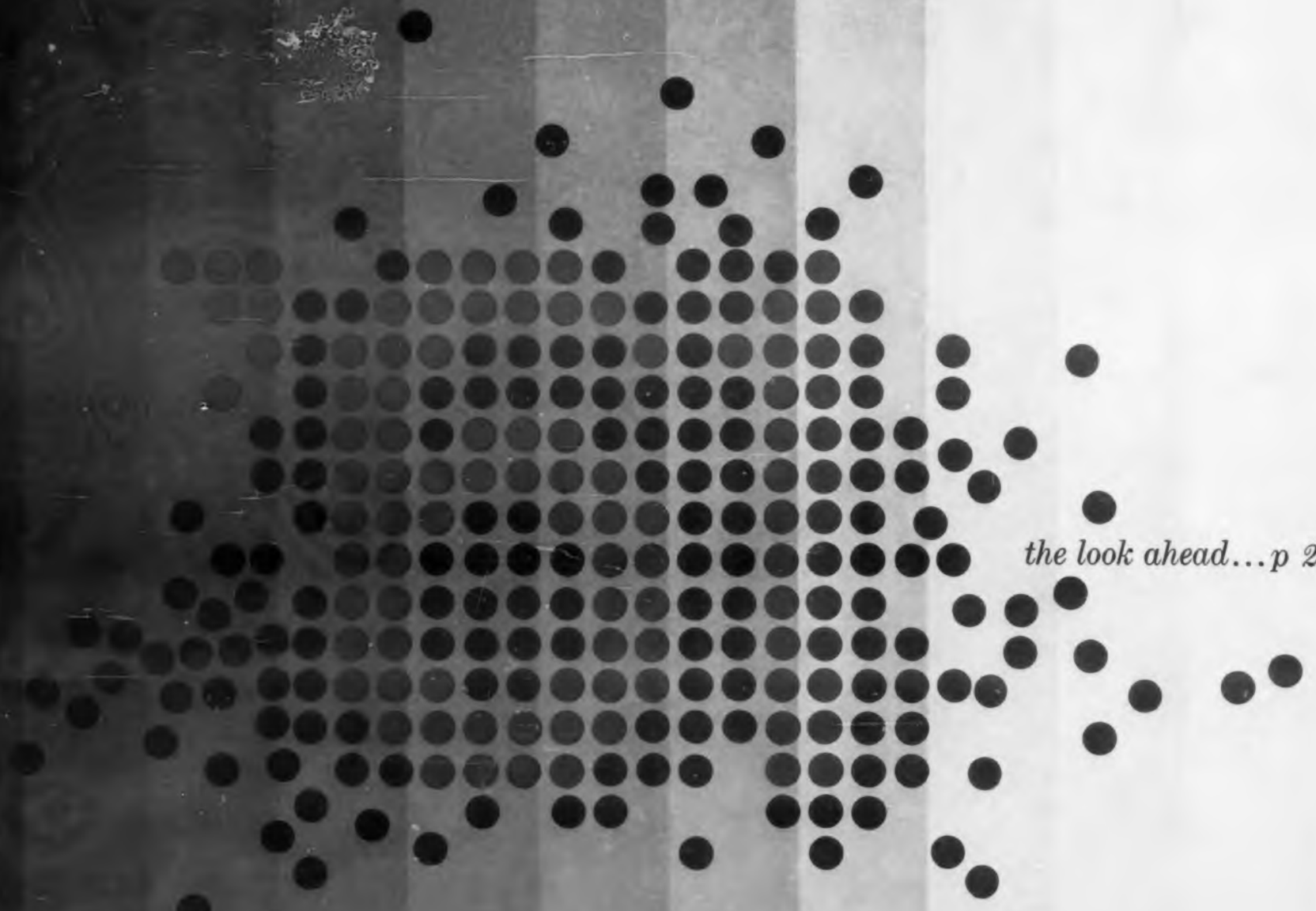
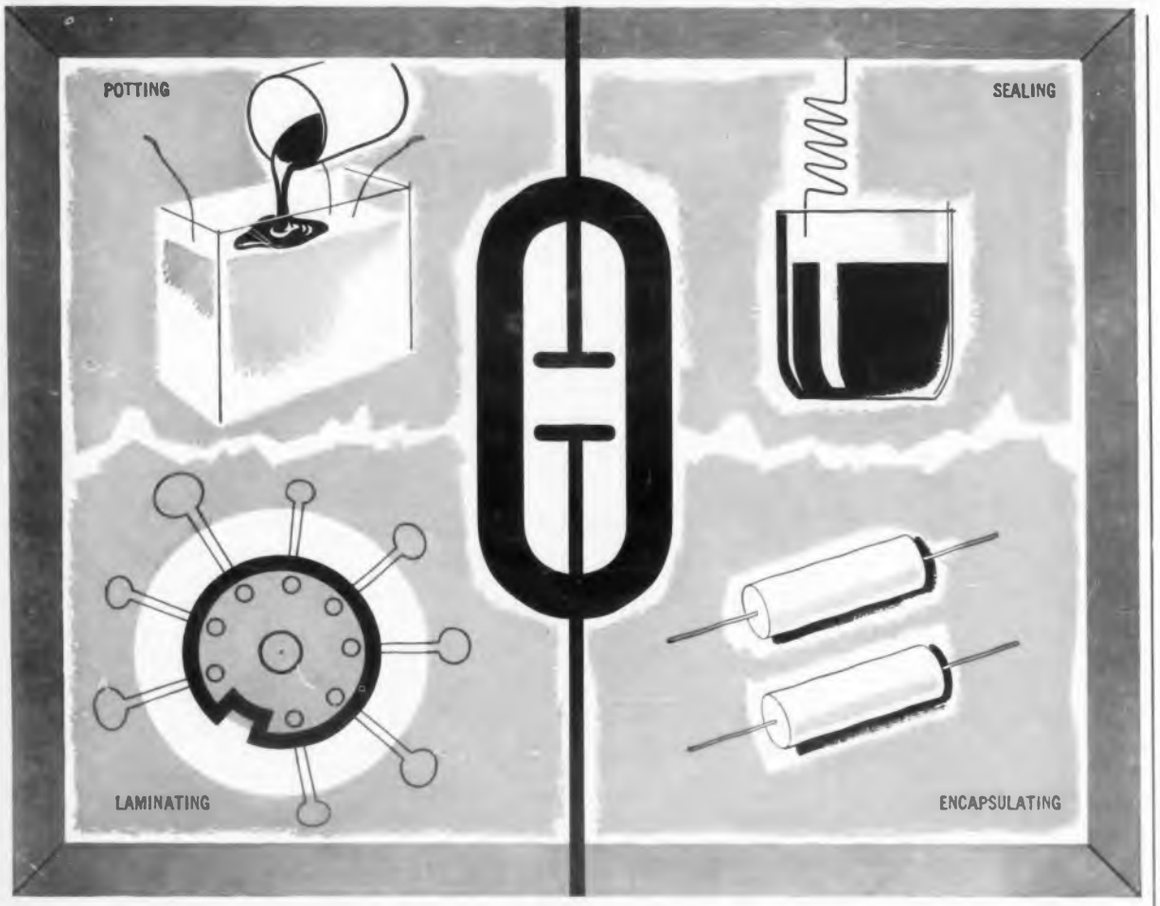
ELECTRONIC DESIGN

