corrosion-resistant
aluminum case,
with an elastomer plunger-seal
bonded to the
operating pin and the case.
It is furnished with wire leads
of any specified length.



ELECTRICAL RATING
5 amperes 125/250 volts a-c
5 amp. 30 volts d-c resistive
2-1/2 amp. 30 v.d-c inductive

OVERALL SIZE
7/8" x 11/32" x 3/4"
WEIGHT: 1/2 ounce
Write today for
engineering data sheet
on the Unimax EA1.

UNIMAX SWITCH

Division The W. L. Maxson Corporation
IVES ROAD, WALLINGFORD, CONNECTICUT

CIRCLE 293 ON READER-SERVICE CARD



What the Russians Are Writing

In response to many reader requests, we have rearranged our abstracts of Russian articles according to subject matter. In addition, we are expanding our coverage to include some of the newest Russian technical journals.

SPUTNIK

UHF Receiver by O. Rzhiga and A. Shakhovskoy. R 7/57, pp 17-20, 4 figs.

A receiver was developed primarily for observation of the artificial earth satellite. It has high selectivity, high sensitivity, good stability of heterodyne frequency and minimum internal noise level. The fact that the signal at the receiving antenna will at best not exceed several microvolts per meter, and the Doppler effect involved in the reception of the signal from a satellite traveling at 8 km/sec, is taken into account. A detailed circuit diagram and instructions for the construction, alignment, and placement of parts are contained in the article.

Observation Procedure by O. Rzhiga and A. Shakhovskoy. R 8/57, pp 17-19, 6 figs.

This is a continuation of the article by the same authors in the July issue of *Radio*, discussing antennas used for the reception of signals from the earth satellite, preparation for observations, recording of the signal on magnetic tape, determination of the instant of passage of the satellite, and various ionospheric observations to be made simultaneously.

Direction Finder Attachment by V. Dubrovin. R 7/57, pp 21-23, 9 figs.

The attachment is intended to enable the radio amateurs to detect the signals from the artificial earth satellite and to determine the instant of

KEY

The sources of the Russian articles and their dates of issue follow the authors' names. Here is the key to the names of the journals in which the articles originally appeared.

- AT** Automation and Telemechanics (*Avtomatika i Telemekhanika*)
- CJ** Communications Journal (*Vestnik Svyazi*)
- EC** Electrical Communications (*Elektrosvyaz'*)
- IET** Instruments and Experimental Techniques (*Pribori i Tekhnika Eksperimenta*)
- R** Radio
- RE** Radio Engineering (*Radiotekhnika*)
- REE** Radio Engineering and Electronics (*Radiotekhnika i Elektronika*)

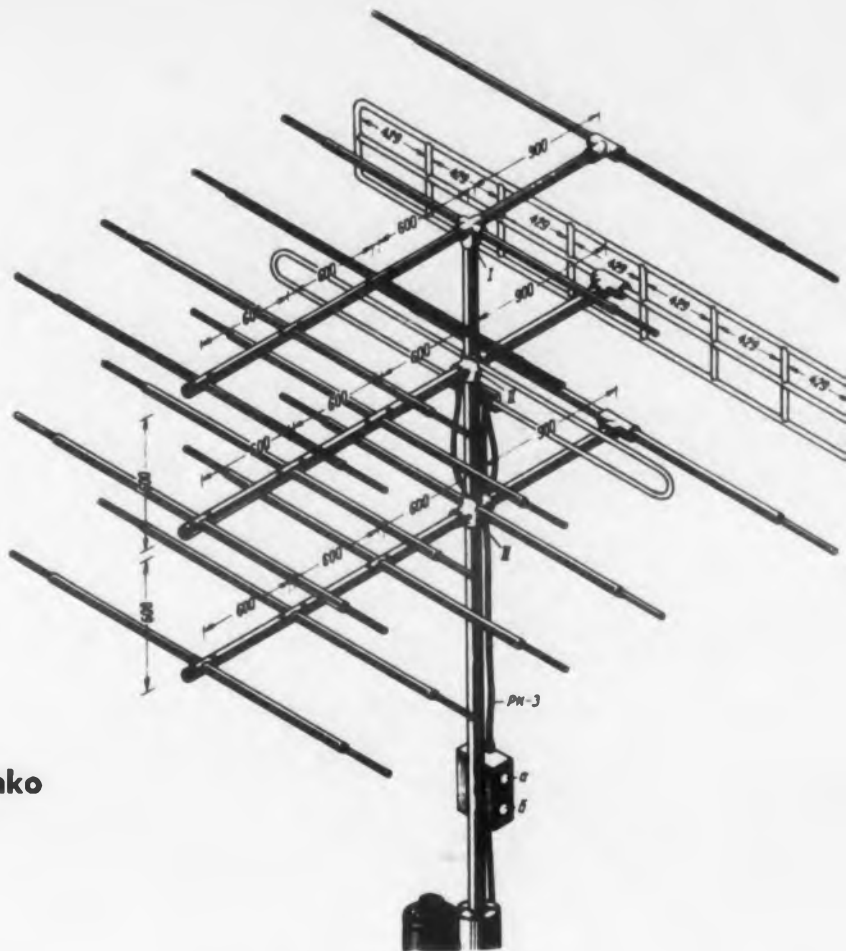
TRANSLATIONS AVAILABLE

ELECTRONIC DESIGN is gratified to learn of the growing availability of full translations of important Russian electronics journals.

Consultants Bureau, Inc. of 227 W. 17th St., New York 11, N.Y. translates *Automatic and Telemechanics* regularly.

Pergamon Press of 122 E. 55th St., New York 22, N.Y. is preparing translations of *Radio Engineering, Radio Engineering and Electronics, and Electrical Communications*.

Readers interested in specific Russian journals can obtain more information by writing directly to one of these publishers.



J. George Adashko

time when the satellite passes over the reception point. The system is based on the use of the so-called "equal signal zone" in which two antennas are used. The location for which the signal from the two antennas is the same is determined with a fair degree of accuracy.

Operation with Direction Finding Attachment by V. Dubrovin. R 8/57, pp 19-20, 3 figs.

Continuation of an article in the July issue of *Radio*. It describes the mounting of the two receiving antennas and of the auxiliary equipment involved in the determination of the passage of the satellite over a certain locality.

RECEPTION

Methods of Combating Pulse Noise in Television Reception by M. Tovbin. R 7/57, pp 40-43, 9 figs.

Description of various schemes employed to reduce the noise level in television sets, including the addition of a RC network in the control grid circuit of the selector tube, various limiting circuits, various methods based on the blocking of the synchronization channel for the duration of the noise pulse, methods based on the compensation of the noise pulses, and a few others.

Sound Channel Receiver for Long Distance Television Reception by S. Sotnikov. R 7/57, pp 44-47, 3 figs.

Long-distance reception of television signals requires the efforts of many workers in the Soviet Union. In such reception, it is necessary to

MAXIMUM POWER • MINIMUM SIZE

A C T U A L

S I Z E



Silotron

TRUE DIFFUSED JUNCTION SILICON POWER DIODES

Now, you can select from a full series of high power silicon rectifiers having the superior uniformity and reliability of true diffused junction construction. Conservatively rated up to 30 amperes at 50 to 400 p.i.v., these high-performance diodes feature a low forward voltage drop and an ambient temperature range of -65°C . to $+150^{\circ}\text{C}$.

Small, rugged and efficient, Silotron stud-mounted types incorporate a glass-to-metal hermetic seal and a solid copper construction for maximum electrical conductivity and heat dissipation. Lower-priced than many less-advanced types, these rectifiers are economical and reliable long-life components for new or replacement designs. For maximum design flexibility, all Silotron diodes are available with reversed polarity.

TYPE NO.	MAX. AVG. FWD. CURRENT, 40°C .*	PEAK INVERSE VOLTS	RMS VOLTS MAX.	LEAKAGE MA.**
P1005	10	50	35	<5
P1010	10	100	70	<5
P1015	10	150	105	<5
P1020	10	200	141	<5
P1040	10	400	283	<5
P1505	15	50	35	<5
P1510	15	100	70	<5
P1515	15	150	105	<5
P1520	15	200	141	<5
P1540	15	400	283	<5
P2005	20	50	35	<5
P2010	20	100	70	<5
P2015	20	150	105	<5
P2020	20	200	141	<5
P2040	20	400	283	<5
P2505	25	50	35	<5
P2510	25	100	70	<5
P2515	25	150	105	<5
P2520	25	200	141	<5
P2540	25	400	283	<5
P3005	30	50	35	<5
P3010	30	100	70	<5
P3015	30	150	105	<5
P3020	30	200	141	<5
P3040	30	400	283	<5

* $6'' \times 6''$ heat sink
 ** at max. rated forward current

Maximum forward voltage drop:
 25°C . at full rated current. 1.2 volts

Write today for complete details on our full line

T H E R M O S E N , I N C .
 375 FAIRFIELD AVENUE • STAMFORD, CONNECTICUT
 CIRCLE 294 ON READER-SERVICE CARD

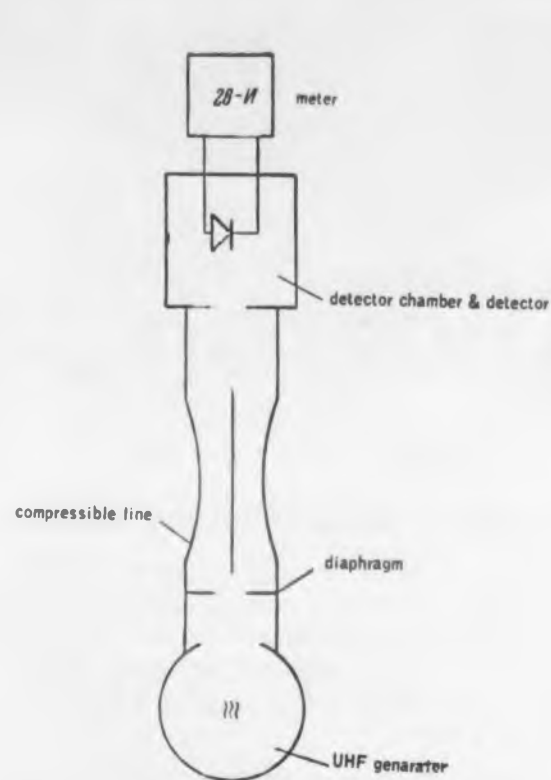


Fig. 1. This scheme uses the video detector to measure its own vswr.

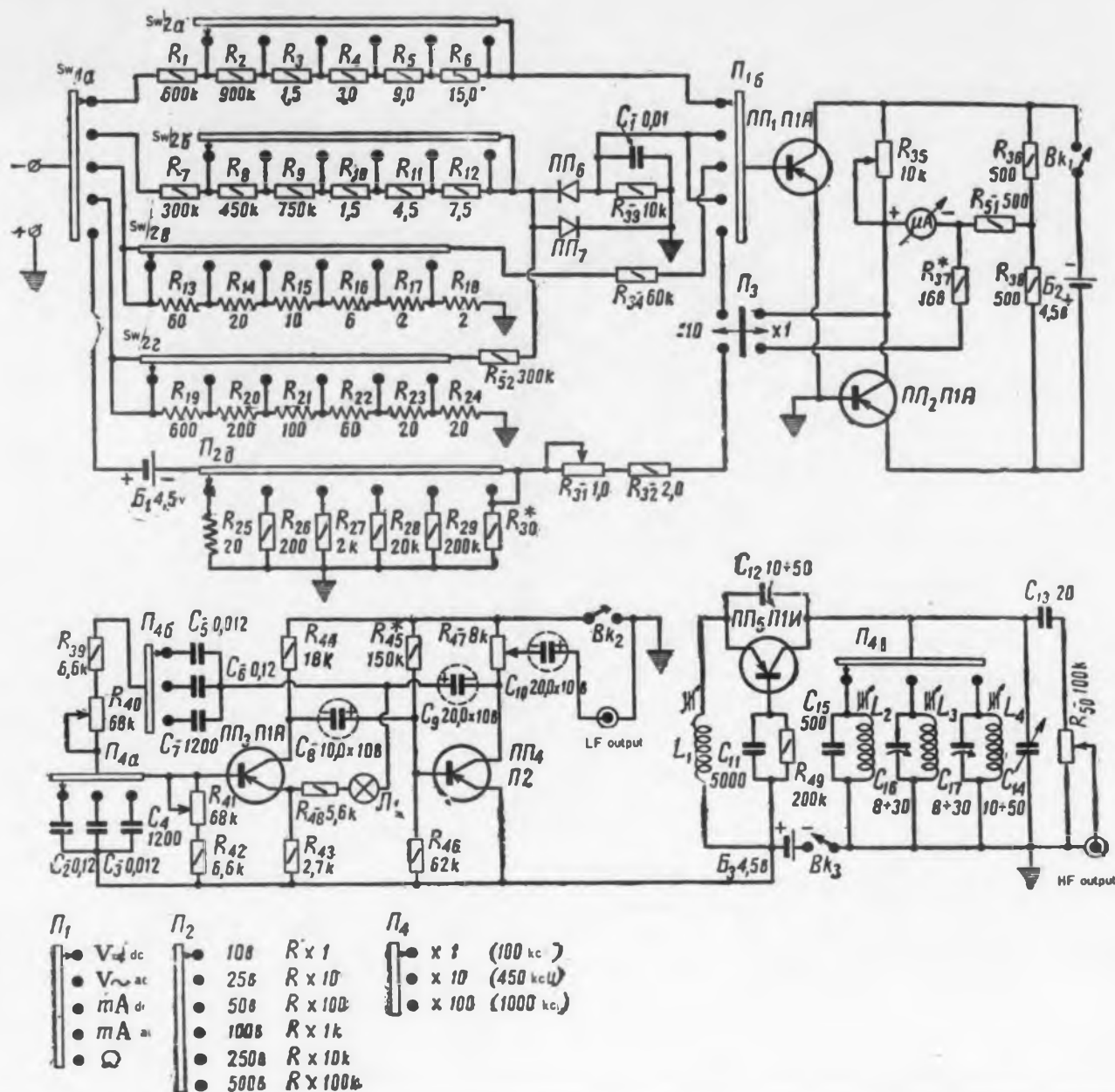


Fig. 2. Completely transistorized, this portable test instrument measures voltage, current, and resistance; and includes a lf and hf signal generator.

П ₁	• V _{dc}	П ₂	• 100	R × 1	П ₄	• x 1 (100 kc)
	• V _{ac}		• 250	R × 10		• x 10 (450 kc)
	• mA _{dc}		• 500	R × 100		• x 100 (1000 kc)
	• mA _{ac}		• 1000	R × 1k		
	• Ω		• 2500	R × 10k		
			• 5000	R × 100k		

have a separate receiver for the sound channel. The article describes a superregenerative and a superheterodyne receiver for the purpose.

Antennas for Long Distance Reception of Television by S. Sotnikov. R 8/57, pp 34-37, 9 figs.

Detailed description of several antennas used to receive television signals reflected by the ionosphere. Construction data and directivity patterns are also given.

Long Distance Reception of Television Broadcasts. R 8/57, pp 37-40, 5 figs.

Report by various amateurs, accompanied by photographs of television reception, mostly from Germany and Italy, at frequencies of 55.25, 48.25, and 62.25 mc.

Setup for Superhigh Distance Television Reception by V. Vasilenko. R 9/57, pp 33-34, 2 figs.

The author in Voroshilov, was able to receive broadcasts regularly from Japan, a distance of about 500 miles. The article describes the equipment employed. The figure shows a drawing of the antenna.

AUTOMATIC CONTROL

Conditionally Stable Regulated Systems (Concerning One Class of Optimum Regulated Systems) by A. M. Letov. AT 7/57, pp 601-604, 6 figs.

A highly theoretical paper, in which it is shown that for a strictly linear system, constructed to satisfy any arbitrarily adopted optimum criterion, it is possible to obtain damping of the transient during the first swing, thus converting the system into a conditionally stable system. The time for conditional damping will be considerably less in such a system than in the initial system. This result can be accomplished without substantially modifying the existing systems, but by merely adding a simple computing device.

Approximate Determination of the Self-Oscillation Transients in Certain Automatic Control Nonlinear Systems by A. A. Voronov. AT 7/57, pp 631-639, 8 figs.

This article shows how to approximate the higher-order equation with two nonlinear sys-

tems of first order, similar to the equations used for second-order systems. It is also shown that by piecewise-linear approximation of a certain function obtained during the process of solving these problems, it becomes possible to obtain a relatively simple approximate solution to the problem. The method frequently yields satisfactory accuracy even in cases when the oscillations attenuate within 1-3 cycles. Refers to "A Frequency Response Method for Analyzing and Synthesizing Contactor Servomechanisms" by R. J. Kochenburger, Transactions AIEE, Vol. 69, Part I, 1950.

GROWING INTEREST

Consultants Bureau reports that the volume of 1957 subscriptions to *Automation and Telematics* increased 46 per cent over the 1956 figure. This is one of the many indications of the growing interest in Russian technical literature.

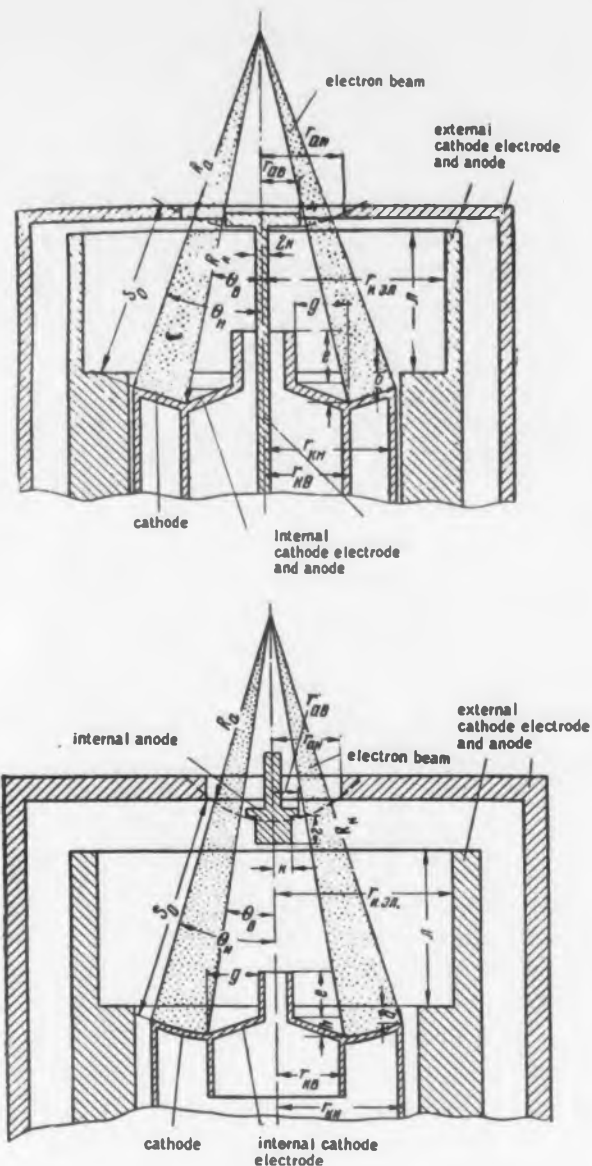


Fig. 3. Two types of guns for forming hollow electron beams.

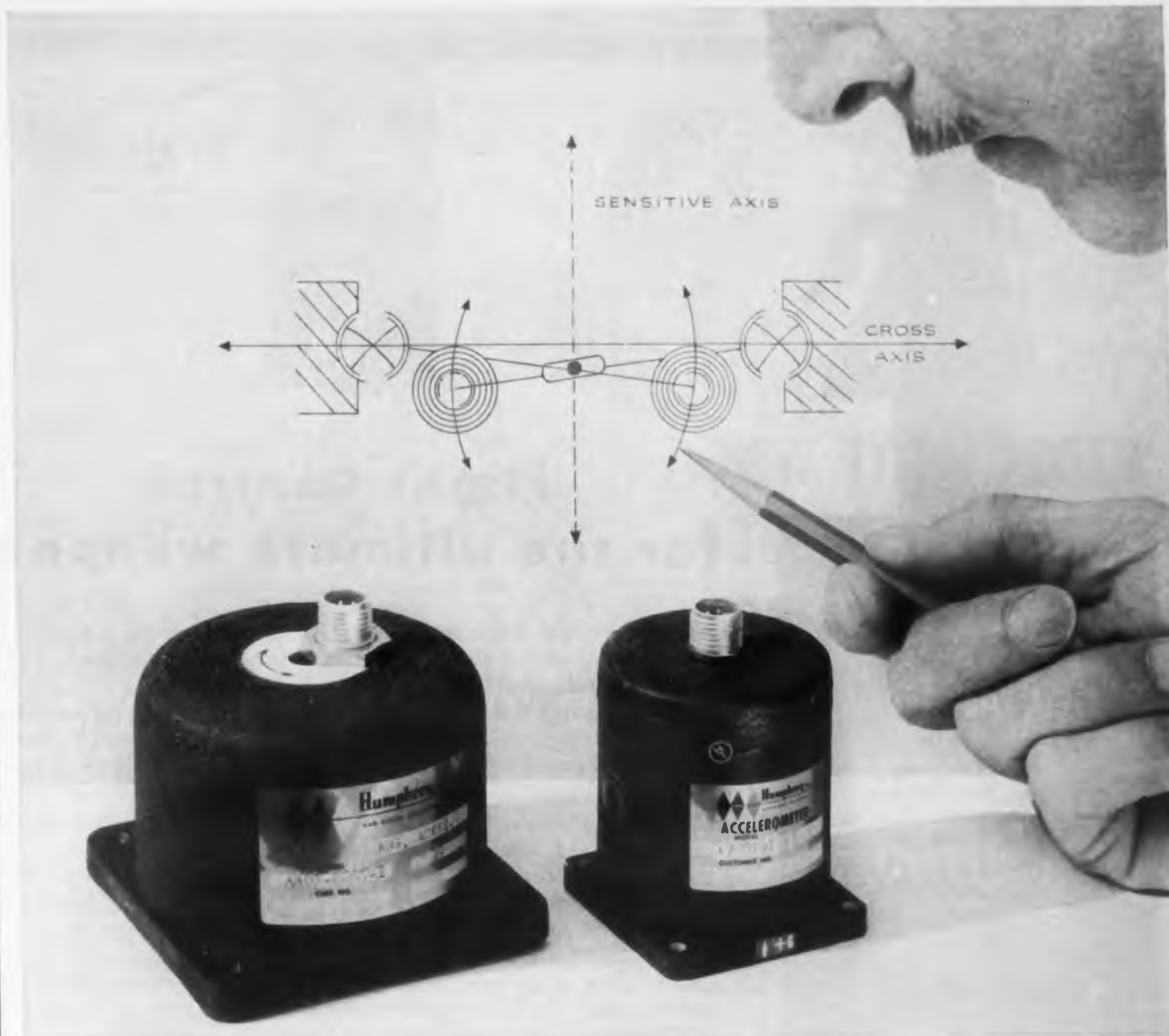
Automatic Control of Liquid Level by Means of Detection of the Phase of UHF Waves by V. B. Brodskiy. AT 7/57, pp 640-652, 3 figs.

A theory is developed and it is shown that the use of transition transformers and dielectric filling in the measuring line makes it possible to measure a liquid level over a range that may be considerably larger (or smaller) than the range over which the minimum of the standing wave is shifted. The errors of the method are analyzed and the limits of its applicability are estimated.

MEASUREMENTS

Method of Measuring the VSWR of Video Detectors by L. S. Liberman. REE 7/57, pp 941-942, 1 fig.

Since the power level must be quite low in such a measurement (not more than 10 microwatts), the ordinary slotted line introduces considerable errors. The author develops a method in which the detector itself serves as an indicator. Fig. 1 shows the instrumentation.



CONTRA-ROTATING WEIGHTS ELIMINATE CROSS TALK IN HUMPHREY ACCELEROMETERS

When an accelerometer used to measure motion of a body in one direction is influenced by motion in another direction, the resulting "cross talk" leads to inaccuracies. Humphrey licks this problem by building accelerometers that cancel out cross talk.

The diagram illustrates the principle. There are two contra-rotating weights on arms that are flexure mounted so they are free to move. Where the arms cross, they are pinned together with a slot and pin that allows them to move. Assume the

accelerometer is measuring vertical motion as shown by the arrows. Lateral motion can't produce error in vertical measurement because "up" error of one weight is cancelled out by "down" error of the other. Flexibility of this design permits covering a wide range of operating characteristics. Low natural frequencies can be furnished to filter out mechanical vibrations. Let us work with you on your linear or angular accelerometer requirements. Write today.



DEPT. ED-38 2805 CANON STREET
SAN DIEGO 6, CALIFORNIA

FOR COMPLETE SYSTEMS, SPECIFY HUMPHREY GYROSCOPES, ACCELEROMETERS, POTENTIOMETERS
CIRCLE 295 ON READER-SERVICE CARD



First test firing of the ATLAS ICBM at Cape Canaveral, Florida, June 11, 1957.



Honeywell Rate Gyro
Type JRT
Shown 1/2 size

Flight Control for the ultimate weapon


Three Honeywell Rate Gyros, Type JRT, provide missiles with precise three-axis directional stability and are currently being supplied to the ATLAS missile program.

The Type JRT is a highly accurate precision instrument for measurement of absolute rates of rotation in inertial space. Viscous damping is electro-mechanically controlled to maintain a constant damping ratio over the entire operating temperature range of -65°F. to $+175^{\circ}\text{F.}$

This new Honeywell Rate Gyro is designed expressly for flight control of missiles and flight instrumentation in missiles and aircraft where severe ambient conditions prevail . . . and at the same time where low threshold, minimum hysteresis, excellent linearity, high natural frequency and ruggedness are essential.

Honeywell inertial components and engineering experience are available to assist in the solution of your Gyro system problems. Write for Bulletin JRT . . . Minneapolis-Honeywell, Boston Division, Dept. 10, 1400 Soldiers Field Road, Boston 35, Mass.

Honeywell

 *Military Products Group*

DESCRIPTIVE DATA

- EXCELLENT LINEARITY: 0.25 % of full scale.
- LOW HYSTERESIS: Less than 0.1 % of full scale.
- LOW THRESHOLD: Less than 0.01 degree/second.
- MICROSYN PICKOFF: Variable reluctance type providing infinite resolution and high signal-to-noise ratio.
- FULL SCALE RATE: Up to 1000 degree/second.
- FULL SCALE OUTPUT: Up to 12 volts.
- RUGGED: Withstands 100 G shock.
- VIBRATION: Withstands 15 G to 2000 cps.
- SIZE: $2\frac{3}{4}$ " diameter $4\frac{1}{8}$ " long.
- WEIGHT: 2 lbs.

CIRCLE 296 ON READER-SERVICE CARD

Universal Measuring Instrument by R. Svoren' and V. Bol'shov. R 5/57, pp 46-50, 5 figs.

Here is a detailed description of a universal measuring instrument, transistorized and miniaturized, for the measurements of a wide range of voltages, currents, and resistances. In addition, the instrument contains a low-frequency and high-frequency signal generator. The instrument shown schematically in Fig. 2, is intended particularly for use in expeditions.

Modulation of Active Radiation for Automatic Control Devices by D. I. Ageykin, L. V. Mel'tser, and N. N. Shumilovskiy. AT 7/57, pp 686-688, 1 fig.

The use of modulated nuclear radiation uncovers new possibilities for automatic control of manufacturing processes, making it possible to obtain more reliable and accurate instruments without dc amplifiers or special converters. The article describes both mechanical and electromagnetic modulation schemes.

ELECTRON PHYSICS

Electron Guns for the Formation of Solid and Hollow Conical Beams with High Current Density by S. N. Treneva. REE 7/57, pp 925-934, 19 figs.

A description of electron guns with electrodes of simple configuration, developed for the production of solid and hollow conical beams with high current density (see Fig. 3). A method is given for the design of such guns and several graphs are provided for determination of the dimensions of the gun electrodes to meet specified parameters of the electron beam. The guns operate at zero potential on the cathode. 98-100 per cent of the total beam current passes through the aperture of such a gun. Such guns can be used in traveling wave tubes, klystrons, and other devices where high intensity solid or hollow electron beams are required. Leans heavily on the work by Pierce (Theory and Design of Electron Beams, 1949, New York) and refers to work by Langmuir & Blodgett, Physical Review, 1924, vol. 24, pp 49-59.

Nonlinear Theory of A Traveling Wave Tube. Part I. Equations and Conservation Laws by L. A. Vaynshteyn. REE 7/57, pp 883-894, 2 figs.

This paper was delivered at the First International Congress on UHF Electronics held in Paris in 1956. This part of the paper contains the equations of nonlinear theory of the traveling wave tube, taking into account the overtaking of one group of electrons by the other. It is shown that it is possible to derive from these equations two laws of conservation and conversion of energy, one in a stationary system of coordinates, and the other in a system of coordinates that moves uniformly with the initial velocity of the electrons. Various methods are given for account-

ing for the repulsion between the electrons in the electron beam. Reference is made to work by A. Nordsieck (Proceedings IRE, 1953, vol. 41, p 630) and Tien, Walker & Wolontis (Proceedings IRE, 1955, vol. 43, p 260).

Integral Energy Distribution of Electrons Behind the Output Cavity of a Transit Time Klystron by I. R. Gekker. REE 7/57, pp 895-900, 9 figs.

The integral energy distribution is obtained in this article in the kinematic approximation. A procedure for determining experimentally the above distribution using a two-cavity klystron as a model, has been attempted. When the electron beam was modulated in the output cavity, the agreement with the elementary theory was quite good. Reference is made to work by Warnecke, Chodorov, Guenard, and Ginzton "Velocity Modulated Tubes," in Advances in Electronics III, 1951, pp 41-83.

Effect of Dielectric on the Phase Constants of Spatial Harmonics of a Helix by V. P. Kryushin. REE 7/57, pp 901-911, 5 figs.

A dispersion equation is derived for a helix surrounded by a dielectric cylinder of finite thickness, using certain approximations. Good agreement is obtained in the comparison of the calculated values of the effect of the dielectric for the first backward harmonic with the measurements made of a double-wound helix made of round wire, secured by means of quartz tubes. Refers to "Traveling Wave Tube Helix Impedance" by P. K. Tien (Proceedings IRE, 1953, vol. 41, p 11, 1617-1623), "Electromagnetic Wave Propagation on Helical Structures" by S. Sensiper (Proceedings IRE, 1955, vol. 43, no. 2, p 149-161), and "The Helix as a Backward Wave Circuit Structure" by Watkins and Ash (Journal of Applied Physics, 1954, vol. 25, no. 6, pp 782-790).

Electron Conductivity of Space Charge Clouds in Magnetrons by V. P. Tychinskiy. REE 7/57, pp 912-924, 6 figs.

This is a paper delivered at the Conference of the Scientific Technical Society for Radio and Electronics in the name of A. S. Popov in May 1957. ELECTRONIC DESIGN reported on this conference in its issue of January 22, February 5, and February 19. The article represents an attempt to calculate the electron conductivity of the magnetron for the case of small amplitudes, using the mathematical theory developed by Buneman and MacFarlane (Wave Propagation in a Slipping Stream of Electrons: Small Amplitude Theory" (Proceedings of the Physical Society, 1954, VLXIII, 6-D, 409). Differential equations are derived for the distribution of the tangential component of the field and a formula is obtained for the electron conductivity introduced into the resonator system. The results of the calculations of the conductivity, of the field, and of the energy flux are given. References are made to numerous other American and British papers.

Freq. Range KMc	Band	Waveguide Number	Bendix Type Number	RE TMA Type No.	Mount Type	Recommended Mode of Operation (Note 2)	Anode Current Ma (Note 1)	Tube Drop Volts (Note 1)	Tube Excess Noise Ratio DB (Note 3)
1.12-1.70	L	RG-69/U	RXB103085	6881 7101	10°E 90°H 90°H 90°H	D.C.	250	130	15.2
			TD-21			D.C.	250	65	15.2
			TD-29			A.C. and D.C.	250	130	18.0
			TD-33			A.C. and D.C.	250	75	15.2
2.6-3.95	S	RG-48/U	TD-12	6358 6782	10°E 90°H 10°E 10°E 10°E 90°H 10°E	D.C.	250	80	15.2
			TD-22			A.C. and D.C.	250	45	15.2
			TD-31			A.C. and D.C.	250	85	15.2
			TD-32			A.C. and D.C.	250	140	18.0
			TD-34			D.C.	250	155	18.0
			TD-35			A.C. and D.C.	250	80	18.0
			TD-38			PULSE*	(250)	(90)	15.2
3.30-4.90	S	WR-229	TD-24	6852	10°E 10°E	A.C. and D.C.	250	65	15.2
			TD-30			A.C. and D.C.	250	110	18.0
3.95-5.85	C	RG-49/U	TD-10	6356	10°E 10°E 10°E	D.C.	250	70	15.2
			TD-39			PULSE*	(250)	(80)	15.2
			RXB103422			D.C.	250	(110)	18.0
5.85-8.20	X	RG-50/U	TD-10	6356	10°E 10°E 10°E	D.C.	250	70	15.2
			TD-39			PULSE*	(250)	(80)	15.2
			RXB103422			D.C.	250	(110)	18.0
8.20-12.40	X	RG-52/U	TD-11	6357 6882	10°E 10°E 10°E 90°H 90°H	D.C.	200	75	15.2
			TD-23			D.C.	200	115	18.0
			TD-40			PULSE*	(200)	(85)	15.2
			RXB103093			D.C.	200	(35)	15.2
			RXB103394			A.C. and D.C.	(100)	(50)	15.2
12.4-18.00	K	RG-91/U	TD-18	6684	10°E 10°E 10°E 10°E 90°H 90°H	D.C.	200	70	15.2
			RXB103399			D.C.	200	(110)	18.0
			RXB103409			A.C. and D.C.	(100)	(65)	15.2
			TD-41			PULSE*	200	(80)	15.2
			RXB103411			A.C. and D.C.	(100)	(50)	15.2
18.0-26.5	K	RG-53/U	TD-13	6359	10°E 10°E 10°E 90°H	D.C.	200	65	15.2
			RXB103423			D.C.	200	(100)	18.0
			TD-42			PULSE*	(200)	(75)	15.2
RXB103411	A.C. and D.C.	(100)	(50)	15.2					
26.5-40.0	K	RG-96/U	RXB103251		10°E	D.C.	(150)	(120)	15.2

NOTE 1: Anode current and tube drop are D.C. values. Values in parentheses are tentative.

NOTE 2: D.C. operation—Cathode at one end only.
A.C. and D.C. operation—Cathodes at both ends.
Pulse operation—Cathode at one end specially designed for pulse operation.

NOTE 3: The Excess Noise Ratio in DB is $10 \log \left(\frac{T_{eff}}{290} - 1 \right)$

*If the anode current during the "on time" of a square pulse (of greater than 100 micro sec. duration) is nominally the same as the rated D.C. anode current, the tube drop during this period will be approximately the same as the rated D.C. tube drop.



Microwave test equipment used in calibrating all Bendix noise source tubes.



Red Bank Division



CIRCLE 297 ON READER-SERVICE CARD

26

NEW TYPES ADDED TO BENDIX NOISE SOURCE TUBE LINE!

Expanding its line from 9 types to 35 types, Bendix Red Bank now offers a great variety of noise source tubes.

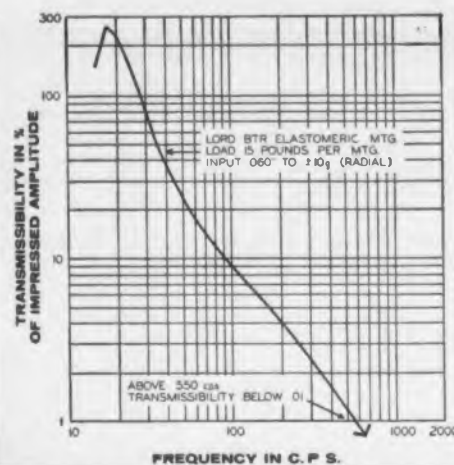
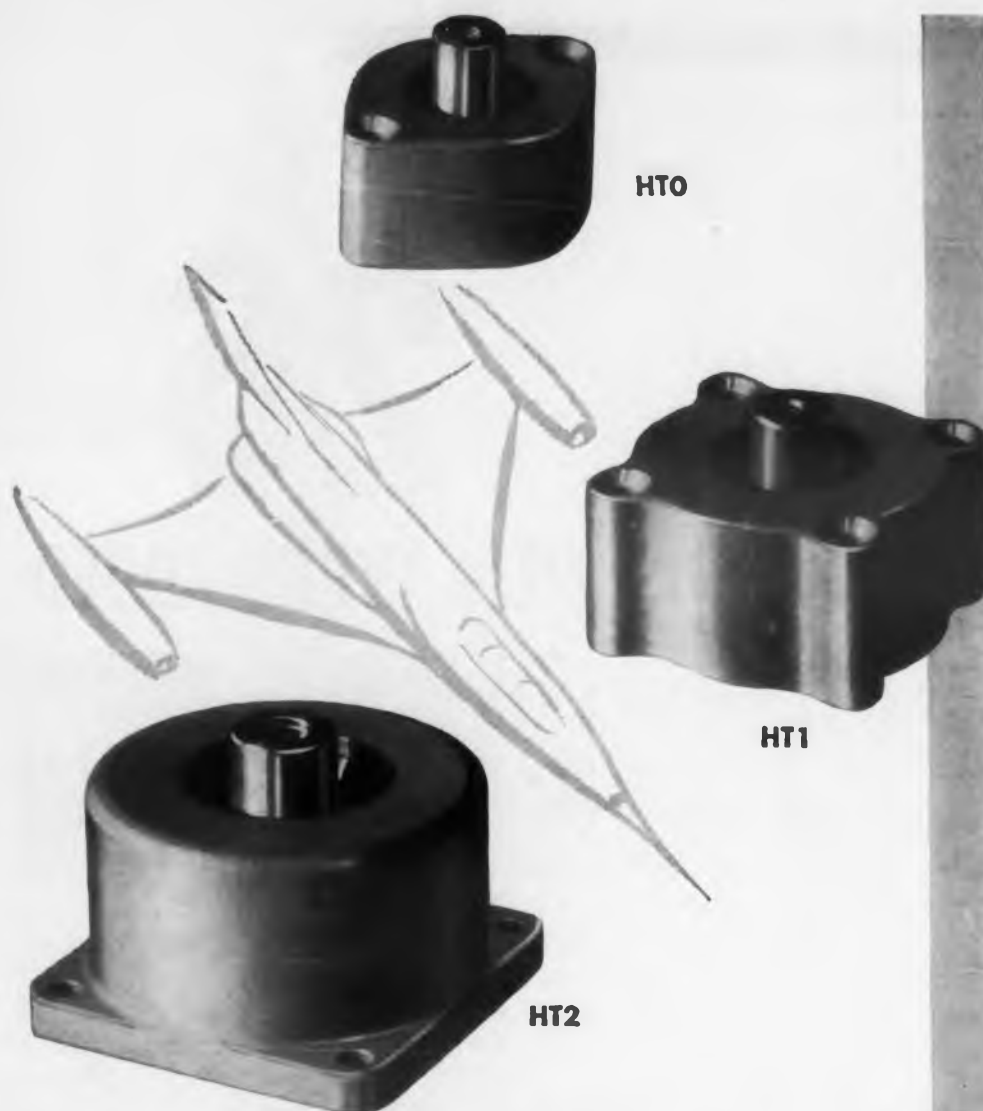
But great variety is only one advantage. Noise source tubes that are free from ambient temperature corrections are the result of making tubes so that no correction in noise figures is necessary from -55°C. to $+85^{\circ}\text{C.}$ What's more, long life and unusual stability result from precise quality control—far beyond the usually accepted tolerances for such products.

Whatever your applications, whether for 10° or 90° angle mounting, check with our specialists for the most efficient solution. Write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

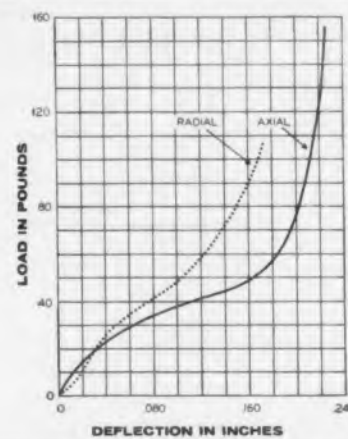
West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.

Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.

Canadian Distributor: Computing Devices of Canada, Ltd., P. O. Box 508,
Ottawa 4, Ontario



Transmissibility curve for new Lord BTR Mountings exhibits no discontinuities. Above 550 c.p.s., transmissibility is below 1%.



Non-linear axial and radial load-deflection curves show smoothly increasing shock absorption characteristics of BTR Mountings.

ABSTRACT

Electrical



Characteristics of Printed Circuit Panels

THE NATIONAL Bureau of Standards has been investigating the electrical characteristics of several types of copper-clad laminates for printed circuit applications. The results of these studies concerning temperature rise, surface resistivity, dissipation factor and dielectric constant are qualitatively discussed here. In addition, a design chart to aid in estimating temperature rise above ambient vs current for various cross sectional areas of etched copper conductors is included. A conversion chart has also been developed showing resistance per linear inch vs cross section.

[A report contained in ELECTRONIC DESIGN of January 22, 1958 discussed the tests conducted at Bell Telephone Co. to determine the "Current-Carrying Capacity of Printed Wiring." Design procedures were noted utilizing data obtained from these tests.]

Temperature Rise Measurement

A large number of measurements were made under different conditions of use on various lengths and widths of conductors bonded to a variety of materials. The curves derived indicated that cross-sectional area is a dominant factor in the ability of a conductor to carry a given current for a particular temperature rise, especially for the usual copper thickness of 0.00135 in. for 1 oz and 0.0027 in. for 2 oz. As might be expected, heavier coppers (0.004 in.) appear capable of carrying less current, and thinner

new LORD BTR mountings for airborne electronic equipment

LORD announces a new series of vibration control mountings for the protection of airborne electronic equipment. They incorporate LORD's new Broad Temperature Range elastomer—"BTR"—which combines performance-proved elastomeric advantages with extreme environmental resistance.

BTR Mountings provide excellent all-attitude vibration isolation of frequencies to 2000 c.p.s. under steady-state accelerations and transient shock conditions . . . with no standing waves, distributed system responses or "bottoming". Broad temperature operation is possible since transmissibility and resonant frequency remain virtually constant from -65° to 300°F.

The BTR elastomer combines three functions: load carrying, damping and snubbing. It resists oil and ozone, has high tensile strength, high tear resistance and good flex life.

The new mountings are designed in three basic sizes—HT0, HT1 and HT2—for loads from 3 to 80 pounds per mounting. Specification MIL-C-172B mounting hole configurations provide maximum interchangeability in standard military equipment.

For further details on the new BTR Mountings, consult your nearest LORD field engineer, or contact the Home Office, Erie, Pa.

FIELD ENGINEERING OFFICES

ATLANTA, GEORGIA - Cedar 7-1123	DAYTON, OHIO - Baldwin 4-8871
BOSTON, MASS. - Hancock 6-9135	DETROIT, MICH. - Trinity 4-2060
CHICAGO, ILL. - Michigan 2-6010	KANSAS CITY, MO. - Westport 1-0138
CLEVELAND, OHIO - ShadySide 9-3175	LOS ANGELES, CAL. - Hollywood 4-7593
DALLAS, TEXAS - Riverside 1-3392	NEW YORK, N. Y. - Circle 7-3326
PHILADELPHIA, PA. - Pennypacker 5-3559	

"In Canada—Railway & Power Engineering Corporation Limited"

LORD MANUFACTURING COMPANY • ERIE, PA.

● provide excellent
all-attitude

vibration control

● withstand extreme
environmental
conditions



designers
and producers
of bonded
rubber
products
since 1924

CIRCLE 278 ON READER-SERVICE CARD

coppers (0.00067 in.) higher current, for a given cross-sectional area.

Thickness of the laminate core material also affects the temperature-current relationship. Core materials about 1/32 in. thick exhibited some reduction in current-carrying capacity compared with heavier cores. When a solid copper backing was used, the same type of material showed a higher-current-carrying capacity.

For the usual 1/16 in. core thickness, only small differences could be noticed between single-clad and double-clad laminate panels. Samples coated with a protective plastic material produced a reduction in current-carrying capacity of about 15 to 20 per cent for a given temperature rise.

Surface Resistivity

Seven groups of XXXP-composition phenolic laminates and one of the epoxy glass-mat type were subjected to a temperature of 70 C and 95 per cent relative humidity for a period of 2000 hr to determine the effects of various protective coatings on the surface electrical resistivity of the core materials. The coatings included various epoxy resins, microwax, varnish and silicone compounds.

The variation in surface resistivity for the coated samples was generally much higher than for uncoated control samples. Little variation was found between dip-soldered and nondip-soldered samples.

Dissipation Factor

Measurements were made over a frequency range of 10^2 to 10^7 cps on the dielectric properties of a group of 16 metal-clad laminates. Individual families of curves for each laminate were developed for dissipation factor and dielectric constant at -30 C, +23 C, and +100 C. Additional measurements were made at 150 C and 200 C on materials that might be expected to be useful at these higher temperatures.

With the exception of one sample, all of the phenolic-base materials showed a general reduction in dissipation factor with an increase in temperature at a frequency of 10^6 cycles. Considerable variation in dissipation factor was observed for the entire phenolic group at the lower frequencies, particularly at the 100 C temperature level.

Two samples of the epoxy-glass mat type laminates also showed a variation in characteristics similar to the phenolics. At temperatures of 100 C or less, both samples showed less change in dissipation factor than those of the phenolic group over the entire frequency range.

For one sample of silicone G-7 material, the dissipation factor at 10^6 cycles was 0.02 or

RELIABILITY
INSIDE
THE
BLACK BOX*



The Pot Thor's thunder couldn't shake!

Only Fairchild's "Pot" Could Meet the Specs for a Big 15G Jolt
... Then Took 12G's More as a Safety Factor*

When the prime contractor on the first guidance system for the Air Force Thor missile required a potentiometer that could take punishment Fairchild was called in. Fairchild's sales engineer working with one of Fairchild's Customer Engineering Groups and the contractor's Standards Engineers, developed the rugged 1" diameter precision 10-turn potentiometer on your right.

This "pot" features a **unique mechanical wiper tab drive** perfected by Fairchild which is **separate** from the helical coil of resistance wire. This minimizes winding wear and electrical backlash thereby extending life and accuracy. Fairchild's de-

sign also offers tight linearity tolerance, high temperature performance, low noise levels and is available in resistance ranges between 1K ohms and 2 megohms, and in diameters of $\frac{3}{8}$ ", 1" and 1-13/16".

The Fairchild potentiometer line is complete. It is the result of careful research and design, of rigid incoming materials inspection, of sub-assembly and final inspection plus performance testing and environmental testing to destruction of random samples.

Write or call for the new condensed catalog — Fairchild Controls Corporation, Components Division, Dept. 12G.

*Fairchild's Built-in SAFETY FACTORS Beyond the Specs for Reliability in Performance.



THE PROBLEM: A small, multi-turn potentiometer was required for the "black box" in the Thor missile which had to withstand severe environmental conditions, and have characteristics of low noise with no discontinuity under vibration, shock and acceleration.

THE SOLUTION: A special high-reliability design of the Fairchild standard type 920, 10-turn potentiometer, a design demanding the closest tolerances, selected materials, and special assembly techniques. The result — a "pot" which delivered a safety factor beyond the specs that helps to assure reliability.

Environmental Tests	Contractors Specification	Fairchild Performance
Vibrations	2-2000 cps—15G	2-2000 cps—30G
Shock	100G	125G
Acceleration	Constant 17G	Constant 50G

In addition, the units were vibrated at resonant peaks between 2-2000 cps from 25G to 50G for 15 minutes without electrical or mechanical degradation.

Potentiometers
Rate Gyros
Pressure Transducers
Accelerometers

RELIABILITY
INSIDE
THE
BLACK BOX*

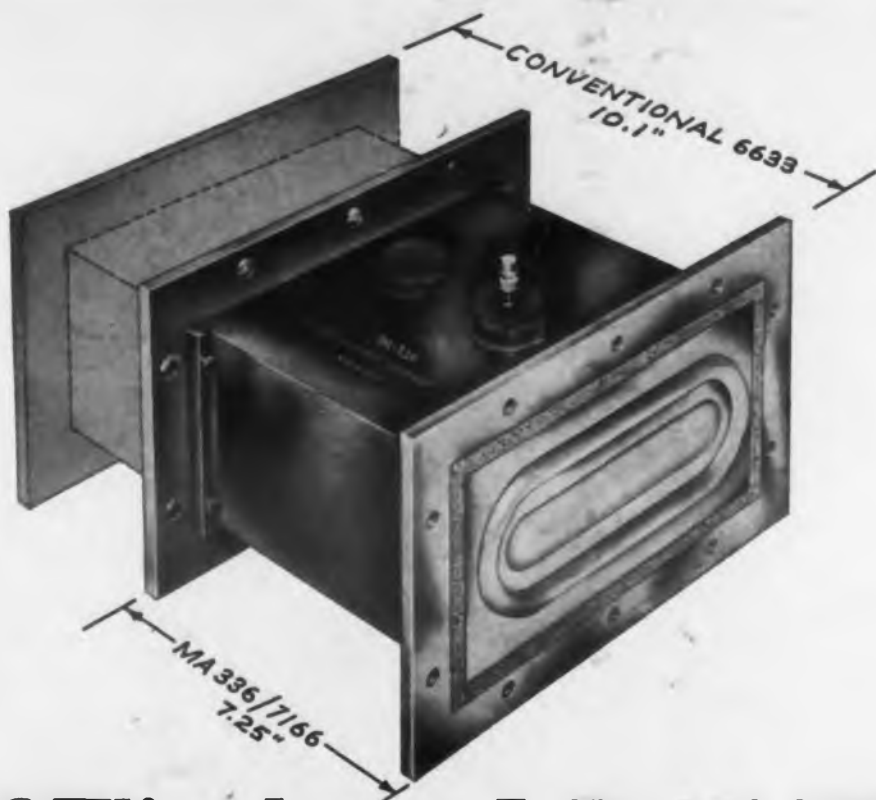
FAIRCHILD
CONTROLS CORPORATION

COMPONENTS DIVISION

225 Park Avenue
Hicksville, L. I., N. Y.

6111 E. Washington Blvd.
Los Angeles, Cal.

CIRCLE 279 ON READER-SERVICE CARD



NOW! a better L-Band TR in a smaller package

*Crystal protection guaranteed over 500 hour
minimum tube life at full rated power in
Microwave Associates new TR!*

NEW, FIELD-TESTED DESIGN

Designed specifically to overcome the field deficiencies of conventional 6633 tubes, the MA 336/7166 offers substantially improved performance in all characteristics. See comparison chart below.

Several hundred of these tubes have been in the field for many months and are used in early warning systems operating 24 hours a day.

The first failure has yet to be reported either from the field or from monthly production life tests!

The MA 336 is a compact, rugged tube built for maximum reliability and completely guaranteed for performance. It is in full production and available now.



PROGRESS IN SWITCHING DEVICES

Microwave Associates' special switching devices group under the direction of Dr. Lawrence Gould is making steady advances in the art. Available right now are high performance tubes of advanced design: high power single and dual pre-TR tubes; low level receiver protector tubes and high power ATR tubes.

If you are interested in switching high powers and in guaranteed crystal protection at any frequency write or call for full information

COMPARISON CHART

	MA 336 /7166	Conventional #6633
Crystal protection	Guaranteed for 500 hrs. min. at full rated power: 2 megawatt peak	Not guaranteed
Recovery time	Short . . . less than 25 μ seconds	Long 45 μ seconds
Low level characteristics	VSWR 1.3 max. over full band. Insertion loss: 0.5 db (.7 db at end of life.)	VSWR 1.4 max. Insertion loss: 0.7 db (1.0 db at end of life.)
Size	7.25" long	10.1" long



MICROWAVE ASSOCIATES INC.

BURLINGTON, MASSACHUSETTS • Telephone BRowning 2-3000
CIRCLE 280 ON READER-SERVICE CARD

less at temperatures up to 100 C but was influenced to a marked degree at lower frequencies.

The polytetrafluoroethylene-glass mat sample had the lowest dissipation factor of any of those tested in the group. At -30 C, the dissipation factor was nearly constant over the entire frequency range.

The nylon-base phenolic N-1 material showed good stability at the lower temperatures. At the higher temperature of 100 C, the dissipation factor increased as the frequency increased.

Dielectric Constant

The dielectric constant of the various core materials increased generally at higher temperatures. The polytetrafluoroethylene-glass mat material showed the opposite trend.

In the phenolic group the dielectric constant was lower for the XXXP materials than for the XXP and XXX materials. At 10⁶ cycles, the approximate average of the dielectric constant was 4 for the XXXP materials tested and 5 for

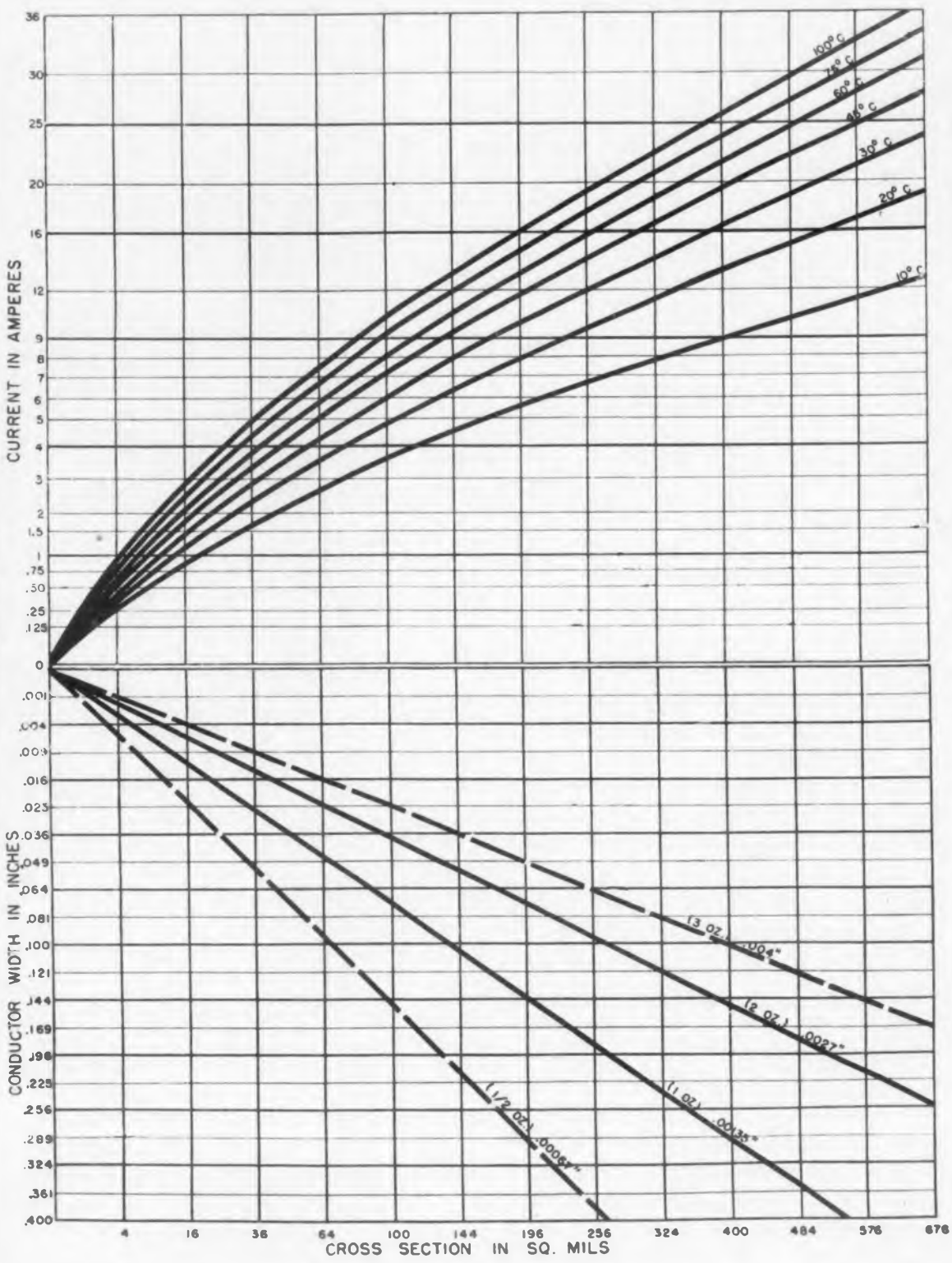


Fig. 1. This design chart is for use in determining current carrying capacity and sizes of etched copper conductors for various temperature rises above ambient.

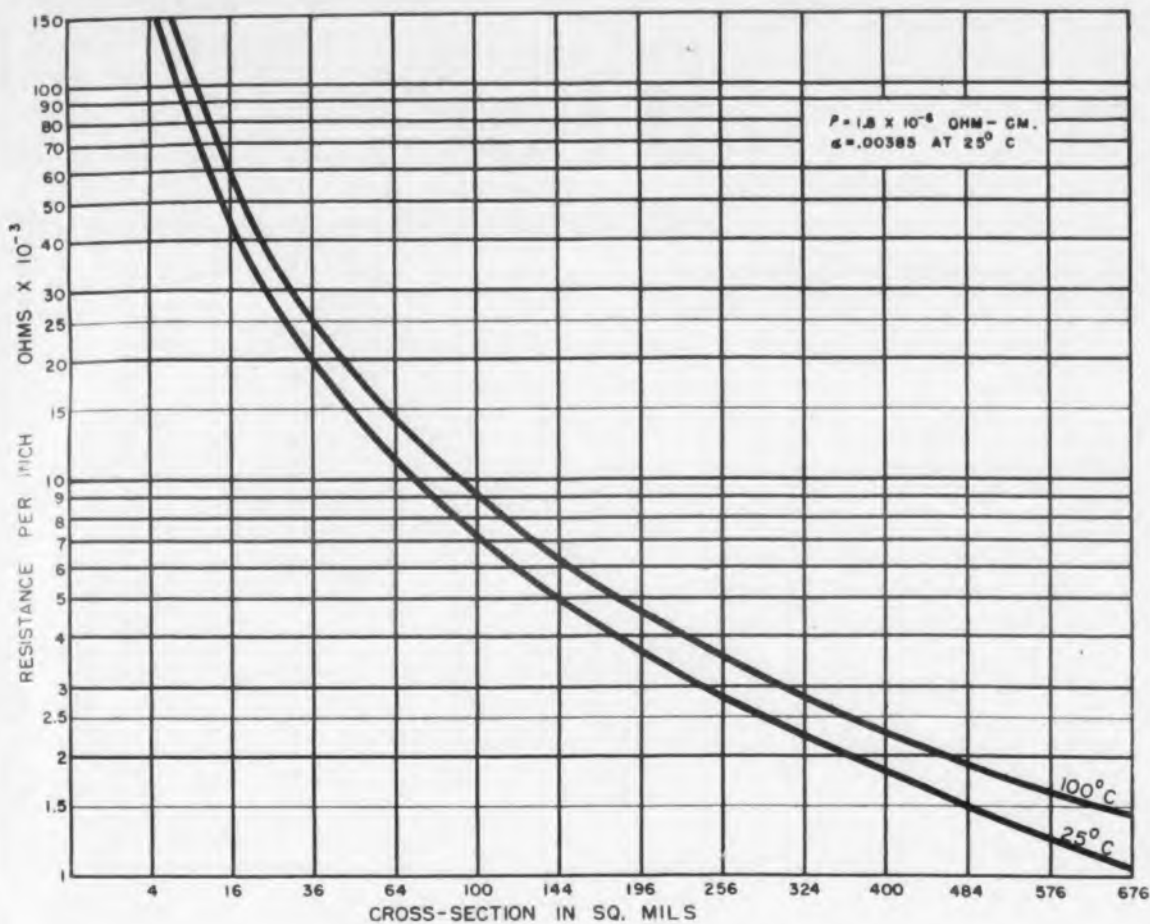


Fig. 2. Conversion chart for etched conductors.

the XXX and XXP materials. Constants for both epoxy-base samples at 10^6 cycles ranged between 5 and 6 at temperatures below 100 C. Above this temperature both samples showed increases to a value above 6.

Design Charts

A tentative design chart to aid in estimating temperature rise above ambient vs current for various cross-sectional areas of etched copper conductors is shown in Fig. 1. It is intended for use primarily with XXXP and epoxy-glass materials of 1/16 in. to 1/8 in. thickness and copper thickness of 0.00135 in. (1 oz), and 0.0027 in. (2 oz). Conductor surface area is assumed to be relatively small compared to the adjacent free panel area. The curves as presented include a nominal 10 per cent current derating to allow for variations in etching technique and conductor width estimates under optimum conditions of use. An additional current derating of up to 50 per cent should be allowed in order to compensate for different panel and copper thicknesses, the use of dip-soldering techniques, and coatings.

For single conductor applications the chart can be used directly for determining conductor widths, conductor thickness, cross-sectional area, and current-carrying capacity for various temperature rises.

For groups of similar parallel conductors, if closely spaced the temperature rise may be found by using an equivalent cross-section and an equivalent current. The equivalent cross-section is equal to the sum of the cross-sections of the parallel conductors, and the equivalent current is equal to the sum of the currents in the conductors.

Where etched coils are to be used, the maximum temperature rise can be obtained by using an equivalent cross-section equal to $2n$ times the cross-section area of the conductor, and an equivalent current equal to $2n$ times the current in the coil, n being equal to the number of turns.

The conversion chart, Fig. 2, shows resistance per linear inch vs cross-section for etched conductors. It is applicable where the IR voltage drop in a conductor may be the primary consideration instead of temperature rise.



New!

actual size

SILICON POWER RECTIFIERS

53 TYPES including military 1N253, 1N254, 1N255 and 1N256

- 200 ma to 1 amp current capability.
- Voltage ratings from 50 to 1000 vd-c.
- Reliable operation at 150°C.



Send for
bulletin 58R...



MICROWAVE ASSOCIATES INC.

Burlington, Massachusetts • BRowing 2-3000

CIRCLE 281 ON READER-SERVICE CARD

WRITE TODAY FOR

New Technical Data on MICROWAVE FERRITE MATERIALS & DEVICES



GET FULL DETAILS on Raytheon's completely new line of microwave ferrite materials and devices including the exclusive high-power L-band load isolator, miniaturized X, K_F, and K_V band isolators and others for C and S bands.

Write to W. C. Plouffe at the address below.

RAYTHEON MANUFACTURING COMPANY
Special Microwave Device Group
Seyon St., Waltham 54, Mass.



CIRCLE 282 ON READER-SERVICE CARD



Hairsprings

Manross Division of A.S.C. is one of the oldest makers of hairsprings used in instruments, meters, gauges, watches, etc. Accuracy and dependability assured. Write for hairspring booklet giving helpful design and material selection information.



**Associated
Spring
Corporation**

General Offices
Bristol, Connecticut

CIRCLE 283 ON READER-SERVICE CARD

STANDARDS AND SPECS

Sherman H. Hubelbank

Batteries

MIL-B-11814A, BATTERY, STORAGE, ZINC-SILVER OXIDE, ALKALINE, PORTABLE, 20 NOVEMBER 1957
One type of portable, alkaline, zinc-silver oxide, storage battery is covered in this spec. This 6-volt, 80-ampere-hour battery is designed for use in electronic and communication equipment. It is specifically intended for use where high rates of discharge for comparatively short periods, or high energy outputs with minimum weight and volume, are desirable. Applications in guided missiles and portable communications equipment are examples of use. This spec supersedes MIL-B-11814(SigC) and MIL-B-17425(Ships).

1,687 Reasons for Supporting ASA

Addressed to executives of corporations, this booklet answers the most asked questions that have been asked of ASA. It comments on the statement executives have most often made that all their standardization work is taken care of in the company and through their trade association. It uses hard facts and cold figures to prove that American Standards will save them money and that lack of more American Standards will cost them more money. Copies of this 32-page booklet are available from the American Standards Association, Incorporated, 70 East 45 Street, New York 17, N.Y.

Insulation Tape

MIL-I-3825, INSULATION TAPE, ELECTRICAL (POLYETHYLENE-BASE, SELF-FUSING; FOR USE IN ELECTRONIC, COMMUNICATIONS AND ALLIED EQUIPMENT), AMENDMENT 3, 6 NOVEMBER 1957
Dielectric strength requirement has been increased to 800 volts per mil and tests are now performed in the air on single thicknesses of tape. Volume sensitivity tests are now conducted on three thicknesses of fused tape. Marking will now be placed on the edge of the core.

Manuals

MIL-M-9830(USAF), PRINTING OF POCKET SIZE TECHNICAL MANUALS, AMENDMENT 1, 4 SEPTEMBER 1957

This new format for Air Force publications provides for the publishing of 8 by 4 inch books. The dimensions for the location of the drilled binding holes have been changed by Amendment No. 1.

HYPERSYN*



A MAJOR
ADVANCE IN

HYSTERESIS-SYNCHRONOUS MOTORS

Based on radically new principles; achieves a performance superior to any known hysteresis motor.

STARTS and accelerates fast as an induction motor

RUNS with a large synchronous torque and excellent damping using permanent magnets

EFFICIENCY up to 80% * Patent Pending TRADEMARK

BEKEY

ELECTRIC COMPANY, INC.
1327 S. Main St.,
Los Angeles 15, Calif.

CIRCLE 284 ON READER-SERVICE CARD

VISITORS TO THE I.R.E. CONVENTION...

Plan now to see a demonstration
of the amazing new **Flowsolder**
method of soldering printed circuits.

In answer to many requests we will conduct daily demonstrations of the new FLOW-SOLDER unit in our offices (see address below) during the I.R.E. Convention. Each demonstration will be presented to a limited number of interested engineers so that all questions may be thoroughly discussed and answered. If you want to attend one of these demonstrations, please contact Mr. Farrell (address below) and he will schedule a demonstration for you at a time that is mutually convenient. This demonstration should prove to be a "high spot" of the I.R.E. convention . . . if you cannot attend write today for complete information.

ELECTROVERT INC.

124 EAST 40th St.

NEW YORK 17, N. Y.

Telephone OXford 7-8397

CIRCLE 285 ON READER-SERVICE CARD

Excellent opportunities
at IBM

SOLID-STATE DEVELOPMENT

Excellent opportunities for well-qualified men with solid-state experience are now open at IBM, a recognized leader in the rapidly expanding electronic computer field. Current openings at IBM's Product Development Laboratory at Endicott, N. Y., are in the following:

- Solid-state physics
- Semi-conductor device evaluation
- Circuit applications of magnetic devices
- Circuit applications of semi-conductor devices
- Magnetic device evaluation
- Physical chemistry

Challenging assignments in developing solid-state circuits, using both magnetic and semi-conductor devices. Heavy interest in theoretical analysis and evaluation of pulse circuit operation and components.

Qualifications

Degree in: electrical, mechanical or chemical engineering, physics, engineering physics, mathematics, metallurgy or chemistry, and

At least one year's experience in the design and development of solid-state devices or circuits.

FOR DETAILS, just write, outlining background and interests, to:

Mr. W. R. Yapple, Dept. 555-0
Product Development
Laboratory
IBM Corporation
Endicott, N. Y.

IBM

INTERNATIONAL
BUSINESS MACHINES
CORPORATION

DATA PROCESSING
ELECTRIC TYPEWRITERS
MILITARY PRODUCTS
SPECIAL ENG'G. PRODUCTS
SUPPLIES
TIME EQUIPMENT

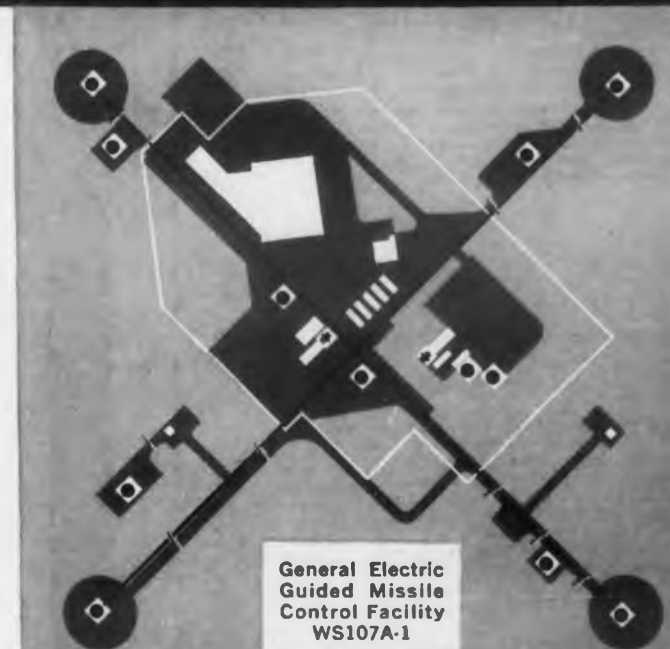
CIRCLE 550 ON READER-SERVICE CARD

GRADUATE EE'S: GENERAL ELECTRIC DISCLOSES HIGH PRIORITY PROGRAM FOR ATLAS

GUIDANCE SYSTEM. MANY POSITIONS OPEN IN ELECTRONIC MISSILE TECHNIQUES

ACCURACIES ON ORDER OF 1 PART IN 10 MILLION

*required for portions of G.E.'s
ICBM ATLAS Guidance System*



Delivering an ICBM over a > 5000 mile trajectory into the target area demands a guidance system of unprecedented accuracy—and this is the calibre of the electronic system General Electric engineers are creating for ATLAS.

But achieving designated accuracies and reliabilities in the laboratory is not enough. *These high standards must be maintained in actual operational environments, with virtually no interruption or degradation.*

CAREERS IN STEP WITH THE FUTURE

Engineers who join the Missile Guidance Product Section of G.E. are doing more than hastening development of one of the nation's most urgent programs—guidance for ATLAS. As Manager of the Section Richard L. Shetler states: *"With this job behind us, there will remain no significant obstacle to the practical guidance and navigation of other space vehicles."*

PROGRAM ACCELERATION OPENS UP WIDE RANGE OF POSITIONS IN:

- Systems analysis, evaluation & integration
- Systems and component reliability
- Transistorized circuits, pulse circuitry, IF-Video circuits
- RF and Microwave components & plumbing
- Communications control devices
- Doppler radar design & development
- Digital data processing techniques, data transmission involving D & D of ground-based & airborne antennae, transmitters, receivers; application of transducers, transponders, etc.
- Test operations, including planning, range instrumentation & test execution; development & application of automatic test equipment

If you feel that your special skills and interests fit you to work in any of the above areas, why not write us in detail? Qualified candidates will be invited to visit our facilities to meet with technical managers and gain first hand knowledge of the living advantages of our locations at Syracuse and Utica, N. Y.

Write in complete confidence to Mr. E. A. Smith, Room 3-C
MISSILE GUIDANCE PRODUCT SECTION

GENERAL  ELECTRIC

Court Street, Syracuse, N. Y.
CIRCLE 551 ON READER-SERVICE CARD

ADVERTISING INDEX

March 19, 1958

Advertiser	Page
AMP, Inc.	23
Ace Electronics Associates	62
Acme Electric Corp.	24
Adel Precision Products	102
Aero Electronics Corp.	99
Airborne Instrument Laboratory, Inc.	72
Allen-Bradley Co.	18
Allied Control Co.	65
Associated Spring Corp.	124
Augat Bros., Inc.	101
Automatic Electric Co.	28
B-I Electronics	87
Bead Chain Mfg. Co.	104
Bekey Electric Co.	124
Belden Mfg. Co.	10
Bendix Aviation Corp., Red Bank Div.	119
Cambridge Thermionic Corp.	98
Celco Constantine Engineering Labs.	102
Centralab, Div. Globe Union, Inc.	86
Chicago Aerial Industries, Inc.	70
Clare, C. P. & Co.	34
Clevite Electronic Components	41
Clevite Transistor Products	11
Communications Accessories Co.	37
Computer-Measurements Corp.	114
Cubic Corp.	106
Curtiss-Wright Corp.	96
Decker Aviation Corp.	45
Diehl Mfg. Co.	91
Dimco-Gray Co.	103
DuMont, Allen B. Laboratories, Technical Products Div.	14
DuPont, E. I. deNemours & Co., Pigment Div.	79
Eastman Kodak Co.	98
Edison, Thomas A., Inc., Instruments Div.	78
Eicor, Inc.	90
Elastic Stop Nut Corp.	98
Electric Regulator Corp.	16
Electro-Pulse, Inc.	88
Electro Snap Switch & Mfg. Co.	69
Electrovert, Inc.	124
EO Electronics, Inc.	36
Epsco, Inc.	43, 108
F-R Machine Works	73
Fairchild Controls Corp., Components Div.	121
Falstrom Co.	112
Fansteel Metallurgical Corp.	8, 100, 101
Fenwal Electronics, Inc.	87
Fischer & Porter Co.	105
Fischer Special Mfg. Co.	83
Ford Instrument Co., Inc.	62
Formica Corp.	71
Frederick Tool & Engineering Corp.	66
Fusite Corp., The	76
General Electric Co., Power Tube Div.	58
General Electric Co., Missile Guidance	125
General Hermetic Sealing Corp.	92
General Radio Co.	99
Gertsch Products Inc.	113
Goerz American Optical Co., C. P.	98
Grant Pulley & Hardware Corp.	55
Gries Reproducer Corp.	66
Guardian Electric	49
Gudebrod Bros. Silk Co., Inc.	88
Gurley, W. & L. E.	36
H & H Machine Co.	44
Hallamore Electronics Co.	19
Handy & Harman Co.	40
Haveg Industries, Inc.	113
Helipot Corp., Div. Beckman	15, 44
Hewlett-Packard Co.	126, 127
Holub Industries, Inc.	109
Hughes Aircraft Co.	7, 80, 81
Hull-Standard	70
Humphrey, Inc.	117
Hunter Mfg. Co.	68
Hycon Eastern, Inc.	93

Simple, direct hookup! Direct reading! Five 11-digit

Complete Printed Digital for Hewlett-Packard



-hp- 560A DIGITAL RECORDER

Analog output for strip-chart recorder. Expanded scale; full scale can represent $1/10^7$. Direct printout from counters; accuracy identical to counter used. Can record output of many electronic or mechanical devices.

SPECIFICATIONS

-hp- 560A/AR Digital Recorder

Accuracy:	Identical to counter used.
Printing Rate:	5 lines/sec maximum.
Digit Capacity:	11 per line.
Driving Source:	Parallel entry staircase voltages. Descending from 135 to 55 v, 0 to 9.
Analog Output:	Proportional to any 3 digits selected. Maximum amplitude 1 ma or 100 mv.
Print Command Signal:	1 μ sec minimum, pos. or neg. 15 v per pulse.
Paper:	3" roll or folded.
Line Spacing:	Single or double, adjustable.
Price: -hp- 560A/AR:	(11 digit, cabinet model) \$1,390.00 (11 digit, rack mount) 1,375.00 (6 digit, cabinet model) 1,265.00 (6 digit, rack mount) 1,250.00

Data subject to change without notice. Prices f.o.b. factory.

New -hp- 560A Digital Recorder works direct with all -hp- counters and most other precision electronic counters; no intermediate equipment is needed. It provides a complete record of all types of test data, plus, through an analog output, a convenient graphic record of very small data variations.

The analog output for driving a strip chart recorder is a voltage or current proportional to the number represented by any three consecutive digits of recorded data. The 560A permits expanded scale strip chart recording and the strip chart can never be driven off scale since range variation for the 3-digit scale is 0 to 999. Wider variation merely causes a repetition of the 0 to 999 sequence.

Model 560A is a complete, self-contained electronic instrument normally controlled by staircase voltages and a print command pulse from an electronic counter. It may, however, be controlled by other electronic or electro-mechanical devices. Printing speed is five, 11-digit lines per second; secondary or coding data may be entered simultaneously with primary data.

Maximum print capacity of the recorder is five, 11-digit lines per second but instruments can be supplied with any lesser number of digits desired.

 offers the most complete line

lines per second!

Record Counters

-hp- Electronic Counters

-hp- 524B Electronic Counter. Measures frequency 10 cps to 220 MC, time interval 1 μ sec to 100 days, period 0 cps to 10 KC. Basic -hp- 524B Counter, 10 cps to 10 MC, \$2,150.00. Plug-in Frequency Converters, Video Amplifiers, Time Interval Unit and Period Multiplier, \$150.00 to \$250.00.

-hp- 521A/C Industrial Counter. Accurate, low cost industrial instrument. Measures frequency, speed, random events, rpm, etc. Direct readings 1 cps to 120 KC. Time of count 0.1 to 1.0 seconds, variable display time. -hp- 521A has 4 place registration; -hp- 521C has 5 place registration, crystal controlled time base. -hp- 521C, \$650.00. -hp- 521A, \$475.00.

-hp- 522B Electronic Counter. Compact, versatile instrument for frequency, period or time measurements. Measures frequency 10 cps to 120 KC, time interval 10 μ sec to 10⁵ sec. Reads direct in cps, KC, seconds, milliseconds. \$915.00.

-hp- 523B Electronic Counter. All-purpose counter measures frequency 10 cps to 1.1 MC, time interval 3 μ sec to 27.8 hours, period 0.00001 cps to 10 KC. Stability 2/1,000,000 per week. Reads direct in sec, msec, μ sec or KC; automatic decimal. Display variable 0.1 sec to 5 sec or indefinite. \$1,175.00.

See your -hp- representative or
write direct for details

HEWLETT-PACKARD COMPANY

4648K Page Mill Road • Palo Alto, California, U.S.A.
Cable "HEWPACK" • DAVenport 5-4451
Field Representatives in all Principal Areas

-hp- at IRE
... top of escalators as you enter show

of precision electronic counters

CIRCLE 307 ON READER-SERVICE CARD



Satellite performance...

NEW -hp- RECORDER PROVIDES VITAL DOPPLER HEIGHT, RANGE DATA!

Two -hp- 560A Digital Recorders and two -hp- 523B Frequency Counters, connected to radio receivers, provided important orbital data on Soviet satellites. The installation in Figure 1 (photo courtesy Stanford Research Institute) shows the equipment arrangement which produced the tape showing frequency shift in cps (Figure 2) and strip chart recordings (Figure 3). Calculation based on Doppler shift is an efficient method of determining satellite range, height and other orbital information. Simultaneous Doppler records from differing frequencies provide propagation data. (See -hp- Journal Vol. 9, No. 3-4, for more details.)



Figure 1. -hp- digital recorders, counters and dual trace oscilloscope assembled for satellite tracking.

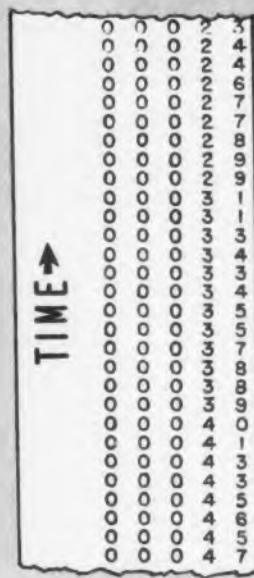


Figure 2. Printed tape from -hp- 560A similar to that used during satellite measurements. Note Doppler frequency shift in cps.

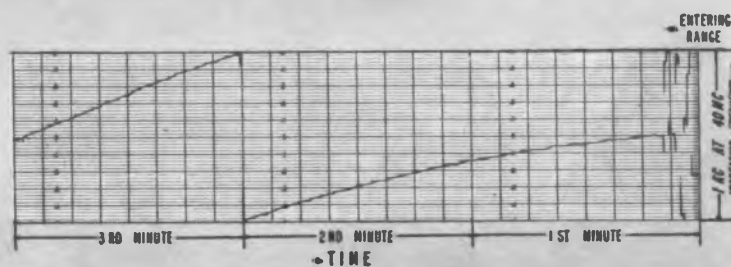


Figure 3. Strip-chart recording of 40 MC transmission from Soviet satellite. Note Doppler shift during 3-minute period when satellite transmitter was continuously keyed.

Advertiser

Page

Illinois Condenser Co.	102
Induction Motors Corp.	25
International Business Machines Corp.	125
International Instruments, Inc.	60
International Resistance Co.	2

JFD Mfg. Co.	57
J-V-M Microwave Co.	86

Kay Electric Co.	111
Kester Solder Co.	54

Landis & Gyr, Inc.	104
Licon Switch, Div. Illinois Tool Works	66
Litton Industries	31
Lord Mfg. Co.	120

Magnetics, Inc., Components Div.	35
Martin Co., The	82, 83
Micro Switch	84, 85
Microwave Associates, Inc.	122, 123
Miniature Precision Bearings	50
Minneapolis-Honeywell Co., Boston Div.	118
Minneapolis-Honeywell Co., Industrial Div.	47

Ohmite Mfg. Co.	64, 65
----------------------	--------

PSP Engineering Co.	109
Panoramic Radio Products Inc.	91
Philco Corp., Lansdale Tube Div.	12
Pike, E. W. & Co., Inc.	54
Plastic Products, Div. Raybestos Manhattan, Inc.	72
Potter Instrument Co.	3
Prodelin, Inc.	42
Pyramid Electric Co.	92

Radio Corporation of America	128
Radio Industries, Inc.	39
Radio Receptor Co.	67
Raytheon Mfg. Co., Maynard Labs.	38
Raytheon Mfg. Co., Microwave & Power Tubes	6
Raytheon Mfg. Co., Semiconductor Div.	4, 9
Raytheon Mfg. Co., Special Microwave Devices	124
Reeves-Hoffman Div.	100
Resistance Products Co.	97
Rex Corp., The	97

Sanders Associates, Inc.	107
Sangamo Electric Co.	17
Sel-Rex Precious Metals, Inc.	113
Servo Corp. of America	109
Sola Electric Co.	89
Sorensen & Co., Inc.	63
Southern Screw Co.	90
Space Technology Laboratories, Div. Ramo Wooldridge	65
Sperry Gyroscope Co.	53, 77
Staedtler, J. S., Inc.	33
Statham Instruments, Inc.	60
Stevens Mfg. Co.	13
System Development Corp.	89

Technology Instrument Corp.	26
Thermosen, Inc.	115
Transitron Electronic Corp.	59, 61
Tung-Sol Electric Co.	74, 75

Unimax Switch Div.	114
United States Gasket Co.	46

Victoreen Instrument Co.	64
Voltron Products	98

Waldorf Instruments	94, 95
Waterman Products Co.	103
Weckesser Co.	50
Weinschel Engineering & Mfg. Corp.	109
Welwyn International, Inc.	110
Westinghouse Electric Corp., Industrial Tube Div.	64
Weston Electrical Instrument Co.	51
Wilmad Glass Co.	68

Zell Products Corp.	110, 111
Zero Mfg. Co.	98
Zippertubing Co.	93

RCA TRANSISTORS

RCA GERMANIUM ALLOY-JUNCTION TRANSISTORS FOR COMPUTER APPLICATIONS			
Type	Typical Alpha-Cutoff Frequency-Mc	Typical DC-Current Transfer Ratio Value at Collector Ma.	Maximum Collector Ma.
n-p-n Types for Medium-Current Switching Applications			
NEW 2N356*	3	30 at +100	+500
NEW 2N585*	5	40 at +20	+200
n-p-n Types for High-Current Switching Applications			
NEW 2N357*	6	30 at +200	+500
NEW 2N358*	9	30 at +300	+500
p-n-p Types for Medium-Current Switching Applications			
NEW 2N581*	8	30 at -20	-100
2N404*	12	40 at -20	-100
NEW 2N582*	18	60 at -20	-100
NEW 2N583	8	30 at -20	-100
2N269	12	40 at -20	-100
NEW 2N584	18	60 at -20	-100
p-n-p Types for High-Current Switching Applications			
NEW 2N578*	5	15 at -400	-400
NEW 2N579*	8	30 at -400	-400
NEW 2N580*	15	45 at -400	-400
p-n-p Type for High-Voltage (-105 Volts) Switching Applications			
2N398*	0.7	60 at -5	-100

*Made in proposed Jetec size-group 30 Case

...a comprehensive line offering superior performance in computer designs

RCA's line now includes 14 types specifically designed to meet the demand from computer manufacturers for electrically *uniform and reliable* transistors. Your RCA Field Representative or your authorized RCA Semiconductor Products Distributor will be glad to discuss with you the many advances being made by RCA in this area of electronics. Specify RCA transistors for *your* computer designs. For technical data on specific types, write RCA Commercial Engineering, Sec. C-18-NN-2, Somerville, N. J.

RCA FIELD OFFICES

EAST 744 Broad Street
Newark, N. J.
HUmboldt 5-3900

MIDWEST . . . Suite 1181
Merchandise Mart Plaza
Chicago, Ill.
WHitehall 4-2900

WEST 6355 E. Washington Blvd.
Los Angeles, Calif.
RAYmond 3-8361

GOV'T 224 N. Wilkinson Street
Dayton, Ohio
BALdwin 6-2366
1625 "K" Street, N. W.
Washington, D. C.
District 7-1260



RADIO CORPORATION OF AMERICA

Semiconductor Division

Somerville, N. J.

HAYDEN PUBLISHING COMPANY, INC.
830 Third Avenue, New York 22, N. Y.