JANUARY 4, 1961



the look ahead... p 26



For lasting dependability, specify...

EPON® RESINS

When you are looking for outstanding reliability, even under severe operating conditions, you can count on Epon resins to give you the excellent electrical and mechanical performance you require.

For example—Epon resins have truly amazing adhesive qualities—form strong bonds to metal, glass, and plastic. They assure air-tight, moisture-tight enclosure for delicate components and vacuum tubes. Even when exposed to solder-bath temperatures, Epon resins retain their dimensional stability.

Epon resin-based insulating varnishes and potting compounds, in addition to providing excellent moisture sealing, have outstanding resistance to attack by solvents and chemicals, even at high temperatures.

When reinforced with inert fibrous filler, Epon resins produce base laminates of superior dielectric properties that can be sheared, punched, drilled, and bath-soldered.

Solvent-free Epon resin adhesive formulations require contact pressure alone and cure at room temperature, or with low heat for accelerated curing.

Will Epon resins solve a production problem for you? For a list of resin formulators and technical literature write to:

POTTING

SEALING

ENCAPSULATING

LAMINATING

SHELL CHEMICAL COMPANY
PLASTICS AND RESINS DIVISION
110 WEST 51ST STREET, NEW YORK 20, NEW YORK

Central District
6054 West Touhy Avenue
Chicago 48, Illinois

East Central District
20575 Center Ridge Road
Cleveland 16, Ohio

Eastern District
42-76 Main Street
Flushing 55, New York

Western District
10642 Downey Avenue
Downey, California

IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited, Toronto

CIRCLE 23 ON READER-SERVICE CARD

COVER: Just as the major feature of this issue, Design '61—The Look Ahead—is made up of individual articles on individual fields, so the cover consists of small circles in which the shape of 61 can be seen.

Selected Topics In This Issue

ELECTRONIC DESIGN devotes most of this first issue of the year to a Staff Report—a panoramic view of the electronic industry's prospects in the months to come.