DESIGN

◀ CIRCLE 470 ON READER-SERVICE CARD

ELECTRONIC DESIGN

APRIL 2, 1958

THE LIBRARY OF
CONGRESS
SERIAL RECORD

APR 2 - 1958

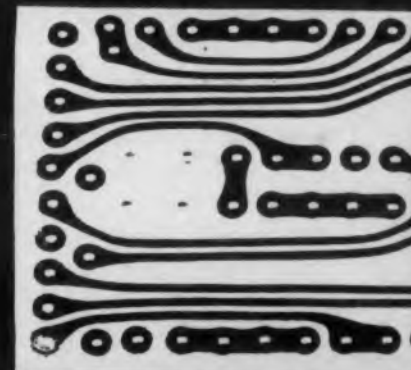
copy

505031

pc

pc

pc



EPON[®] RESINS

... preferred for potting

If potting, laminating, sealing or encapsulation are factors in your operation, you should investigate Epon resins. Because they provide a unique combination of desired electrical and physical properties, they are finding increased use in many phases of the electrical industry.

Potting and Encapsulation . . . Epon resins offer remarkable adhesive properties, forming strong bonds to metals and glass, and creating airtight enclosures for sensitive components and vacuum tubes.

Sealing . . . Epon resin-based compounds are ideal for moisture sealing even at elevated temperatures.

Laminating . . . Epon resin, laid up with inert fibrous fillers, produces laminates with superior dielectric properties and moisture resistance. Epon resin laminates can be dip soldered, sheared, punched and drilled, and provide excellent dimensional stability.

And, solvent-free Epon resin adhesive formulations . . . between glass, metal, or plastic . . . cure at room temperature with contact pressure alone.

Can Epon resins solve a production problem for you? For assistance and technical literature, write us now.



These miniature electronic components potted in Epon resin will withstand solder bath temperatures and retain excellent dimensional stability.

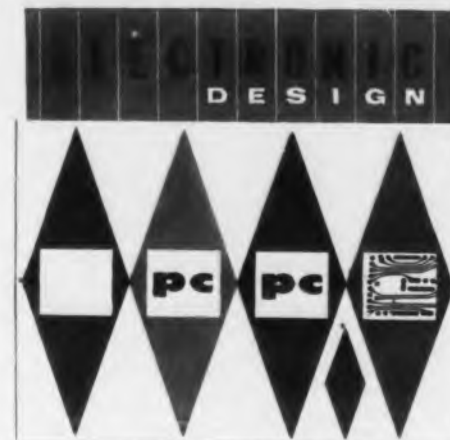


Sections of magnetic amplifier coils, when embedded in Epon resin, have exceptional resistance to solvents and chemicals

SHELL CHEMICAL CORPORATION CHEMICAL SALES DIVISION

Atlanta • Boston • Chicago • Cleveland • Detroit • Houston • Los Angeles • Newark • New York • San Francisco • St. Louis
IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited, Montreal • Toronto • Vancouver

CIRCLE 1 ON READER-SERVICE CARD



COVER STORY

Copper-Metallized P-C Boards Have High Bond Strength and Withstand 250 C 18

Starting with clear photographic glass, step 1 above, an image is exposed, step 2, (in P-C's the images are holes). Holes are chemically machined in this new glass-type ceramic P-C base, step 3. Copper circuit runs are plated on, step 4. Bond of copper to substrate is exceptionally high and not affected by solder pot temperatures. Components can be removed and resoldered with a hot iron with no deleterious effect.

The Resisting Transistor for Servo Design 14

By using a transistor as a "resisting device" in a servo amplifier you get twice the output expected from Class B output stages. The efficiency is as high as 95 per cent. In the resisting transistor output stage, voltage across the load is in phase with that across the conducting resistor. The transistor acts as a variable resistor between the power supply and the load. Power delivered to the load is greater than maximum dissipation.

How to Correct Phase Distortion with an L-C Lattice 20

Since real electrical circuits do not always provide desirable phase characteristics, special networks are often required to control phase distortion. Mr. Fogarty shows how to use a universal phase curve to design lattices to do the job.

3 issues this month. Watch for April 16, and special Thermistor report April 30.

ELECTRONIC DESIGN

DATA REQUEST PROCESS CARD
Use Before May 14th, 1958



Name

Title

Company

Company Address

City

Zone

State

For Change of Address:
Old Company Name

Old Company
Address

10	20	30	40	100	110	120	130	140	200	210	220	230	240	300	310	320	330	340	400	410	420	430	440	500	510	520	530	540	
1	11	21	31	41	101	111	121	131	141	201	211	221	231	241	301	311	321	331	341	401	411	421	431	441	501	511	521	531	541
2	12	22	32	42	102	112	122	132	142	202	212	222	232	242	302	312	322	332	342	402	412	422	432	442	502	512	522	532	542
3	13	23	33	43	103	113	123	133	143	203	213	223	233	243	303	313	323	333	343	403	413	423	433	443	503	513	523	533	543
4	14	24	34	44	104	114	124	134	144	204	214	224	234	244	304	314	324	334	344	404	414	424	434	444	504	514	524	534	544
5	15	25	35	45	105	115	125	135	145	205	215	225	235	245	305	315	325	335	345	405	415	425	435	445	505	515	525	535	545
6	16	26	36	46	106	116	126	136	146	206	216	226	236	246	306	316	326	336	346	406	416	426	436	446	506	516	526	536	546
7	17	27	37	47	107	117	127	137	147	207	217	227	237	247	307	317	327	337	347	407	417	427	437	447	507	517	527	537	547
8	18	28	38	48	108	118	128	138	148	208	218	228	238	248	308	318	328	338	348	408	418	428	438	448	508	518	528	538	548
9	19	29	39	49	109	119	129	139	149	209	219	229	239	249	309	319	329	339	349	409	419	429	439	449	509	519	529	539	549
50	60	70	80	90	150	160	170	180	190	250	260	270	280	290	350	360	370	380	390	450	460	470	480	490	550	560	570	580	590
51	61	71	81	91	151	161	171	181	191	251	261	271	281	291	351	361	371	381	391	451	461	471	481	491	551	561	571	581	591
52	62	72	82	92	152	162	172	182	192	252	262	272	282	292	352	362	372	382	392	452	462	472	482	492	552	562	572	582	592
53	63	73	83	93	153	163	173	183	193	253	263	273	283	293	353	363	373	383	393	453	463	473	483	493	553	563	573	583	593
54	64	74	84	94	154	164	174	184	194	254	264	274	284	294	354	364	374	384	394	454	464	474	484	494	554	564	574	584	594
55	65	75	85	95	155	165	175	185	195	255	265	275	285	295	355	365	375	385	395	455	465	475	485	495	555	565	575	585	595
56	66	76	86	96	156	166	176	186	196	256	266	276	286	296	356	366	376	386	396	456	466	476	486	496	556	566	576	586	596
57	67	77	87	97	157	167	177	187	197	257	267	277	287	297	357	367	377	387	397	457	467	477	487	497	557	567	577	587	597
58	68	78	88	98	158	168	178	188	198	258	268	278	288	298	358	368	378	388	398	458	468	478	488	498	558	568	578	588	598
59	69	79	89	99	159	169	179	189	199	259	269	279	289	299	359	369	379	389	399	459	469	479	489	499	559	569	579	589	599

Home Address

City

Zone

State

For Personnel Ads Only
(Nos. 550-599)

ELECTRONIC DESIGN

DATA REQUEST PROCESS CARD
Use Before May 14th, 1958



Name

Title

Company

Company Address

City

Zone

State

For Change of Address:
Old Company Name

Old Company
Address

10	20	30	40	100	110	120	130	140	200	210	220	230	240	300	310	320	330	340	400	410	420	430	440	500	510	520	530	540	
1	11	21	31	41	101	111	121	131	141	201	211	221	231	241	301	311	321	331	341	401	411	421	431	441	501	511	521	531	541
2	12	22	32	42	102	112	122	132	142	202	212	222	232	242	302	312	322	332	342	402	412	422	432	442	502	512	522	532	542
3	13	23	33	43	103	113	123	133	143	203	213	223	233	243	303	313	323	333	343	403	413	423	433	443	503	513	523	533	543
4	14	24	34	44	104	114	124	134	144	204	214	224	234	244	304	314	324	334	344	404	414	424	434	444	504	514	524	534	544
5	15	25	35	45	105	115	125	135	145	205	215	225	235	245	305	315	325	335	345	405	415	425	435	445	505	515	525	535	545
6	16	26	36	46	106	116	126	136	146	206	216	226	236	246	306	316	326	336	346	406	416	426	436	446	506	516	526	536	546
7	17	27	37	47	107	117	127	137	147	207	217	227	237	247	307	317	327	337	347	407	417	427	437	447	507	517	527	537	547
8	18	28	38	48	108	118	128	138	148	208	218	228	238	248	308	318	328	338	348	408	418	428	438	448	508	518	528	538	548
9	19	29	39	49	109	119	129	139	149	209	219	229	239	249	309	319	329	339	349	409	419	429	439	449	509	519	529	539	549
50	60	70	80	90	150	160	170	180	190	250	260	270	280	290	350	360	370	380	390	450	460	470	480	490	550	560	570	580	590
51	61	71	81	91	151	161	171	181	191	251	261	271	281	291	351	361	371	381	391	451	461	471	481	491	551	561	571	581	591
52	62	72	82	92	152	162	172	182	192	252	262	272	282	292	352	362	372	382	392	452	462	472	482	492	552	562	572	582	592
53	63	73	83	93	153	163	173	183	193	253	263	273	283	293	353	363	373	383	393	453	463	473	483	493	553	563	573	583	593
54	64	74	84	94	154	164	174	184	194	254	264	274	284	294	354	364	374	384	394	454	464	474	484	494	554	564	574	584	594
55	65	75	85	95	155	165	175	185	195	255	265	275	285	295	355	365	375	385	395	455	465	475	485	495	555	565	575	585	595
56	66	76	86	96	156	166	176	186	196	256	266	276	286	296	356	366	376	386	396	456	466	476	486	496	556	566	576	586	596
57	67	77	87	97	157	167	177	187	197	257	267	277	287	297	357	367	377	387	397	457	467	477	487	497	557	567	577	587	597
58	68	78	88	98	158	168	178	188	198	258	268	278	288	298	358	368	378	388	398	458	468	478	488	498	558	568	578	588	598
59	69	79	89	99	159	169	179	189	199	259	269	279	289	299	359	369	379	389	399	459	469	479	489	499	559	569	579	589	599

Home Address

City

Zone

State

For Personnel Ads Only
(Nos. 550-599)

VIA
AIR
MAIL

FIRST CLASS
Permit No. 725
New York, N. Y.

B U S I N E S S R E P L Y C A R D

No Postage Stamp Necessary If Mailed In U. S.

8 CENTS AIR MAIL POSTAGE WILL BE PAID BY

ELECTRONIC DESIGN
Statistical Tabulating Dept.

830 Third Avenue
New York 22, New York

VIA
AIR
MAIL

FIRST CLASS
Permit No. 725
New York, N. Y.

B U S I N E S S R E P L Y C A R D

No Postage Stamp Necessary If Mailed In U. S.

8 CENTS AIR MAIL POSTAGE WILL BE PAID BY

ELECTRONIC DESIGN
Statistical Tabulating Dept.

830 Third Avenue
New York 22, New York

SUBSCRIPTION POLICY

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies. If design for manufacturing is your responsibility, you qualify for subscription without charge provided you send us the following information on your company's letter head: Your name and engineering title, your company's main products, and description of your design duties. The letter must be signed by you personally. Any address changes for old subscribers necessitates a restatement of these qualifications. Subscription rate for non-qualified subscribers—\$15.00 for 1 year only.

Hayden Publishing Co., Inc., 830 Third Avenue, New York 22, N.Y.

CONTENTS

Editorial	13	The Engineer with a Job Knows No Recession
Engineering Review	5	Processing Pictorial Information on Digital Computers
Features	14	The "Resisting Transistor" for Servo Design, T. R. Nisbet
	18	Copper-Metallized P-C Boards
	20	How to Correct Phase Distortion with an L-C Lattice, J. D. Fogarty
	24	Two-Gyro Master Reference
Ideas for Design	42	Digital Signal Checker
	42	Servo Null Detector
	43	A Variable Inductor
Russian Abstract	48	Electronics in the USSR
Departments	12	Meetings
	26	New Products
	44	New Literature
	50	Services for Designers
	51	Advertisers' Index



ELECTRONIC DESIGN is published bi-weekly by Hayden Publishing Company, Inc., 830 Third Avenue, New York 22, N. Y., T. Richard Gascoigne, President; James S. Mulholland Jr., Vice-President & Treasurer; and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Accepted under section 34.6. P. L. & R. authorized. Copyright 1958 Hayden Publishing Company, Inc. 30,000 copies this issue.

APR -1 1958

**Dependability
and long life
previously available
only in
high-cost relays...**

G-V

RED / LINE

**low-cost thermal
timing relays**



The sound design, sturdy construction and reliable operation long associated with G-V Hermetically Sealed Thermal Relays is available in a low-cost form, fully qualified for industrial control . . . light and inexpensive enough for electronic and communications circuits.

Delays of 2 seconds to 3 minutes • Energizing voltages - 6.3 to 230 AC or DC.

• **RUGGED STAINLESS STEEL MECHANISM**

Relay mechanism is of stainless steel, differential expansion type, used in all G-V Thermal Relays. All parts are welded into a single integral structure.

• **SHATTERPROOF—NO GLASS**

No glass is used in mechanism, encasing shell, or base. This avoids the danger of cracking or breakage in handling and use.

• **STEEL ENCASED HEATERS**

Heating elements are conservatively designed, wound with Ni-chrome wire on mica and encased in stainless steel, insuring long heater life even when energized continuously.

• **DUST TIGHT ENCLOSURE**

A dust tight metal shell completely enclosing the relay mechanism and contacts, crimped tightly to the base, provides complete protection for the structure.

• **TAMPER PROOF**

Time delay intervals are preset at the factory. Thus changes of delay interval in the field which might damage associated equipment are avoided.

• **DIRECTLY INTERCHANGEABLE**

Directly interchangeable with all other octal-size relays.



Available through Selected Distributors



G-V CONTROLS INC.
18 Hollywood Plaza, East Orange, New Jersey

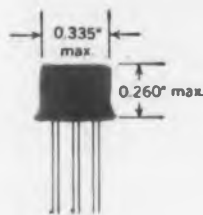
Write for Publication 131.

U. S. PAT. 2,700,084 OTHER U. S. & FOREIGN PATENTS PENDING

NPN as well as PNP... only RAYTHEON offers both



New NPN SILICON TRANSISTORS



NEW RAYTHEON NPN HIGH TEMPERATURE SILICON TRANSISTORS

Type	Reverse Current at -20V*		Beta	Base Resistance ohms	Collector Resistance kilohms	Noise Figure db(max.)	Collector Capacity $\mu\mu\text{f}$	Alpha Freq. Cutoff KC
	Collector μA	Emitter μA						
2N619	0.005	0.005	14	2000	500	30	35	200
2N620	0.005	0.005	25	2500	500	30	35	350
2N621	0.005	0.005	50	2700	500	30	35	500
2N622	0.005	0.005	20	2400	500	15	35	300

RAYTHEON PNP HIGH TEMPERATURE SILICON TRANSISTORS

Type	Reverse Current at -20V*		Beta	Base Resistance ohms	Collector Resistance kilohms	Noise Figure db(max.)	Collector Capacity $\mu\mu\text{f}$	Alpha Freq. Cutoff KC
	Collector μA	Emitter μA						
2N327A	0.005	0.005	14	1200	500	30	65	200
2N328A	0.005	0.005	25	1400	500	30	65	300
2N329A	0.005	0.005	50	1500	500	30	65	400
2N330A	0.005	0.005	18	1300	500	15	65	250

All ratings are for 25°C. For all types: Dissipation Coefficient in air, 0.4°C/mW; infinite sink, 0.25°C/mW.

RAYTHEON SEMICONDUCTOR DIVISION
Silicon and Germanium Diodes and Transistors • Silicon Rectifiers

Newton, Mass..... .55 Chapel St., Bigelow 4-7500
New York:..... .589 Fifth Ave., Plaza 9-3900
Chicago: 9501 Grand Ave., Franklin Park, National 5-6130
Los Angeles: 5236 Santa Monica Blvd., NOrmandy 5-4221

CIRCLE 3 ON READER-SERVICE CARD

STAFF

Editor	Edward E. Graza
Managing Editor	J. A. Lippke
Associate Editor	L. D. Shergalis
Associate Editor	G. H. Rostky
Assistant Editors	T. E. Mount D. S. Viebig E. T. Blake M. M. Robinson B. Patrusky
Contributing Editors	S. H. Hubelbank J. M. Montseram J. G. Adashko E. Brenner
Editorial Assistants	F. Muehleck M. S. Buckley N. A. Leftwich H. E. Dadinis
Art Director	S. Sussman
Asst. Art Director	R. A. Schulze
Designer	S. F. Richter
Production Manager	T. V. Sedita
Asst. Prod. Manager	M. D. Hedrick
Production Assistant	J. Siegel
Business Manager	P. L. Canfield
Circulation Manager	N. M. Elston
Asst. Circ. Manager	A. C. Lovett
Reader Service	E. Hession

CO-PUBLISHERS

T. Richard Gascoigne
James S. Mulholland, Jr.

ADVERTISING REPRESENTATIVES

Advertising Sales Manager

Bryce Gray, Jr.

New York: Owen A. Kean
830 Third Avenue
Plaza 1-5530
Robert W. Gascoigne
Blair McClenahan
Richard Parker
James P. Quinn
Charles C. Wadsworth

Chicago: Thomas P. Kavooras
664 N. Michigan Ave.
SUperior 7-8054
Berry Conner, Jr.
Fred T. Bruce

Los Angeles: Robert E. Ahrensford
5720 Wilshire Blvd.
WEbster 8-3881
John Quillman
Stanley I. Ehrenclou

San Francisco: Stanley I. Ehrenclou
260 Kearny Street
EXbrook 7-0690

London: Michael B. Horne
56 Deane Croft Road
Eastcote, Middlesex
England

ENGINEERING REVIEW

For more information on developments described in "Engineering Review," write directly to the address given in the individual item.

Processing Pictorial Information on Digital Computers

Exploratory experiments involving the use of general purpose digital computers to help understand the nature of pictorial information are being conducted by National Bureau of Standards.

To feed pictorial information to the Bureau's Electronic Computer (SEAC), a simple mechanical drum scanning device digitalizes the information as illustrated in Fig. 1. Through associated scanner circuitry, a dark square on the picture is

converted into a binary 1. A sufficiently white square produces a binary 0.

To display a picture that has been fed into the computer from the scanner, a program was prepared to derive a pair of coordinate numbers for the position of each binary 1 in the picture stored in the memory. When decoded, the numbers produce a pair of analog voltages that are

(Continued on following page)

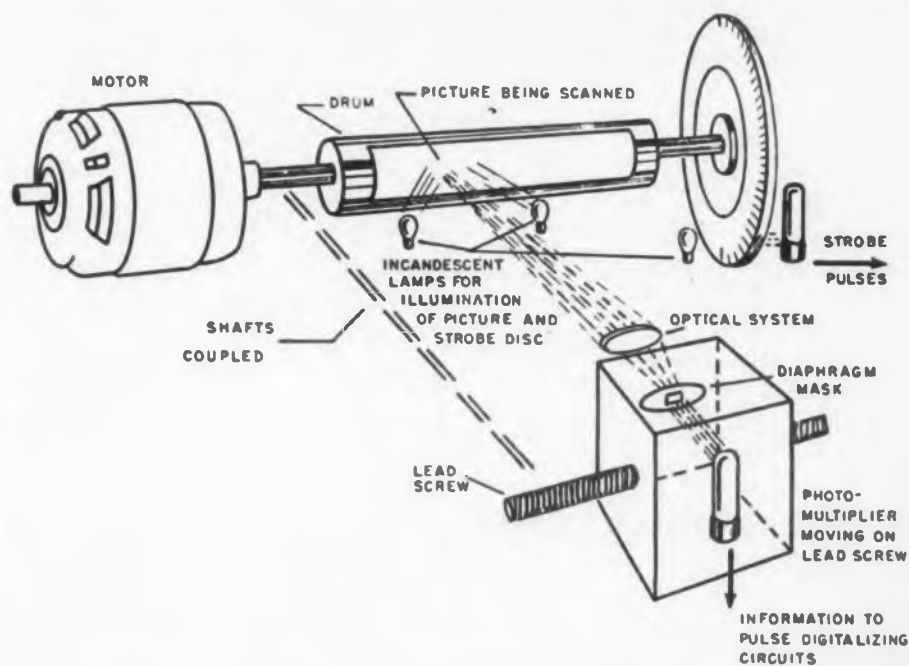


Fig. 1. Photograph to be scanned is mounted on a drum 2/3 in. in diam. As the drum rotates a photomultiplier and a source of illumination mounted on a lead screw move parallel to the axis of the drum. A mask in the optical system illuminates a 0.25 mm square and a strobe disc produces optical pulses for each 0.25 mm of drum rotation. The photo-multiplier can examine the relative reflectance of each 0.25 mm square.



Raytheon — World's Largest Manufacturer of Magnetrons and Klystrons

MAGNETRONS • KLYSTRONS
BACKWARD WAVE OSCILLATORS
SPECIAL PURPOSE TUBES



microwave tube
CHARACTERISTICS

RAYTHEON MANUFACTURING COMPANY

**NOW AVAILABLE—
WITHOUT CHARGE**

**New Consolidated
Data Booklet for
Raytheon
Magnetrons,
Klystrons and
Special Tubes**



Comprehensive presentation of maximum ratings, typical operating values, frequency ranges, and power levels for most of the principal unclassified types manufactured. An essential reference-guide for microwave engineers and purchasing departments.

Raytheon is the world's largest producer of CW and pulse magnetrons, available in either fixed or tunable designs.

Raytheon klystrons, which can be tuned mechanically or thermally, fit the widest range of requirements from 550 to 60,000 Mc. The special tubes include backward wave oscillators, square law tubes, storage tubes and others.

Use coupon below to reserve your copy of the new Raytheon Consolidated Data Booklet. There is no cost or obligation, of course.

MAIL THIS COUPON

TECHNICAL DATA SERVICE

The most complete data service available for magnetrons, klystrons, special tubes and semiconductor products. Available on a continuing basis at a modest charge. Use coupon to get full details.

Regional Sales Offices: 9501 W. Grand Avenue, Franklin Park, Illinois • 5236 Santa Monica Blvd., Los Angeles 29, California

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Miniature and Sub-Miniature Tubes, Semiconductor Products, Ceramics and Ceramic Assemblies

**RAYTHEON
MANUFACTURING CO.**

Microwave and
Power Tube Operations
Section PT-23,
Waltham 54, Mass.



Excellence in Electronics

Please send me, without cost or obligation:

- Free Consolidated Data Booklet.
 Complete details on Raytheon's Technical Data Service for Microwave and Power Tubes.

Name _____ Title _____

Company _____

Street _____

City _____ Zone _____ State _____

ENGINEERING REVIEW

applied to the vertical and horizontal inputs of an oscilloscope, thus generating the visual display.

In these experiments, the approach was to develop a library of computational processes for simplifying patterns in order to obtain their most significant features. Preliminary experiments were concerned with determining those manipulations which would prove to be the most informative. The compilation of discrete routines for the performance of these elementary manipulations would provide the basis of a flexible system for simulating many widely diversified pattern-identification logics. After determining the intended course of his pattern analysis, the programmer needs only to refer to this file and to select those routines which in combination will best serve his purpose.

One routine counts the total black area in a pattern. Advantage is taken of the fact that in many patterns there will be numerous words that are all black or all white. By comparing whole words against constants of all zeros or all ones, much time is saved.

Another routine was designed to count the number of "objects" in a picture. An object is a black area which is completely surrounded by white areas.

Nor was the routine for counting limited to solid, simply connected objects. The SEAC, could handle objects containing re-entrant profiles (spirals), multiply-connected objects (a letter B), or objects interspersed among other objects. Another type of question that SEAC was programmed to answer involved evaluating the area of each of the objects counted. The area of an object was defined as the total black part of the object and did not include, for example, the white circle enclosed by a black annular area.

A study of various logical schemes that have been proposed for recognizing printed characters was undertaken. A routine was written based upon the identifica-

◀ CIRCLE 4 ON READER-SERVICE CARD

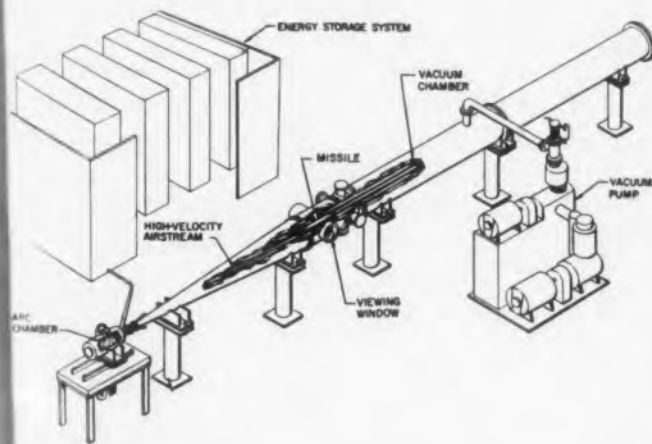
tion of unique areas for each character in an alphabet. Several photographs of different characters were compared to determine which parts of the viewing matrix were: (1) black for all letters concerned; (2) white for all letters concerned; or (3) sometimes black and sometimes white. This last area is the only part of the whole viewing frame that can be used to identify characters. Studies can now be made of characters in different fonts to determine the percentage of useful recognition areas that characterize each font.

Programs were coded to perform simple operations on each of the spots in a 30,000 spot picture.

One operation that produces unusual results is a kind of spatial differentiation. In this operation the computer investigates every black spot. If completely surrounded by eight other black spots, it is converted to a white spot. In any other case, a black spot is written. The effect of such an operation is to preserve the boundaries of an image while erasing all the internal area. After performing this operation the computer inverts all the digits of the picture, converting black to white and vice versa. One such operation constitutes a "cluster." Even after clustering 50 times, some traces of the image still remain.

Routines have also been written to superimpose pictures, to smear pictures by translating and superimposing them, to magnify and to record in permanent form on tapes and wire.

Additional information is contained in the NBS Technical Report No. 2194.



Hotshot Tunnel

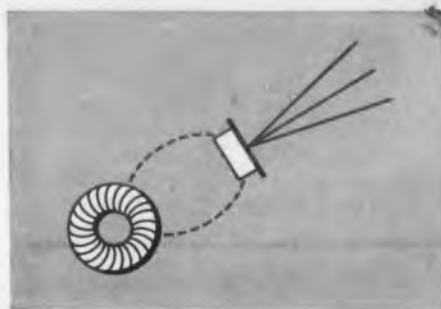
Speeds up to 15,000 mph and temperatures of 18,000 deg will be reproduced in this 44 ft wind tunnel. Designed by Lockheed at Palo Alto, California, it will be, reportedly, the fastest and hottest wind tunnel in use by private industry. Compressed gas in the arc chamber, will be fired by a 20-million kw jolt of electricity from 320 condenser units-energy storage system—stacked in an adjoining room. Gas will be heated instantly causing it to erupt through a diaphragm. Superheated air will explode through the tunnel, which is evacuated by a vacuum pump, and blast against the nose of a test missile.



PERKIN POWER SUPPLY Review

Announcing an Important Engineering Achievement!

Now—the *reliability* and *efficiency* of Magnetic Amplifiers are combined with the fast transient *response* and *precise regulation* of transistor circuitry in a completely new line of DC Power Supplies



PERKIN HAS INCORPORATED the above features for completely new lines of transistorized B+ units, as well as low voltage power supplies. The following is the detailed description of the design features and performance characteristics of both lines.

B+ POWER SUPPLIES.



Model MTB 300-200

THESE PERKIN POWER SUPPLIES are designed to incorporate the latest *magnetic amplifier*, *transistor* assisted design circuitry which insures long, trouble-free, continuous-duty type service, with virtually no maintenance. This circuitry features the latest in reliability, since it contains no vibrating contacts and no vacuum tubes. Latest type Printed Circuit techniques are employed.

The circuitry is based on AC transistor amplifiers; therefore, the effect of any changes in transistor parameters is greatly minimized. AC amplification is obtained by the use of modulators and detectors. The actual carrier frequency is approximately 80 Kc which, in effect, regulates steady state as well as attenuating the ripple.

Magnetic amplifiers are used in the circuitry for preregulation purposes, and the transistors used supply the final regulatory element. Provision is made within the circuitry to limit the transistor voltages—especially in the power output transistors—to a safe limit under all conditions of switching, line voltage transients, and short circuits to insure against any possible transistor failure.

SPECIFICATIONS AND RATINGS AVAILABLE:

AC INPUT: 105-125 volts, single phase, 50-400 cps.
 RIPPLE: 6 millivolts peak to peak (2 millivolt).
 REGULATION:
 ±.1% for line changes of 105-125 volts.
 ±.1% for load changes of no load to full load.
 DYNAMIC IMPEDANCE: 1 ohm from 20 to 20,000 cycles.
 OUTPUT VOLTAGE ADJUSTMENT: Potentiometer controlled.
 METERS: Optional.
 CONSTRUCTION: Rack panel; panel dimensions 200 ratings: 5½"H x 19"W.
 1.5 A ratings: 10½"H x 19"W.

SPECIFIC MODELS AND RATINGS AVAILABLE:

MODEL NO.	OUTPUT VOLTAGE RANGE	LOAD CAPACITY
MTB 150-200	150 V ± 10%	200 MA
MTB 200-200	200 V ± 10%	200 MA
MTB 250-200	250 V ± 10%	200 MA
MTB 300-200	300 V ± 10%	200 MA
MTB 30150-200	30-150 V	200 MA
MTB 30200-200	30-200 V	200 MA
MTB 30250-200	30-250 V	200 MA
MTB 30300-200	30-300 V	200 MA
MTB 150-1500	150 V ± 10%	1.5 Amperes
MTB 200-1500	200 V ± 10%	1.5 Amperes
MTB 250-1500	250 V ± 10%	1.5 Amperes
MTB 300-1500	300 V ± 10%	1.5 Amperes
MTB 30150-1500	30-150 V	1.5 Amperes
MTB 30200-1500	30-200 V	1.5 Amperes
MTB 30250-1500	30-250 V	1.5 Amperes
MTB 30300-1500	30-300 V	1.5 Amperes

TRANSISTORIZED LOW VOLTAGE UNITS.



Model MTR 060-5

TYPICAL OF PERKIN'S NEW LINE of low voltage DC power supplies employing magnetic amplifier circuitry is Model MTR060-5 rated at 0-60 Volts, 0-5 amperes. Features include excellent transient response for both line and load changes, 1 millivolt ripple, regulation to 5 millivolts, continuously adjustable to 0 volts, wide AC line range, and remote sensing.

Applications for these units are transistor circuitry, relays, strain gauges, filament power and general laboratory testing.

DETAILED SPECIFICATIONS AND RATINGS:

DC OUTPUT VOLTAGE RANGE: 0-60 volts DC.
 DC OUTPUT CURRENT: 0-5 amperes DC.
 AC INPUT: 95-135 volts, single phase, 60 cps.
 RIPPLE: 1 millivolt maximum.
 REGULATION:

Line

Static: Less than ±5 millivolts for line changes from 95-135 volts AC.

Dynamic: Less than 10 millivolts for step changes of 20 volts, anywhere between 95 to 135 volts AC.

Load

Static: Less than 25 millivolts for changes from no load to full load.

Note: The regulation accuracies above are applicable for any output setting between 0-60 volts DC.

OUTPUT IMPEDANCE:

Less than 5 milliohms from 0 to 100 cps.
 Less than 25 milliohms from 100 cps to 2 KC.
 Less than 50 milliohms from 2 KC to 20 KC.

CONTROLS: Coarse control with resolution of 120 millivolts. Fine control with resolution of 5 millivolts.

PROTECTION: Unit will sustain short circuits without damage. Input and output fuses on front panel.

METERS:

Voltmeter, 0-75 volts DC, 4½" rectangular.
 Ammeter, 0-5 amperes DC, 4½" rectangular.

DIMENSIONS: Rack panel construction, 19"W x 14¼"D x 12¼"H. (Cabinet unit also available.)

OTHER MODELS AVAILABLE WITH SIMILAR SPECIFICATIONS ARE:

MODEL NO.	OUTPUT VOLTAGE RANGE	LOAD CAPACITY
TR 036-15	0-36 V	15A
MTR 036-30	0-36 V	30A
MTR 28-30	24-32 V	30A

Further engineering data and quotations available upon receipt of your letterhead inquiry.

PERKIN ENGINEERING CORPORATION

345 Kansas Street, El Segundo, California
 Eastgate 2-1375

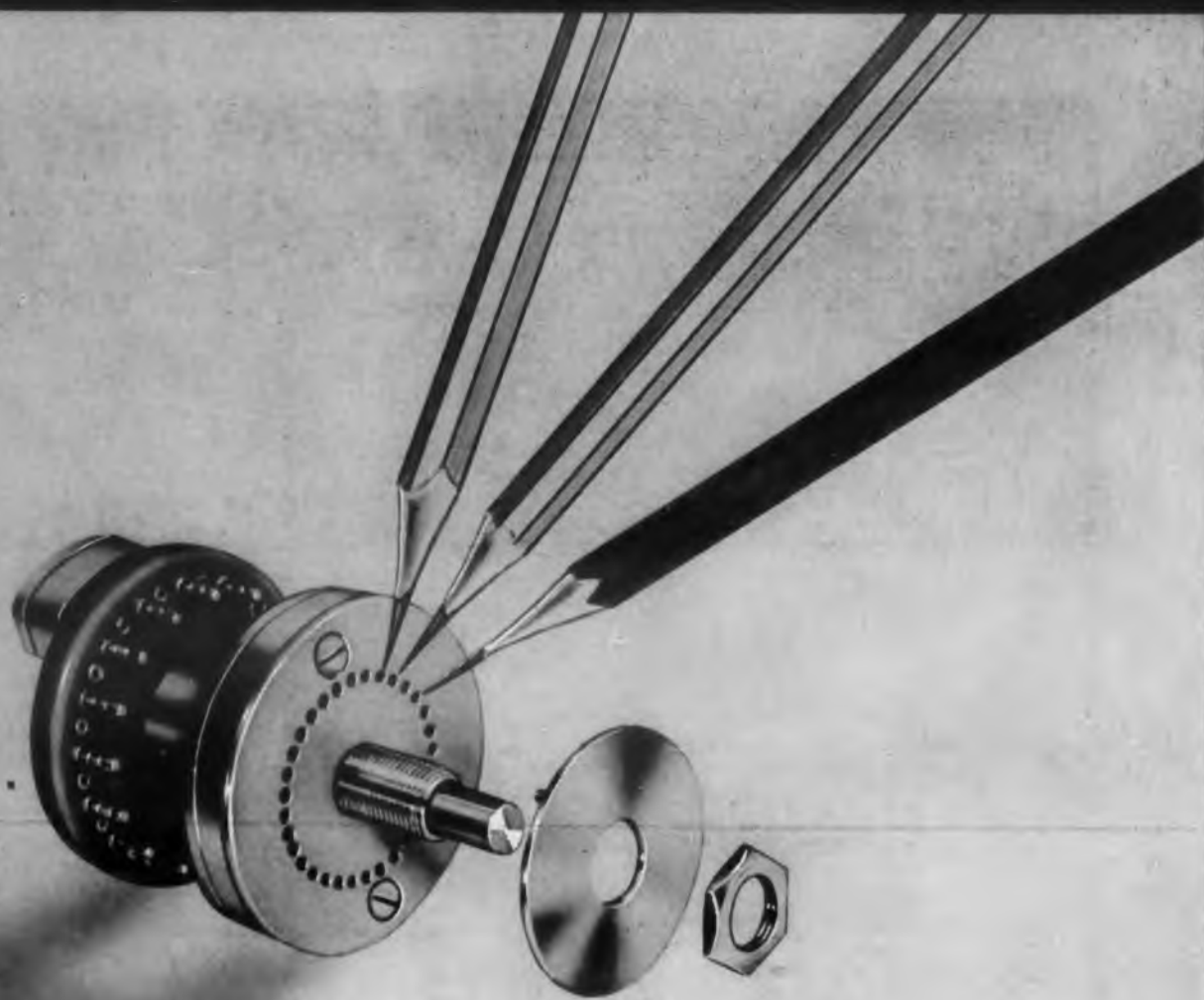
New York Area Office:

Sales and Warehousing: 25 Great Neck Road
 Great Neck, Long Island, New York
 HUnter 2-8608, HUnter 2-8609

New England Area Office:

46 Amesbury, Lawrence, Massachusetts
 MURdock 3-3252

CIRCLE 5 ON READER-SERVICE CARD



Stop it

... where you want it!

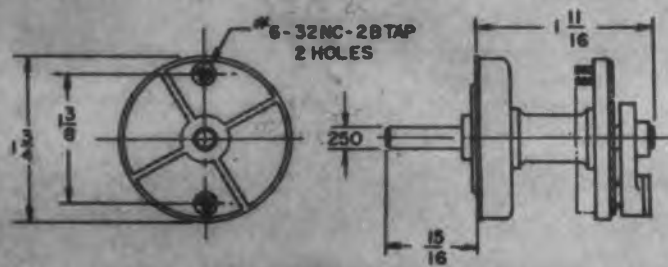
Daven's New Rotary Switch with Adjustable Stop

For flexibility in all types of circuit experimentation, laboratory work, breadboard setups, and in circuitry where the exact number of switch positions might be changed at a later date, the new DAVEN Rotary Switch with an Adjustable Stop is ideal. This unit, as a single pole switch, can have a maximum of either 24 shorting positions with 15° spacing or 32 shorting positions with 11½° spacing. One, two, three, and four pole units are available in this design.

In common with all other DAVEN Rotary Switches, the Adjustable Stop Switch features sturdy, dependable construction; silver alloy contacts and slip rings; tamper-proof,

KNEE ACTION* silver alloy rotor blades; high grade, accurately machined dielectric; and gold flashed turret-type terminals for ease of soldering.

*Patented



Write for complete information.

THE **DAVEN** CO.

LIVINGSTON, NEW JERSEY



AVAILABLE THROUGH SELECTED DISTRIBUTORS

TODAY, MORE THAN EVER, THE DAVEN SWITCH IS THE DEPENDABILITY!

ENGINEERING REVIEW

Counting System Totals Newspaper Output

An electronic counting system, which can total simultaneously the output of forty different operations will be used to program the press output of the Detroit News, daily and Sunday editions. The multiple-source counting system, reportedly first of its kind, is completely transistorized and can count up to 120,000 units a minute.

The counter is a twelve-channel system which will record newspapers being carried from the press room on eleven different conveyors. One or more of the eleven newspaper conveyors can be totaled simultaneously. The twelfth channel serves as a spare.

The installation will also provide detection devices at the input section of each of the eleven conveyors, which sense the folded edge of each paper as it moves along the conveyor, and a master totalizer, remotely located, which provides the centralized accounting of newspaper production. The totalizer houses eleven input devices, one for each newspaper conveyor, together with memory and dividing systems, an electro-mechanical counter and visible recording dial, and pre-setting controls to enable the production staff to dial the required quantity of each edition.

Each input device relays the incoming signals to its own memory system. The memory stores them for a split-second and then releases them in rapid sequence to a dividing system. The latter automatically divides the signals and sends a triggering count-signal to the electro-mechanical counter for each 100 signals received. Each numeral added on the counting dial represents 100 newspapers.

When the pre-set number of copies of an edition has been recorded, a signal is sent automatically to the press room superintendent to shut down the presses.

◀ CIRCLE 6 ON READER-SERVICE CARD

Russian Taught on TV

Russian is now being taught on television. Broadcast over WRGB-TV, Schenectady, N.Y., the course is being sponsored jointly by General Electric, the Mohawk-Hudson Council on Educational Television, and the Northeastern branch of the American Chemical Society. It was conceived by the latter group who saw opportunity in the heavy concentration of scientific personnel in this area.

The course, conducted by Dr. Irving S. Bengelsdorf, organic chemist at the GE Research Laboratory, is designed to help in the rapid dissemination of Russian technical literature to scientists and engineers.

Occupying a 6:30 to 7 a.m. spot, the Tuesday-Thursday programs reach a potential audience of more than one million upstate New Yorkers.

A special series of six television programs on Russia's historical and cultural background featuring recent visitors to Russia, preceded the language course.



Moon Bounce Tracking.—This 50-ft. dish antenna, in combination with a new radio transmitter, the Space Sentry, located at the U. S. Army Signal Corps Labs, Fort Monmouth, N. J., is being used to bounce signals from the moon for close tracking of the earth satellites. Transmitter power is equal to a million and a half watts. Before the new transmitter was installed, Diana was used to establish the feasibility of the method for aligning the satellite receiving and computing equipment.

Waldes Truarc GRIP RINGS Replace Expensive Parts... Reduce Manufacturing Costs...Eliminate Rejects

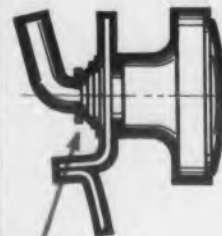
WALDES TRUARC SERIES 5555 GRIP RING*

application: external for shafts
range: .077 in. — .755

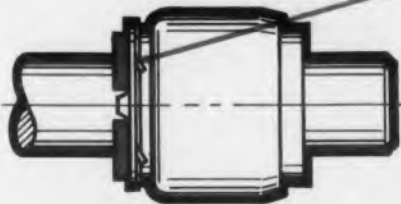
The Waldes Truarc Grip Ring requires no groove, holds fast by friction forces, can be used again and again. It provides a positioning shoulder secure against moderate thrusts or vibration. The ring's unusually large radial width exerts considerable frictional hold against axial displacement.

*U. S. Pat. No. 2,574,034

Rings cut costs 33%, eliminate rejects

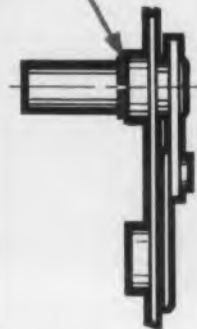


B & J Tool uses series 5555 grip ring to secure parts of damper control made for Vulcan Radiator. Shaft formerly was machined down to provide coil spring shoulder, often broke during bending operation. (Rejects ran as high as 80%!) New design eliminated rejects and field failures, cut production costs 33%.



Rings save \$300 per die, \$.03 unit

Ray Oil Burner Co. uses a Truarc series 5555 grip ring in fuel pump drive shaft to position seal and drive it to assure continuous rotation with shaft. Original design used complicated die-cast collar and driver which required special groove and shoulder. Savings: \$300 per die for each size manufactured. \$.03 per part.



Rings save \$32.42/M:

Swift Business Machine Co. replaced collars and set screws in hollow shaft assembly of its adding machine with series 5555 grip rings, saving \$32.42 per 1000 units. Rings require no groove, make possible positioning adjustments without slippage encountered when set screws were used.

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

In Truarc, you get

Statistically Controlled Quality from engineering and raw materials to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available

quickly from leading OEM distributors in 90 stocking points throughout the U. S. and Canada.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today . . . let our Truarc engineers help you solve design, assembly and production problems . . . without obligation.



WALDES
TRUARC[®]
RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, N. Y.