ELECTRONIC DESIGN · ONE DAY SERVICE

USE BEFORE FEBRUARY 15th, 1961

A

Name Title

Company

Company Address City Zone State

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290
1	11	21	31	41	51	61	71	81	91	101	111	121	131	141	151	161	171	181	191	201	211	221	231	241	251	261	271	281	291
2	12	22	32	42	52	62	72	82	92	102	112	122	132	142	152	162	172	182	192	202	212	222	232	242	252	262	272	282	292
3	13	23	33	43	53	63	73	83	93	103	113	123	133	143	153	163	173	183	193	203	213	223	233	243	253	263	273	283	293
4	14	24	34	44	54	64	74	84	94	104	114	124	134	144	154	164	174	184	194	204	214	224	234	244	254	264	274	284	294
5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155	165	175	185	195	205	215	225	235	245	255	265	275	285	295
6	16	26	36	46	56	66	76	86	96	106	116	126	136	146	156	166	176	186	196	206	216	226	236	246	256	266	276	286	296
7	17	27	37	47	57	67	77	87	97	107	117	127	137	147	157	167	177	187	197	207	217	227	237	247	257	267	277	267	297
8	18	28	38	48	58	68	78	88	98	108	118	128	138	148	158	168	178	188	198	208	218	228	238	248	258	268	278	288	298
9	19	29	39	49	59	69	79	89	99	109	119	129	139	149	159	169	179	189	199	209	219	229	239	249	259	269	279	289	299
300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
301	311	321	331	341	351	361	371	381	391	401	411	421	431	441	451	461	471	481	491	501	511	521	531	541	551	561	571	581	591
302	312	322	332	342	352	362	372	382	392	402	412	422	432	442	452	462	472	482	492	502	512	522	532	542	552	562	572	582	592
303	313	323	333	343	353	363	373	383	393	403	413	423	433	443	453	463	473	483	493	503	513	523	533	543	553	563	573	583	593
304	314	324	334	344	354	364	374	384	394	404	414	424	434	444	454	464	474	484	494	504	514	524	534	544	554	564	574	584	594
305	315	325	335	345	355	365	375	385	395	405	415	425	435	445	455	465	475	485	495	505	515	525	535	545	555	565	575	585	595
306	316	326	336	346	356	366	376	386	396	406	416	426	436	446	456	466	476	486	496	506	516	526	536	546	556	566	576	586	596
307	317	327	337	347	357	367	377	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	537	547	557	567	577	587	597
308	318	328	338	348	358	368	378	388	398	408	418	428	438	448	458	468	478	488	498	508	518	528	538	548	558	568	578	588	598
309	319	329	339	349	359	369	379	389	399	409	419	429	439	449	459	469	479	489	499	509	519	529	539	549	559	569	579	589	599
600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890
601	611	621	631	641	651	661	671	681	691	701	711	721	731	741	751	761	771	781	791	801	811	821	831	841	851	861	871	881	891
602	612	622	632	642	652	662	672	682	692	702	712	722	732	742	752	762	772	782	792	802	812	822	832	842	852	862	872	882	892
603	613	623	633	643	653	663	673	683	693	703	713	723	733	743	753	763	773	783	793	803	813	823	833	843	853	863	873	883	893
604	614	624	634	644	654	664	674	684	694	704	714	724	734	744	754	764	774	784	794	804	814	824	834	844	854	864	874	884	894
605	615	625	635	645	655	665	675	685	693	705	715	725	735	745	755	765	775	785	795	805	815	825	835	845	855	865	875	885	895
606	616	626	636	646	656	666	676	686	696	706	716	726	736	746	756	766	776	786	796	806	816	826	836	846	856	866	876	886	896
607	617	627	637	647	657	667	677	687	697	707	717	727	737	747	757	767	777	787	797	807	817	827	837	847	857	867	877	887	897
608	618	628	638	648	658	668	678	688	698	708	718	728	738	748	758	768	778	788	798	808	818	828	838	848	858	868	878	888	898
609	619	629	639	649	659	669	679	689	699	709	719	729	739	749	759	769	779	789	799	809	819	829	839	849	859	869	879	889	899

For employment brochures give home address City Zone State
Home Address

For Change of Address:
Old Company Name

Old Company Address City Zone State

☐ I Do Design Work
☐ I Supervise Design Work
☐ I Do No Design Work

ELECTRONIC DESIGN · ONE DAY SERVICE

USE BEFORE FEBRUARY 15th, 1961

B

Name Title

Company

Company Address City Zone State

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290
1	11	21	31	41	51	61	71	81	91	101	111	121	131	141	151	161	171	181	191	201	211	221	231	241	251	261	271	281	291
2	12	22	32	42	52	62	72	82	92	102	112	122	132	142	152	162	172	182	192	202	212	222	232	242	252	262	272	282	292
3	13	23	33	43	53	63	73	83	93	103	113	123	133	143	153	163	173	183	193	203	213	223	233	243	253	263	273	283	293
4	14	24	34	44	54	64	74	84	94	104	114	124	134	144	154	164	174	184	194	204	214	224	234	244	254	264	274	284	294
5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155	165	175	185	195	205	215	225	235	245	255	265	275	285	295
6	16	26	36	46	56	66	76	86	96	106	116	126	136	146	156	166	176	186	196	206	216	226	236	246	256	266	276	286	296
7	17	27	37	47	57	67	77	87	97	107	117	127	137	147	157	167	177	187	197	207	217	227	237	247	257	267	277	267	297
8	18	28	38	48	58	68	78	88	98	108	118	128	138	148	158	168	178	188	198	208	218	228	238	248	258	268	278	288	298
9	19	29	39	49	59	69	79	89	99	109	119	129	139	149	159	169	179	189	199	209	219	229	239	249	259	269	279	289	299
300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
301	311	321	331	341	351	361	371	381	391	401	411	421	431	441	451	461	471	481	491	501	511	521	531	541	551	561	571	581	591
302	312	322	332	342	352	362	372	382	392	402	412	422	432	442	452	462	472	482	492	502	512	522	532	542	552	562	572	582	592
303	313	323	333	343	353	363	373	383	393	403	413	423	433	443	453	463	473	483	493	503	513	523	533	543	553	563	573	583	593
304	314	324	334	344	354	364	374	384	394	404	414	424	434	444	454	464	474	484	494	504	514	524	534	544	554	564	574	584	594
305	315	325	335	345	355	365	375	385	395	405	415	425	435	445	455	465	475	485	495	505	515	525	535	545	555	565	575	585	595
306	316	326	336	346	356	366	376	386	396	406	416	426	436	446	456	466	476	486	496	506	516	526	536	546	556	566	576	586	596
307	317	327	337	347	357	367	377	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	537	547	557	567	577	587	597
308	318	328	338	348	358	368	378	388	398	408	418	428	438	448	458	468	478	488	498	508	518	528	538	548	558	568	578	588	598
309	319	329	339	349	359	369	379	389	399	409	419	429	439	449	459	469	479	489	499	509	519	529	539	549	559	569	579	589	599
600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890
601	611	621	631	641	651	661	671	681	691	701	711	721	731	741	751	761	771	781	791	801	811	821	831	841	851	861	871	881	891
602	612	622	632	642	652	662	672	682	692	702	712	722	732	742	752	762	772	782	792	802	812	822	832	842	852	862	872	882	892
603	613	623	633	643	653	663	673	683	693	703	713	723	733	743	753	763	773	783	793	803	813	823	833	843	853	863	873	883	893
604	614	624	634	644	654	664	674	684	694	704	714	724	734	744	754	764	774	784	794	804	814	824	834	844	854	864	874	884	894
605	615	625	635	645	655	665	675	685	695	705	715	725	735	745	755	765	775	785	795	805	815	825	835	845	855	865	875	885	895
606	616	626	636	646	656	666	676	686	696	706	716	726	736	746	756	766	776	786	796	806	816	826	836	846	856	866	876	886	896
607	617	627	637	647	657	667	677	687	697	707	717	727	737	747	757	767	777	787	797	807	817	827	837	847	857	867	877	887	897
608	618	628	638	648	658	668	678	688	698	708	718	728	738	748	758	768	778	788	798	808	818	828	838	848	858	868	878	888	898
609	619	629	639	649	659	669	679	689	699	709	719	729	739	749	759	769	779	789	799	809	819	829	839	849	859	869	879	889	899

For employment brochures give home address City Zone State
Home Address

For Change of Address:
Old Company Name

Old Company Address City Zone State

☐ I Do Design Work
☐ I Supervise Design Work
☐ I Do No Design Work

VIA
AIR
MAIL

FIRST CLASS
Permit No. 725
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed In U. S.

POSTAGE WILL BE PAID BY

ELECTRONIC DESIGN
ONE DAY READERS INQUIRY SERVICE
830 Third Avenue
New York 22, New York

VIA
AIR
MAIL

FIRST CLASS
Permit No. 725
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed In U. S.

POSTAGE WILL BE PAID BY

ELECTRONIC DESIGN
ONE DAY READERS INQUIRY SERVICE
830 Third Avenue
New York 22, New York

This precision DC VTVM is also a wide range, precision ohmmeter and ammeter!

1% accuracy 100 μv to 1,000 volts!

Also 2% accuracy, 1 μa to 1 amp full scale.

Measures 0.02 ohms to 5,000 megohms.

No zero adjustment. Fast minute warm-up.

Floating chassis. $1,000 worth of convenience for $375!

Haven't you wished for one compact, simple instrument that would make *precision* dc voltage, dc current and resistance measurements over a wide range?

The new ϟ 412A is it! In its VTVM circuit, the 412A uses an exclusive ϟ photo-chopper instead of old-style mechanical vibrators—no drift, no 60 cps pickup. Input is floating, with resistance increasing from 10 megohms on the 1 mv range to 200 megohms on ranges above 100 mv. Current and voltage ranges have a 10 db sequence for maximum readability and overlap. The ohmmeter is a modified Kelvin bridge eliminating lead resistance error; you measure resistance accurately on hook-up wire sections as short as 6".

Model 412A also includes a 1 v or 1 ma recorder output, and 3 separate probes. Call your ϟ rep today for a demonstration on your bench. Price, $375.00.