Waldes Kohinoor, Inc., 47-16 Austel Place, L.I.C. 1, N. Y.
Please send new, descriptive catalog showing all types of Truarc rings and representative case history applications.

(Please print)

Name _____

Title _____

Company _____

Business Address _____

City _____ Zone _____ State _____

ED 040

Consult the Yellow Pages of Your Telephone Directory for Name of Local Truarc Factory Representative and Authorized Distributor.

CIRCLE 8 ON READER-SERVICE CARD



Engineered by Tinnerman...

It's a fastener...It's a friction-lock...
It's a Tinnerman **SPEED NUT**[®] doing double-duty

Turn this Westinghouse Mobilair[®] Fan to any angle...and it *stays* angled. The Tinnerman SPEED NUT Brand Fastener that holds the fan trunnions tight to the housing also supplies live spring-tension to keep the fan positioned at any angle you choose.

These SPEED NUT fasteners, developed by joint efforts of Tinnerman and Westinghouse designers, eliminate special adjusting thumb-screws. Only 2 SPEED NUT parts serve the purpose of several stampings and ordinary fasteners. Material and assembly costs are lower than with ordinary fastening methods. And the consumer gets a better fan that's easier to adjust.

Chances are that Tinnerman designers can develop SPEED NUT parts for your product to cut costs, speed production, improve that product.

Call your local SPEED NUT representative now...if he's not in your Yellow Pages Directory under "Fasteners", write to:

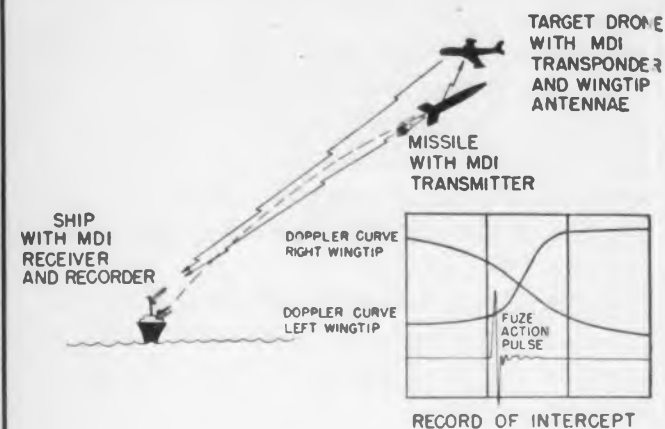
TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio



CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Accessories Ltd., Treforest, Wales. FRANCE: Simmonds S.A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

CIRCLE 7 ON READER-SERVICE CARD

ENGINEERING REVIEW



Miss-Distance Indicator

Anti-aircraft gunners can now tell how close their missiles come to a target with vhf miss-distance indicator perfected at the Naval Ordnance Laboratory, Silver Spring, Md. Based on the Doppler effect the system consists of a transmitter in the missile, a ship-board receiver-recorder, and an aircraft transponder, which receives a radio signal from the missile transmitter on one frequency and retransmits it to the shipboard receiver on another. The distance by which the missile missed the target is noted by taking the frequency difference between the two signals. Analysis reveals the distance in feet and the relative speed between missile and target aircraft. Insert on lower right is an enlarged facsimile of a graph made by an electronic recording device at the shipboard receiving station. The indicator is intended expressly for crew training and missile development, not for combat use.

Capacitance Pickup Detects Heart Defects

A heart sound pickup that detects chest wall movements as small as one-half billionth of an inch is being used for detection of defects in the heart valves at an earlier stage than was possible.

Developed cooperatively by Dale Groom, M.D., assistant professor of medicine at the Medical College of South Carolina, and Yro T. Sihvonen of General Motors Research Staff's Physics & Instrumentation Dept., GM Technical Center, the capacitance device is contained in a small bell-shaped housing similar to the bell of a physician's stethoscope and transduces chest wall vibrations directly into electrical signals.

These faint signals are amplified and reproduced on an oscilloscope or recorded on tape. Utilizing the capacitance principle, the skin on the patient's chest may serve as one electrode, or a suitable diaphragm may be used, applied directly to the skin. The other electrode is suspended above the skin surface, inside the pickup, and is connected by cable to electronic accessories that amplify and record heart murmurs.

Copper Plating On Aluminum

A process for electroplating copper on aluminum strip and aluminum wire has been developed at Sylvania Electric Products, Inc., Warren, Pa. The new technique is reported to permit plating of aluminum strip in widths up to 10-in. and in thicknesses from 0.008 to 0.050 in. Thickness of the copper plating ranges from a flash coating to 0.002 in. per side. Aluminum plated by the new process can be tinned, soldered or formed without breaking the copper plating.

5 Billion Dollars For 1959 Missiles

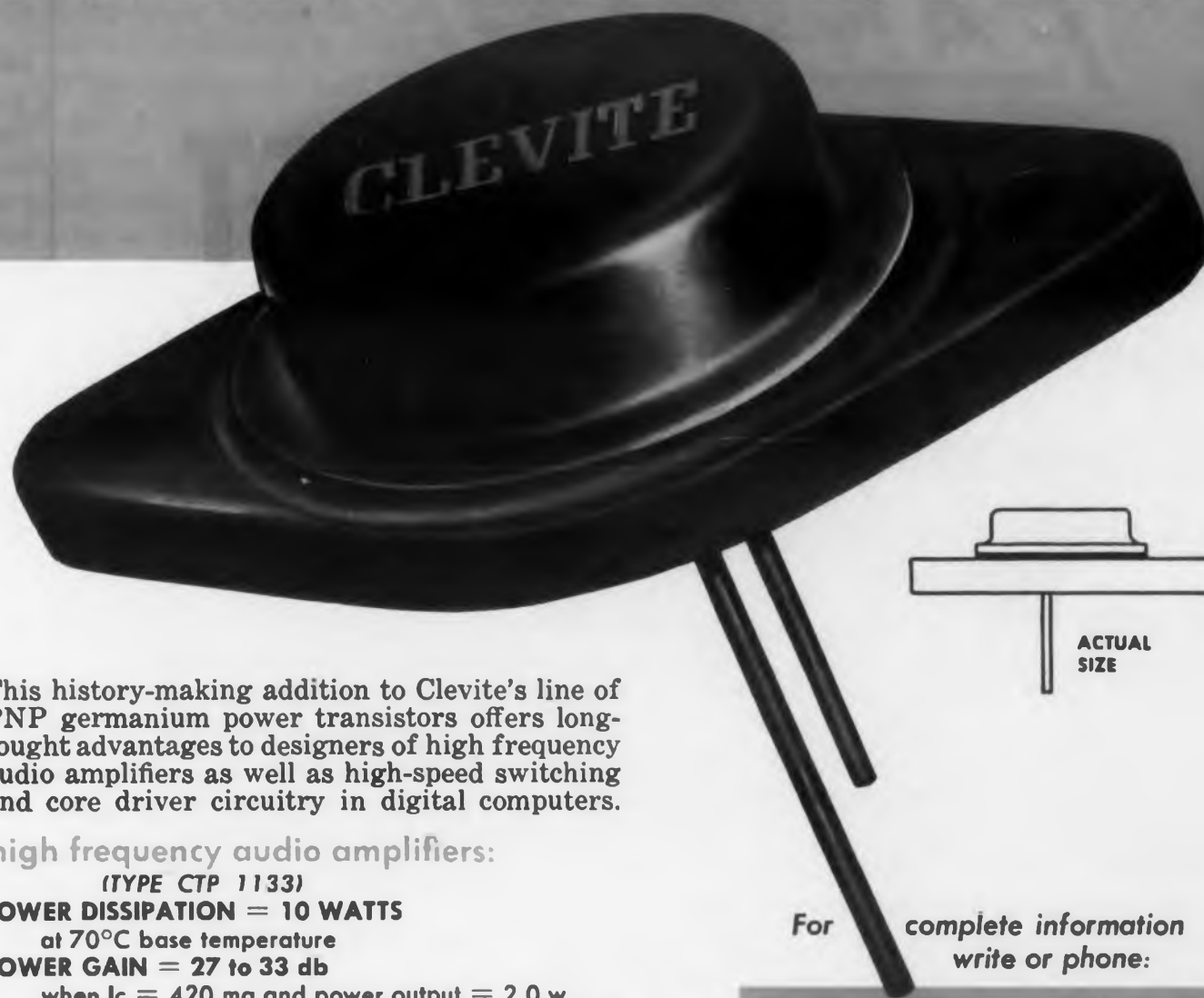
Orders for missiles in fiscal year 1959 will amount to \$5,729,000,000, a four-fold increase since 1955. In a report by "Planes" official publication of the Aircraft Industries Association, it was also indicated that funds scheduled for ICBM's and IRBM's, compared with total missile obligations, jumped from less than 1 per cent in 1951 to 41 per cent in 1958. However, orders for ICBM's and IRBM's in fiscal 1959 reveal for the first time that obligations for these two types of missiles will decline, both in actual amount of money and in percentage comparison to total programmed obligations. In fiscal 1959 only 34 per cent of the total (\$1,941,000,000) is scheduled, compared with 41 per cent of the total (\$2,070,000,000), in fiscal 1958.

Know Thyself

A strong radio signal interfered with a railroad communication system in the San Francisco area. Unable to locate the trouble, the company requested aid from the local FCC engineering office. The latter traced the signal to a yard locomotive with a transmitter in continuous operation because of a defective control relay. The company expressed appreciation with an apology since the trouble was in its own switchyard.

Another Clevite Break-through!

HIGH FREQUENCY POWER TRANSISTORS



This history-making addition to Clevite's line of PNP germanium power transistors offers long-sought advantages to designers of high frequency audio amplifiers as well as high-speed switching and core driver circuitry in digital computers.

For high frequency audio amplifiers:

(TYPE CTP 1133)

POWER DISSIPATION = 10 WATTS

at 70°C base temperature

POWER GAIN = 27 to 33 db

when $I_c = 420$ ma and power output = 2.0 w

POWER GAIN CUTOFF FREQUENCY = 20 kc minimum

... compared with 5 to 7 kc for conventional transistors

DISTORTION = 5% maximum

at 1.2 w output

For high-speed switching:

(TYPE CTP 1135)

POWER DISSIPATION = 10 WATTS

at 70°C base temperature

DC CURRENT GAIN = 40 minimum

at 0.5 amp

COMMON EMITTER GAIN BANDWIDTH PRODUCT = 1 megacycle

For complete information
write or phone:

CLEVITE

TRANSISTOR PRODUCTS

241 Crescent St., Waltham 54, Mass.
Twinbrook 4-9330

A DIVISION OF

CLEVITE

OTHER CLEVITE DIVISIONS: Brush Instruments • Clevite Ltd. • Clevite Ordnance • Cleveland Graphite Bronze • Clevite Harris Products, Inc. • Clevite Electronic Components • Clevite Research Center • Intermetall G. m. b. H.

CIRCLE 9 ON READER-SERVICE CARD



"Here's the news
we promised you"

FANSTEEL

TANTALUM SHEET

IS NOW AVAILABLE

FROM STOCK

For the first time since the beginning of its commercial production, Fansteel Tantalum Sheet is now available from "on hand" warehouse stocks.

With our new Muskogee, Oklahoma plant now in production, and our expanded processing and fabricating facilities at North Chicago in full operation, we can make delivery of unannealed sheet from stock—annealed sheet within two weeks.

If you are now using tantalum or are planning its use in your product, you can count on Fansteel to deliver tantalum in any form or shape—on time to meet your production schedules.

And you can count on Fansteel quality. Our completely integrated production, with strict quality control in all of the steps from the processing of the ore to the finished metal, guarantees you the finest quality tantalum.

IMMEDIATE
DELIVERY
ON THESE
FIVE
MOST USED
SIZES

.002"
.003"
.005"
.007"
.010"



WE'LL RUSH YOU PRICE BULLETIN

Call, wire or write for new price bulletin just released. Contains complete prices for both tantalum stock items and special mill runs.



FANSTEEL®

TANTALUM • MOLYBDENUM • COLUMBIUM • TUNGSTEN • FANSTEEL 77 METAL

FANSTEEL METALLURGICAL CORPORATION, NORTH CHICAGO, ILLINOIS, U. S. A.

CIRCLE 10 ON READER-SERVICE CARD

MEETINGS

Apr. 8-10: Sixth National Conference on Electromagnetic Relays

Oklahoma State University, Student Union Building, Stillwater, Okla. Sponsored by the National Association of Relay Manufacturers. Papers will include the results of individual investigation by the authors. More information may be obtained from Charles F. Cameron, Dept. of Electrical Engineering, Oklahoma State University, Stillwater, Okla.

Apr. 8-10: Symposium on Electronic Waveguides

Auditorium of Engineering Societies Bldg., 33 W. 39th St., New York. Sponsored by IRE, PGED and PGMTT, and the Department of Defense Research Agencies. The symposium will deal with the interaction of electromagnetic fields and electron or plasma beams in general waveguide regions. The symposium covers the fields of electron beams, plasma, and electromagnetics to compare the rather widely disparate theories and techniques employed to describe the wave phenomena encountered in the interaction of such fields. For further information contact the Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, New York.

Apr. 10-12: IRE South West Regional Conference and Electronics Show

San Antonio Hotel and Municipal Auditorium, San Antonio, Tex. Write for details to J. O. Parr, Jr., 202 Janis Ave., San Antonio, Tex.

Apr. 14: Symposium on "Chemical Aspects of Printed Wiring"

San Francisco, Calif. Sponsored by the American Chemical Society. Speakers will discuss new developments in printed wiring technology. For further details write Louis H. Sharpe, Bell Telephone Labs., Inc., Murray Hill Lab., Murray Hill, N.J.

Apr. 17-18: Second Annual Technical Meeting of the Institute of Environmental Engineers

Hotel New Yorker, New York. A display of the earth satellite model and an address by Kurt R. Stehling, Propulsion Head of the Vanguard Missile Project, Naval Research Laboratory, will highlight the meeting. Write Institute of Environmental Engineers, 9 Spring St., Princeton, N.J., for further information.

EDITORIAL

The Engineer with a Job Knows No Recession

We've yet to run across the employed engineer with time on his hands. Just about everyone is on a crash program. Not so the shopkeepers and car dealers we meet. They have much time to talk recession. But as we see it, and as most of the engineers we talk to see it, there is no recession in electronics.

Our subjective view is born out by business reports. According to an *ELECTRONIC WEEK* article March 3, the worst in slow-downs in defense is over and companies are reporting expansion. It is not accurate to claim consumer electronics is booming. Radio and TV are off for this time of year. But in defense electronics prosperity is just around the corner, and the anticipated big pickup should be taking place now. Third quarter government contract money will begin to be paid out in the form of salaries. There will be more money for more jobs.

Right now the electronic engineer out of a job has better prospects than his professional brothers in chemistry, aeronautics, and mechanical engineering. In fact the only electronics people who haven't been on a payroll for some time are those with the least to sell. Employment agencies report that engineers with strong backgrounds are snatched up quickly. It's the junior engineers (many of whom are upgraded technicians), industrial engineers, and junior administrators who are not getting jobs.

One effect of the cutbacks last fall and the current national dip in the economy is to make engineers security-conscious. It appears that good engineers are more cautious than they need be. For fear of being the last man hired and the first man off, many are passing up good opportunities. Companies are always on the lookout for qualified good men and will hire a good man any day even though they don't have widely publicized recruitment programs going on. Wise companies do not drop good men.

Without asking a single question, without picking up a phone, an editor can see business activity. The signs are: business is good. For one thing, our advertising in March was 313 pages—over eight per cent over 1957. Judging from the new product announcements that pour in daily, there's no retraction of plans, no fear of the market. For example, new products shown at the IRE Show are greater in number in 1958 than they were in 1956, and only slightly below the record-breaking 1957.

We see no reason for preoccupying oneself with thoughts of pessimism. Electronics is still in its infancy and there are needs to be filled by bold, level-headed engineering.

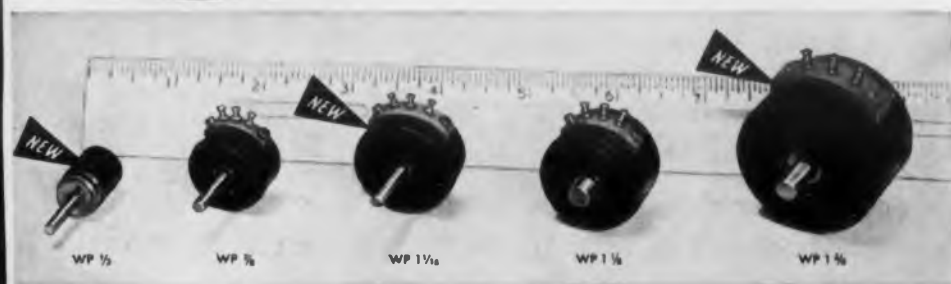
BIG-POT PERFORMANCE in Miniature-pot size

Waters PRECISION MINIATURE POTENTIOMETERS

are built, tested, and certified* to such rigid specifications as AIA, RETMA, JAN-R-19, MIL-E-5272A, and other applicable military specifications. *This new line* of single-turn pots packs Waters traditional performance into tight spots.

NOW! A complete single-turn pot line
from *Waters*

*Complete data on request



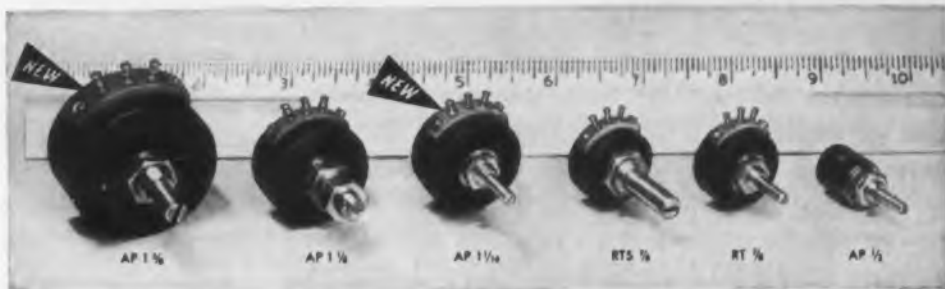
BIG-POT PERFORMANCE in Miniature-pot size

Waters ROTARY TRIMMER POTENTIOMETERS

are built, tested, and certified* to rigid military environmental specifications and are available in many variations: ganged, tapped, with various electrical and mechanical angles, locking shafts, anti-rotation pins, "O" rings, etc.

*Complete data on request

NOW! A complete single-turn pot line
from *Waters*



Write for catalog of the Waters complete single-turn pot line — precision, trimmer, low-torque, miniature.

Waters
MANUFACTURING, inc.

APPLICATION ENGINEERING OFFICES
IN PRINCIPAL CITIES

Wayland, Massachusetts



CIRCLE 11 ON READER-SERVICE CARD

Developed by the author during the design of a servo-amplifier to be manufactured by the Alto Scientific Company, the *resisting transistor* technique provided 94 per cent efficiency from a pair of Sylvania 2N307's in a prototype model. This technique, which was named by the author, effectively uses the transistor as a variable resistor between the power supply and the load. The technique is useful only in amplifiers where the ac input signal is of fixed frequency and phase angle with respect to the ac power source. But in the case of servo amplifiers, such as the one described in the text, the substantial increase in efficiency and operating temperature over previous designs should make the technique of particular interest in aircraft and missile electronics.

COMPARISON with the conventional class B output stage shows that using the *resisting transistor* technique in the design of a servo amplifier, more than twice as much output can be delivered with an efficiency of the order of 95 per cent. Smoothing components are eliminated, and the transistor pair is so arranged that the transistor acts as a variable resistor. If the comparison between class B and the new technique includes a rectified ac power supply in each case, there are further advantages in weight, size and temperature of the operation.

The type of amplifier to which this technique can be applied is limited to that which uses an ac input of variable amplitude but of fixed frequency and phase angle with respect to the ac power source as in servo amplifiers where the ac error signal varies either side of a null. The output from the resisting transistor is a faithful replica of the amplitude and phase of the input. Negative feedback can be used to improve linearity if required.

A conventional Class B output stage and a resisting output stage are shown in Fig. 1. The principal circuit difference is the omission of smoothing components in the latter. The theory of operation is quite different in the two cases.

In the conventional output stage, the voltage

across the load is 180 deg out of phase with the voltage across the conducting transistor. At maximum output the transistor current and dissipation are greatest. An output of about 3-1/2 times single transistor dissipation can be obtained—the theoretical maximum of 78 per cent efficiency being reduced to about 64 per cent in practice.

In the resisting transistor output stage, the voltage across the load is *in phase* with that across the conducting transistor. The transistor is, in effect, acting as a variable resistor between the power supply and the load. When the transistor and load resistances are equal, maximum transistor dissipation takes place (Fig. 2). If the transistor were shorted out, the power delivered to the load would be four times the maximum transistor dissipation. This fact offers a quick check

on the possible output from a pair of resisting transistors—eight times the dissipation rating of a single transistor.

From Fig. 3 it can be seen that with each transistor conducting on alternate half-cycles, the action of the rectifier is complemented. At full output the ac power source is connected directly through the 1:2 step-up transformer to the load. It can also be seen that the voltage applied between collector and emitter rises to a peak which is twice that of the supply voltage.

Absence of electrolytic capacitors in the resisting transistor circuit means an easing of the problems associated with design for high temperature operation. Transistor dissipation being comparatively low, higher ambient temperatures of operation are possible.

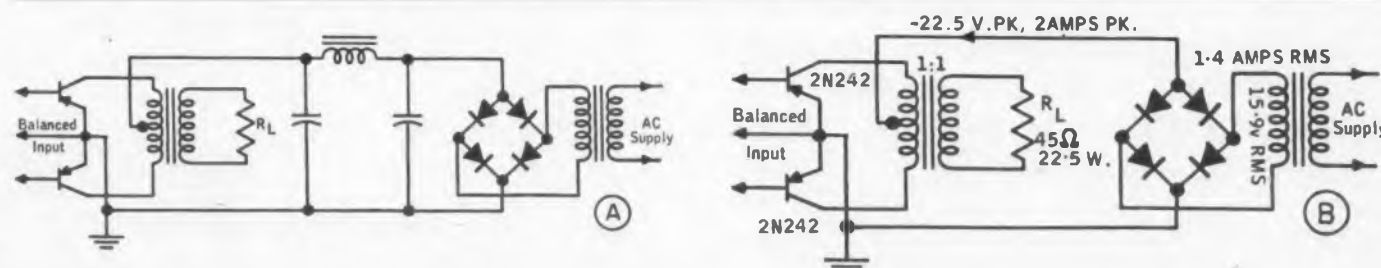


Fig. 1. (a) Simplified circuit of a conventional class B output stage. (b) Resisting transistor basic circuit. Values shown are impractical: losses were ignored in the calculations.

The "Resisting" Transistor for Servo Design

T. R. Nisbet
 Also Scientific Co., Inc.
 Palo Alto, Calif.

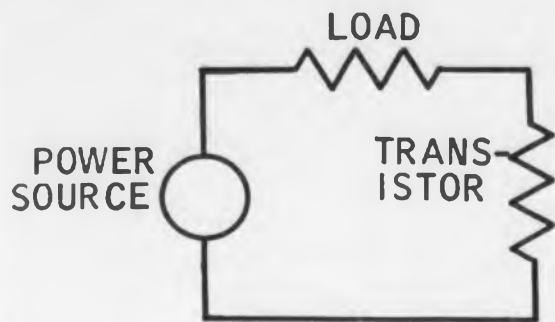


Fig. 2. Maximum dissipation occurs when load and transistor resistances are equal. The transistor can control the power in the load from zero to four times its maximum dissipation.

The efficiency of the resistive transistor circuit varies with the ratio of actual output to maximum output, reaching 50 per cent at the 6 db point, when maximum transistor dissipation occurs. Efficiency vs output is shown in Fig. 4, with the equivalent for a conventional Class B amplifier.

Load Line

As in the case of the conventional amplifier, a load line can be drawn across the transistor characteristics for the resistive configuration. This is the *peak load line*, representing the locus of peak voltages and currents at different signal amplitudes. For a given amplitude, the operational load line is a straight line from the origin to a point on the peak load line, as shown in Fig. 5. This operational load line rotates about the origin for different signal amplitudes: the one shown in Fig. 6 represents the condition of maximum transistor dissipation, when the power output is 6 db below the maximum power output. In practice, this operational load line may not be centered quite at the origin, and it may be slightly elliptical or irregular due to the series impedance in the power circuit and nonlinearity of the transistor characteristics. The use of negative feedback will cause the base current to adjust itself towards the value which is necessary to preserve the similarity between input and output waveforms.

Design

Where a choice exists, the load impedance should be as low as possible. This rule of thumb arises from consideration of the nature of the maximum voltage and current ratings, and it suggests the use of the maximum current rating as the starting point in the design.

Clearly there are three limits which must not be exceeded—voltage, current and dissipation. In some transistors, such as the 2N242, 2N256 or the silicon 2N289, the permissible dissipation cannot be taken advantage of, except by increas-



New... Hughes silicon capacitors

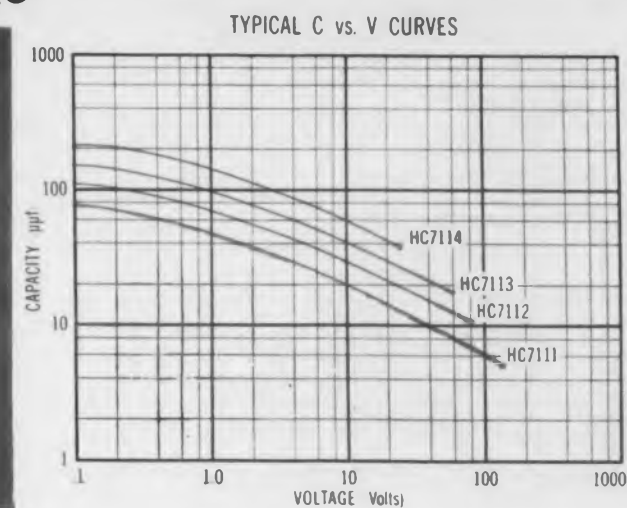
high Q • wide capacitance range

This is a practical series of new components; capacitors whose capacitance is determined by the applied DC voltage. The Q is high and the capacity range, great. For the first time, circuits can be tuned by electrical rather than mechanical methods.

The concept opens up a whole domain of useful applications. And, in every instance, circuit simplification plus considerable reduction in space and weight result. When designed around Hughes silicon capacitors, remote tuning becomes practical. Automatic frequency controls, modulators, automatic gain controls, and band pass filters become smaller, lighter, and simpler. Additional possibilities are numerous.

SPECIFICATIONS				
Type	Capacity @ -4VDC ± 20% (μmf)	Typical Capacity Range (μmf)	Voltage Range Over Which Capacity Is Varied (VDC)	Typical Q @ 25Mc and Maximum Voltage
HC7111	35	6-90	0.1-130	75
HC7112	50	12-120	0.1-80	70
HC7113	70	20-170	0.1-60	58
HC7114	100	44-240	0.1-25	43

For additional data, please write: Semiconductor Division, HUGHES PRODUCTS, International Airport Station, Los Angeles 45, California



Creating a new world with ELECTRONICS



HUGHES PRODUCTS

© 1958. HUGHES AIRCRAFT COMPANY

CIRCLE 12 ON READER-SERVICE CARD

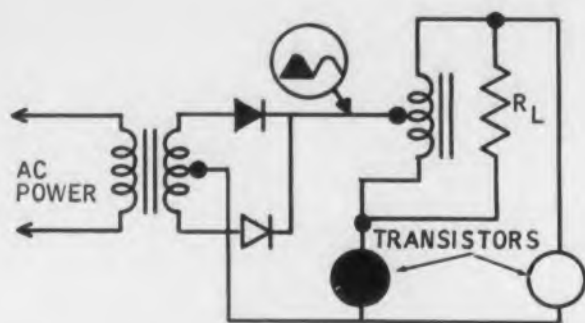


Fig. 3. Shading indicates conduction in this schematic. Transistor action complements that of rectifier; 180 deg phase shift in transistor input will result in 180 deg shift in output. Intermediate phase angles cannot be handled.

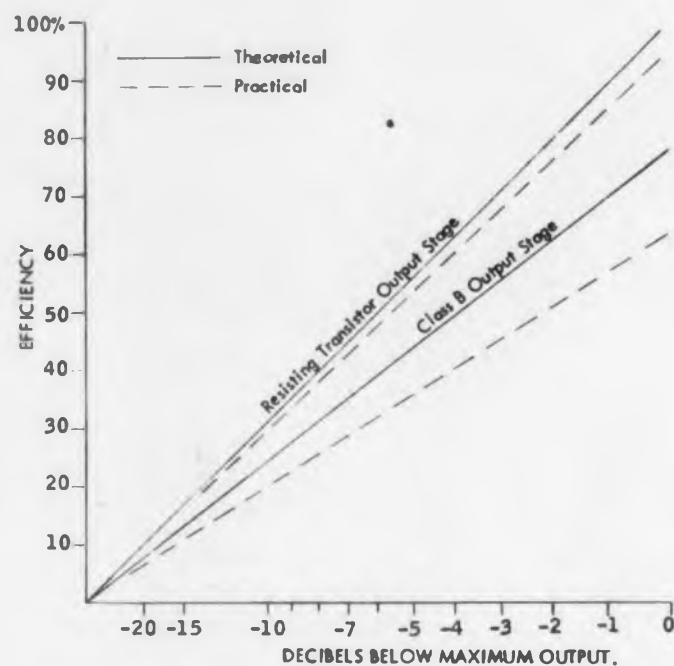


Fig. 4. In the resisting circuit efficiency rises toward 100 per cent as dissipation decreases, after passing the 6 db point. In the class B amplifier dissipation continues to increase up to full volume of output.

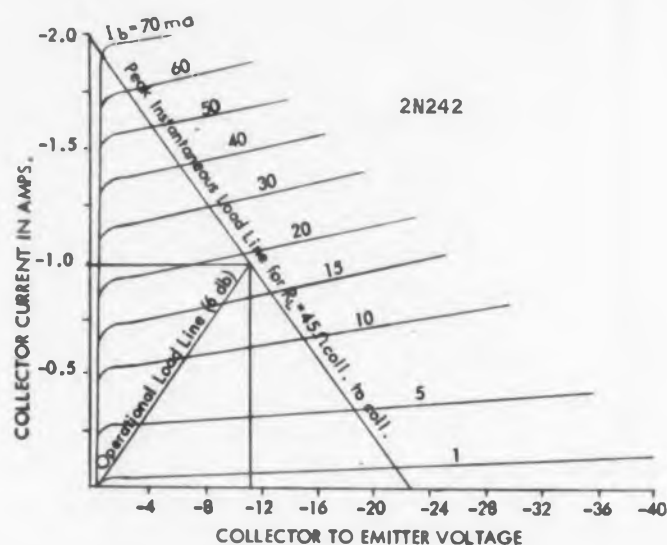


Fig. 5. Operational load line rotates about origin from zero output to maximum output, extending as far as the peak load line in each case. In practice, the vertical (maximum) will never quite be obtained.

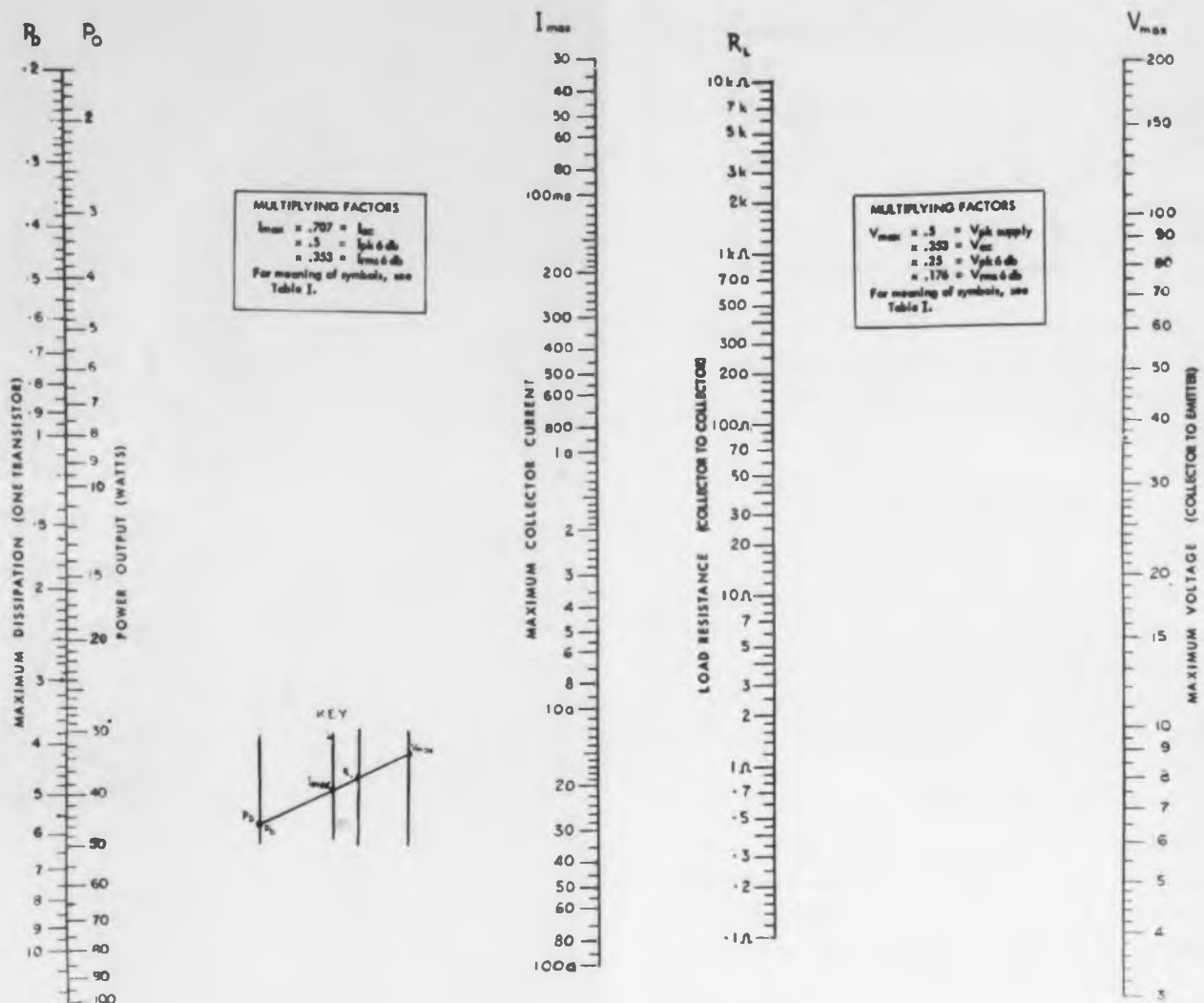


Fig. 6. Resisting transistor design nomogram. From the maximum voltages and currents used in the nomogram, the other relevant values can be found by using the multiplying factor shown. For meaning of symbols, see Table 1.

Table 1. Resisting transistor design procedure.

Symbol	Description	Derivation	2N242	2N174	2N156	2N389	2N352	Units
I_{max}	Absolute maximum collector current	Mfr's rating	2	13	3	2	2	amp
$I_{pk} \text{ 6db}$	Peak collector current at half volume	$1/2 (I_{max})$	1	6.5	1.5	1	1	amp
$I_{rms} \text{ 6db}$	Rms collector current during half-cycle at half volume	$.707 I_{pk} \text{ 6db}$	.7	4.6	1.1	.7	.7	amp
P'_D	Maximum permissible collector dissipation	Mfr's rating	5	7.7	5	15	7	watts
P_D	Actual dissipation (one transistor, full cycle)	$1/2 (I_{rms} \text{ 6db} V_{rms} \text{ 6db})$	2.8	7.7	2.1	3.7	1.2	watts
$V_{rms} \text{ 6db}$	Rms voltage across transistor during conducting half-cycle at half volume	$P_D / I_{rms} \text{ 6db}$	7.9	3.3	4	11.3	3.5	volts
$V_{pk} \text{ 6db}$	Peak collector-to-emitter voltage during conducting half-cycle at half volume	$1.414 V_{rms} \text{ 6db}$	11.2	4.7	5.6	15	5	volts
$V_{pk} \text{ supply}$	Peak supply voltage	$2 V_{pk} \text{ 6db}$	22.5	9.5	11.2	30	10	volts
V_{max}	Maximum collector-to-emitter voltage	$2 V_{pk} \text{ supply}$	45	19	22.5	60	20	volts
V'_{max}	Maximum permissible collector-to-emitter voltage	Mfr's rating	45	60	22.5	60	20	volts
R_L	Collector-to-collector load resistance	$4 V_{rms} \text{ 6db} / I_{rms} \text{ 6db}$	45	2.9	15	60	20	ohms
P_O	Power Output (two transistors)	$1/2 (I_{max} V_{pk} \text{ supply}) = 8 P_D$	22.5	62	16.8	30	20	watts
—	Typical Class B output (two transistors)	Mfr's example	2.5*	—	9	15	10	watts

Other symbols used in nomogram: V_{ac} = rms supply voltage, I_{ac} = rms supply current.

*One transistor, Class A.

†Assumed to be 75 per cent of maximum collector-to-base voltage

ing the upper temperature limit of operation. In others, such as the 2N174 and 2N177, the current or voltage must be less than the maximum permissible. In such cases it is preferable to keep the current high and the voltage low.

If the maximum current rating is used, half of it represents the peak current when the output is 6db below maximum, and its rms value during the conducting half-cycle can be found. This current causes maximum dissipation during the half-cycle. If it flowed during a full cycle, it would cause twice the permissible maximum transistor dissipation. With this as a basis, the equivalent rms voltage can be determined, and from it the peak voltage across the conducting transistor at the 6 db output level can be calculated. Twice this peak gives the peak supply voltage, and twice the peak supply voltage is the peak which the transistor must be able to withstand. If the transistor cannot withstand it, then the maximum voltage which it *can* withstand is taken and the sequence of the calculation changed to provide information as to the maximum transistor dissipation which will occur.

Table 1 shows the design procedure, with results for various transistor types. The nomogram, Fig. 6, is useful for designs to meet specifications other than maximum output from a given type of transistor.

Maximum Ratings

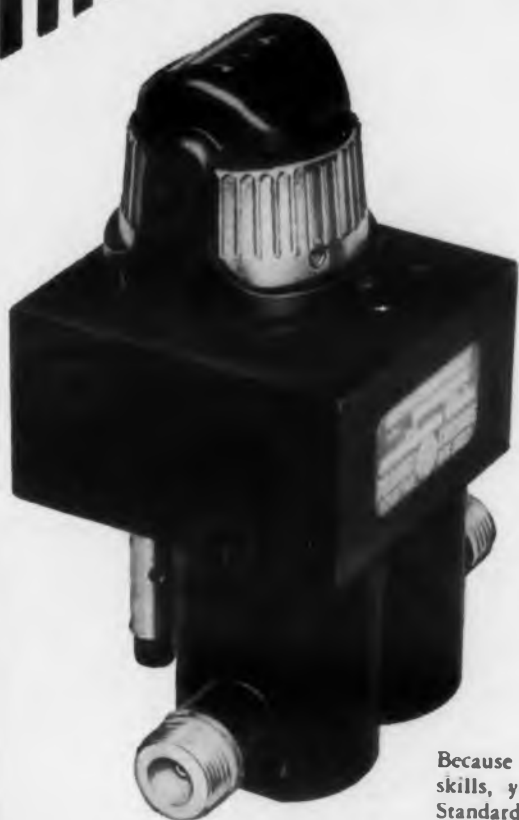
No really accurate method is available for stating what peak voltage may safely be permitted in a resisting—or any other—circuit, since one of the factors upon which it is dependent is the base-to-emitter circuit resistance. This must be kept as low as possible.

The dangers involved in exceeding the maximum voltage, on the other hand, can be quite simply stated. Saturation current I_{co} is driven by a peak voltage twice that of the supply: it is temperature sensitive, and its tendency to produce avalanche effect increases with the applied collector-to-emitter voltage. When it occurs, avalanche effect can be completely destructive, since it prevents the center-tapped transformer from reflecting the load into the power circuit.

If the maximum permissible collector-to-emitter voltage is not specified by the manufacturer, a fairly safe rule-of-thumb is to take a figure of two thirds to three quarters of the maximum permissible collector-to-base voltage, or twice the dc supply voltage specified for a typical Class B amplifier.

Still better, the difficulty should be avoided altogether—and in many cases this can be done, since the limit imposed by the maximum collector dissipation may leave an unused margin of voltage or current. The maximum permissible voltage then need not always be used.

THE STANDARD FOR MICROWAVE COMPONENTS



Because of a unique combination of engineering and production skills, you can expect microwave components from Frequency Standards, Inc. that offer a dependability and accuracy ($\pm 0.01\%$) unmatched in the field.

For here you will find the highly specialized engineering experience and the intricate tooling and production facilities needed to produce such sensitive microwave components as the two pictured on this page.

These two Tunable Band Pass Filters, both passive frequency selective devices, are capable of providing large amounts of selectivity in the stop band consistent with low dissipation losses in the pass band. Our standard line includes 2-, 3- and 4-section filters with a ganged tuning control feature, over a wide frequency range, assuring you of an accuracy of $\pm 0.01\%$.

For details, contact Frequency Standards, Inc., and we will furnish information on our standard products, our custom products and our facilities for meeting all requirements, no matter how exacting, in the microwave components field.

Please address inquiries to Frequency Standards, Inc., Box 504A, Asbury Park, N. J., Prospect 4-0500, or your nearest representative in all principal cities.

FREQUENCY STANDARDS, INC.



A DIVISION OF
NATIONAL ELECTRIC PRODUCTS CORP.

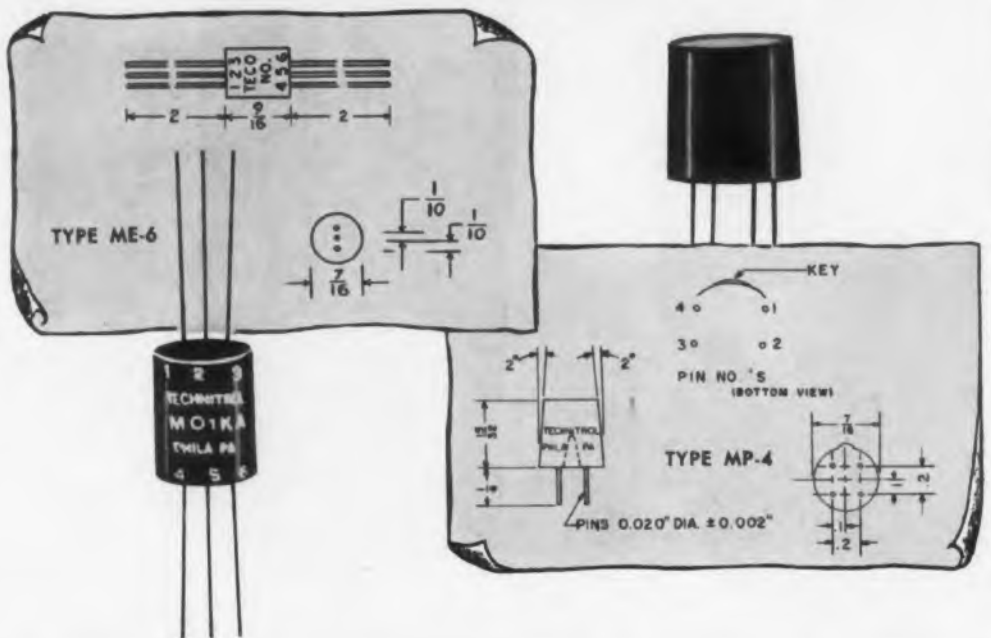
CIRCLE 13 ON READER-SERVICE CARD



miniature
encapsulated

PULSE TRANSFORMERS

by **TECHNITROL**



Wound on ferrite cores, the Type M series is available in a variety of windings to cover pulse widths from 2 microseconds down to .05 microsecond, wound inverting or non-inverting.