HEWLETT-PACKARD COMPANY
1001K PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
CABLE "HEWPACK" • DAVENPORT 6-7000
FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS

ϟ 400L LOGARITHMIC VOLTMETER—$325
New ϟ voltmeter covers 10 cps to 4 MC; accuracy high as ±2% of reading or 1% of full scale. Voltage range 0.3 mv to 300 v, 12 ranges, 1-3-10 sequence. Max. full scale sensitivity 1 mv. Large 5" true log voltage scale, linear 12 db scale, generous overlap. High stability, high input impedance. Also useful as amplifier for small signals, or to monitor waveforms.

ϟ 400H PRECISION VOLTMETER—$325
Extreme accuracy as high as ±1% to 500 KC, ±2% to 1 MC, ±5% full range. Frequency coverage 10 cps to 4 MC. Large 5" meter with precision mirror scale. Voltage range 0.1 mv to 300 v; max. full scale sensitivity 1 mv. High 10 megohm input impedance minimizes circuit disturbances. Amplifier with 56 db feedback insures lasting stability. Reads direct in db or volts.

ϟ 400D WIDE RANGE VOLTMETER—$225
Highest quality, extremely versatile. Covers 10 cps to 4 MC. Highly sensitive, accurate to within ±2% to 1 MC. Measures 0.1 mv to 300 v; max. full scale sensitivity 1 mv. Reads direct in dbm. High 10 megohm input impedance virtually eliminates circuit loading. 56 db amplifier feedback insures high stability and freedom from change due to external conditions.

Data subject to change without notice. Prices f.o.b. factory

hp complete precision voltage measuring equipment

CIRCLE 1 ON READER-SERVICE CARD

Call your hp engineering representative today for data demonstration of these time-saving, precision, advanced voltmeters

Your hp representative is your headquarters for sales, service and parts on the industry's most complete coverage voltmeter array. (•) indicates factory-level field repair stations.

Eastern Seaboard

Asbury Park, New Jersey
The I. E. Robinson Co.
905 Main St., KE 1-3150

Baltimore 15, Maryland
Horman Associates, Inc.
3006 West Cold Spring Lane
MO 4-8345

• Boston Area
Burlington, Mass.
Yewell Associates, Inc.
Middlesex Tnpike., BR 2-9000

• Bridgeport 8, Conn.
Yewell Associates, Inc.
1101 E. Main St., FO 6-3456

Camp Hill, Pennsylvania
The I. E. Robinson Co.
Park Place Office Bldg.
Box 187, RE 7-6791

Englewood, New Jersey
R. M. C. Associates
391 Grand Ave., LO 7-3933

• New York 21, New York
R. M. C. Associates
236 E. 75th St., TR 9-2023

• Philadelphia Area
West Conshohocken, Penn.
The I. E. Robinson Co.
144 Elizabeth St.
CH 8-1600 and TA 8-6200

Pittsburgh 27, Pennsylvania
S. Sterling Company
4232 Brwnsvle. Rd., TU 4-5515

Poughkeepsie, N. Y.
Yewell Associates, Inc.
806 Main St., GR 1-3456

• Rochester 25, New York
Edward A. Ossmann & Assoc.
830 Linden Ave., LU 6-4940

Syracuse, New York
Edward A. Ossmann & Assoc.
101 Ficard Dr., P.O. Box 128
GL 4-2461

Vestal, New York
Edward A. Ossmann & Assoc.
149 Front St., ST 5-0296

• Washington, D. C. Area
Rockville, Maryland
Horman Associates, Inc.
941 Rollins Ave., HA 7-7560

Southeastern States

Atlanta 5, Georgia
Bivins & Caldwell, Inc.
3133 Maple, N.E., CE 3-7522

• High Point, North Carolina
Bivins & Caldwell, Inc.
1923 N. Main St., 882-6873

Huntsville, Alabama
Bivins & Caldwell, Inc.
534-5733 (Dir. line to Atlanta)

• Orlando, Florida
Stiles Associates, Inc.
1226 E. Colonial, GA 5-5541

Richmond 30, Virginia
Bivins & Caldwell, Inc.
1219 High Point Ave.
EL 5-7931

St. Petersburg 8, Fla.
Stiles Associates, Inc.
410-150th Ave., Madeira
Beach, WA 1-0211

Central, South Central States

• Chicago 45, Illinois
Crossley Associates, Inc.
2501 W. Peterson, BR 5-1600

• Cleveland 24, Ohio
S. Sterling Company
5827 Mayfield Rd., HI 2-8080

• Dayton 19, Ohio
Crossley Associates, Inc.
2801 Far Hills Ave., AX 9-3594

• Detroit 35, Michigan
S. Sterling Company
15310 W. McNichols Rd.
BR 3-2900

• Indianapolis 20, Indiana
Crossley Associates, Inc.
5420 N. College Av., CL 1-9255

Kansas City 30, Missouri
Harris-Hanson Company
7916 Paseo Blvd., HI 4-9494

St. Louis 17, Missouri
Harris-Hanson Company
2814 S. Brentwood Blvd.
MI 7-4350

• St. Paul 14, Minnesota
Crossley Associates, Inc.
842 Raymond Ave., MI 6-7881

• Dallas 9, Texas
Earl Lipscomb Associates
P. O. Box 7084
FL 7-1881 and ED 2-6667