While the M series is particularly adapted to subminiature and transistor circuits, we design and build pulse transformers to fit specific circuits or to meet definite mechanical or thermal requirements, including MIL-T-27A.

Additionally, Technitrol makes a complete line of lumped and distributed parameter Delay Lines and a variety of electronic test equipment.

*For additional
information,
write today for
our bulletin*



CIRCLE 14 ON READER-SERVICE CARD

Copper-Metalized P-C Boards

have high bond strength and withstand 250C

REMOVING and resoldering components 50 times to the same circuit run of a printed wiring board without blistering or lifting sounds improbable. You can do it with Corning Glass Works' Fotoceram—plated copper on a high-strength, high-temperature ceramic-type glass substrate. The company literature conservatively states "components have been resoldered to the same circuit run more than 20 times without indication of failure." Applications engineer Tom O'Leary said he resoldered 25 components 50 times with no evidence of trouble, so he quit. Other claims of the "believe-it-or-not" variety are these: additional heat actually increases the bond between the copper and the base; you can immerse the board in a 500 F solder-pot for five minutes without damage (a prospective customer left a board in for three days and it was reported better than new).

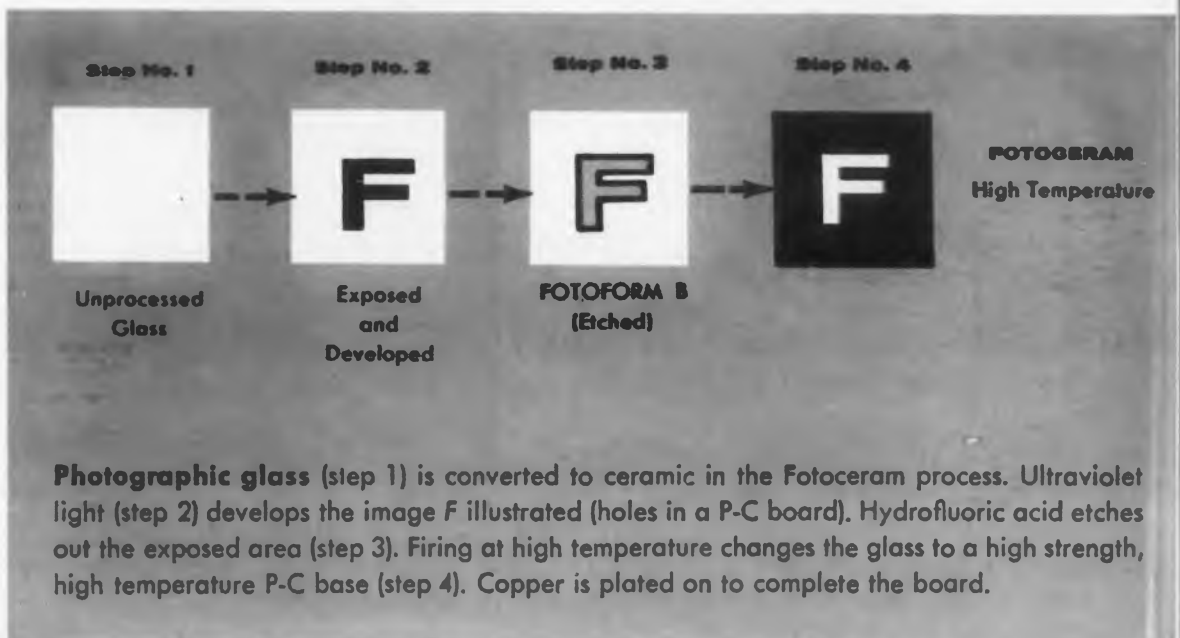
Fotoceram is intended for missiles,

communication systems, control and measuring instruments, radar, and other high reliability units. It is competitive in price with high quality epoxy base boards.

Fotoceram is a Different Process

There are a number of steps involving unusual materials necessary to produce Fotoceram. Photographic glass is used at the start; holes are chemically machined and the glass is converted to a ceramic with zero water absorption, no sag, and no warp. In detail:

1. Customer provides drawing of board and Stabiline film (or equal) of circuit;
2. Corning makes photographic negative for holes only;
3. Using this negative and an ultraviolet light source, a contact print is made on Fotoceram glass;
4. Heat treatment converts the exposed area to an etchable glass;



5. Application of hydrofluoric acid etches out the image to form holes and shape of board;

6. The transparent glass is heat-treated at 800 C to produce Fotoceram, a brownish ceramic with a resistivity of 6×10^{15} ohm-cm (at 25 C) and flexural strength of 25,000 psi. Crystalization takes place making it different from other glass;

7. The entire board is then coated with a layer of nickel. Holes and edges are covered with nickel;

8. A resist for protecting the insulated areas is silk-screened on the board;

9. Copper is electroplated on the nickel base and through the holes;

10. A finish plate of gold or tin-lead, etc., to customer specifications is added;

11. Plating resist is dissolved and nickel plate chemically stripped. Board is ready for use.

Most of the steps can be performed automatically by batch or continuous flow processing. The process cannot compete price-wise with lower quality boards used by radio and TV manufacturers. It may be cheaper than epoxy boards depending on the quantity and number of holes. Any number of holes are etched out simultaneously. Because the board is reliable and soldering techniques are no problem, the final cost of incorporating printed wiring into equipment may be lower than present methods.

The fact that the photographic glass can be etched precisely opens up new fields for packages in three dimensions.

Seemingly Disadvantages

The material is glass-like. Although the flexural strength is 25,000 psi, the base is brittle. Mounting precautions should be followed. Usually all that is necessary is to use a fiber washer between the board and mounting bracket for support. Mounting is no problem in the Falcon missile where Fotoceram has been used two years.

You cannot add holes easily once the board has been completely processed. Cavitron or other glass-drilling techniques would have to be used. However, it is not too difficult to make an engineering change while an order is in process because no tools and dies are involved.

The company is accepting sample orders for quick delivery. For more detailed specifications, turn to the Reader-Service card and circle 15.

thousands of "SPECIALS" without DELAY!

THESE 22 SERIES
OF STANDARD SWITCHES
WILL HANDLE ALMOST
ANY LOW-CURRENT
APPLICATION . . .

ROTARY



MINIATURE: 8, 10, and 12 positions; up to 18 contacts per wafer.

Series A



SMALL: Up to 12 positions in phenolic, Mycalex, or steatite insulation.

Series F



ADAPTABLE: 8, 10, 12, and 14 positions; many variations; economical.

Series J, K, N



GENERAL PURPOSE: Up to 12 positions; 30°, 45°, 60° throw.

Series H



LOW COST: Up to 12 positions; staked or strut screw construction.

Series QH



18-POSITION: Single or double eyelet fastening of clips.

Series L



24-POSITION: 15° throw handles complex circuits.

Series MF



LOW COST: 2 to 5 positions; fits in limited space.

Series 50, 53



SIMPLE SWITCHING: Up to 5 positions combined with AC switch.

Series 52, 54



SIMPLE SWITCHING: Up to 4 positions; numerous variations.

Series 20



LEVER OPERATED: 2 to 5 positions; numerous versions using std. wafers.

Series 185



CONCENTRIC SHAFTS: Dual and triple shafts with many wafer types.



FOR PRINTED CIRCUITS: Special lug designs for direct insertions.

CUSTOM-MADE
TO YOUR EXACT
SPECIFICATIONS
FROM
STANDING TOOLS



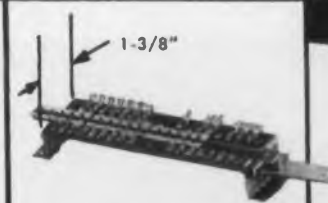
SOLENOID SWITCH: Oak wafers with G. H. Leland type of Rotary Solenoid.

SLIDE



2-POSITION: Shorting type with floating slider.

Series 70



COMPLICATED SWITCHING: 2 to 4 positions; up to 20 poles; very thin.

Series 150

ROTARY SLIDE



COMPACT—2 to 4 positions; max. switching in min. space.

Series 160

PUSHBUTTON



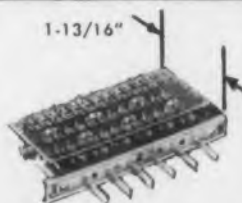
SINGLE BUTTON—1 to 4 poles; spring return and push-push.

Series 170, 175



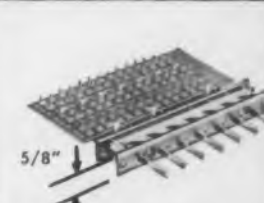
SIMPLER CIRCUITS: 3 to 12 buttons; very adaptable unit.

Series 80



COMPLICATED CIRCUITS: 1 to 18 buttons, up to 32 contacts each.

Series 130



ULTRATHIN: 1 to 12 buttons; up to 14 contacts per button.

Series 131

EACH SWITCH
IS PRETOOLED
IN NUMEROUS
VARIATIONS.
DETAILS
ON ANY SERIES
ARE AVAILABLE
ON REQUEST

For Recommendations on Unusual Applications, send us a sketch and short description.

OAK

MFG.
CO.



1260 Clybourn Ave., Dept. D, Chicago 10, Illinois

Phone: MOhawk 4-2222



SWITCHES



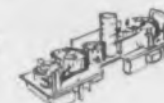
ROTARY
SOLENOIDS



CHOPPERS



VIBRATORS



SPECIAL
ASSEMBLIES

CIRCLE 16 ON READER-SERVICE CARD

How To Correct Phase Distortion with an L-C Lattice

J. D. Fogarty

Remington Rand Univac
Division of Sperry Rand Corp.
Philadelphia, Pa.

Network phase distortion can often be corrected, or at least improved by means of a simple L-C lattice. Here, Mr. Fogarty analyzes the problem and presents a useful design aid for phase correction.

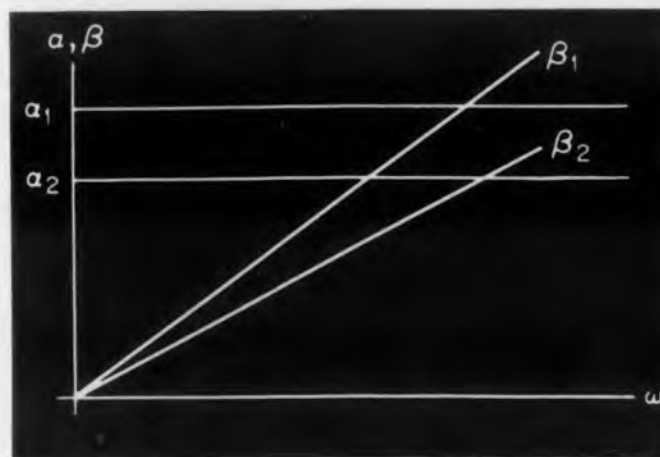


Fig. 1. Ideal distortionless transfer functions.

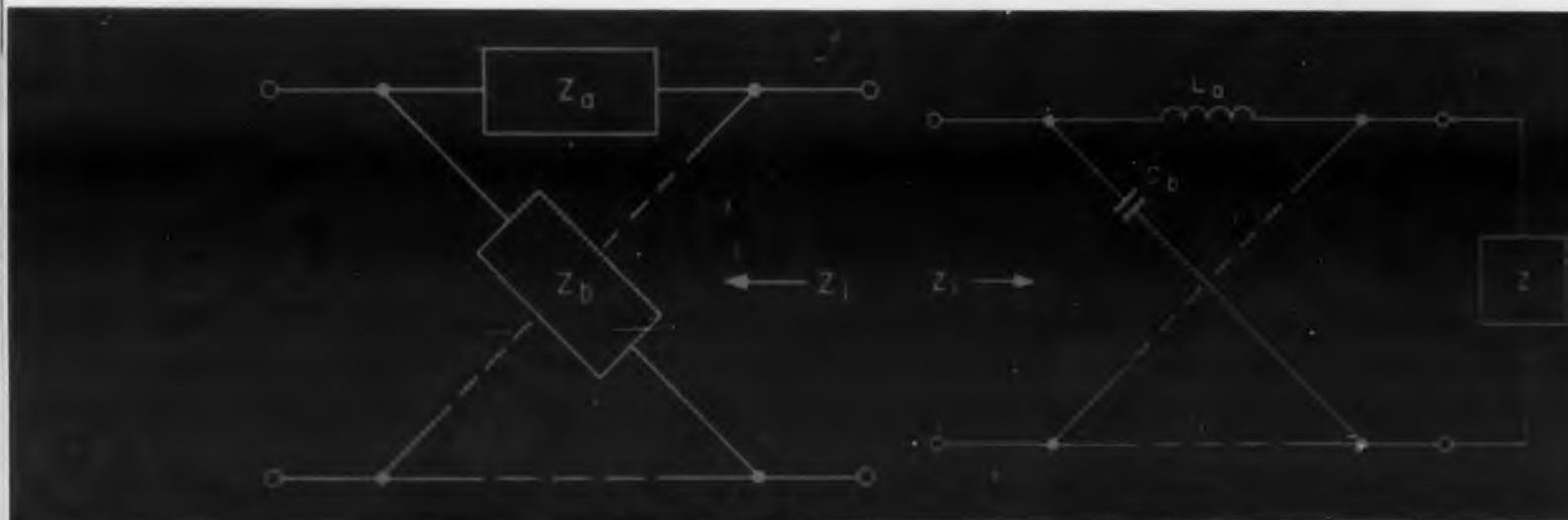


Fig. 2. General symmetrical lattice structure.



Fig. 3. The symmetrical L-C lattice.

Fig. 4. An example of phase correction using an L-C lattice.

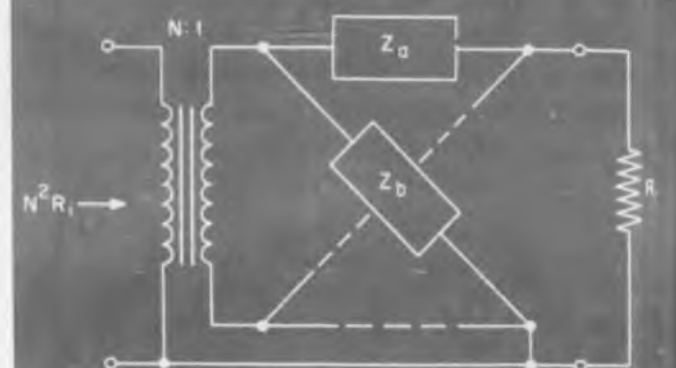
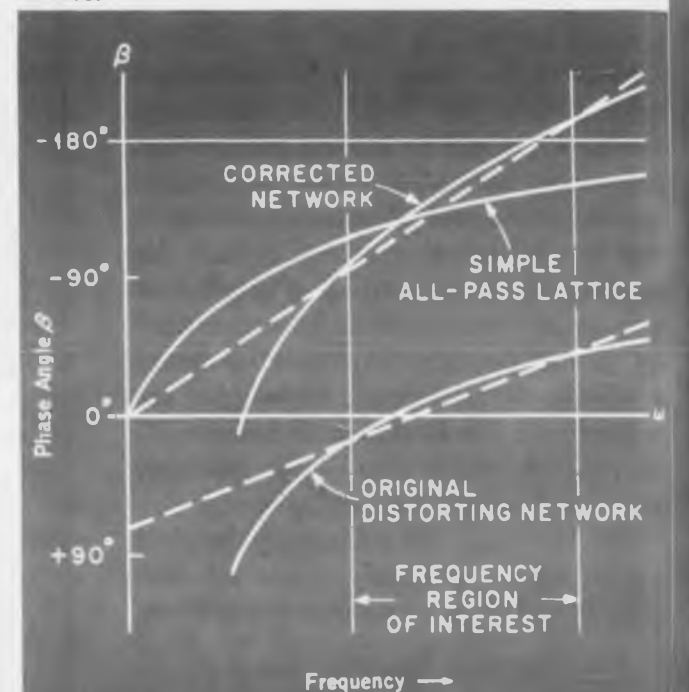


Fig. 5. A lattice network with a transformer to achieve a common ground.

ELECTRICAL networks can provide constant time delay with no phase distortion if two conditions exist.

- The network phase shift must be linear in the frequency region of interest, and
- The phase characteristic, if extended, should pass through zero phase shift at zero frequency. Thus, the networks whose phase characteristics are sketched as a linear function of frequency in Fig. 1 provide different time delays with no phase distortion.

Since real electrical circuits do not always provide desirable phase characteristics, a special network is often added to control phase distortion. The symmetrical lattice of Fig. 2 is sometimes used as such a phase equalizer. If the branches are reciprocal reactances, it will have zero attenuation for all frequencies from dc to infinity when the lattice is terminated in its image impedance. This image impedance is

$$Z_i = \sqrt{Z_a Z_b}$$

and the phase characteristic is such that

$$\tan \frac{\beta}{2}$$

$$\tan \beta/2 = \pm \sqrt{Z_a/Z_b}$$

This phase characteristic can be controlled by the branch impedances, but its slope will always be such as to give increasing phase with increasing frequency.

The Symmetrical L-C Lattice

Fig. 3 shows a symmetrical L-C lattice with single inductors or capacitors in each branch. The L and C branches can be interchanged. This reverses the polarity of the output but does not affect the phase characteristic. The attenuation remains at substantially zero at all frequencies where the component Q's exceed 10. The image impedance is a pure resistance and is

$$R = \sqrt{L/C}$$

The phase characteristic can be represented by

$$\tan \beta/2 = -2\pi fT$$

where $T = RC = L/R = \sqrt{LC} = 1/2\pi f$

Phase Correction

Fig. 4 illustrates the use of this L-C lattice as a phase equalizer. The original network has a phase characteristic, in the frequency region of interest, which gives phase distortion. (Its extension does not pass through zero phase at zero frequency. By adding the phase response of the L-C lattice to the original network, a new phase characteristic is achieved which minimizes phase distortion. The equalizer increases the total signal delay, but in many applications, this is not important.

GO-NO-GO



For production testing and process control CMC announces the Model 620A ELECTRONIC GO-NO-GO GAUGE

Here's an interesting new instrument from CMC with a host of applications in production testing and process control.

The Electronic Go-No-Go Gauge monitors any control or limiting situation which can be stated in terms of frequency. For instance, in the electronics industry relatively unskilled workers can tune oscillator circuits, filter networks, etc. with great accuracy. Frequency stability and comparison checks can be made quickly and easily. In mills and factories producing a continuous flow of goods such as steel, rubber, paper, the device can be used as a material flow controller keeping the output in tune with the input, preventing line buckle and stretch-out. In chemical and petroleum processing, the Model 620A can serve as a pressure or liquid flow regulating indicating system. Wherever motor speed control is a problem, the Model 620A will hold the speed within preselected limits.

How it Works

In operation, the unknown frequency generated by either the unit under test or one of the many types of transducers on the market is applied at the input. Upper and lower frequency limits are selected by setting the control knobs on the front panel. If the unknown frequency falls

below the lower limit, a red "low" lamp lights. Equal to or above the higher limit, a red "high" lamp lights. Within either limit, a green "in limits" lamp lights. Relay contact closure for external control occurs at each lamp condition.

Actual input frequency is displayed on decades. Remote visual monitoring can be obtained with CMC's new Inline-Inplane Readable Readout. Use of CMC's new fast printer provides a permanent printed record.

Like all CMC instruments, the new Model 620A features unitized construction for structural strength and low weight.

KEY SPECIFICATIONS

FREQUENCY RANGE	1 - 40,000 cps
INPUT REQUIREMENTS	.05v rms: 10 - 40,000 cps .07v rms: 1 - 10 cps Positive Pulse Rise Time: 1/2 volt or more/sec.
ACCURACY	±1 count ± stability
STABILITY	0.1% (Normal power line stability) Crystal time base optional.
TIME BASES	0.1 sec. and 1 sec. (10 sec. optional)
READOUT	4 digits (5 digits optional)
DISPLAY TIME	Automatic: Continuously variable 0.1 to 10 seconds. Manual: Until reset
INPUT IMPEDANCE	0.5 megohm and 50 mmfd
PRICE	\$1120.00 f.o.b. factory

For more information, contact your nearest CMC engineering representative or write to us directly for complete specifications and applications data. Please address Department 194

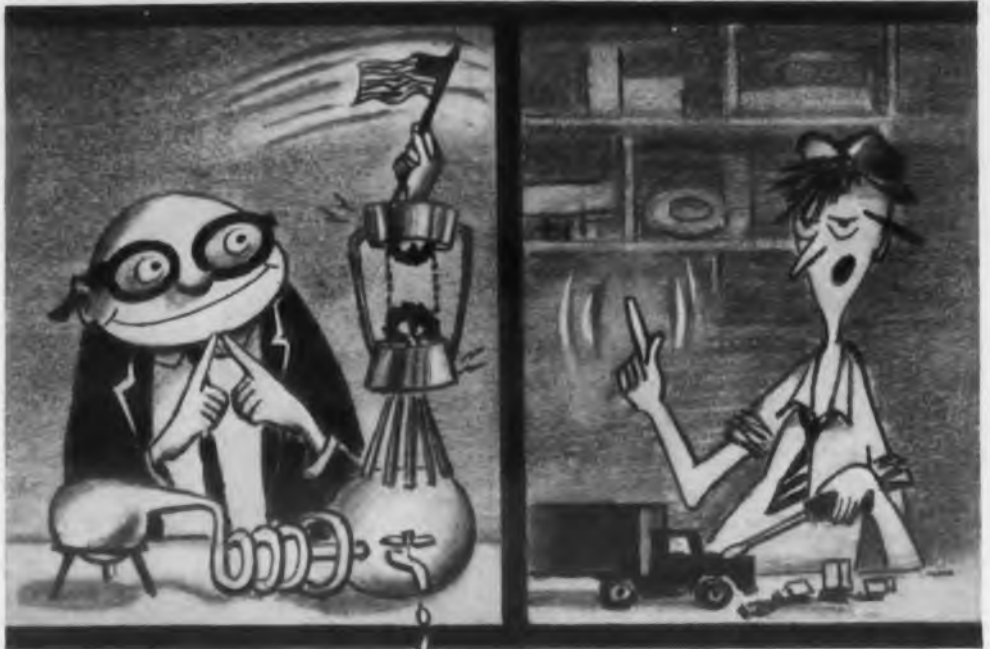
Subsidiary of
Hancock
Manufacturing
Company



Computer-Measurements Corporation

5528 Vineland Avenue • No. Hollywood, California
Phone: STanley 7-0401 • TWX: N HOL 2160

CIRCLE 17 ON READER-SERVICE CARD



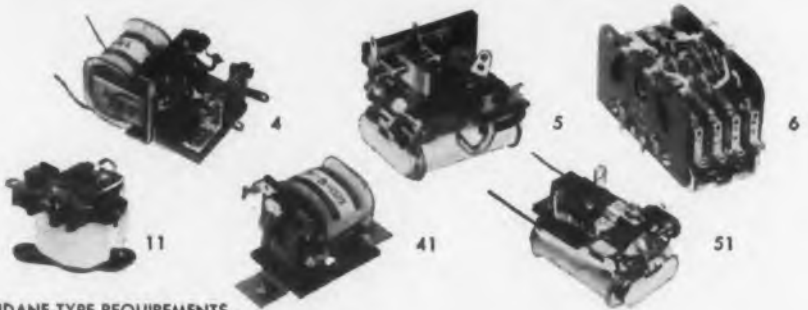
SIGMA TYPES AT YOUR SERVICE

On the left, Hardwicke J. von Cumulus exemplifies scientific inquiry in the best tradition, pondering problems of the highest order concerning interrelation of theoretical factors in sensitive relay design. His is an 0.6^{-13} world, beyond the ken of most, deaf to the Cry of the Coliseum. He's the gentleman to see if you're just wondering about the characteristics of a relay for use somewhere out of this world.

At right is Sigma's General Purpose Application Man of the Year, Mackinaw L. Mundane. Although Mackinaw will never quite understand what all the Hardwickes are muttering about, he doesn't care; he's closing in fast on some good unsophisticated jobs for Sigma relays. He's heard all about Progress, Improvement and Doing the Difficult Jobs Well, but he knows *his* bread is buttered

by the guy who wants a relay that will work well, on the ground, under everyday circumstances. He will enthusiastically tell you, point blank, which Sigma type to pick for speed, quietness, price, life or some combination thereof. His customers make toys, burglar alarms, electric blanket controls, machinery controls, UL-approved items and such, and some of his favorite relays are shown below.

Actually, there's a whole crew of Mundanes here ready to jump when you speak — not at you, but up with answers. Or from a distance you can get some useful data on which to judge and select, in the form of specific relay Bulletins, or assembled within elegant covers as the NEW Sigma Catalog. Communication with H. J. von C. and other Scientists, however, is restricted to 8:30-5:00, Monday through Friday.



AMONG MUNDANE-TYPE REQUIREMENTS . . .

LOW PRICE: Series 11 sells at less than a dollar in quantity, with mechanical life of 100,000,000 operations. DC and shaded pole AC.

RANGE OF ADJUSTMENT: Series 4 and 5 can be adjusted and specified as to both drop-out and pull-on. Standard sensitivities from 1 to 200 mw.

HIGH CONTACT RATING: Series 51 switches 10 amperes of incandescent lamp load yet operates on 100 mw.

HIGH SPEED: Series 41 can be operated in less than 2 milliseconds and will switch loads up to 1 ampere 100,000,000 times.

AC OPERATED: Shaded pole 41 with no rectifiers. Extremely quiet, reliable operation with switch ratings up to 5 amperes, or operating sensitivity as low as 0.06 v-a.

MAGNETIC LATCHING: Series 6 (Form Z) polar relay provides an exceptionally reliable latching contactor. Up to 4-pole double throw with no mechanical catches to wear.

SIGMA

SIGMA INSTRUMENTS, INC.

91 Pearl Street, So. Braintree 85, Massachusetts

CIRCLE 18 ON READER-SERVICE CARD

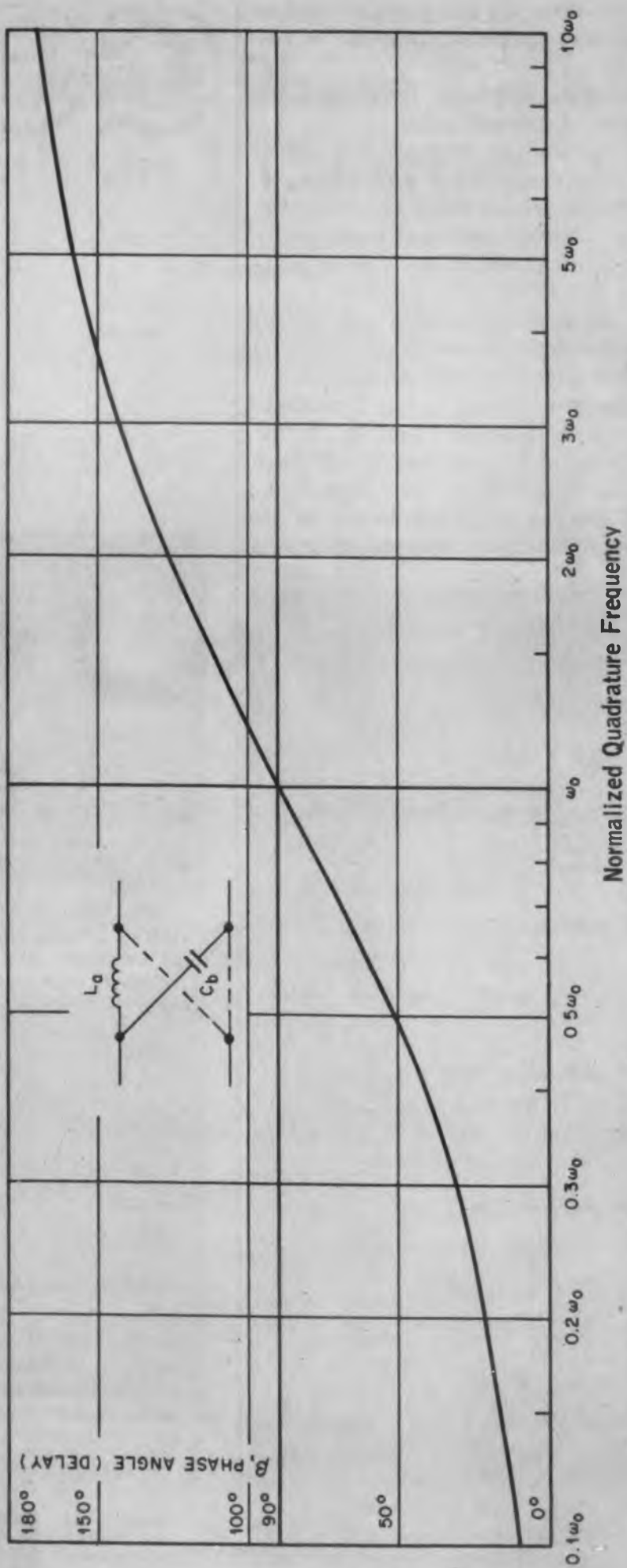


Fig. 6. Universal Design Curve for the all-pass L-C lattice network. (Two cycle semi-log paper, such as Dietzgen #340-L210, may be used as an overlay).

Since the phase vs frequency function of the simple L-C lattice is uniquely defined for this network configuration, the frequency chosen for one phase point on the curve determines the frequency of all other points. This frequency placement and the image resistance are the two independent variables at the disposal of the lattice designer. Thus, the simple L-C lattice cannot guarantee perfect phase equalization for all networks.

A Universal Phase Curve

Fig. 6 is a universal phase curve which can aid in the judicious choice of an L-C lattice for optimum phase correction. The lattice designer picks the two extremes of the frequency range over which the phase is to be optimized. Knowing the phase response of the network to be corrected, he goes to Fig. 6 and tries to locate two points on the quadrature frequency scale having the same ratio as his extreme frequencies, and having phase delays which, when added to the phase angles of the original network at the extreme frequencies, will most closely define a linear phase characteristic passing through zero at zero frequency. The designer should plot the original phase response on a linear scale as in Fig. 4. The designer should mark the ratio of the extreme frequencies on the edge of a card held along a logarithmic frequency scale such as the one in Fig. 6.

Knowing the ratio will be constant, he can move the card along the scale and attempt to find two phase delays at this ratio which will add to his original response to produce a linear phase characteristic. Once a "fit" is achieved, one of the known extreme frequencies is divided by the reading corresponding to it on the frequency scale to obtain the quadrature frequency, f_0 , of the desired lattice. Finally a desirable image resistance is chosen to match the circuit impedance at the point of insertion.

The desired lattice elements will be

$$C = \frac{1}{2\pi f_0 R}$$

and

$$L = \frac{R}{2\pi f_0}$$

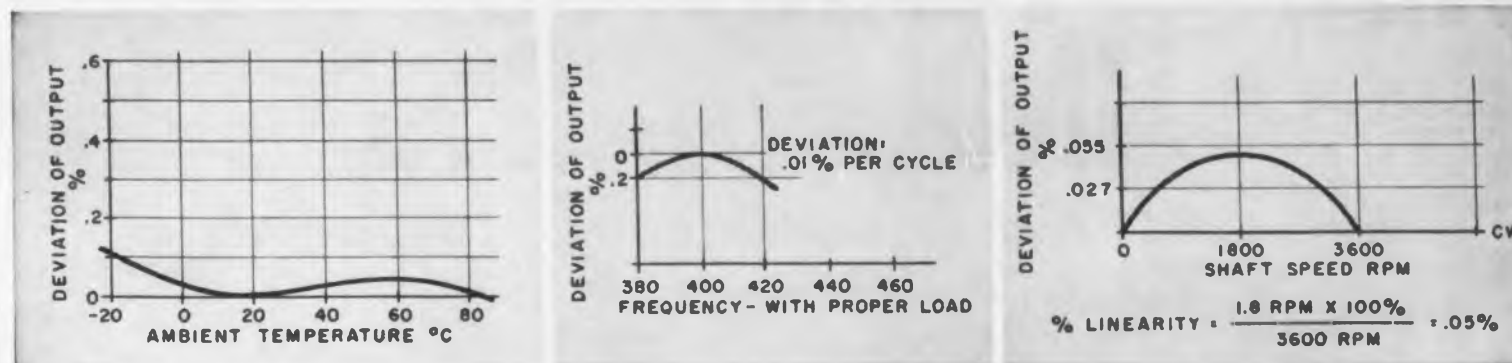
The fact that a symmetrical lattice structure does not have a ground common to both input and output terminals limits its use in practical circuits. One terminal may be grounded and a transformer used at the opposite end to overcome this difficulty. This transformer may be used to transform the image resistance to a value leading to more easily realized components. Fig. 5 shows such a circuit.

NEW KEARFOTT TACHOMETERS:



KEARFOTT SIZE 11 AND SIZE 15
INTEGRATING TACHOMETERS
ACTUAL SIZE

... provide precise integration under all conditions



TEMPERATURE

Variations of output, due to temperature changes, are minimized by Kearfott's precise unit temperatures control and/or compensation.

FREQUENCY

Variations due to frequency changes are held to .01% per cycle with appropriate loading.

SPEED

Minimum deviation of output from mean value due to speed is characteristic of these precision tachometers.

Kearfott Tachometers are ideally suited for applications in aircraft, missiles, and other equipment requiring precise integration. They are compact and light in weight. They offer excellent environmental resistance due to all stainless steel construction. Kearfott's unique design eliminates the need for thermostatic temperature control. Units available to operate under high temperature (200°C.), high vibration (500 cps) and shock (10 G's).

ENGINEERS:

Challenging opportunities at Kearfott in advanced component and systems development.

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Illinois.
South Central Office: 6211 Denton Drive, Dallas, Texas.
West Coast Office: 253 N. Vinedo Avenue, Pasadena, California.

GENERATOR CHARACTERISTICS

MODEL	VOLTS OUTPUT PER 1000 RPM	LINEARITY TO 3600 RPM	EXCITATION AT 400 CPS
Size 11 R860-25	2.75	0.1%	115V
Size 11 R862-22	2.75	0.1%	115V
Size 15 T816-25	2.9	0.05%	115V

SERVO MOTOR CHARACTERISTICS

MODEL	NO LOAD SPEED	STALL TORQUE
Size 11 R860-25	5500 RPM	0.55 in. oz.
*Size 11 R862-22	4500 RPM	0.5 in. oz.
Size 15 T816-25	4500 RPM	0.4 in. oz.

*Drag Cup Motor—Maximum starting voltage, 1 volt.

Send for data sheet on Kearfott Tachometers and other Kearfott Components and Systems.

Kearfott

PRECISION
EQUIPMENT
CORPORATION
GPE

CIRCLE 19 ON READER-SERVICE CARD

Radio Receptor silicon
diodes

IN ANY COMBINATION OF CHARACTERISTICS INCLUDING...

high speed high conductance high temperature
high voltage high back resistance

General Instrument semiconductor engineering has made possible these new silicon diodes with a range of characteristics never before available to the industry. Particularly outstanding is the all-purpose type 1N658 which offers uniform excellence in all parameters. The RRco. diodes shown here are just a small sampling of the line — the complete list will be sent you upon request to Section DN-3

Code No.	Max. Fwd. Voltage Drop @ Indicated DC Current	Max. Rev. DC Cur. @ Test V.		Test Voltage	Min. Break-down Voltage*	Reverse Recovery
		25° C.	150° C.			
1N658	1 @ 100 mA	.05 μ A	25 μ A	50V	120V	80K Ω in 0.3 μ sec†
1N457	1 @ 20 mA	.025 μ A	5 μ A	60V	70V	
1N458	1 @ 7 mA	.025 μ A	5 μ A	125V	150V	
1N459	1 @ 3 mA	.025 μ A	5 μ A	175V	200V	
DR668	1 @ 200 mA	.025 μ A	5 μ A	60V	80V	
DR669	1 @ 200 mA	.025 μ A	5 μ A	125V	150V	
DR670	1 @ 200 mA	.025 μ A	5 μ A	175V	200V	
			100° C.			
1N625	1.5 @ 4 mA	1 μ A	—	10V	30V	15K Ω in 0.15 μ sec†
		10 μ A	50 μ A	20V	—	—
1N627	1.5 @ 4 mA	20 μ A	100 μ A	75V	100V	400K Ω in 1.0 μ sec†
1N629	1.5 @ 4 mA	20 μ A	100 μ A	175V	200V	400K Ω in 1.0 μ sec†
DR677	1 @ 100 mA	0.5 μ A	25 μ A	20V	30V	15K Ω in 0.15 μ sec†
DR673	1 @ 100 mA	0.5 μ A	10 μ A	75V	100V	400K Ω in 1.0 μ sec†
DR675	1 @ 100 mA	0.5 μ A	10 μ A	175V	200V	400K Ω in 1.0 μ sec†

*Reverse voltage at which a reverse current of 100 μ A flows.
†When switching from 5 mA to -40V.
‡When switching from 5 mA to -20V.



semiconductor division
RADIO RECEPTOR COMPANY, INC.

Subsidiary of General Instrument Corporation
240 Wythe Avenue, Brooklyn 11, N. Y. EVergreen 8-6000

Germanium & Silicon Diodes • Dielectric Heating Generators and Presses
Selenium Rectifiers • Communications, Radar and Navigation Equipment

CIRCLE 20 ON READER-SERVICE CARD

Two-Gyro M

INFORMATION on this two-gyro stable platform has recently been made more public. Under development for the military during the past few years, the system proves to be truly worthy of its title of master reference. The instrument serves as a source of directional and vertical gyroscope intelligence for all systems aboard the aircraft, and thus eliminates the traditional necessity for individual gyros in each system. Moreover, the system is of relatively simple design, and is enclosed within a single package measuring a little over one foot in length.

The two-gyro master reference, developed by Lear, Inc., 110 Ionia Ave., N. W., Grand Rapids, Mich., is a completely non-tumbling type. In operation, the reference combines accuracies of newly designed gyros with the stabilized azimuth feature of the conventional Abbott-type stable platform. Both gyros are constructed on a common no-gimbal-lock type suspension. The directional gyro is a two-axis element stabilized by servo techniques in pitch and roll to eliminate gimbaling errors, which often occur in conventional directional gyros during routine jet aircraft maneuvers. Random drift is extremely low. Drift rates are less than one degree per hour when magnetic heading control is removed.

The vertical gyro has a dual function, providing both non-tumbling roll and pitch signals for control systems. The no-gimbal-lock design of the vertical gyro allows full freedom of that element throughout 360 degrees in either pitch or roll. Because of this, the system can provide accurate stabilization information during such aircraft maneuvers as the planned Immelman and the one-half Cuban Eight, both used in loft bombing, and during sustained near-vertical flight of



Master Reference

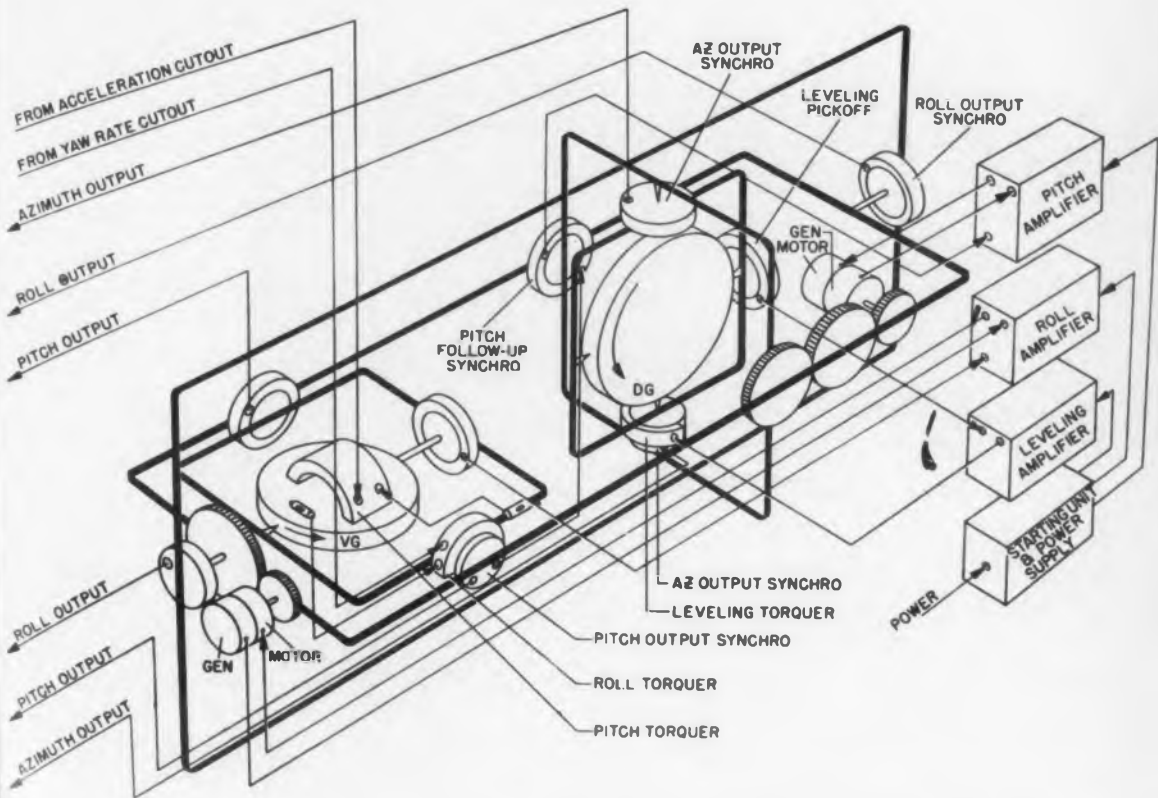


Diagram of the gyro reference system, showing its general construction. Note that both gyros are mounted on a common no-gimbal-lock type suspension. Gimbaling errors in the directional gyro are eliminated by standard servo techniques. The vertical gyro is non-tumbling, permitting reference information during unusual aircraft maneuvers.

advanced aircraft. The master reference has been subjected to random noise type vibration through the range from 10 to 2000 cps at an average force of 10 g, and has also demonstrated good resistance to shock of this same magnitude. Other environmental characteristics meet those specifications typical for military jets.

For more information on this gyro system, turn to the Reader-Service Card and circle 21.