• Houston 5, Texas
Earl Lipscomb Associates
P. O. Box 6646, MO 7-2407

Western States

• Albuquerque, New Mexico
Neely Enterprises
6501 Lomas Blvd., N.E.
AL 5-5586

• Denver 10, Colorado
Lahana & Company
1886 S. Broadway, PE 3-3791

Las Cruces, New Mexico
Neely Enterprises
114 S. Water St., JA 6-2486

• Los Angeles, California
Neely Enterprises
3939 Lankershim Blvd.
N. Hollywood, TR 7-0721

• Phoenix, Arizona
Neely Enterprises
641 E. Missouri, CR 4-5431

Portland 9, Oregon
ARVA
1238 N.W. Glisan, CA 2-7337

• Sacramento 14, California
Neely Enterprises
1317-15th St., GI 2-8901

Salt Lake City 15, Utah
Lahana & Company
1482 Major St., HU 6-6166

• San Diego 6, California
Neely Enterprises
1055 Shafter St., AC 3-8106

• San Francisco Area
San Carlos, California
Neely Enterprises
501 Laurel St., LY 1-2626

• Seattle 9, Washington
ARVA
1320 Prospect St., MA 2-0177

Tucson, Arizona
Neely Enterprises
232 S. Tucson, MA 3-2564

FOR MORE VOLTMETERS, LIFT PAGE

Select he
VOLTMETERS, AMMET
Mar

AC

hp 403A Transistor ac Voltmeter-

Battery-operated, weighing less than 5 pounds and in your hand — this new transistor ac voltmeter m. (max. full scale sensitivity 1 mv) over frequencies voltage ranges; also reads direct in db from −72 to tery life equals 6 months of average use; battery v by front panel switch. Noise less than 30 μv on all pletely isolated from power line or ground interfer meter minimizes turnover and waveform errors. Ac −5% to 1 MC. Input impedance 2 megohms, ge capacity on higher ranges, 25 v maximum on lower

All of these widely useful -hp- instruments are available in
-hp- voltmeter accessories—voltage dividers, coaxial conn

DC

hp 405AR Digita
Automatic range

Here's true "touch-and-re ity. Automatic range, po 0.001 v to 1,000 v. (Accura 1 count). New, unique cir ity of readings virtually jitter in the last digit. electronic code output corders. Uses electronic insure low maintenance. Just 7" high! $825.00.

Complete array of ac and dc measuring e

ere the TERS, any are

versatile, precision OHMMETERS you need. multi-purpose!

ter—1 cps to 1 MC

ls and small enough to hold
ter measures 100 μv to 300 v
ncies 1 cps to 1 MC! Twelve
-72 to +52 db. 400 hour bat-
tery voltage may be checked
in all but lowest range. Com-
nterference. Average reading
rs. Accuracy ±3% to 500 KC.
s; generous 600 v overload
lower ranges. $250.00.

hp 400D
10 cps to 4 MC

Regarded by many as finest ac VTVM ever built. Covers all frequencies 10 cps to 4 MC, extremely sensitive, wide range, accurate within 2% to 1 MC. Measures 0.1 mv to 300 v (max. full scale sensitivity 1 mv), 12 ranges. Direct reading in v, db. 10 megohm input impedance with 15 μμf shunt insures negligible loading to circuits under test. $225.00.

hp 400L
Log VTVM—10 cps to 4 MC

Covering 10 cps to 4 MC, this new hp VTVM features a true logarithmic scale 5" long plus a 12 db linear scale. The log voltage scale plus long scale length provides a voltmeter of maximum readability, with **accuracy a constant percentage of the reading.** Accuracy is ±2% of reading or ±1% of full scale, whichever is more accurate, to 500 KC, ±5% full range. Range 0.3 mv to 300 v, 12 steps. (max. full scale sensitivity 1 mv). $325.00.

hp 400H
1% accuracy VTVM

Here's extreme accuracy of 1% in a precision VTVM covering 10 cps to 4 MC. Big 5" meter has exact-reading mirror-scale, measures voltages 0.1 mv to 300 v (max. full scale sensitivity 1 mv). 10 megohm resistance with 15 μμf shunt minimizes circuit loading. Amplifier with 56 db feedback insures lasting stability. $325.00.

hp 410B
ac to 700 MC, also dc

Time-tested standard all-purpose voltmeter. Covers 20 cps to 700 MC, full scale readings 1 to 300 v. Input capacity 1.5 μμf, input resistance 10 megohms. Also serves as dc VTVM with 122 megohms input impedance, or ohmmeter for measurements 0.2 ohms to 500 megohms. $245.00.

n rack-mounted
nnectors, voltage

models! Also, inquire about
multipliers and shunt resistors.