Instrument Calibration



MODEL 829

a
modern
method of
maintaining
ACCURACY

Superior and sustained quality control, through frequent calibration of test instruments, can be achieved by semi-skilled personnel using these self-contained standards.

Portable Model 829 calibrates both AC and DC meters over ranges from 0.25 millivolt to 2000 volts and 2 microamperes to 20 amperes. Direct reading accuracy of 1% (0.5% using charts supplied). Output frequency from 50 to 400 cps depending on line frequency used.

Net price \$2,650.



MODEL 261B

Console Model 261B calibrates all types of AC meters to direct reading accuracies of 0.5% (0.25% using calibration charts) over frequency range of 50 to 1600 cps. Current range from 1.5 milliamperes to 200 amperes; voltage range from 75 millivolts to 1500 volts. Output of electronic power oscillator has less than 5% total harmonic content at 60 cycles.

Net price \$9,250.



MODEL 262B

Model 262B Dual Potentiometer Standard calibrates DC electrical measuring instruments to direct reading accuracies of 0.1% (0.05% using calibration charts) through voltages ranging from 1 millivolt to 1500 volts and currents ranging from 1 microampere to 150 amperes. Employs Weston instruments and standard cells.

Net price \$15,600.

Prices are f.o.b. Boonton, N.J. & subject to change without notice.



WE CAN HELP YOU

Technical and application data for our six basic models are fully described in a new 24-page catalog. Send for it today.



Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

CIRCLE 22 ON READER-SERVICE CARD

NEW PRODUCTS

To provide a complete coverage of ALL new products generally specified when designing electronic original equipment, the New Product section has been extended. To include the larger number of items, products which are best suited to a brief description have been noted at the end of the section.



TRIGGER DIODE

A cold cathode gas trigger diode tube series has been designed for isolation purposes, switching, RC timing circuits, and other applications. The miniature tube has an extremely high input resistance before a critical voltage is reached, at which time the diode breaks down and becomes a very low resistance. A typical model of the series, Model TAA-113, has these characteristics: nominal firing voltage of 113 v; leakage resistance at 95 v of 5×10^{10} ohm; and energy transfer of 3000 ergs.

The Victoreen Instrument Co., Dept. ED, 5806 Hough Ave., Cleveland 3, Ohio.

CIRCLE 23 ON READER-SERVICE CARD



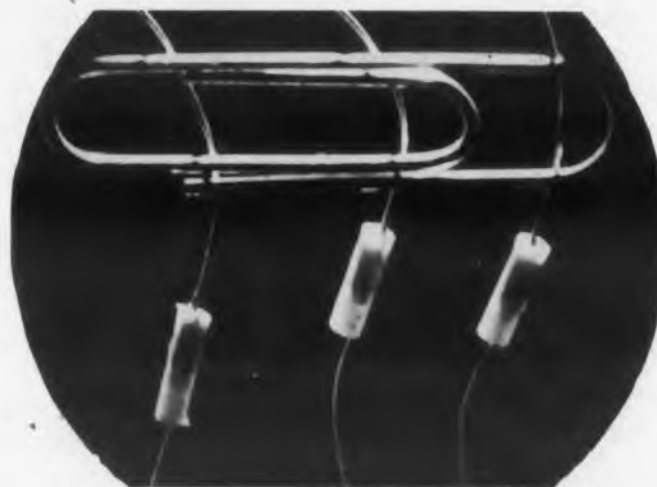
NOISE SOURCE

Thermal agitation of the electrons in an ordinary carbon resistor acts as the noise source in model 300B. The resulting voltage, about 13 μ v, is then amplified by a stabilized feedback amplifier with 100 db of gain. Stability is such that it takes a change of about 54 F before the noise output varies 0.5 db.

Other specifications include an output of about 1 v for a frequency band up to 20,000 cps, output impedance of 20 ohm, and internal noise at least 10 db below thermal spectrum. The noise source furnishes constant energy per cycle, that is, rising 3 db per octave.

Western Electro-Acoustic Lab., Inc., Dept. ED, 11789 San Vicente Blvd., Los Angeles 49, Calif.

CIRCLE 24 ON READER-SERVICE CARD



TANTALUM CAPACITORS

These miniature polar electrolytics are slug-types recently added to the Tantalytic line. Designed for low voltage transistor applications, such as hearing aids, the units are rated from 1 to 20 v dc at values ranging from 0.1 to 16 μ f. A typical unit measures 0.25 in. long with a diameter of 0.075 in. with the Mylar sleeve. Without the sleeve, the diameter is 0.067 in.

General Electric Co., Dept. ED, Schenectady, N.Y.

CIRCLE 25 ON READER-SERVICE CARD



DC AMPLIFIER

Multi-channel analog-digital conversion of strain-gage signals is greatly facilitated by the Model 1350 dc amplifier. An adjustable passband control can be set to suit the sampling rate while an output limiting circuit prevents a broken gage or other malfunction on one channel from saturating the rest of the commutation system. Signal compression, low noise, voltage gains to 1000, 2- μ v zero stability, and 100 k input impedance are also featured.

Dynamics Instrumentation Co., Dept. ED, 1118 Mission St., So. Pasadena, Calif.

CIRCLE 26 ON READER-SERVICE CARD



DRIFT TRANSISTOR

A low collector-to-base capacitance of 1.65 μ mf is made possible by the design of type 2N544 drift transistor. The unit can provide a power gain of 30.4 db at 1500 kc in circuits utilizing a neutralizing network and somewhat lower gains in circuits without a neutralizing network. The frequency range of the transistor is 535 kc to 1620 kc.

Radio Corporation of America, Dept. ED, 30 Rockefeller Plaza, New York 20, N.Y.

CIRCLE 471 ON READER-SERVICE CARD

437

NOW! END READOUT CONFUSION... with the new KIN TEL digital voltmeter

ANOTHER FIRST FROM KIN TEL! Here is a digital voltmeter that shows numbers on a readable single plane! With KIN TEL's new design, there are no superimposed outlines of numbers in the picture...no confusion caused by dials and old style numerical readouts. This digital readout uses a simple projection system - provides 7,000 to 8,000 hours of lamp life, compared with 100 to 200 hours for ordinary readouts.

FIRST OF A COMPLETE LINE OF DIGITAL INSTRUMENTS! Others include: Converters for measuring AC, ohms, ratios...multiple input scanners...serial converters to drive typewriters and punched tape units.

WIDE APPLICATION! KIN TEL digital instruments are ideal for automatic check-out systems for missiles and rockets; computer measurements; process control monitoring; production testing; test system calibration; strain gage, thermocouple and other transducer measurements, and calibration of laboratory and industrial electronic instruments.

Talk to your local KIN TEL representative. Sales and service everywhere. Or write us direct for further information.

See the difference!



ORDINARY READOUT



KIN TEL READOUT



CLEAR AND SHARP. ANY WAY YOU LOOK AT IT

CIRCLE 28 ON READER-SERVICE CARD

- 100 Microvolt Sensitivity
- Automatic, Continuous Standard Cell Calibration
- High Reliability
- 0.0001 to 999.9V—Plus Automatic Decimal and Polarity Indication

SPECIFICATIONS

Display...Four (4) digit with automatic polarity indication and decimal placement. Total display area 2" high x 7.5" long, internally illuminated. Individual digits 1.25" high.

Automatic Ranges...0.0001 to 999.9 volts covered in four ranges.

Accuracy...0.01% or 1 digit, whichever is larger.

Counting Rate...30 counts per second, providing average balance (reading) time of 1 second, maximum balance time of less than 2 seconds.

Reference Voltage...Chopper-stabilized supply, referenced to an unsaturated mercury-cadmium standard cell.

Input Impedance...10 megohms, all ranges.

Output...Visual display, plus print control. Automatic print impulse when meter assumes balance. No accessories required to drive parallel input printers.

Input...115 volt, 60 cycle, single phase, approximately 75VA.

Dimensions...Control unit, 5 1/4" high x 19" wide x 16" deep. Readout display, 3 1/2" high x 19" wide x 9" deep.

Weight...Approximately 40 lb.

Price...\$2,100

Over 10,000 KIN TEL instruments in use today!



5725 Kearny Villa Road
San Diego 11, California

A Division of Cohu Electronics Inc.

NEW STABLVOLT*

**REGULATED
RELIABLE
MAINTENANCE
FREE**

DC POWER

only **STABLVOLT*** with
Dual Magnetic Regulation
offers all these features...

- Ultra-fast transient regulation
- Static magnetic amplifier circuitry. No tubes, variacs or vibrator elements
- Maintenance free. No costly downtime
- Short circuit protected, without breakers or fuses
- Quiet operation
- Modern and distinctive cabinet design
- Competitively priced

Write for
Technical
Bulletin
DMR-100

These new power supply units from the Stablvolt Division of Magnetic Research Corporation carry the same high quality of workmanship and superior design that has always been attributed to our products... products you can depend upon to be the finest of their kind.

*Reg. Trade Mark



STABLVOLT DIVISION

of Magnetic Research Corporation

200-202 Center Street, El Segundo, California

EAsgate 2-2403

CIRCLE 29 ON READER-SERVICE CARD



Model DMR 28-5

Other Models Available

NEW PRODUCTS

Choppers

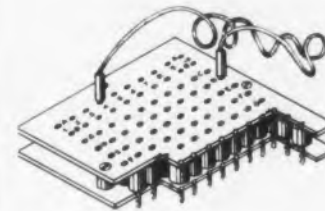
Very low residual noise levels



Having nine pin bases with top coil connections, these choppers are available in both 20-120 cps and 350-500 cps models. The top coil connections in both hermetic seal and dust seal types assure residual noise of levels in one megohm circuits of less than 10 μ v at 60 cps and 20 μ v at 400 cps. These choppers have dpdt switching with both break-before-make and make-before-break contact closures. Like previous models, these choppers have center pivot construction and applicable to military environmental conditions.

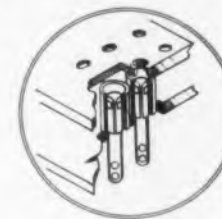
The James Vibrapowr Co., Dept. ED, 4050 N. Rockwell St., Chicago 18, Ill.

CIRCLE 30 ON READER-SERVICE CARD



Patchboard

Inexpensive assembly



These programming patchboards consist of a sandwich of two sheets of phenolic punchboard assembled with metallic terminals and spacers as shown. The panels have 0.095 in. diam holes. When the outer panel is removed the receptacles are exposed and can be easily changed or adjusted for optimum contact pressure. Since the outer panels are inexpensive, extra ones may be printed for different set-ups and are easily placed in position when needed. Standard units are made up in blocks of 100 receptacles on 0.265 in. centers, ten rows of ten receptacles each. Various color finishes are available.

Vector Electronic Co., Dept. ED, 1100 Flower St., Glendale 1, Calif.

CIRCLE 31 ON READER-SERVICE CARD

Power Supply

Delivers up to 1600 v dc at 300 ma



Model 6030 power supply is a laboratory type supplying 0-600 v dc at currents to 300 ma at any voltage setting. The circuitry insures rapid transient response with recovery times less than 50 μ sec. Regulation for full load change is 100 mv. Ripple is 3 mv maximum. In addition to the main voltage range there is a bias supply delivering 0-150 v dc at currents to 5 ma.

Deltron, Inc., Dept. ED, P. O. Box 192, Glenside, Pa.

CIRCLE 32 ON READER-SERVICE CARD

Variable Delay Line

Delay is function of control voltage



Series EV-600 electrically variable delay lines provide a time delay which is a function of the applied voltage. Infinite resolution over a 50 per cent range of the nominal delay value is available. Since delay is proportional to control voltage, an amplitude function can be converted into time modulation of a pulse or phase modulation of a frequency. Delay range is 0.5 μ sec to 50 μ sec. Impedance range is 50 ohms to 2000 ohms. Delay to rise time ratio is 5 to 50.

ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Pk., N.J.

CIRCLE 33 ON READER-SERVICE CARD

CIRCLE 34 ON READER-SERVICE CARD

Transitron

SILICON

TRANSISTORS

*Now...
The widest
POWER RANGE
in the
industry!*

Two new high power transistors have just been added to the Transitron line, increasing power ratings to 80 watts. Now, whatever the application, you can choose from the broadest power range in the industry... with Transitron reliability built into every transistor.

HIGH POWER

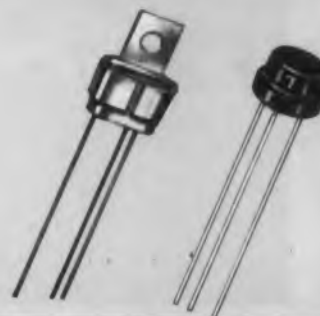
- Ratings to 60 watts
- Operation to 5 amps
- Low Rcs, 1.5 ohms typical
- Voltage Ratings to 60V



Type	Maximum Power Dissipation at 25°C case (watts)	Minimum D.C. Common Emitter Current Gain B	Typical Collector Saturation Resistance (ohms)	Maximum Collector Voltage Vc (volts)
ST400	60	15@2 amps	1.5@2 amps	60
2N389	37.5	10@2 amps	3@1 amp	60

MEDIUM POWER

- Operation to 500 ma
- Ratings to 5 watts
- Low Rcs, 6 ohms typical
- Voltage Ratings to 100V

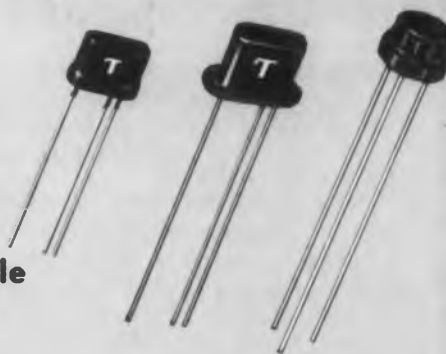


Type	Maximum Power Dissipation at 25°C case (watts)	Maximum Collector Voltage VcMax (volts)	Minimum D.C. Common Emitter Current Gain B	Typical Collector Saturation Voltage (volts)
2N545*	5	60	15@500 ma	3V@500 ma
2N547	5	60	20@500 ma	3V@500 ma
2N498	4	100	12@200 ma	4V@200 ma
2N497	4	60	12@200 ma	4V@200 ma
2N551	5	60	20@50 ma	1V@50 ma
2N243	.75	60	9@5 ma	3.5V@20 ma
2N244	.75	60	28@5 ma	3.5V@20 ma

*Fast Switching Type

SMALL SIGNAL

- Operation to 175°C
- Low Ico at Rated Vc max.
- High Current Gain
- Three package sizes available



Type	Minimum Common Emitter Current Gain, β	Maximum Collector Voltage Vcc Peak (Volts)	Typical Cut-off Frequency (MC)	Maximum Collector Cut-off Current at 25°C at Vc MAX (μ a)
2N543	80	45	15	.5
2N480	40	45	11	.5
2N475	20	45	10	.5
2N336	78	45	13	50
2N334	18	45	11	50
2N118	18	30	4	10
2N119	36	30	4	10
ST904	18	30	4	10
ST905	36	30	4	10

Send for Bulletin TE-1353

Transitron

electronic corporation • wakefield, massachusetts



Transistors

Diodes Regulators

Rectifiers

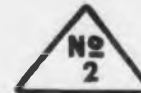


VISIT US AT IRE SHOW — BOOTH 3912-14

Nickelonic News



DEVELOPMENTS IN NICKEL AND NICKEL ALLOYS AND THEIR APPLICATIONS



New ultrasonic welder solves heat problem in thin gauge welding



Purity of Inco Nickel helps Raytheon stabilize emission characteristics in magnetron

The vitality of a radar set is centered in its magnetron oscillator. This is why Raytheon chose their RK2J42 fixed-frequency magnetron to pulse their Mariners Pathfinder Radar Model 1500. This tube is designed for long-life operation at 7kw and 1500 pps.

One reason for the tube's top performance is the use of Electronic Grade "A" Nickel in the cathode. This commercially pure, wrought nickel is non-contaminating, and thus helps maintain optimum emission characteristics.

Raytheon engineers also report that it stands up against high ambient temperatures, and has good machinability.

Magnetostrictive "A" Nickel transducer provides the vibratory energy

A new welding process has caught the ear of the electronics industry: "Sonoweld", developed by Aeroprojects, Inc., West Chester, Pa. By means of high-frequency mechanical



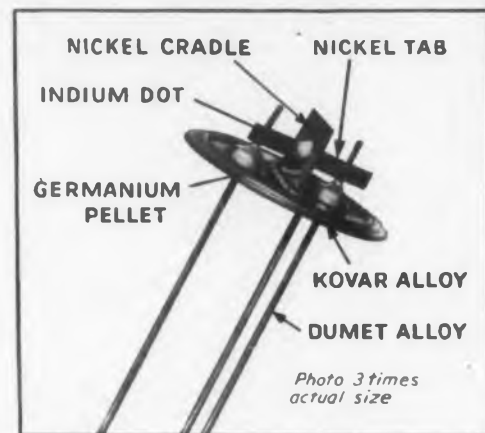
vibrations, it produces a metallurgically sound weld — and *without the application of heat.*

Thin gauge forms of metals like copper and aluminum are now being welded ultrasonically without melting and with little deformation. Photo shows "Sonoweld" unit being used to weld aluminum and copper foil conductors in American Machine & Foundry Co.'s wafer transformer project.

To maintain its high power levels, "Sonoweld" relies on a laminated stack transducer made from Electronic Grade "A" Nickel, a rugged magnetostrictive material. In a periodic electro-magnetic field, nickel undergoes alternating length-changes to vibrate at the field's frequency.

This magnetostrictive effect of "A" Nickel is relatively large, and is useful over a wide frequency range. "A" Nickel also has high resistance to fatigue, heat and corrosion, and is easily fabricated.

G. E. builds rugged PNP triode for computer use



Even the testing treatment (being shot out of mortars) doesn't harm the 2N123 transistor. G. E. (Syracuse) engineers build it with rugged, 99% + pure nickel.

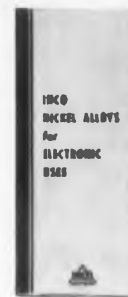
Non-contaminating, corrosion resistant Electronic Grade "A" Nickel has the strength to withstand shock and vibration. It also holds its shape at processing temperatures, and forms, welds and solders easily.

For sure glass-to-metal seals, G. E. uses the special purpose alloys Kovar® (29% Ni) and Dumet (42% Ni).

©Trademark, Westinghouse Electric Corp.

Reprints of useful booklet on "Inco Nickel Alloys for Electronic Uses" now available

This booklet describes the compositions and special properties of the various grades and alloys of nickel which are widely used in the industry. It also lists many important electronic applications of the Inco Nickel Alloys. For your copy, fill out the Reader Service Card, or write to The International Nickel Company, Inc., 67 Wall St., New York 5, N.Y.



THE INTERNATIONAL NICKEL COMPANY, INC. • 67 Wall Street • New York 5, N. Y.

For more information on nickel alloys for electronic uses, send reader service card or write.

CIRCLE 35 ON READER-SERVICE CARD



NEW PRODUCTS

DC Insulation Tester

Has high sensitivity at speeds of 4000 fpm



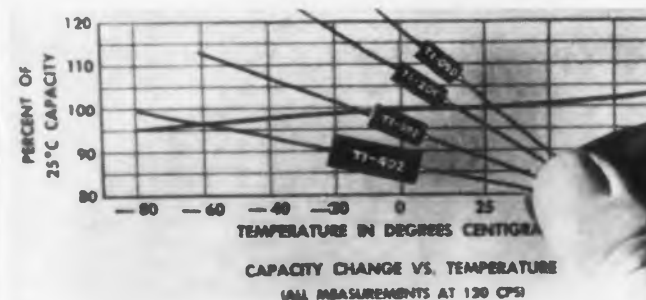
The CVX line of high voltage dc sparkers permits non-destructive fault detection at wire speeds of 4000 fpm. Absence of electrode length saves the floor space in a wire line usually needed for a 36 in. long electrode. The test unit is stated to greatly exceed the limitations of comparable ac testers in respect to speed and sensitivity.

Peschel Electronics, Inc., Dept. ED, Towners, RFD 1, Patterson, N.Y.

CIRCLE 36 ON READER-SERVICE CARD

Electrolytic Capacitors

Solid tantalum types up to 200 µf



These solid tantalum electrolytic capacitors, called Tan-ti-caps, are now available in 18 ratings. Five models are 6 v units ranging from 22 to 200 µf, five are 15 v devices from 10 to 100 µf, five are 15 v capacitors from 5 to 55 µf, and four are 35 v units from 4 to 25 µf. These units are stable within 10 per cent of rating from -80 to +85 C, and ±20 per cent capacity tolerances at 25 C. The case, which is cylindrical and without a protruding lip, measures 0.358 by 0.173 in. for the smallest device and 0.7 by 0.264 in. for the largest.

The capacitors are constructed of a solid pellet of pressed and sintered tantalum powder with an integral wire lead. The dielectric is formed by a tantalum-derived coating deposited electrochemically on the pellet, resulting in a semiconductor-type junction with the solid electrolytic. The pellet is solidly embedded within the case to withstand high and low frequency vibrations and high impact.

Texas Instruments, Inc., Dept. ED, P.O. Box 312, Dallas, Texas.

CIRCLE 37 ON READER-SERVICE CARD

Frequency Converter

Supplies precise frequencies of 45 to 2000 cps



Model FCR100 frequency changer is for use in testing equipment drawing up to 100 va over a range of frequencies between 45 and 2000 cps. Because of its low output distortion, the FCR100 is a good servo supply. An auxiliary input allows an external signal to be applied to its oscillator circuit, permitting the frequency to be set with a precision frequency standard.

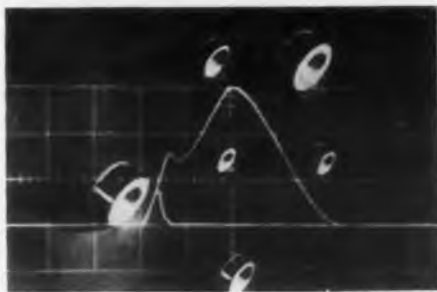
Features include input voltage range of 105-125 v at 45-65 cps; output voltage range of 0-130 v with ± 1 per cent regulation for line or load; output frequency regulation of ± 1 per cent normally, ± 0.01 per cent with a built-in frequency standard or any accuracy obtainable with an external frequency standard. Frequency drift is less than 1 per cent in 24 hours; power factor is unity to 0.7 lagging at 100 va, unity to 0.5 lagging at 50 va, and fully inductive at 25 va; output distortion is 1 per cent for 75-125 v output. The unit has a 0 to 40 C ambient temperature range.

Sorensen & Co., Dept. ED, Richards Ave., South Norwalk, Conn.

CIRCLE 38 ON READER-SERVICE CARD

Bobbin Cores

Feature consistent uniformity



These magnetic bobbin cores are available in either of two materials: 4-79 molybdenum permalloy—a rectangular hysteresis loop material characterized by minimum switching time and medium saturation flux density. The bobbins feature consistent uniformity and are made of high quality ceramic or stainless steel. The cores are supplied protected by Mylar tape or by Nylon caps when it is desirable.

G-L Electronics, Dept. ED, 2921 Admiral Wilson Blvd., Camden 5, N.J.

CIRCLE 39 ON READER-SERVICE CARD



World's Biggest Eater Dines Without Interruption



Typical insulator and insulating bolts used on power shovels.

You are looking at 3 million dollars' worth of power shovel, a 14-story monster capable of biting off 70 cubic yards of dirt at a clip.

Continuous operation is essential because downtime on a shovel of this size could top 500 dollars an hour. Reliability is shared by many interrelated parts. Some are made of Synthane laminated plastics.

Why Synthane? Because Synthane laminated plastics have the right combination of properties—dielectric strength, mechanical strength, and ease of machining. And Synthane uses only first-quality raw materials, watches every step in the production and fabrication of the laminate,

is deeply concerned about delivery requirements.

Good materials, competent people, excellent tools and workmanship may not guarantee reliability but they're strong assurance of it.

If you are interested in a reliable source of laminated plastics—sheets, rods, tubes, or completely fabricated parts, write for an interesting catalog or call our representative near you.

SYNTHANE
S

SYNTHANE CORPORATION, 42 RIVER RD., OAKS, PA.

CIRCLE 40 ON READER-SERVICE CARD

dc supply for transistor applications



Model D1-100B

*— needs no derating... two 1-100 vdc outputs
accurately set with 10-turn Duodials**

Here's a power supply for your transistor lab that provides constant 20 MV regulation throughout its range without derating the output current. Outputs may be pulsed with a square wave load without affecting normal regulation. Ripple remains below 1.5 MV RMS under the worst conditions. Both outputs are current-metered, both are controlled by 10-turn Helipot* for easy, continuous settings at increments down to 0.1 VDC.

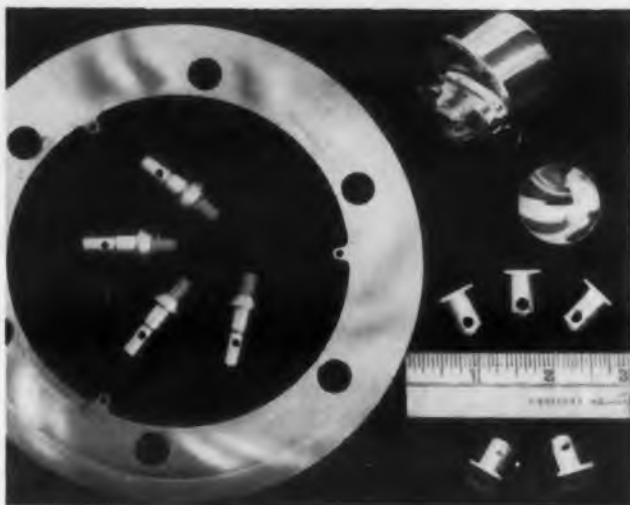
for complete information request Bulletin 1016

*HELIPOT CORP. TRADEMARK

dressen-barnes

DRESSEN-BARNES CORP. 250 N. Vinado Ave. Pasadena, California
CIRCLE 41 ON READER-SERVICE CARD

call on
BART
for controlled
**PRECIOUS
METALS
PLATING**



BART specializes in plating to heavy industrial thicknesses with every type of precious metal. Backed by 44 years of experience and equipped with large modern facilities augmented by one of the most extensive engineering and research organizations in the electroplating field, Bart Manufacturing Corporation can provide an unequalled plating service.

Contact BART today regarding your present precious metal plating problems or future requirements.

GOLD PLATING: Specification plating up to .001 inch with conventional or bright gold over complete surface or on specified areas. Heavier deposits on critical areas can be deposited by use of BART-developed techniques. Piece parts up to 6'0" long can be processed. Complete barrel facilities available for small parts.

SILVER PLATING: Heavy platings running up to 1/8" and more for caustic processing equipment and other uses. Specification platings as under-plating for Gold and Rhodium.

RHODIUM PLATING: Heavy platings to .000150" and heavier for corrosion resistance and wear resistance on contact surfaces.

PALLADIUM PLATING: Heavy platings for corrosion resistance used as a non-tarnishing finish on silver plated waveguides and other electronic components.

BART

MANUFACTURING CORPORATION
ELECTROFORMING • PIPE LINING & COATING • PLATERS
CHEMICAL PUMPS • ENGINEERING DESIGN SERVICES
227 Main St., Dept. E, Belleville 9, New Jersey

CIRCLE 42 ON READER-SERVICE CARD

NEW PRODUCTS

Ferrite Isolators

Complete test equipment series



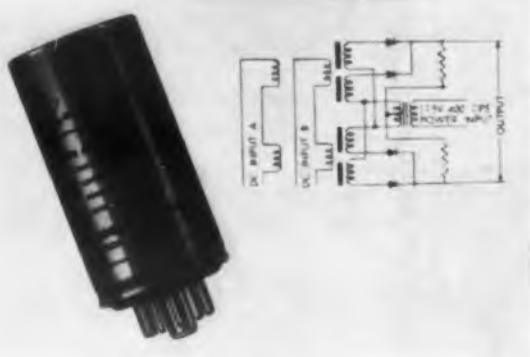
Designed to meet the requirements for test equipment applications, this series of broad band ferrite isolators are available in WR-28, WR-42, WR-62, WR-90, WR-112, WR-137, WR-187, WR-284 waveguide sizes. Frequency ranges extend from 2.6-3.95 to 26.5-40 kmc. Minimum isolation for most models is 30 dc, and average power rating ranges from 5 to 25 w. The isolators provide optimum frequency stability of test equipment and measurements during test, and extend the life of the rf source due to their high isolation.

Airtron, Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.

CIRCLE 43 ON READER-SERVICE CARD

Integrating Mag Amp

Takes less than 3 w



Model 430 is a plug-in, hermetically sealed, integrating magnetic amplifier which requires less than 3 w and operates from standard 115 v, 400 cps. Control winding A has a nominal gain of one volt dc output for 100 μ a dc input current. Control winding B has a nominal gain of 10 v dc output for 100 μ a dc input current. Signal frequency response extends from dc to 25 cps, depending on circuitry. Accuracy of integrators employing the model 430 is better than 2 per cent.

Acromag, Inc., Dept. ED, 22519 Telegraph Rd., Detroit 41, Mich.

CIRCLE 44 ON READER-SERVICE CARD

Protect Your Printed Circuits against corrosion BEFORE SOLDERING DURING SOLDERING AFTER SOLDERING



FLUXCOTE 21-XR

The liquid soldering flux with protective coating characteristics...

plus:

- Smooth, fast action
- High insulation resistance
- Light, tack-free, varnish-like protective film after soldering

Whatever your printed circuit production, dip... spot... or area soldering you get full three-way protection against corrosion with Lonco Fluxcote 21-XR.



← REQUEST FREE TECHNICAL BULLETIN

"The Soldering of Printed Circuits"

Also request free samples and data on other Lonco Products used in printed circuit manufacture: INSULATING ROSIN FLUXES

SEALBRITE COATINGS • SOLDER RESIST • FLUX REMOVERS
FLUX THINNERS • OXIDE REMOVERS



LONDON CHEMICAL COMPANY, Inc.

1531 North 31st Avenue
Melrose Park, Illinois

CIRCLE 45 ON READER-SERVICE CARD



Solenoid Valve

Very high flow in small unit

Series AG, valves utilize the company's coaxial principle and provide a full ported flow rate that has previously been possible only with valves of twice the dimensions. Pilot operated, the valve functions under pressures in excess of 3000 psi, and requires no pressure differential to operate or remain open. The design inherently provides minimum internal leakage.

Eckel Valve Co., Dept. ED, 1325 First St., San Fernando, Calif.

CIRCLE 46 ON READER-SERVICE CARD

Video Oscillator

Thermistor bridge stabilized



Type 0-22C is a thermistor bridge stabilized LC oscillator covering the frequency band of 10 kc to 10 mc in six ranges. The accuracy of calibration is 1 per cent and the frequency is independent of load impedance. Total harmonic content of the output wave-form is less than 1 per cent. The amplitude remains constant to within $\pm 1/2$ db throughout the frequency range and is independent of variations in supply voltage and range setting. This feature not only avoids the necessity of resetting the reference level, but also provides a means of measuring the load impedance by the reading on the output voltmeter.

The reference level of the oscillator is 1 v peak to peak and a constant resistance attenuator provides a control of output between -50 db and $+10$ db in steps of $1/2$ db. The output impedance is 75 ohm. An additional high level output socket is provided so that the oscillator may be used as a variable frequency source for bridge measurement.

Wayne Kerr Instruments, Dept. ED, P.O. Box 801, Philadelphia 5, Pa.

CIRCLE 47 ON READER-SERVICE CARD



Here are laminations for miniaturization

If you are making transformers for transistorized or other miniaturized equipment, information about our ultra-small size "performance-guaranteed" laminations can be important news to you. These nickel-iron laminations are produced in standard gauges, and are available in Hy Mu 80, 48 Alloy and, if required, Orthonol.

Dry-hydrogen annealed by our exclusive process, these laminations provide all-important uniform quality. This annealing at a dewpoint of -60°C . brings our Performance-Guaranteed laminations to ultimate permeability from as little as 5% of that value in the unannealed state.

Like all laminations from Magnetics, Inc., the "miniatures" are packed in standard nine-inch boxes to facilitate handling in your plant, and are immediately available from stock. These features alone provide substantial savings.

Edges of these fine tolerance laminations are cut off squarely and cleanly to minimize air gap where mating parts are butted. Thus, high operating efficiency is insured.

There's no room here for the really detailed story, but for complete information on our "Performance-Guaranteed" magnetic laminations, send for our newest catalog—just published—ML-41. Write today. *Magnetics, Inc., Dept. ED-41, Butler, Pennsylvania.*

MAGNETICS inc.

CIRCLE 48 ON READER-SERVICE CARD

NEW PRODUCTS

Accelerometer

Plastic deformation of a metal sphere provides peak readings

Series G101 peak reading accelerometer and velocity transducers are inexpensive units, intended to be utilized for the determination of high G peak acceleration and velocities in such applications as drop impact equipment, gun systems, and explosive devices.

The principle of operation involves the degree of plastic deformation of a metal sphere caused by means of a movable piston, acting as a mass in acceleration. The units are small, lightweight, and made with corrosion resistant materials. The available top ranges are 2000 to 50,000 g. Accuracy is ± 5 per cent over most of the range.

Avionic Products Eng. Corp., Dept. ED, Route 46, Dover, N.J.

CIRCLE 49 ON READER-SERVICE CARD

Video Translator

Accessory unit with 20 kc to 20 mc range



The VT-132 video translator is an accessory unit which extends the range of the company's uhf-vhf signal generator, SG-132, into the 20 kc to 20 mc region. It can also be used in conjunction with any other sweep generator having outputs in the 50-70 mc band. The instrument provides a 50 ohm output signal which sweeps from 20 kc to 20 mc, or produces narrower sweep width over any portion of this spectrum.

Completely quantitative results are obtainable, since the instrument is so designed as to permit use of the attenuator dial calibration and the crystal frequency markers of the SG-132 while maintaining their calibration accuracy. It is possible to vary the output of the video sweep from -3 db to below -100 db without affecting the output impedance. Flatness of the VT-132 output is better than ± 0.15 db total variation, and second harmonics are better than 35 db below the fundamental output.

Van Norman Industries, Inc., Electronics Div., Dept. ED, Manchester, N.H.

CIRCLE 50 ON READER-SERVICE CARD

Direct, automatic power readings



CW or pulsed power
Wide frequency range
No calculations
Assured accuracy
Operates with wide variety of bolometers

-hp- 430C **Microwave Power Meter**

Here is the finest, most dependable source of instantaneous microwave power readings available today. The *-hp- 430C* gives you power readings direct in db or mw and completely eliminates tedious computations or troublesome adjustment during operation. The instrument measures either pulsed or CW power on either waveguide or coaxial systems. Operation is entirely automatic, stability is extremely high, and the meter may be used with a wide variety of bolometer mounts having either positive or negative temperature coefficients. The broad nominal measuring range can be extended to higher powers by means of directional couplers and attenuators.

For measurements of CW or pulsed power, *-hp- 430C* uses either an instrument fuse, barretter or thermistor as a bolometer element. Operation may be at either 100 or 200 ohms. Power is read direct in milliwatts from 0.02 to 10 mw, or in dbm from -20 to $+10$ dbm.

SPECIFICATIONS

Power Range: 5 ranges, front panel selector. Full scale readings of .1, .3, 1, 3 and 10 mw. Also continuous readings from -20 to $+10$ dbm. (0 dbm = .001 watt). Power range may be extended with attenuators or directional couplers in microwave system.

External Bolometer: Frequency range depends on bolometer mount. Bolometers can operate at resistance levels of 100 or 200 ohms and can have positive or negative temperature coefficients. Any dc bias current up to 16 ma is available for biasing positive or negative temperature coefficient bolometers. Dc bias current is continuously adjustable and independent of bolometer resistance and power level range.

Suitable bolometers are:

Instrument fuses: *-hp-* G-28A and G-28B 1/100 amp fuse.

Barretters: Sperry 821, Narda N821B or N610B, PRD 610A, 614, 617 or 631C.

Thermistors: Western Electric D166382, Victory Engineering Co. 32A3, 32A5, Narda 333, 334.

Accuracy: $\pm 5\%$ of full scale reading.

Power: 115/230 v $\pm 10\%$, 50/1,000 cps, 75 watts.

Dimensions: Cabinet Mount: $7\frac{3}{8}$ " wide, $11\frac{1}{2}$ " high, 14" deep.
Rack Mount: 19" wide, 7" high, $12\frac{1}{2}$ " deep.

Weight: Net 14 lbs. Shipping 32 lbs. (cabinet mount).

Price: \$250.00.

Data subject to change without notice.



ELECTRONIC TEST INSTRUMENTS for

**Use these precision -hp- instruments with
-hp- 430C for greater coverage, convenience**

-hp- 752 Multi-Hole Couplers—For measuring average power 1 watt to 1 kw (with attenuator) in waveguide systems. Models cover all frequencies 2.6 to 40 KMC. Coupling factors of 3, 10 and 20 db available most bands. Directivity better than 40 db full range; accuracy within ± 7 db full range. Primary guide SWR less than 1.10. \$375.00 to \$75.00.

-hp- 764-767D Dual Directional Couplers—For wide band coax reflectometer and power measurements. Four models cover frequencies 216 to 4000 MC. 20 db attenuation, coupling accuracy 0.5 db, max. primary SWR 1.1 to 1.25; max. secondary SWR 1.2 to 1.5. Minimum directivity (216 to 940 MC) 30 db; 26 db at higher frequencies. 50 watts CW capacity, 10 kw peak. Low insertion loss. \$125.00 (any frequency).

-hp- 382A Precision Attenuators—For measurements up to 5, 10 and 15 watts, this revolutionary new broad band instrument may be employed. -hp- 382A attenuates from 0

to 50 db, full range, independent of frequency. Phase shift constant with attenuation. Accuracy within $\pm 2\%$ of db reading. Models cover frequencies 3.95 to 40.0 KMC, maximum dissipation 5 to 15 watts. SWR less than 1.15. \$500.00 to \$250.00.

-hp- 370 Waveguide Attenuators — Waveguide sections providing fixed amounts of attenuation. Used to extend power range of -hp- 430C. Models for frequencies 2.6 to 18.0 KMC, power dissipation 1.0 watts (1 kw peak), SWR 1.15; 3, 6, 10 or 20 db attenuation. \$75.00 to \$55.00.

-hp- 487B Thermistor Mounts—Simplify setups, save time and insure maximum accuracy in waveguide power measurements. Models cover frequencies 3.95 to 26.5 KMC with full range SWR of less than 1.5 (except K487B, 2.5). Permanently installed negative temperature coefficient thermistors. No tuning, large overload factor makes burnout virtually impossible. \$95.00 to \$75.00.



-hp- 485 Detector Mounts



-hp- 382A Precision Attenuators



-hp- 476A Bolometer Mount

-hp- 752 Multi-Hole Couplers



-hp- 487B Thermistor Mounts



-hp- 477B Coaxial Mount

-hp- 477B Coaxial Mount — Thermistor mount providing full frequency coverage 10 MC to 10 KMC with SWR less than 1.5. Requires no tuning, uses long time constant elements for accuracy even on low duty cycle pulses. For use with 430C or other bolometer bridges providing negative temperature coefficient operation at 200 ohms. Requires 13 ma bias. Power range 0.02 to 10 mw. Uses Type N rf connector. \$75.00.

-hp- 485 Detector Mounts — Single tuning control accurately matches waveguide section to bolometer element; instrument also detects rf energy with crystal substituted for

bolometer element. Models for frequencies 2.6 to 18.0 KMC, SWR 1.25 to 1.5. All models employ crystal or barretter except P485 (thermistor only) and S485 (crystal only). \$125.00 to \$75.00.

-hp- 476A Bolometer Mount—Universal bolometer mount requiring no tuning, no adjustment. Frequencies 10 to 1,000 MC, instantaneous, automatic power readings 0.02 to 10 mw. SWR less than 1.15, 20 to 500 MC; less than 1.25, 10 to 1,000 MC. Uses four 1/100 amp fuses. Uses Type N rf connectors. \$85.00.



-hp- 764/7D Dual Directional Couplers



**Permanent
Magnet Motors**

Increased torque ratings
in 1-in. diam

Series B permanent-magnet motors feature increased torque ratings although they measure only slightly over 1-in. diam. Stock models are available in voltages up to 115 vdc. The field structure consists of Alnico VI cast in the form of a circular ring which completely surrounds the armature. A flat wafer-type commutator is used to reduce overall length. No-load speeds are available in the 3000 to 20,000 rpm range. A speed of 7200 rpm under load is recommended for most applications.

Servo-Tek Products Co., Dept. ED, 1086 Goffle Rd., Hawthorne, N.J.

CIRCLE 52 ON READER-SERVICE CARD

Power Transistor

Covers entire audio range



Since the CTP-1133 power transistor has a cut-off frequency of 20 kc for a 3 db drop in power gain, it has immediate application as a replacement for audio tubes, as well as use in high speed switching devices. The transistor has a total harmonic distortion at 8 w of 3.5 per cent. Other ratings are as follows: collector to base voltage of 40 v max; collector to emitter voltage of 40 v max; emitter to base voltage of 6 v max; and junction temperature of 90 C. The power dissipation at 70 C mounting base temperature is 10 w.

Clevite Corp., Clevite Transistor Products Div., Dept. ED, Waltham 54, Mass.

CIRCLE 53 ON READER-SERVICE CARD

Prices f.o.b. factory. Data subject to change without notice.

HEWLETT-PACKARD COMPANY

4651K PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U. S. A.

Cable "HEWPACK" • Davenport 5-4451

FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS

COMPLETE COVERAGE, HIGHEST QUALITY

CIRCLE 51 ON READER-SERVICE CARD



"Is seat of pants Amerikan spacemen is flying by. Is not knowing of Reeves-Hoffman's . . .

NEW HIGH PRECISION CRYSTAL FOR FREQUENCY MEASUREMENT

WRITE FOR BULLETIN RH-5MC.



Designed for use as frequency standards, Reeves-Hoffman's new 5mc, high precision crystals offer exceptionally long term frequency stability, $\pm .0001\%$, with aging of less than one part per 10^8 a week! These units are available in hermetically sealed glass T5 1/2 enclosures with pigtail leads or 9-pin Bakelite bases. They are manufactured to meet the most exacting military and commercial standards for frequency measurement.

DIVISION OF DYNAMICS CORPORATION OF AMERICA
CARLISLE, PENNSYLVANIA

CIRCLE 54 ON READER-SERVICE CARD



reduce tube temperatures in JAN shields BELOW bare bulb temperatures with



BIRTCHER N. E. L. CORRUGATED INSERTS

MATERIAL
.003 spring brass
FINISH
Matte black to N. E. L. specification
SIZES
6 sizes available to fit all T-5 1/2 (7-pin) and T-6 1/2 (9-pin) miniature tubes.

N. E. L. reports that 85% of all electronic equipment failures are caused by tube failures and the major cause of tube failure is excessive heat. The use of a Birtcher corrugated insert between miniature tube and JAN shield reduces tube temperatures well below bare bulb temperatures.

Write for catalog

THE BIRTCHER CORPORATION

INDUSTRIAL
DIVISION

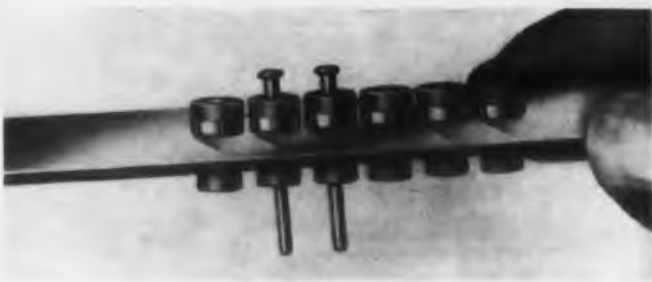
4371 Valley Blvd.,
Los Angeles 32, Calif.

CIRCLE 55 ON READER-SERVICE CARD

NEW PRODUCTS

Capacitors

Hip-mounted feed thru type



Type CFT ceramic feed thru capacitors are useful where compactness is desired. The units are $3/8$ in. long, and protrusion from the chassis plane is only $9/64$ in. for the larger-diameter end, and less than $15/64$ in. for the shank end, depending on chassis thickness. Diameters of the head and shank ends are $7/32$ in. and 0.187 in. respectively. A hip ridge holds insertion of the capacitor in the chassis hole to a fixed uniform distance. Type CFT capacitors have a dc working voltage of 600 v, and are available in capacitance values from 4.7 μf to 1000 μf . Operating temperature range is -55 to $+85$ C.

Cornell-Dubilier Electric Corp., Dept. ED, South Plainfield, N.J.

CIRCLE 56 ON READER-SERVICE CARD

Differential Transformer

Miniature sensitive unit

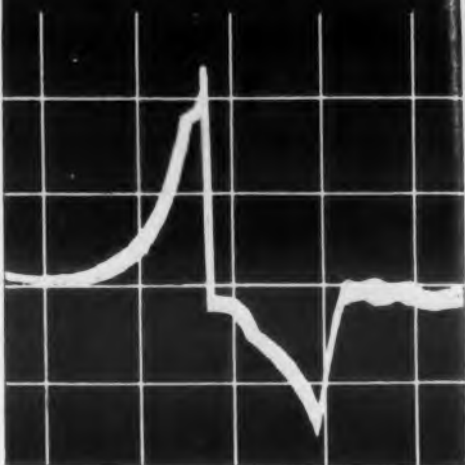


The ceramic bobbin of this $3/8$ in. diam coil is wound with Teflon insulated wire and encased in a stainless steel shell. The coil is vacuum impregnated with a silicon varnish. Armature dimensions are $2-9/32$ in. long by 0.105 in. od by 0.062 in. id. Range is ± 0.25 in. Sensitivity features 0.25 mv output per 0.001 in. displacement per volt input at 60 cps. Null voltage is 0.1 mv. Input is 1.5 v, 60 cps; the output, which doubles for 3 v input, is 77 mv at 0.2 in. armature displacement and 93 mv at 0.25 in. armature displacement.

Automatic Timing & Controls, Inc., Dept. ED, King of Prussia, Pa.

CIRCLE 57 ON READER-SERVICE CARD

ELECTRONIC ENGINEERS



SEVERAL UNUSUAL OPENINGS

Unfaltering progress, even during the past six months, in the Electronics and Avionics Division of Emerson Electric is directly attributable to the sound planning of our long-range expansion program. As a result, we must broaden our organizational structure and immediately staff several excellent, challenging career positions.

We emphasize research, design and development and maintain a sound ratio of production. Current projects include the B-58 fire control system, mortar locators, radar components and assemblies, servomechanisms, missiles and rockets, ground support equipment, microwave antennas, F-101 Voodoo subsystems, plus many other classified electronic devices for the supersonic era.

You must have an E.E. degree plus 4-6 years' experience in electronics. Your electronic design experience must be in either servomechanisms, radar systems, analog or digital computers, fire control systems or ground support equipment. Missile guidance and/or infra-red experience is helpful but not essential.

Emerson Electric is one of the leading missiles and military electronics firms—well established, medium size, aggressive. Salaries are top level, benefits are fully comprehensive. Location is perfectly suburban. All moving expenses completely paid.

Your Future Is Our Business!

Please send your complete resume NOW, with business experience, education and salary requirements, to A. L. Depke.



8100 W. Florissant • St. Louis 21, Mo.

CIRCLE 550 ON READER-SERVICE CARD

STRAITS TIN REPORT

New developments in
the production, mar-
keting and uses of tin



A new engine bearing alloy of tin (about 20%) and aluminum was recently perfected after more than 3 years of testing. Of meshed tin-aluminum, in which the tin forms a lace-work within the aluminum, the alloy gives a better balance between high fatigue resistance and low rate of wear than any other standard bearing known. It is also cheaper to manufacture than ordinary copper-lead plated types.

★ ★ ★

In his address to the Legislative Council in December, His Majesty the Yang di-Pertuan Agong again stated that the policy of his government will be to assist the tin and rubber industries, upon which the economy of the Federation of Malaya largely depends. "My government realizes it cannot maintain or increase the prosperity of the country unless it renders every assistance possible to both these industries," he said.

A new alloy of tin (13%), aluminum and titanium shows very good high-temperature characteristics. It is now being used in Europe for turbine parts in aircraft engines.

All modern dredges used in Malayan tin mining are now powered by electricity. The equipment for a single dredge may cost close to \$170,000.



Ask us to send you TIN NEWS, a monthly letter. It will keep you posted on tin supply, prices, new uses and applications.

The Malayan Tin Bureau

Dept. 13D, 1028 Connecticut Ave., Washington 6, D.C.

CIRCLE 59 ON READER-SERVICE CARD



Water Load

Provides 100 kw continu-
ous μ hf dissipation

A 6-1/8 in. diameter 50 ohm coaxial load, rated at 100 kw maximum continuous power dissipation has been developed for μ hf application. The vswr is 1.3 or less from 380 to 570 mc and 1.2 or less in the 390 to 525 mc range. Called the 518-A Mega-Sorber, the unit can be supplied to cover other uhf frequency ranges or a particular uhf frequency with optimum vswr. It is designed to handle peak power of two megawatts.

Continental Electronics Mfg. Co., Dept. ED,
4212 S. Buckner Blvd., Dallas 27, Texas.

CIRCLE 60 ON READER-SERVICE CARD

Filters

Minimum of 50 db attenuation



Three models of Twin-T filters are available for any fixed frequency from 15 to 1500 cps. The CO series, shown, have octal plug basing. The C series have banana plugs and jacks, and the CU series are uncased units designed for incorporation into circuit wiring. The filters are offered in two frequency tolerance ranges of 2 per cent and 0.3 per cent. Units of both ranges have a minimum attenuation of 50 db at the specified frequency. The units are constructed from low negative temperature coefficient deposited carbon resistors and low positive coefficient silver mica capacitors.

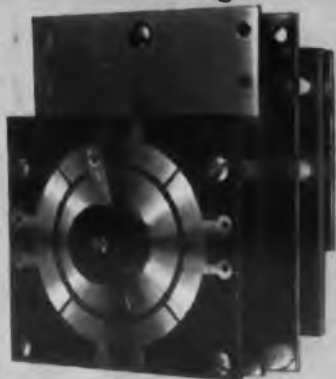
Custom Electronic Services, Dept. ED, P.O.
Box 7504, San Diego 7, Calif.

CIRCLE 61 ON READER-SERVICE CARD

HIGH ALTITUDE BALLOON

CONTROL INSTRUMENTS
require **MAXIMUM** Performance
MINIMUM Size - Weight - Power Drain

**Brailsford
AGC Timers
Are Unmatched
In These Basic
Requirements**



**If You Have A
Timing Problem
Where Size,
Mass and Power
Drain Are Critical
Read These**

Model AGC

SPECIFICATIONS

- Number of decks—1-4
- Speed regulation— $\pm 1.0\%$ at 50% voltage shift
- Size— $1\frac{1}{4}'' \times 2\frac{1}{4}''$ —depth depends on number of decks
- Segments per deck—2-8 for stock units.
- Special commutators to order for a nominal tool charge.
- Shorting or non-shorting contact
- Power input—.008 Amp. at 6 VDC

WRITE FOR LITERATURE

BRAILSFORD & CO. INC.
670 MILTON ROAD • RYE, N.Y.

ENGINEERING DEVELOPMENT
SUB FRACTIONAL WATT D.C. MOTORS



MANUFACTURING
SIGNALLING SYSTEM COMPONENT

CIRCLE 62 ON READER-SERVICE CARD

**SAVE UP TO 50% on
SELENIUM RECTIFIER COST and SIZE
NEW**

VICKERS
**HIGH CURRENT
Selenium Rectifier**



Improved vacuum process produces
rectifiers with ratings up to twice those
of conventional size.

Cell Ratings: 18, 22, 26, 30, 33 and
36 volts.

FREE Bulletin 3116-1 gives detailed
information, including per-
formance data, rating tables and engi-
neering application data. Write today for
free copy and prices.



VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
ELECTRIC PRODUCTS DIVISION
1841 LOCUST STREET • SAINT LOUIS 3, MISSOURI

CIRCLE 63 ON READER-SERVICE CARD

BLADE ANTENNAS

by
CANOGA

A new series of high performance blade antennas has been developed for high speed aircraft and missile applications which provide the following features:

All metal leading edge for maximum strength and erosion resistance

High aspect ratio with straight or swept back leading edge

Simple installation, no space required inside airframe

Circular radiation pattern, small ground plane

High temperature resistance

Broad band design

APPLICATIONS

- COMMUNICATION
- NAVIGATION
- TELEMETERING
- BEACON
- DATA LINK
- COMMAND CONTROL



TECHNICAL SPECIFICATIONS

Model No.	Center Freq. Mc.	Band width Percent	VSWR Max.	Dimensions	
				Length inches	Height inches
9928	5600	20	1.5	0.76	0.375
9933	3400	35	1.5	1.30	0.75
9927	3000	25	1.5	1.30	0.75
9934	2200	20	1.5	1.75	1.00
9926	1100	27	2.0	3.55	1.70
9925	310	55	2.0	15.00	7.00

Other blade antennas are also available for special applications.

FOR ADDITIONAL INFORMATION COMPLETE THE COUPON BELOW AND RETURN TO CANOGA.

CANOGA
CORPORATION
OF CALIFORNIA

5955 SEPULVEDA BLVD
VAN NUYS, CALIFORNIA

- ANTENNAS
- RECEIVERS
- RADAR SYSTEMS
- TEST EQUIPMENT
- MICROWAVE COMPONENTS

NAME AND TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

DESIGN, DEVELOPMENT AND MANUFACTURE TO YOUR SPECIFICATIONS

CIRCLE 64 ON READER-SERVICE CARD

NEW PRODUCTS



Signal Generator

Tests video transmission facilities

This video transmission test signal generator is designed to produce precise signals for the testing of all long lines transmission facilities. Multiburst, stairstep and window waveforms are generated, along with standard Retma synchronizing waveform. Model 1006-A consists of three Model 1005-A-1 video transmission test signal units, and one Model 1005-A-2 Retma Synchronizing waveform unit.

Telechrome Mfg. Corp., Dept. ED, 28 Ranick Dr., Amityville, N.Y.

CIRCLE 65 ON READER-SERVICE CARD

Microwave Sweep Oscillator

Provides convenient microwave power



Model 2701 sweep power supply is a voltage tuned oscillator that allows evaluation of microwave devices with convenience and speed. Sweep is adjustable from a fixed frequency to the full tuning range of the backward wave oscillator tube, which is housed in a detachable r-f head. The oscillator now available, model 2701X, covers the frequency range 8.2 to 12.4 kmc.

Features include good isolation from load variations, high signal-to-noise ratio, and operation with amplitude or pulse modulation. Triggering is recurrent and may be external or manual. Sweep rates are from 30 v per sec to 30 v per msec. The time for a full band sweep is 0.01 to 30 sec with a sweep output of 20 v. A 1-kc square wave internal modulation is supplied together with provision for external modulation.

Maxson Instruments Corp., Sub. of the W. L. Maxson Corp., Dept. ED, 47-37 Austell Pl., Long Island City 1, N.Y.

CIRCLE 66 ON READER-SERVICE CARD



TEST
INSTRUMENTS

for

LABORATORY/PRODUCTION

automatic continuous



NOISE FIGURE measurement

The AIL Type 72 Automatic Noise-Figure Indicator permits rapid and accurate evaluation of parameters that effect receiver noise figure. This equipment finds wide use in the laboratory as well as on the production line. Noise figure can be measured over the 30 to 26,000 Mc range when either an AIL Type 70A Coaxial or an AIL Type 70B Waveguide Gas-Discharge Noise Generator is used. Accuracy of measurement is ± 0.5 db over a 0 to 20 db range. The Noise Generator furnishes an excess noise output of 15.3 ± 0.25 db.

Detailed literature is available on request.



1345 NEW YORK AVENUE
Huntington Station, L. I., N. Y.

CIRCLE 67 ON READER-SERVICE CARD

**NOW...1 to 80
polaroid exposures
in ONE loading
with the newest
BEATTIE
OSCILLOTRON!**



LABORATORY recording of oscilloscope traces is far more efficient with this new camera.

Key to the versatility of the new Beattie Oscillotron with a polaroid back is the feather-touch Multiple Exposure Positioning Bar. Now you can get one-to-one presentation or up to 10 exposures on a



single frame—by a simple adjustment. Other features: f/1.9 lens, shutter speeds from 1 sec. to 1/100 sec., time, and bulb.

This new Oscillotron camera fits the same periscope to which all other Beattie Oscillotron cameras are attached.



Multiple Exposure Positioning Bar

for more information write to



1000 N. Olive St., Anaheim, California
CIRCLE 68 ON READER-SERVICE CARD

Power Supply

32-v unit offers regulation of 0.03 per cent



Model SC-32-0.5 transistorized power supply delivers 0.32 v at 0.-0.5 amp. Regulation for line or load is less than 0.03 per cent or 0.003 v, whichever is greater. Ripple is less than 3 mv rms. Recovery time is less than 50 μ sec. Stability for eight hours is less than 0.03 per cent or 0.003 v, whichever is greater. Output impedance is less than 0.02 ohms. Additional features include a 0.005 per cent resolution with 10 turn voltage control.

Kepeco Labs., Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 69 ON READER-SERVICE CARD

Parabolic Antenna Calculator

Conversion rule for microwave systems

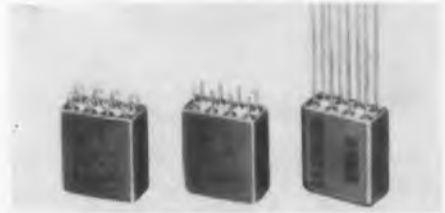
A slide-rule type of calculator is available for rapid computation of parabolic antenna radiation characteristics, passive repeater performance, free space and scatter propagation attenuation, and thermal and equivalent noise input of receiver. The reverse side of the calculator is a transmission line and waveguide selector showing attenuation and power ratings as well as other characteristics.

Andrew Corp., Dept. ED, 363 E. 75th St., Chicago 19, Ill.

CIRCLE 70 ON READER-SERVICE CARD

Relay

Miniature type with fast response



Type F relay is rated for ambient temperatures from -65 to $+125$ C, shock of 50 g, and vibration of 75-2000 cps at 20 g acceleration. Pickup time is 3.5 msec nominal; drop-out time is 1.5 msec nominal. Contact rating is 3 amp resistive at 28 v dc or 115 v ac. Terminal arrangements are suited to 1/10 in. grid spacing.

C. P. Calre & Co., Dept. ED, 4101 Pratt Blvd., Chicago 45, Ill.

CIRCLE 71 ON READER-SERVICE CARD



Pencil-thin slides increase valuable chassis space

CHASSIS-TRAK slides, with a new design improvement which increases the bearing area, are stronger and more rigid . . . yet as thin as a pencil (.250")!

This ultra-thin design allows up to 3" more in important chassis space and makes your electronic equipment more accessible with smoother sliding action—even on heavy-duty chassis.

Because of the thin design, you can fit a standard 17" chassis into a standard 19" panel rack. Thus you can cut engineering costs in half by using standard stock racks and chassis.

Slides are available in eight different lengths on both the "Detent,"

which locks in 7 positions (45°, 90° and 105° up, down, and horizontal), and the "Basic," which tilts upward but has no tilt-lock assembly.

Before making a slide selection, consider the advantages of the CHASSIS-TRAK *ultra-thin* design.

"Detent" model, locked in one of seven positions.



Write today for complete specifications and prices.

525 South Webster, Indianapolis 19, Indiana

CIRCLE 72 ON READER-SERVICE CARD



**ORDER TODAY...
GET 'EM TODAY!**

from local distributors

Need resistors in a hurry for a production emergency, a prototype or what not? That's what Stackpole local distributors are for! Over 50 of them in leading centers carry complete industrial stocks. Write, wire or 'phone for name of nearest one!



**NEW
STACKPOLE
Coldite 70⁺
FIXED COMPOSITION
RESISTORS**

A major resistor development designed for the most stringent requirements . . . at ordinary resistor prices.

Distributors' Division, STACKPOLE CARBON CO.
26 Rittenhouse Place, Ardmore, Pa.

TYPE RC-20 • TYPE RC-32 • TYPE RC-42
(1/2 watt) (short-length 1 watt) (2 watts)

CIRCLE 73 ON READER-SERVICE CARD

PULSE DELAY GENERATOR • MODEL 10 K



NEW
with
**Extended
Range
Delay**

THE MODEL 10K IS A PRECISION INSTRUMENT WHICH PRODUCES A PULSE VARIABLE IN DELAY FROM AN EXTERNAL OR INTERNAL TRIGGER. THE DELAY RANGE IS 1.0 TO 9999.9 μ SEC IN .1 μ SEC STEPS. THE UNIT MAY BE TRIGGERED OVER A RANGE OF 0.2000 PPS. THE PRF BEING INDICATED ON A METER. THE METER ALSO FUNCTIONS AS A NULL INDICATOR FOR A BUILT-IN CRYSTAL CALIBRATOR. THE OUTPUT IS A .5 μ SEC WIDE POSITIVE PULSE WITH A RISE TIME OF .03 μ SEC. AND AMPLITUDE OF 0.40 V. INTO 100 OHMS.

ACCURACY $\pm 0.01\%$ or 0.05 μ sec.

STABILITY less than 0.005 μ sec. jitter & 0.005% change in delay with change in prf.

VERSATILITY single or paired pulse output & delayed scope trigger in advance of delayed pulse.

EXTERNALLY TRIGGERED

ORBITRAN

COMPANY

LAKESIDE

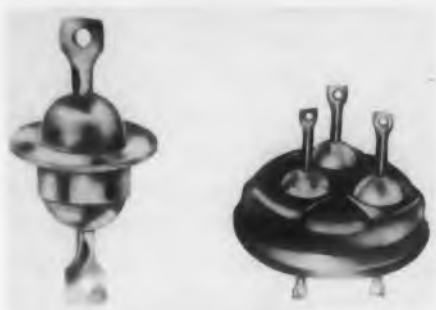
CALIFORNIA

CIRCLE 74 ON READER-SERVICE CARD

NEW PRODUCTS

Compression Seals

Glass extends beyond metal



These Hi-Dome compression seals permit the fused glass to extend beyond the metallic configuration without cracking or shearing. The dielectric properties of the increased glass mass in these seals provide higher electrical surface resistance and higher arc-over values. The glass-to-metal compression seals are expected to permit further miniaturization of components through closer terminal connections.

Hermetic Seal Corp., Dept. ED, 29 S. 6 St., Newark 7, N.J.

CIRCLE 75 ON READER-SERVICE CARD

Potentiometers

Provide long load life



All 8 standard resistance values (100 to 25,000 ohms) of these potentiometers are manufactured with 20 ppm resistance wire. The units can dissipate more than 1/2 w at 125 C for more than 2000 hr. Two basic 7/8 in. diam models, types 118F (bronze bearings) and 118H (ball bearings) are available as stock items. Both models feature linearities to ± 0.25 per cent for all resistance values, up to 9 taps to ± 0.5 deg, and precision machined metal housings.

Carter Mfg. Corp., Dept. ED, 23 Washington St., Hudson, Mass.

CIRCLE 76 ON READER-SERVICE CARD



Krohn-Hite POWER SUPPLIES



MODEL UHR-220

FEATURING

- **ULTRA-HIGH REGULATION — 0.001%**
- **HUM and NOISE LESS THAN 100 MICROVOLTS**
- **IMPEDANCE 0.1 OHM A-C TO 100 KC WITH NO PEAKS**

The Krohn-Hite Power Supplies Line

Model	Voltage	Current	Regulation	Price
UHR-220**	0-500v	0-200ma	0.001%	\$390.00
UHR-240*	0-500v	0-500ma	0.001%	\$625.00
UHR-225**	150-500v	0-200ma	0.002%	\$275.00
UHR-245*	150-500v	0-500ma	0.002%	\$425.00
UHR-230R	two Models UHR-220, Rack Mounted			\$790.00
UHR-235R	two Models UHR-225, Rack Mounted			\$560.00

- Two isolated 6.3v a-c sources in all models
- 5-12.6v, 2.5a d-c source in model 240
- 0-150v d-c bias source in models 220 and 240

*Available for rack mounting at \$5.00 additional.
**Available for rack mounting at \$10.00 additional.

For further information on:

- Filters
- Power Supplies
- Oscillators
- Power Amplifiers

write for our free catalog D



Krohn-Hite CORPORATION

580 MASSACHUSETTS AVENUE
CAMBRIDGE 39, MASS., U. S. A.

CIRCLE 77 ON READER-SERVICE CARD

For
SERVO MOTORS
and
MOTOR GENERATORS

Y C B T B S *



***TRANSLATION: You Can't Beat
The Bendix "Supermarket"**

Our "supermarket" of rotating components offers a larger variety of high-precision, low-inertia servo motors, rate generators and servo motor generators than any other single source. Bendix units are available in frame sizes 5, 8, 10, 11, 15, 20 and 28; they meet or exceed practically any applicable specification and include both corrosion-resistant and high-temperature models. Volume-production prices. Immediate delivery in many cases. Why not find out about our "supermarket" service!

**FEATURING
CENTER-TAPPED
CONTROL
WINDINGS . . .**



... for use in transistor circuits and for either parallel or series operation. Reduce size and weight of transistorized packages by eliminating coupling transformers. Standard models, or will wind to meet your specific requirements.

**Eclipse-Pioneer
Division**
Teterboro, N. J.



District Offices: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C. Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

CIRCLE 78 ON READER-SERVICE CARD

COIL FORMS.—Ceramic types in five sizes available with or without terminal collars, and up to four terminals per collar. An internal, preset torque spring positions and locks the adjusting cores.

National Company, Inc., Dept. ED, Malden 48, Mass.

CIRCLE 79 ON READER-SERVICE CARD

TRANSFORMERS.—Used with transistor power supplies, types 685-745 operate on 12-14 v dc input with output from 250-600 v dc. The units provide 80 to 85 per cent efficiency in the 2000 cps region.

Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

CIRCLE 80 ON READER-SERVICE CARD

DOOR PANELS.—Side-hinged blank types, all 19 in. wide in different heights from 3½ to 21 in. The panels are constructed of no. 12 gage steel, and are hinged on either side.

Premier Metal Products Co, Dept. ED, 337 Manida St., New York 59, N. Y.

CIRCLE 81 ON READER-SERVICE CARD

HIGH VOLTAGE REGULATORS.—For voltages from 3500 to 6000 v, series GV6C corona type regulators are designed to supplement the GV5C series previously announced.

The Victoreen Instrument Co., Components Div., Dept. ED, 5806 Hough Ave., Cleveland 3, Ohio.

CIRCLE 82 ON READER-SERVICE CARD

TUBES.—Two tubes have been announced. The 7029 multiplier phototube is a small, dormer-window type for detection of low-level light signals in the presence of relatively high background illumination. Spectral response is from 2900 to 6200 Å. The 7094 high-perveance beam power tube is designed for use at r-f power amplifier, oscillator, a-f power amplifier, modulator. The 7094 can be operated with 500 w input in cw applications at frequencies to 60 mc.

Radio Corp. of America, Tube Div., Dept. ED, Harrison, N. J.

CIRCLE 472 ON READER-SERVICE CARD

FLASHER UNIT.—A hermetically sealed unit operating at a nominal frequency of 100 cps with a 1 to 1 ratio of on to off time. Normal contact capacity is 1.5 amp inductive.

Radar Relay, Inc., Dept. ED, 2120 Pontius St., Los Angeles 25, Calif.

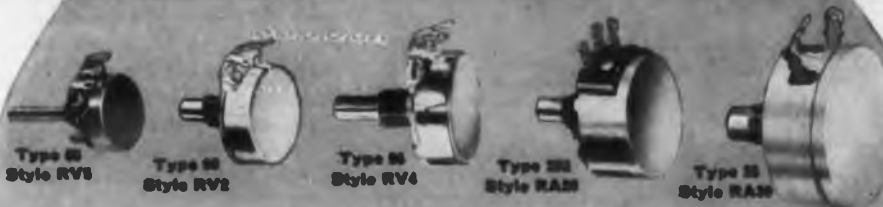
CIRCLE 83 ON READER-SERVICE CARD

GEARS AND SERVO COUPLING.—Two products have been announced: the first is a line of precision 2c gears in stock quantities, and the second is a zero adjustable bellows coupling allowing precision adjustment on the shafts of servo motors, resolvers and synchros.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., E. Rockaway, N.Y.

CIRCLE 84 ON READER-SERVICE CARD

CERTIFIED TO LATEST MIL-R-94B-19A SPECS



Newly Developed CTS Military Variable Resistors

Complete line composition and wirewound military variable resistors now in production. Dependable, exceptionally good delivery cycle. Tested and certified to meet latest specs of MIL-R-94B characteristics X and Y, and MIL-R-19A.

Composition controls Styles RV2 (1 watt), RV4 (2 watts) and RV5 (1/2 watt miniaturized) meet latest MIL-R-94B specs. Wirewound controls Styles RA20 (2 watts) and RA30 (4 watts) meet latest MIL-R-19A specs. All are available in a variety of shafts, bushings and resistances. All except Type 65 are available in 2 or 3 section concentric shaft and straight shaft tandem constructions.



CHICAGO TELEPHONE SUPPLY Corporation

ELKHART

INDIANA

Specialists in Precision Mass Production of Variable & Fixed Resistors
CIRCLE 129 ON READER-SERVICE CARD

What is the TOTAL COST of a plastic part?

First costs often are only part of the total cost of plastic components. Poorly designed or inaccurately produced plastic parts can mean excessive inspection and assembly costs in your plant and a high failure rate, as well. American's *precision production* saves you money by eliminating these hidden cost factors and thus keeping your *total cost per part* to the barest minimum. That is why so many exacting buyers say, "We turn to American first for our plastic parts—because they are precision made."

American Plastics is equipped to give you full line service—injection, compression, extrusion, multiple-shot injection, and low pressure vacuum assisted forming.

Next time you need plastic parts, try American first. Others have for over 50 years! Write or wire Dept. ED.



AMERICAN PLASTICS CORPORATION

Subsidiary of Hayden Chemical Corporation
Executive Offices at 342 Madison Avenue
New York N. Y.

CIRCLE 85 ON READER-SERVICE CARD

REGULATED DC POWER SUPPLIES

HI-VOLTAGE SERIES



Model 250 S 025

Designed for powering airborne electronics equipment under the most adverse environmental conditions, Arnoux High Voltage DC Power Supplies assure the utmost in reliability. These magnetic-amplifier regulated supplies are available in the range of 108 to 450 volts DC, with current ratings from 50 ma to 800 ma. Other ratings are also available on special order.

ARNOUX

Input Power:	115 volts, 400 cps	
Regulation:	Input (Variation)	Output (% Rated)
Line Voltage:	$\pm 10\%$	± 0.25
Line Frequency:	± 20 cps	± 0.1
Load Current:	20-100%	± 0.1
	0-100%	± 0.2

Ripple: Less than 0.05% rms at full load

Output Adjustment: 5% adjustment available on request at slightly higher price.

Environmental: Meets specification MIL-E 5272 A for acceleration, vibration, altitude, humidity and temperature operating at 20% to 100% rated load.

Also meets MIL-I 6181 B

Connector: AN-type connector

Mounting: Stud-mounted

(Write for Bulletin 200)

LO-VOLTAGE SERIES



Model 5 S 10

Intended for use in precision airborne instrumentation systems, Arnoux Low-Voltage DC Power Supplies are available in both single and dual output. Ranging from 5 to 50 volts of currents up to 10 amperes, these rugged units are hermetically sealed.

ARNOUX

Input Power:	115 volts, 400 cps	
Regulation:	Input (Variation)	Output (% Rated)
Line Voltage:	± 15 volts	± 0.10
Line Frequency:	± 20 cps	± 0.15
Output Load:	20-100%	± 0.05
	0-100%	± 0.10

Temperature Stability: 0.5% per 100°F.
[−60°F. to +160°F.]

Ripple: Less than 0.1% rms at full load.

Output Adjustment: Screwdriver adjustment provides ± 0.5 volt change. Wider range of adjustment available on request

Connector: Standard AN-type connector, or hermetically sealed header on request

Mounting: Stud-mounted.

Environmental: Meets specification MIL-E 5272 A for acceleration, vibration, altitude, temperature and humidity.

(Write for Bulletin 100)

Designers and Manufacturers of
PRECISION INSTRUMENTATION



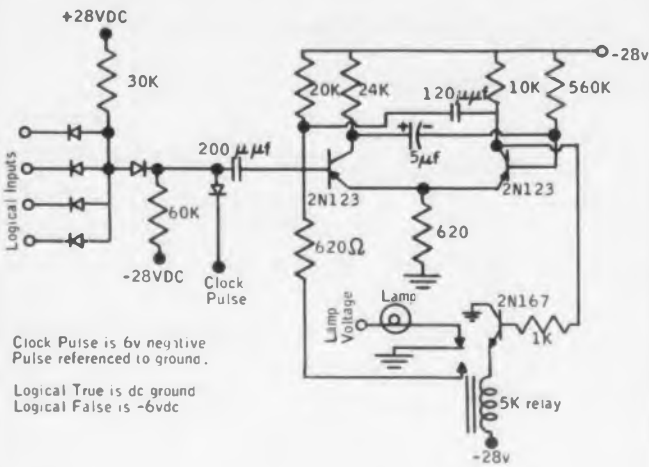
ARNOUX CORPORATION

11924 WEST WASHINGTON BLVD. • LOS ANGELES 66, CALIFORNIA

CIRCLE 86 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Digital Signal Checker



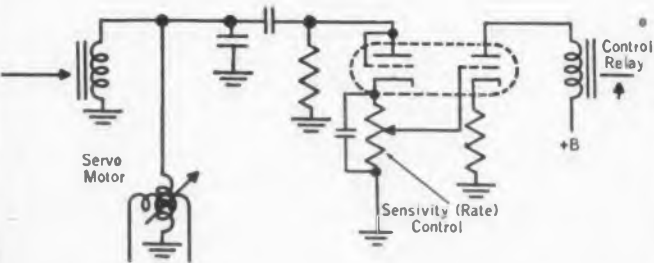
In designing digital computer logical circuits, transient type signals are difficult to check with conventional oscilloscope methods. A special indicator to detect a transient signal should save time in checking new computer circuits.

A special gated transistorized one-shot multi-vibrator was designed which would light an incandescent bulb for about 2 seconds whenever the logical inputs are true. Four inputs to the gate are shown in the schematic although more could be added by adding more diodes. When all the inputs are true, the clock pulse is impressed across the input condenser which triggers the left transistor into conduction. The right transistor is then cut off and the light goes on. With the components shown, the light will stay on for about 2 seconds before the one-shot multi-vibrator is reset.

Louis Kurkijian, Sub-Group Head, Hughes Aircraft Co., Los Angeles, Calif.

Servo Null Detector

The circuit shown here was developed in order to provide a means for indicating a null or balance condition in a servo system, and to provide automatic data print commands and tape punch when this balance occurs, or when a prescribed rate of change is exceeded. This arrangement is applicable in analog computers, data processing machines, and servo-type chart recorders for con-



Null Detector and "Print-Punch Command" Control Circuit.

Trans Electronics, Inc.

DESIGNERS
MANUFACTURERS

power supplies
semiconductor test equipment

POWER
SUPPLIES

Transistor or Hard Tube

AC
or
DC

Regulated
or
Unregulated

Voltage
regulated
or current
regulated

Variable
or
Fixed

MODELS RS 205
RS 305

Modular for easy
substitution
Floating output
carefully engineered
for bench or rack use
Barrier type
terminal strip
For breadboard or
original equipment

IMMEDIATE
DELIVERY



RS 205 150-225 VDC
at 50 MA
RS 305 225-325 VDC
at 50 MA

Rack mounted \$69.50
Rack mounted
with meters \$99.50

49⁵⁰

*Supplies with other ranges or
modifications of these units
also available.

SPECIFICATIONS:

- Filament Output: 6.3 volts CT AC @ 3 amperes (unregulated).
- *Current Range: 0-50 milliamperes, continuous duty.
- Ripple and Noise: 7 millivolts peak-to-peak maximum.
- *DC Voltage Range: Model RS-205, 150-225 volts, continuously adjustable. Model RS-305, 225-325 volts, continuously adjustable.
- Recovery Time: Less than 25 microseconds.
- Input Voltage: 105-125 volts, 60 cps, AC.
- Internal Impedance: Less than 1 ohm.
- Load Regulation: 0.1%
- Line Regulation: 0.1%

Note: We welcome opportunities to discuss your special power supply requirements.

Trans Electronics, Inc.

7349 Canoga Avenue
Canoga Park, California

CIRCLE 87 ON READER-SERVICE CARD

STROMBERG-CARLSON



PUSH-KEYS

now available with
automatic interlock

In such precision operations as automation programming, you can now eliminate the risk of pushing more than a single button at a time.

This new interlock feature is based on a simple arrangement of sliding cams. Only one button at a time can be depressed. This feature is available in all multiple-pushbutton assemblies (7, 10, 12 and 20 button arrangements).

All "telephone-quality" advantages of Stromberg-Carlson keys continue as before. You may apply "make," "break," "break-make" and "make-before-break" combinations as required. You get standard spring combinations with Form A, C or D contacts—or you may order special strips of keys with intermixed contacts.

Buttons are available in white or colors—blank or with letter or number designations.

For complete technical data on Stromberg-Carlson Key Switches send for our illustrated Bulletin T-5002R.



STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS CORPORATION

Telecommunication Industrial Sales
116 Carlson Road, Rochester 3, N. Y.

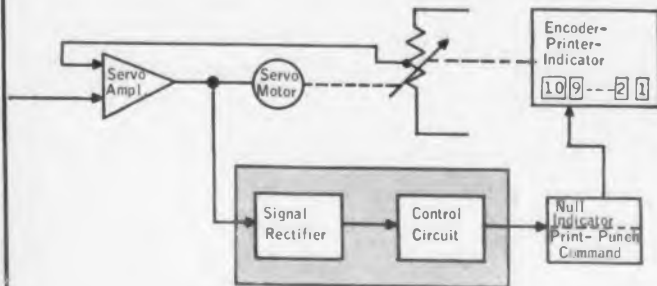
Electronic and communication products for
home, industry and defense

CIRCLE 88 ON READER-SERVICE CARD

trolling various functions and operations.

A part of the servo output voltage, which energizes the servo drive motor, is rectified and applied as a grid control voltage to a stage which activates a relay, light, alarm or auxiliary control circuits. A single duo-triode performs both the rectifying and relay control functions shown.

Joseph A. Siderman, U.S. Army Signal Engineering Labs., Ft. Monmouth, N.J.



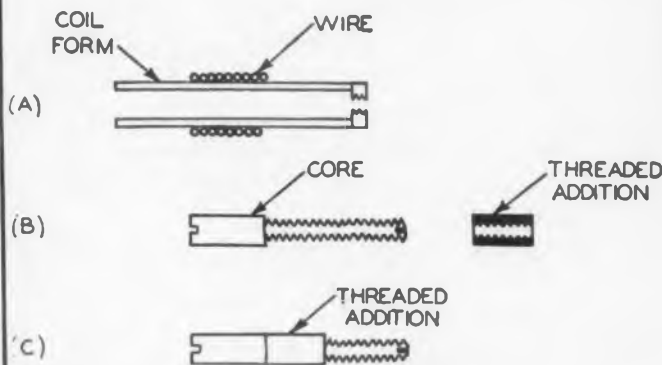
Servo System block diagram showing introduction of Null Detector and Control Circuit.

A Variable Inductor

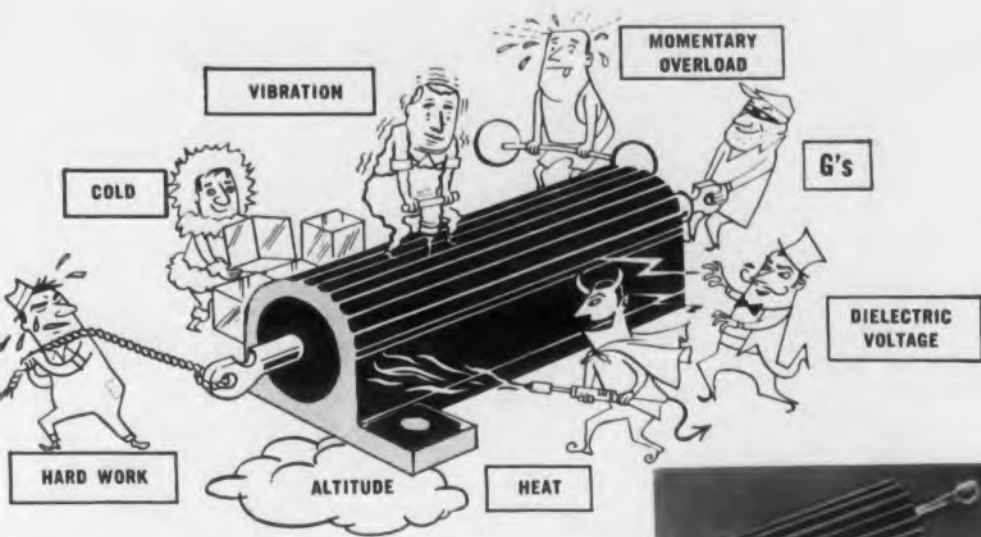
The range of a variable inductor is increased by adding a threaded piece (see fig.) to the existing core of the coil form. If the existing form has a powdered iron or ferrite slug (whose presence increases the inductance of an air core coil) then the threaded additional piece should be made of a good conducting material such as copper, brass, or aluminum. The addition of the extra piece would extend the low inductance end of the variable coil. If, however, the core is made of a good conducting material then the additional piece should be made of a ferrite type material. In this case, the additional piece will extend the high inductance end of the inductor.

This piece is attached by merely removing the original core from the coil form and screwing the threaded piece onto the core as shown at C. If the additional piece is given an extra half turn after it is threaded on, it will not come loose.

H. Roberts, New York University, N.Y., N.Y.



Mechanical Construction required to extend the range of a variable inductor. The coil form with tuning slug removed is shown at A. At B is the core with threaded "addition." At C is the modified core.



SAGE pioneered the metal-clad, chassis-mounted resistor. Truly miniature for the job it does, the Type "M" is establishing a reputation for dependable, trouble-free performance—a tribute to SAGE engineering skill and manufacturing "know-how."

We invite your inquiry regarding heat-sink applications . . . Write for complete specifications.



NEW SAGE "Silicohm" TYPE "M", METAL-CLAD RESISTORS

Available in 25 and 50 watts up to 60,000 ohms. Meet MIL-R-18546 requirements.

SAGE

ELECTRONICS CORPORATION

309 North Goodman St., Rochester 7, N. Y.

CIRCL 89 ON READER-SERVICE CARD

Victoreen Company has ordered over 100,000 New Phaostron PRESTIGE Panel Meters to be used in their equipment in 1958.



NEW PHAOSTRON PRESTIGE PANEL METERS

MODERN DESIGN
NEW RINGCOR MOVEMENT
SHALLOW MOUNT
HIGH VISIBILITY
PROVEN PRODUCTS CONSTRUCTION



Available in:
2½" Round · 3½" Round · 2½" Rectangular
3½" Rectangular · 4½" Rectangular

The new Phaostron Prestige Panel Meters provide shielding from magnetic fields. Simplified Ringcor Movement and structural improvement insures consistent accuracy, long life. Precision cast elements for increased mechanical stability. Prestige meters have shock mounted jewels, ground and polished pivots. Meters can be mounted on magnetic or non-magnetic panels without recalibration. Colors are available in your choice of combinations for scale and case.

FEATURES:

Colors: Metallic or pastel. Permanent Accuracy: Within 2% D.C. or 3% rectified A.C. Insulated Zero Adjustment. Large Clear Scales: For easy reading. Longer Scales: For close tolerance reading. Jewels: Shock mounted. Pivots: Ground and polished. Movement: Ringcor self-shielded.

PHAOSTRON Instrument & Electronic Co.

151 Pasadena Avenue, South Pasadena, California

CIRCLE 90 ON READER-SERVICE CARD

PHAOSTRON



CIRCLE 91 ON READER-SERVICE CARD



...new insulator plastics hold strength at 500°F

High heat resistance and high insulation resistance are now added to the superior electrical and structural properties of Diallyl Phthalate materials.

DIALL FS-4 and FS-5 behave like Silicones at 500°F, showing excellent compressive, tensile and flexural strength. DIALL can be molded like conventional general-purpose materials.

Two types of compounds are available: FS-4, long-fiber, glass-filled; and FS-5, short-fiber, glass-filled. Both are meeting applicable Mil. Specs. Proof of military approval furnished on request.

Write for complete data in Bulletin FS.

MESA PLASTICS COMPANY

11751 Mississippi Ave., Los Angeles 25, Calif.



CIRCLE 92 ON READER-SERVICE CARD

NEW LITERATURE

Precision Potentiometer 93

Complete mechanical and electrical specifications, three-view drawings of servo and bushing mount models, power input chart, and environmental characteristics, are included in Data Sheet 54-99. Outstanding features of the miniature pot include -55 to $+150$ C temperature range, resistance range of 500 to 70,000 ohms, with a linearity tolerance of ± 0.5 per cent, and best practical linearity of ± 0.25 per cent. Beckman-Helipot Corp., Newport Beach, Calif.

PC Laminates 94

The six most widely used grades of metal-clad laminates for printed circuitry used are described in a 6-page folder. Fully illustrated, it contains detailed tables giving strengths, properties, and dimensions of the various metal-clad laminates. Synthane Corp., Oaks, Pa.

Dials, Panels, Nameplates 95

This 6-page folder lists data for guidance in specification of dials, panels, and nameplates. The opening section gives information on various marking techniques available, including screening, photo marking, lithography, engraving, and etching. United States Radium Corp., Morristown, N.J.