HEWLETT-PACKARD COMPANY
1004K Page Mill Road • Palo Alto, California, U.S.A.
Cable "HEWPACK" • DAvenport 6-7000
Field representatives in all principal areas

igital Voltmeter
ange, polarity

and-read" measuring simplic-
ge, polarity selection; covers
ccuracy ± 0.2% of reading ±
ue circuitry provides a stabil-
rtually eliminating fatiguing
digit. Floating input, multi-
tput for use with digital re-
tronic computing circuits to
hance, trouble-free operation.
00.

hp 412A Precision
Volt-Ohm-Ammeter

At last a true, **precision** multi-purpose instrument. Measures dc voltage 100 μv to 1,000 v (max. full scale sensitivity 1 mv), 1% accuracy full scale. Measure currents 1 μa to 1 amp with ± 2% accuracy full scale. 13 ranges. As ohmmeter measures 0.02 ohms to 5,000 megohms. Extremely low noise, drift. Recorder output provides 1 v full scale. $375.00.

hp 425A Microvolt-
Micromicroammeter

New, high sensitivity, high stability instrument reading end scale voltages of 10 μv to 1 v in 11 ranges, or currents of 10 μμa to 3 ma in 18 step, 1-3-10 sequence. Accuracy ±3% on all ranges. Drift less than 4 μv per day. Input impedance 1 megohm ±3% on all ranges. Also usable as 100 db amplifier with up to 1 v output from signals as small as 10 μv. $500.00.

hp 428A
Clip-On Milliammeter

Employs radical new approach to current measurement which eliminates breaking leads, soldering connections or loading of circuit under test. Revolutionary "current sensing" probe **clips around** wire under test, measures the magnetic field around the lead. Easily measures dc current in presence of strong ac. Covers 0.3 ma to 1 amp in 6 steps; full scale sensitivity 3 ma. Accuracy ±3%, probe inductance less than 0.5 μh. $475.00.

equipment

—unique value, traditional -*hp*- dependability

CIRCLE 2 ON READER-SERVICE CARD

CIRCLE 3 ON READER-SERVICE CARD

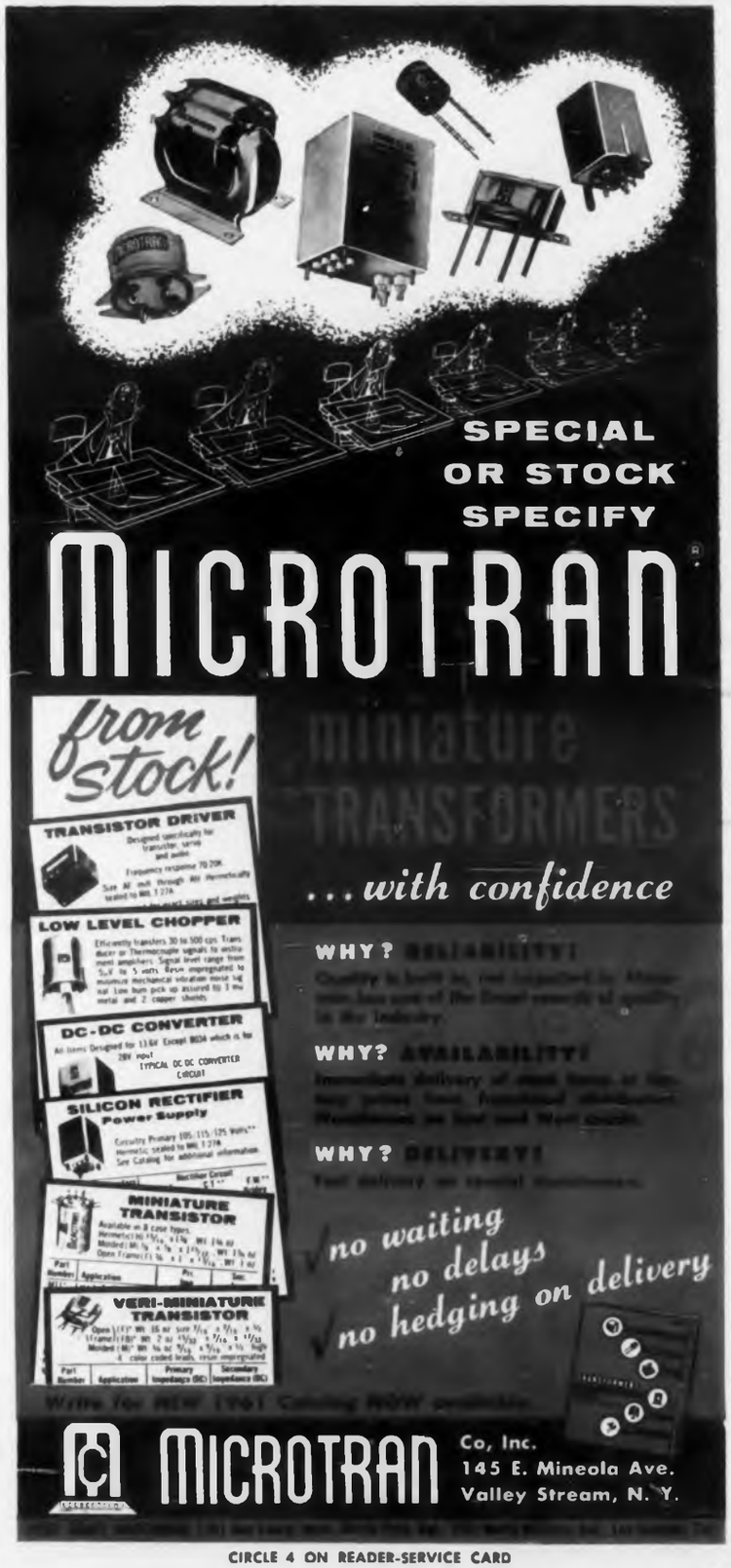
CONTENTS FOR JANUARY 4, 1961 VOL. 9 NUMBER 1