Millisecond Operations Recorder 96

Catalog 30A1400 describes a millisecond operations recorder (MOR) for continuous automatic logging of power station operations at a cost 1/3 less than previous methods. Fischer & Porter Co., 488 Jacksonville Rd., Hatboro, Pa.

Nuclear Amplifiers 97

A 4-page bulletin available covers the N-300 series of nuclear amplifiers manufactured for use in the fields of radiation monitoring, scintillation spectroscopy, and proportional counter analysis. Discussing the units in the amplifier line, the bulletin lists specifications for the various models. Hamner Electronics Co., Inc., P.O. Box 531, Princeton, N. J.

Data Logger 98

Series 1200 data logger features "building-block" construction and flexible pinboard programming. Complete information is included in the catalog. Fischer & Porter, 464 Jacksonville Rd., Hatboro, Pa.

*don't you
have to be
sure
of quality
on parts
like these? . . .*



2/3 ACTUAL SIZE
(produced in one operation on high-speed multi-slide equipment)

World leaders in manufacturing electrical and electronic products have depended on us for years for critical parts such as these.

Why? . . . To be sure the quality of such parts matches the reputation of their products!

Don't you want to be sure of such quality, too?



DETROIT STAMPING COMPANY

Established 1915

411 Midland Ave. • Detroit 3, Mich.
America's Leading Job Stamping Manufacturer

Depend on Detroit!

CIRCLE 99 ON READER-SERVICE CARD

Save Money
and Time with

Malco

**SOLDERING LUGS
• TERMINALS •
PRINTED CIRCUIT
HARDWARE**



Tell us about your application and production requirements. We'll supply your needs from our complete line—or adapt to your specifications—and show you how to cut costs and speed up production!

- Miniature Tubular Terminals, Wire Wrap Terminals and Contacts for Automated Printed Circuit Applications
- Solderless Crimp-on Terminals
- Line Cord Interlock Terminals
- Automatic terminal inserting, crimping and staking machines

Contact us today. Send blue print or specifications for specific information. Request bulletins for general information.

Malco TOOL and MANUFACTURING CO.

1027 W. LAKE ST. • CHICAGO 24, ILL.
CIRCLE 100 ON READER-SERVICE CARD

Electronic Equipment 101

A 2-page sheet shows a phase meter, a null meter, impedance comparators, precision power oscillators, an automatic hi-pot tester, a frequency standard, a multiplier, a phase shifter, and a null detector. Each unit is described with specifications and a picture. Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y.

Electric Impulse Counters 102

Two 4-page folders tell how to use electric impulse counters in electronic circuits. Bulletin E-13 explains their use with transistors, and Bulletin E-28 their use with electronic tubes. In both folders wiring diagrams help describe several set-ups. Landis & Gyr, Inc., 45 W. 45th St., New York 36, N. Y.

Coil Winding Machines 103

A 2-page catalog sheet illustrating and giving condensed descriptions of coil winding machines has been announced. The machines include three bobbin winders, a 12 in. precision space winder, a multiple fly-back winder, a hand winder, and an automatic variable pitch progressive universal winder. Geo. Stevens Mfg. Co., Inc., Pulaski Road at Peterson, Chicago 30, Ill.

Shielded Measurements 104

Data Sheet 131 describes a portable shielded measuring chamber for testing delicate instruments under simulated pressure, vacuum, altitude, or nonpressurized conditions. The two pages include a drawing and a table of specifications. Perfection Mica Co., Magnetic Div., 1322 N. Elston Ave., Chicago 22, Ill.

Connectors 105

Manual C4 contains 44 illustrated pages on procedures for assembling AN, miniature AN, power, audio microphone, and RF connectors. Wire preparation and soldering techniques are illustrated and discussed. Amphenol Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

Programmed Centrifuge 106

A 14-page brochure describes a programmed centrifuge, both as a whole

and unit by unit. Electrical, physical, and performance characteristics are among the detailed specifications presented. The booklet also gives typical test run data on the device, which was originally designed to simulate rocket flights. Dimensional diagrams, graphs, and photographs illustrate the booklet. The Magnavox Co., Ft. Wayne 4, Ind.

Resistor, Pot Data File

Engineers are offered a detailed technical data file on precision potentiometers and resistors. The file combines general information with sheets on individual products. The capabilities of each product are outlined along with electrical and mechanical specifications and other data. The complete set comes in a file-type folder. *Qualified engineers who want the file should write on company letterhead to Clarostat Mfg. Co., Inc., Dept. ED, Dover, N. H.*

Electronic Hardware 107

Catalog 600 fully describes a line of electrical and electronic components. The 75-page booklet presents detailed specifications and actual size illustrations. Products listed include solder terminals, terminal boards, hardware, insulated terminals, coil forms, shielded coil forms, coils, and capacitors. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.

Electronic Connector 108

A periodical has been initiated to announce recent product developments and designs in electronic connectors and components. Called "Electronic Connector", the bulletin will be issued quarterly. The first issue discusses coaxial, triaxial, and printed circuit connectors. H. H. Buggie, Inc., Box 817, Toledo 1, Ohio.

Small Lamp Sockets 109

Catalog S-557 contains 28 pages on sockets for small lamps used in electrical and electronic products. It gives technical descriptions and actual-size illustrations for each group of sockets. Solderless terminals, specialty items, and military specification equivalents are also covered. Leecraft Mfg. Co., Inc., 58-60 Greene St., New York 12, N. Y.

GET THE FACTS

LOW and constant
contact drop
LOW
electrical noise
HIGH
current density
LONG life...



HIGH PERFORMANCE



BRUSHES CONTACTS SLIP RINGS

& Slip Ring Assemblies

BRUSH HOLDERS, CONTACT ASSEMBLIES,
BRUSH ASSEMBLIES



USED EXTENSIVELY IN:

**SERVOS • GUN-FIRE CONTROLS
TELEMETERING • ROTATING
THERMOCOUPLE and STRAIN
GAGE CIRCUITS • ROTATING
JOINTS • DYNAMOTORS**

Wide range of grades available for standard and special applications. Call on our 40 years of design experience to help solve your problems.

OTHER GRAPHALLOY

PRODUCTS: Unique (oil-free) self-lubricating bushings and bearings (applicable -450° to +700°F; with expansion coefficient half that of steel will not seize shaft at low temperatures); Oil-free Piston Rings, Seal Rings, Thrust and Friction Washers, Pump Vanes.



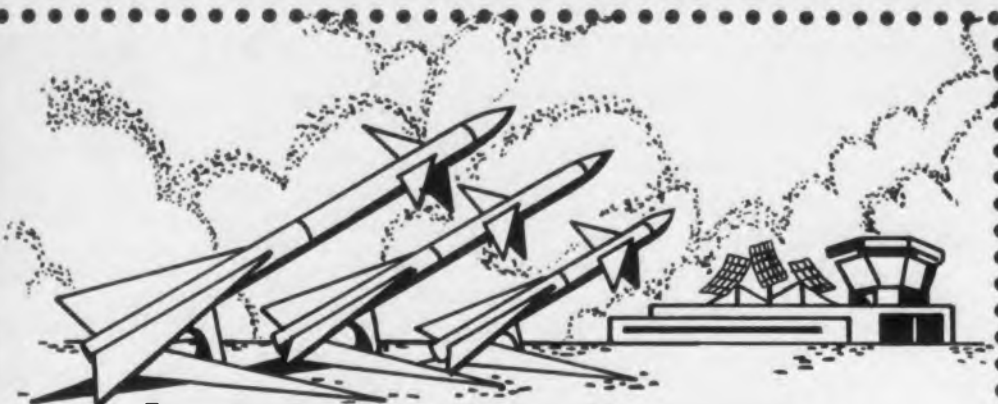
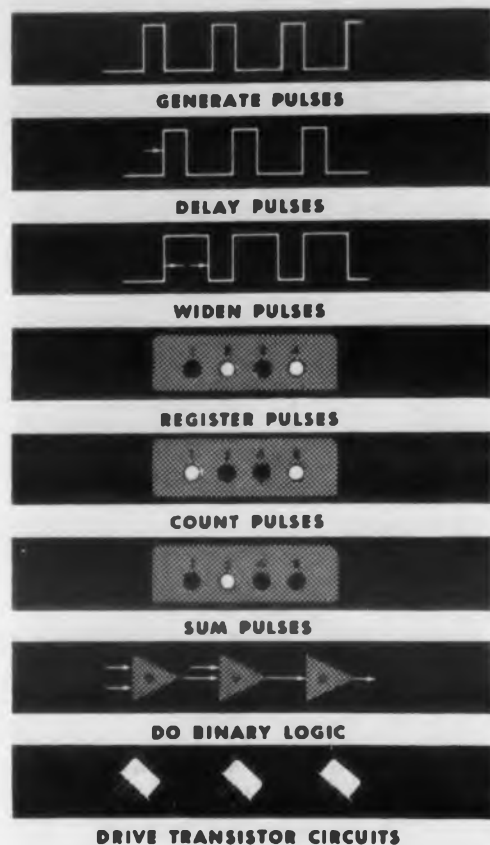
GRAPHITE METALLIZING CORPORATION

1046 Nepperhan Ave. • YONKERS, NEW YORK

Please send data on Graphalloy BRUSHES and CONTACTS.
 Send data on BUSHINGS.

NAME & TITLE _____
COMPANY _____
STREET _____
CITY _____ ZONE _____ STATE _____

CIRCLE 110 ON READER-SERVICE CARD



From the launching pad to machine controls—

NAVCOR completely transistorized pulse programming equipment is being utilized to do many military and industrial jobs, and do them well! The original concept of functional units pioneered by NAVCOR, and already proven in thousands of hours of use-test, feature quickly interchangeable modular blocks creatively engineered for multi-purpose operations. Write for data and specifications that will show how NAVCOR transistorized pulse programming equipment can be effectively used in your current computer project.

NAVIGATION COMPUTER CORPORATION

1621 SNYDER AVE., PHILADELPHIA 45, PENNA. / HOward 5-7700

CIRCLE 111 ON READER-SERVICE CARD

In meter-relays..



—to Contact RELIABILITY!



API locking coil meter-relays have wiping contacts which clean themselves with each operation. This self-cleaning assures maximum reliability, and is found in no other meter-relay.



When contacts touch, the locking coil grabs and holds them. They are sharply separated by a spring which is loaded during locking. This positive make and break gives 10 to 20 million trouble-free operations.

Ask for Catalog 4-D

Assembly Products Inc.



Chesterland 17, Ohio

Booth 1039, DESIGN ENGINEERING SHOW,
April 14-17, International Amphitheatre, Chicago

CIRCLE 115 ON READER-SERVICE CARD

HIGH
POWER
from a
Little

Variac®



The Type W5L VARIAC auto-transformer is designed for many applications in which output voltages not in excess of line are all that are needed. Through modifications of the popular Type W5 units, the power rating of the Type W5L is increased to 1265 va. As with all VARIACS the output voltage is continuously adjustable from zero. Other VARIAC features included are Duratrak brush construction for extra-long life . . . excellent regulation . . . low losses . . . linear output. The Type W5L VARIAC is moderately priced at \$17.50.

Write for the Variac Bulletin for Complete Data

GENERAL RADIO Company



275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.
Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 1000 N. Seward St. LOS ANGELES 38
8055 13th St. Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA
1182 Los Altos Ave., Los Altos Calif. SAN FRANCISCO 6605 W. North Ave., Oak Park, Ill. CHICAGO

In CANADA: 99 Floral Parkway TORONTO 15

CIRCLE 116 ON READER-SERVICE CARD

NEW LITERATURE

Speed Control Drives

112

Packaged drives for equipment requiring adjustable speed or speed synchronization are described in an 8-page bulletin No. 20,000. The bulletin explains the basic circuit, and the many modifications available including speed regulation, constant-potential dc supply, dynamic braking, and acceleration control. Major components are pictured and described. G. M. Basford Co., 422 Leader Bldg., Cleveland 14, Ohio.

Power Resistor Decade

113

Details of a power resistor decade box, providing a power resistor of any value from 1 ohm to 999,999 ohms, are presented in this four-page bulletin. Clarostat Mfg. Co., Inc., Dover, N.H.

High Torque Actuator Motor

114

A new high torque motor featuring split-second starting and stopping with starting torque equal to running torque is described in a detailed engineering Bulletin. The motor operates at temperatures up to 500 deg F at 60 or 400 cycles as well as pulsating dc. Viking Tool & Machine Corp., 20 Main St., Belleville 9, N. J.

NEW TWIN CONTACT MINIATURES

DC-AC CHOPPER

STEVENS-ARNOLD, INC.
SO. BOSTON, MASS.

DC-AC CHOPPERS

Eleven types, both single and double pole.

Long life.

Low noise level.

Extreme reliability.

Write for Catalog.

STEVENS INCORPORATED
ARNOLD

7 ELKINS STREET
SOUTH BOSTON 27, MASS.

CIRCLE 117 ON READER-SERVICE CARD

112
ng ad
e des
. The
man
egula
brak
onent
d Co.

113
s, pro
l oh
r-pag
H.

114
split
orque
tailed
t tem
les ac
chine

ALLIED RADIO
FREE send for the most widely used
ELECTRONIC SUPPLY GUIDE

**ALLIED'S
COMPLETE 404-PAGE
1958 CATALOG**

send for it!

your buying guide to the world's largest stocks
of ELECTRONIC SUPPLIES FOR INDUSTRY

- Receiving Tubes
- Test Instruments
- Power & Gas Tubes
- Meters & Supplies
- Diodes & Transistors
- AN Connectors
- Relays & Switches
- Metal Chassis Bases
- KNIGHT Public Address Systems

Simplify and speed your purchasing of electronic supplies and equipment at ALLIED. We make fast, expert shipment from the world's largest stocks of everything in Electronics. Manufacturers' prices available on quantity purchases. Send today for your FREE 1958 ALLIED Catalog—the complete Buying Guide to Electronic supplies for Industrial and Communications use.

One Complete Dependable Source for Everything in Electronics

ALLIED RADIO
100 N. Western Ave., Dept. 69-D8
Chicago 80, Illinois

our 37th year

Send for FREE Catalog

CIRCLE 118 ON READER-SERVICE CARD



ACT
S
S

New TEMP-R-TAPE® C
.002" thick, 2750 v/m
pressure sensitive TEFLON* tape
For -100°F to 500°F applications

TEMP-R-TAPE® C, CHR's newest pressure-sensitive tape, is made of ultra-thin, high dielectric, cast Teflon film to which a silicone polymer adhesive has been applied. Both pressure-sensitive and thermal curing, the adhesive sticks well to any surface over a -100°F to 500°F (-70°C to 260°C) temperature range. Providing an easy-to-apply, extremely thin, high dielectric insulator (2750 volts/mil), TEMP-R-TAPE C was designed for and is now being used in the manufacture of miniature electronic units to withstand Class H and higher temperature requirements. Send for data on TEMP-R-TAPE C and CHR's other extreme temperature, electrical and mechanical pressure-sensitive tapes.

CONNECTICUT HARD RUBBER

NEW HAVEN 9
*du Pont TM.

CHR CONNECTICUT

CIRCLE 119 ON READER-SERVICE CARD

Connectors 120

How to select a connector is concisely described in a 40-page Plug Guide. A check-list for selecting the proper connector includes important consideration such as size, number and style of contacts, and mounting space. It also shows photographs of representative connectors, and gives basic information on application. Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif.

Electronic Chemicals

A 28-page technical bulletin covers the use of electronic chemicals. The booklet takes up such chemicals as oxide cleaners, cements, resin sprays, varnishes, and others. A brief description of each product in the line is given, then the technical specifications and other information is presented. The booklet entitled "Electronic Chemicals", is available at a list price of \$1.00. For further information write directly to General Cement Mfg. Co., Div. Textron Inc., Dept. ED, 400 S. Wyman St., Rockford, Ill.

Ceramic Parts 121

A booklet, "Precision Ceramic Parts for Industry," stresses the increasing demands of the electronics industry for precision parts capable of withstanding extreme heat and vibration. The 4-page booklet describes various factors involved in the fabrication of precision ceramic parts and vacuum-tight ceramic-to-metal composites. Sylvania Electric Products Inc., Parts Div., Warren, Pa.

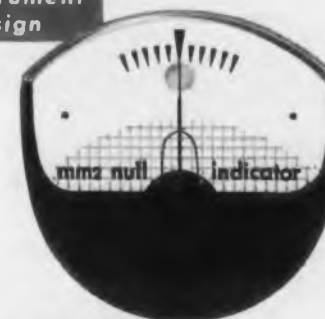
Thermostat Wells 122

Complete specifications on wells for thermostat applications in fluids, gases, or high pressure environments are included in this catalog. The 2-page, 2-color catalog describes copper and stainless steel designs suitable both for immersion and surface mounting. Each of the seven designs listed has complete dimensions, and operating specifications. Fenwal Inc., Pleasant St., Ashland, Mass.

Nuclear Instruments 123

A 23-page catalog, No. 58, describes over 40 different instruments including such items as single and multi-channel pulse height analyzers, scalars, pulse generators, and timers. Technical descriptions, complete specifications, and photos of the instruments are included. Tullamore Electronics Lab., 6055 S. Ashland Ave., Chicago 36, Ill.

marion
advancement
in instrument
design



**MEDALIST*
null indicators**

READABLE... WIDE RANGE SENSITIVITY
Modern MEDALIST design provides far greater readability and modern styling in minimum space. Unique core and magnet structure provides 1/4 ua/mm sensitivity at null point with sharp square law attenuation to 100 ua at end of scale in Type A. Internal resistance is 2000 ohms. Other sensitivities available. ASA/MIL 2 1/2" mounting. Standard and special colors. Bulletin on request. Marion Electrical Instrument Co., Manchester, N. H., U. S. A.

*T.M. Reg. U.S. Pat. Off. U.S. & Foreign Patents
Copyright © 1958, Marion

marion
"WHERE ELECTRONICS MEETS THE EYE"
meters

CIRCLE 125 ON READER-SERVICE CARD



TEFLON*

Fully describes its advanced usage as a cushioning and insulating material for wire and tube supporting clamps.

Send now for your copy of this new 20-page illustrated "TX" Engineering Handbook on Teflon* (Tetrafluoroethylene). Contains all latest information on Teflon* including chemical, thermal, electrical and aging properties as well as modern methods of handling it. Illustrates seven models of Teflon* cushioned support clamps which are available in 18 standard types. Included is a comprehensive tabulated chart covering 28 tests, furnished courtesy of the Du Pont Company. Write today for free copy.

*Du Pont Company registered trademark.

TA MFG. CORP.
4607 ALGER STREET • LOS ANGELES 39, CALIFORNIA

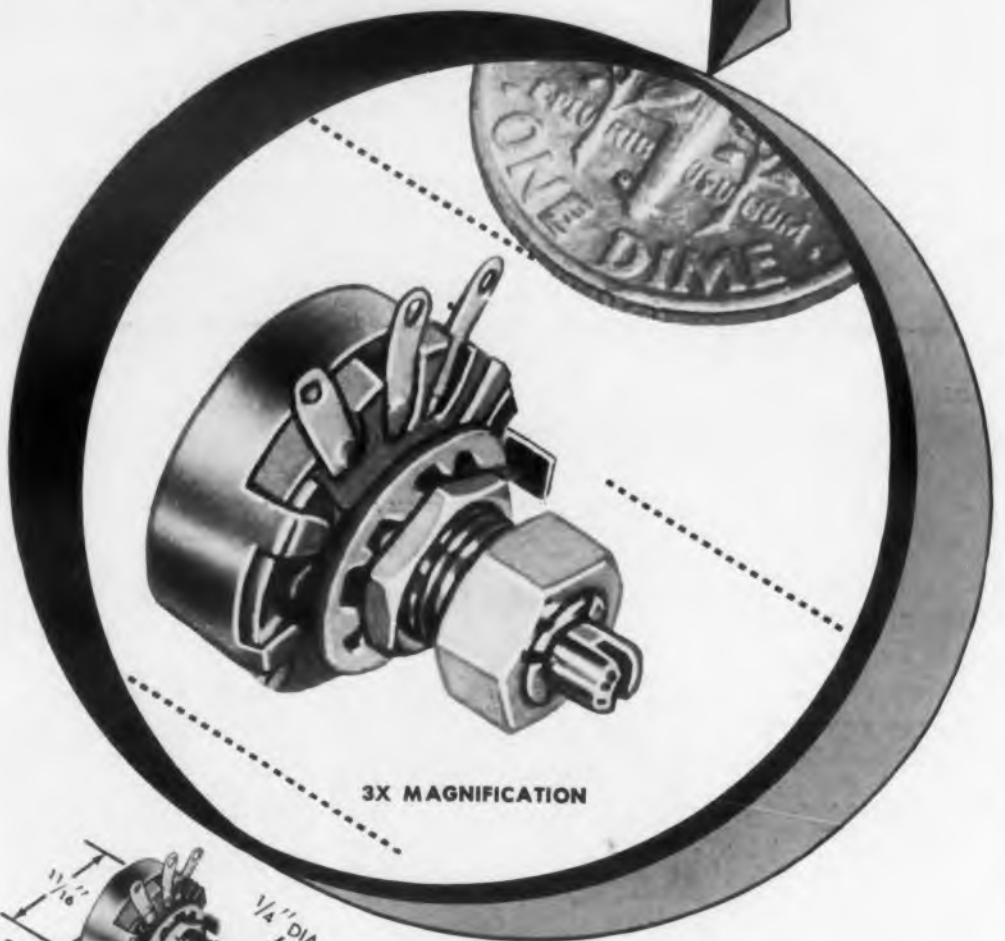
CIRCLE 124 ON READER-SERVICE CARD

for high reliability applications

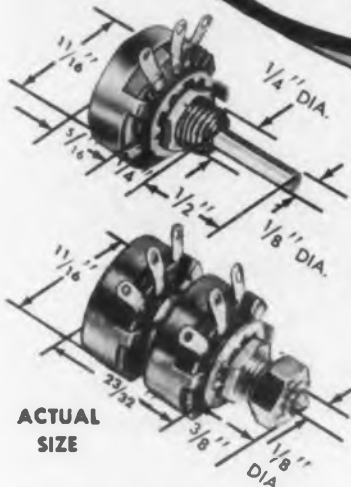
Centralab[®] MODEL 3 Radiohm[®]

1/4 watt sub-miniature
variable resistor

with  *



3X MAGNIFICATION



ACTUAL
SIZE

Your local Centralab distributor carries a wide variety of these units in stock. Ask him for Model JP and JL controls—as listed in Catalog 30.

The Model 3 utilizes Centralab's ICE* (Interfused Composition Element) to provide exceptional heat dissipation and electrical stability under the most severe operating conditions. It is recommended for high temperature operation in both military and commercial equipment.

- Will meet MIL-R-94B resistance change requirements under *twice* its rated load.
- Meets or exceeds MIL-R-94B requirements for moisture resistance, insulation resistance, thermal cycling, etc.
- Completely enclosed case can be sealed or potted.
- Resistance range: 200 ohms to 2.5 megohms, linear taper and 5000 ohms to 2.5 megohms 10% log audio taper.

Write for Technical Bulletin EP-63 containing detailed specifications or contact your Centralab representative.

Centralab[®]

B-5809

A DIVISION OF GLOBE-UNION, INC.
960D E. KEEFE AVE. • MILWAUKEE 1, WIS.
In Canada: 804 Mt. Pleasant Rd. • Toronto, Ontario

VARIABLE RESISTORS • PACKAGED ELECTRONIC CIRCUITS • ELECTRONIC SWITCHES
CERAMIC CAPACITORS • ENGINEERED CERAMICS • SEMI-CONDUCTOR PRODUCTS
CIRCLE 127 ON READER-SERVICE CARD

ABSTRACT



The X-band pill box feed for the Radio Telescope at Pulkovo.

Electronics in the USSR

Impressions of Four Touring U.S. Engineers

Four U.S. engineers were invited to the USSR to attend a radio engineers' convention last year. They were permitted to visit a number of electronic plants and laboratories in Moscow and Leningrad. Among the sites visited were a radio transmitting complex called Radio Town, the Moscow Physics Institute, a television broadcasting station, a tube and transistor plant, a television research institute, and a radio astronomy station. The observations made during their visit were reported in the January, 1958 issue of *Signal Magazine*. Some of the highlights of their report are presented here.

Radio Astronomy Station at Pulkovo

About 10 miles south of Leningrad exists the most uniquely constructed radio telescope observed. Use was made of a subterfuge to construct a telescope having a focal length of 50 meters and a physical aperture of 75 meters utilizing a section of a paraboloid. The paraboloid section is a horizontal slice that is formed by a row of flat mirrors, each mirror being adjusted in tilt to correspond to the theoretical paraboloid contour.

Plans are underway to conduct investigations at 3, 9, and 10 centimeters. For

this purpose, it was shown by actual measurements that there is a resolution of 1-1/2 minutes of arc. One particular recording shows a track of a sunspot moving across the sun over a period of several days with only a portion of the mirrors used. The feed of this particular parabolic section consisted of a pillbox having an aperture of about four feet and excited in the TE mode. The installation utilized normal tubes and Soviet crystals, a bandwidth of 20 mc at an intermediate frequency of 60 mc, from which a noise figure of 13 db had been obtained.

Radio Town

A radio transmitting complex with point to point hf broadcast transmitters, Radio Town is a series of large buildings located just outside Moscow. One building contained 19 radio transmitters ranging from 15 kw to 100 kw output at frequencies up to 27 mc; forty antennas, primarily of the rhombic type; and a switching system capable of connecting transmitters in pairs or singly to any one of the forty antennas.

A second building and an adjacent annex housed six 60 kw broadcast transmitters with hf frequency ranges up to 27 mc and six arrays of half-wave dipoles, 8 x 4, 6 x 4, and 4 x 4 in width and height for operation at various frequencies. Any transmitter or pair of transmitters could be connected to the antennas at a master control board.

Television Research Institute at Leningrad

The Institute employs a staff of 3000. The work done here is described as advanced development rather than research. The Russians were engaged in building elaborate studio equipment for NTSC-type color television modified for the Russian frequency allocation. They were planning to locate the color subcarrier at 4.43 mc using double sideband transmission with sidebands extending 1.5 mc. The sound carrier is located 6.25 mc from the picture carrier.

Television Broadcasting Station in Moscow

Moscow has two channels each 8 mc wide. The antennas are of the batwing type one with three stacks and the other with four. One channel is used for regular broadcasts made from four to five hours daily while the other is used for special events and news broadcasts.

The stations are located in a group of buildings which was not originally built for their present function. However, it appeared that plans were in effect to build television facilities somewhat similar to our television cities in Hollywood.

One of the transmitters is a rebuilt RCA product purchased by the Russians in 1930 and having an output of 12-1/2 kw. The other is Russian built having a

7-1/2 kw output. The cameras used were either image iconoscopes or image orthicons.

Reportedly, only one coaxial link exists in Russia, 150 kilometers in length, but the Russians stated that they planned to install 60,000 kilometers of wide-band microwave circuits by 1960.

Moscow Physics Institute

Fundamental research work on the properties of solid state devices, propagation, and electron discharge phenomena is conducted at the Moscow Physics Institute. Investigations were being carried out on the characteristics of p-n junctions, checking Shockley's theory, and on the characteristics of platinum-ruthenium and platinum-rhodium welded point contact diodes, for which noise figures of about 1.5 to 3 have been obtained on X-band. Russian engineers had concluded that a positive bias gave somewhat lower noise figures.

A molecular resonance generator was shown of the Townes-Maser type utilizing ammonia. On the basis of a frequency standard of unknown reliability a frequency stability of 1 in 10^9 with an output of 10^{-9} watt had been obtained. The authors noted completeness of equipment found in these laboratories.

Svetlana Tube and Transistor Plant

Here are situated facilities for designing and constructing receiving tubes, automatic tube manufacturing equipment, transistors and high power transmitting tubes.

Though operations were not mechanized to the same extent as in the U.S., they were nevertheless, quite similar. A lot of the handwork, however, will be replaced by assembly line techniques. The authors noted that the receiving tube section was making 200,000 6AK5's per month. Transmitting tubes were being manufactured up to 240 kw rating with a number of tubes with 1 megawatt peak, 2 kw average pulse ratings up to 200 mc.

Abstracted from an article in *Signal*, Vol. XII, No. 5, Jan. 1958. Article by A. J. Jensen, Bell Telephone Labs.; C. L. Rouault, General Electric Co.; R. F. Schulz, Sylvania Electric Products; and J. N. Dyer, Airborne Instruments Labs.

MARCONI

a must for
missile
measurements

FM Telemetry equipment is quickly and accurately checked with the unique instruments described below. All are immediately available against DX Priorities.



FM DEVIATION METER model 928/2
 Freq. Range: 215 to 260 Mc, directly calibrated.
 Modulation Freqs: 50 cps to 120 kc.
 Deviation Ranges:
 0 to 100, 200 and 400 kc, or to order.
 Accuracy of Measurement: 3%.

Built in crystal standardization, aural and visual monitoring, counter type discriminator. Instrument is ruggedized and waterproof.

FM DEVIATION METER model 928,
 similar to 928/2, covers 20 to 500 Mc.

FM SIGNAL GENERATOR model 1086/1
 Freq. Range: 10 to 470 Mc in 5 bands.
 FM, continuously variable:
 0 to 100 kc. Higher to order.
 Δ Frequency: 1 to 200 kc, calibrated.
 Stability: .0025% per 10 min.



AMPLITUDE MODULATOR model 1102 For use with any Sig Gen. Gives monitored AM, 0 to 80% with zero FM. Handles any wave shape.



EDDYSTONE FM/AM RECEIVERS,
 models 770 R. 770 U
 Model 770 U covers 150 to 500 Mc, 770R covers 19 to 165 Mc. Both are sensitive, stable, directly calibrated and have excellent logging scales.

AS SUPPLIED TO: US Signal Corps, Wright Patterson AFB, Navy Electronics Lab, AEC, Convair, Martin, Douglas, McDonnell, GM, Chrysler, etc., etc.



MARCONI instruments
 111 Cedar Lane • Englewood, New Jersey

CIRCLE 128 ON READER-SERVICE CARD



On April 7, 45 B.C., during the reign of Cleopatra, Memamadun Ptolemy (pronounced me-mama-done-toll-me), radar operator, fell asleep at just the time chosen by some unfriendly neighbors to make a border raid.

Memamadun (he was the only survivor) was brought before Cleopatra.

"Can you give me any reason why I shouldn't throw you to my pet crocodile Julius for letting such a terrible thing happen?" she asked.

Memamadun stifled a yawn.

"Even if I'd been awake, our radar wouldn't have prevented the attack," he said. "Our radar won't work."

"Why not?" the queen asked, stroking Julius' head.

"It can't," Ptolemy told her. "For one thing, Bomac* tubes haven't been invented yet."

"That's right, too!" Cleopatra said. "Case dismissed."

No. 2 of a series . . . BOMAC LOOKS AT RADAR THROUGH THE AGES



* Bomac makes the finest microwave tubes and components this side of the Nile

Bomac LABORATORIES, INC.



Leaders in the design, development and manufacture of TR, ATR, Pre-TR tubes; shutters; reference cavities; hydrogen thyratrons; silicon diodes; magnetrons; klystrons; duplexers; pressurizing windows; noise source tubes; high frequency triode oscillators; surge protectors.

Offices in major cities—Chicago • Kansas City • Los Angeles • Dallas • Dayton • Washington • Seattle • San Francisco • Toronto • Export: Maurice I. Parisier, 1860 Broadway, New York City.

SERVICES FOR DESIGNERS

High Power Linear Accelerator

Applied Radiation Corporation is offering for sale or lease to physics and electronics laboratories, a high powered traveling wave linear electron accelerator, designed for research in nuclear and solid state physics. The Mark 1-F4 linear electron accelerator emits high energy electrons, x-rays, or neutrons, as desired. Its electron beam, variable in energy from 2 to 10 million electron volts, can penetrate material of unit density up to 1-1/4 in. thick from one side. At full power (4kw), it can process a maximum of 3000 megarad-pounds per hour.

Applied Radiation Corp., Dept. ED, Walnut Creek, Calif.

Instrument Repair Service by L&N

A new factory instrument repair service is now available through Field Offices of the Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia 44, Pa. With this new service the user may specify the type of repair to be made on his equipment. Emergency service is available. A new folder, EN(6), gives details of this instrument repair service.

Noise Interference Measured

A new radio interference measurement facility has been completed by Sprague Electric Co., North Adams, a custom interference measurement service on all types of electrical machinery such as synamotors, actuator motors, vibrator power supplies, etc., as well as on electronic equipment. Coupled with the new measurement service is an expanded interference filter sample shop and pilot plant to expedite service to customers with interference problems. This service is for missile, electronic equipment, and portable tool manufacturers, both on the East and West coasts.

Sprague Electric Co., Dept. ED, North Adams, Mass.

◀ CIRCLE 126 ON READER-SERVICE CARD

ADVERTISERS' INDEX

April 2, 1958

Company Name	Page
Instrument Labs Inc.	38
Radio Corp.	47
Plastics Corp.	41
Corp.	42
Assembly Products Inc.	46
Mfg. Corp.	32
Seattle-Coleman Inc.	39
Aviation Corp., Eclipse Pioneer Div.	41
Corp.	36
Laboratories, Inc.	50
Trailsford & Co., Inc.	37
Corp.	38
Centralab, Div. of Globe Union Inc.	48
Chassis-Trak Corp.	39
Chicago Telephone Supply Corp.	41
Elite Transistor Products	11
Computer-Measurements Corp.	21
Connecticut Hard Rubber Co.	47
Daven Co., The	8
Detroit Stamping Co.	44
Dressen-Barnes Corp.	32
Emerson Electric Mfg. Co.	36
Steel Metallurgical Corp.	12
Frequency Standards	17
V Controls Inc.	3
General Radio Co.	46
Graphite Metallizing Corp.	45
Hewlett-Packard Co.	34, 35
Hughes Aircraft Co.	15
International Nickel Co., Inc.	30
Kearfoot Co., Inc., Little Falls Div.	23
Kester Solder Co.	44
Kintel	27
Krohn-Hite Instrument Co.	40
London Chemical Co.	32
Magnetic Research Corp.	28
Magnetics Inc., Components Div.	33
Malco Tool & Mfg. Co.	45
Marconi Instrument Co.	49
Marion Electrical Instrument Co.	47
Mesa Plastics Co.	44
Navigation Computer Corp.	46
Oak Manufacturing Co.	19
Orbitran Company	40
Perkin Engineering Corp.	7
Phaestron Co.	43
Radio Corp. of America	52
Radio Frequency Labs Inc.	25
Radio Receptor Co.	24
Raytheon Mfg. Co., Microwave & Power Tube Div.	6
Raytheon Mfg. Co., Semi-Conductor Div.	4
Reeves-Hoffman Div.	36
Rage Electronics Corp.	43
Shell Chemical Corp.	2
Sigma Instruments Inc.	22
Stackpole Carbon Co., Jobbing Div.	40
Stevens-Arnold Inc.	46
Stromberg-Carlson, Division of General Dynamics	43
Synthane Corp.	31
Manufacturing Corp.	47
Control Engineering Co.	18
Timman Products Inc.	10
Electronics Co.	42
Electronics Corp.	29
Transformer Co.	51
Inc.	37
Kohinoor Inc.	9
Mfg. Co.	13

CIRCLE 130 ON READER-SERVICE CARD

OUR MILLIONTH FILTER SHIPPED THIS YEAR...

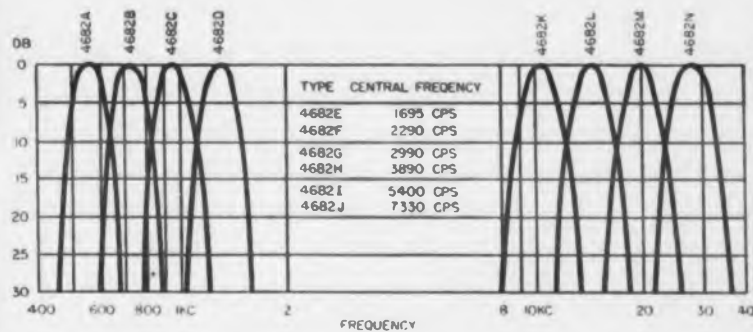
FILTERS

FOR EVERY APPLICATION



TELEMETERING FILTERS

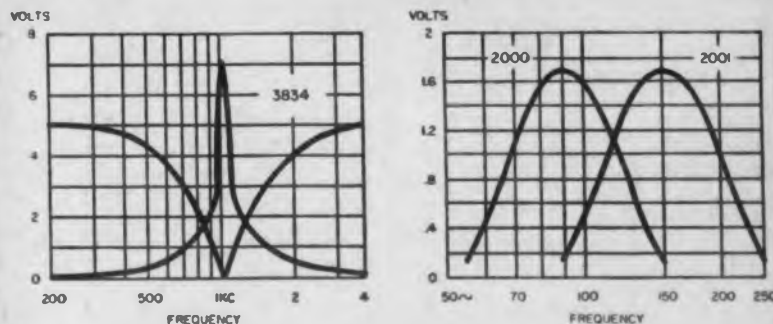
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.



Dimensions:
(4682A) 1 1/2 x 2 x 4"



Dimensions:
(3834) 1 1/4 x 1 3/4 x 2-3/16"
(2000, 1) 1 1/4 x 1 3/4 x 1 5/8"



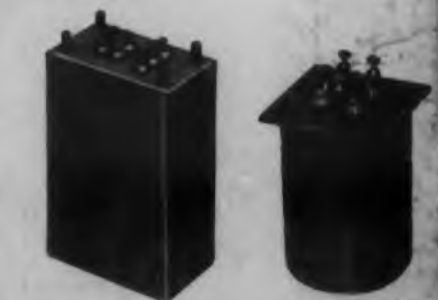
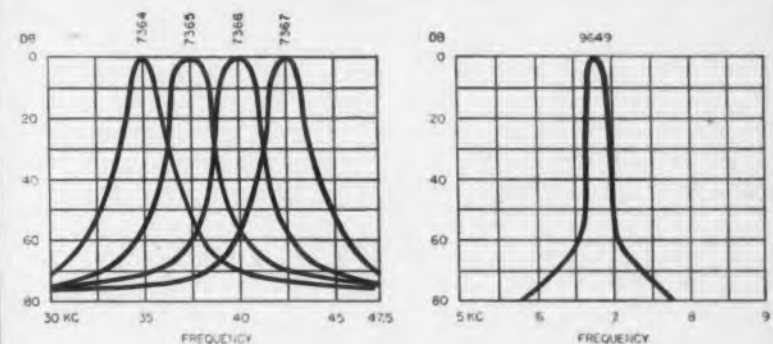
AIRCRAFT FILTERS

UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

CARRIER FILTERS

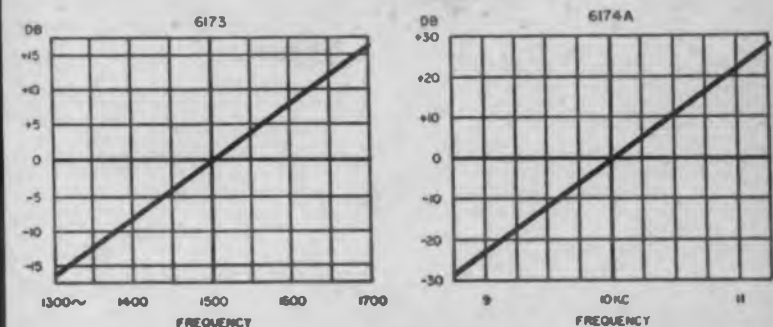
A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.



Dimensions:
(7364 series) 1 1/4 x 1 3/4 x 2 1/4"
(9649) 1 1/2 x 2 x 4"

DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.



Dimensions:
(6173) 1-1/16 x 1 3/4 x 3"
(6174A) 1 x 1 1/4 x 2 1/4"

UNITED TRANSFORMER CORPORATION

150 Varick Street, New York 13, N.Y.

EXPORT DIVISION: 11 EAST 40th STREET, NEW YORK 16, N.Y. CABLES: "ARLAB"

For full data on stock UTC transformers, reactors, filters, and high Q coils, write for Catalog A.

RCA TRAVELING- WAVE TUBES

A milestone... RCA's 2,000,000,000 tube year



RADIO CORPORATION OF AMERICA

Electron Tube Division

Harrison, N. J.

Typical RCA Traveling-Wave Tubes for S-Band (2000 to 4000 Mc) Operation

RCA Type No.	Function	Saturated Power Output	Small Sig. Gain (db)	Focusing Method	Dia. (in.)	Length (in.) Approx.	Weight (lb.)
4008	Low-Noise Receiving Type #	1 mw	20	Light-Weight Solenoid*	2 1/4	16	10
4009	Driver for 4010	10 mw	35	Integral Periodic Permanent Magnet	1 1/2	14	1 1/2
4010	Power Type	2 w	35	Integral Periodic Permanent Magnet	1 1/2	14	1 1/2
4006	Power Type	10 w	25	Integral Periodic Permanent Magnet	1 1/2	18 1/2	3 1/2
4007	Power Type	100 w (peak)	30	Integral Periodic Permanent Magnet	2 1/2	20	12 1/2
Dev. No. A1134	Power Type	1,000 w (peak)	30	Integral Periodic Permanent Magnet	2 1/2	22	15

Noise Figure 10 db

for every job in microwaves

Pacing the fast-moving advancements in tubes for microwaves, RCA offers designers a comprehensive line of low-noise and power traveling-wave tubes—for any application in the L, S, C, and X bands. These tubes feature a major improvement in traveling-wave tube manufacture: *high uniformity of characteristics maintained through rigid RCA quality control.*

RCA power types incorporate integral periodic-permanent-magnetic focusing—a design advantage that eliminates the need for solenoid power and reduces package size and weight.

RCA low-noise receiving types provide increased receiver sensitivity across octave bandwidths. And they are “tailored” to meet the requirements both in new equipment designs and in *modernization of existing microwave systems!*

Reflecting RCA's traditional engineering knowhow, RCA traveling-wave tubes are designed for military environments. For prompt service on your needs for traveling-wave tubes, get in touch with the RCA Sales Office nearest you.

GOVERNMENT SALES

- 415 South Fifth St., Harrison, N.J.
Humboldt 5-3900
- 224 N. Wilkinson St., Dayton 2, Ohio
Baldwin 6-2366
- 1625 "K" St., N. W., Washington 6, D.C.
District 7-1260

INDUSTRIAL PRODUCTS SALES

- 744 Broad St., Newark 2, N.J.
Humboldt 5-3900
- Suite 1181, Merchandise Mart Plaza
Chicago 54, Illinois
Whitehall 4-2900
- 6355 E. Washington Blvd., Los Angeles 22, Calif.
Raymond 3-8361

HAYDEN PUBLISHING COMPANY, INC.
830 Third Avenue, New York 22, N. Y.

ELECTRONIC
DESIGN