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

Sidelights of the Issue

The drawings which illustrate the ELECTRONIC DESIGN Staff Report, "Design '61—The Look Ahead," beginning on p 26, are the work of Art Assistant José Aruego. His lantern-jawed, underslung cartoon figures have been a feature of *ED*'s illustration for more than a year now, and while some of our engineer-editors occasionally accuse him of taking them as models, Aruego denies all and keeps on drawing. A native of the Philippines, he studied law before picking up the artist's pen.

ELECTRONIC DESIGN is published bi-weekly by Hayden Publishing Company, Inc., 830 Third Avenue, New York 22, N. Y., T. Richard Gascoigne, Chairman of the Board; James S. Mulholland, Jr., President; Edmund C. Grainger, Jr., Secretary. Printed at Hildreth Press, Bristol, Conn. Accepted as controlled circulation at Bristol, Conn. and at New York, N. Y. Copyright © Hayden Publishing Company, Inc., 1961, 37,400 copies this issue.



CIRCLE 4 ON READER-SERVICE CARD

Advanced Computer Concepts Reaching Hardware

Developmental Equipment at Eastern Joint Computer Conference Dramatizes Moves to New Concepts in Specialized Designs

ADVANCED technical and applications concepts are rapidly moving into the developmental equipment stage in the fast-growing computer industry.

This was evident both in technical sessions and in informal conversations with engineers during the Eastern Joint Computer Conference in New York. Important progress in such diverse areas as teaching machines, thin-film and cryogenic memories, automated speech recognition, and electroluminescent displays were discussed during the three-day meeting.

(For a description of new computers announced during the convention, and improved peripheral equipment displayed, see p 8.)

Improved commercial machines could be the result of the work being done on cryogenic thin-film memories, it was indicated by Robert R. Seeber, Jr., International Business Machines Corp.'s Product Development Laboratory.

Automatic sorting within a memory might be done using cryotrons as memory elements, according to Mr. Seeber. In this type of associative memory all stored words could be compared to a key word to determine if they were equal to, greater, or less than the key. This could also be done with a portion of a word.

Use of single-crossing, thin-film cryotrons would allow the logical as well as storage functions to be performed within the memory.

IBM is developing cryotron matrices built up of many layers of material. Automatic masking techniques are used to get reproducible deposited thin-film planes.

Optical character recognition may also soon become an important factor in high-speed computer input, it was learned during the show. Recently IBM introduced its 1418 for optical character recognition input of selected characters.

Radio Corp. of America is developing new techniques for this field, and will soon make its first installation of this type input equipment.

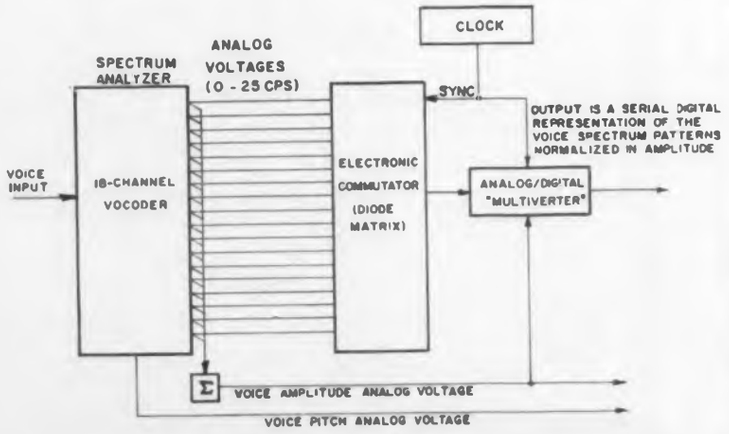
RCA is also understood to be developing a line of five types of optical input equipment, ranging from simple equipment recognizing only selected characters, to more complex equipment suitable for a variety of type fonts.

An RCA spokesman indicated that the new sensing technique does not use the conventional scanning disk for recognition. The disk technique limits the speed that can be achieved, he commented, so that a new approach is felt to be necessary.

The prominence at the show of military data-processing systems and equipment was more evidence that strides are being taken in applying advanced concepts. Against the background of the news that the military services are nearing standardization on Fieldata language as a common computer language, speakers and exhibitors discussed many items of military data processing equipment.

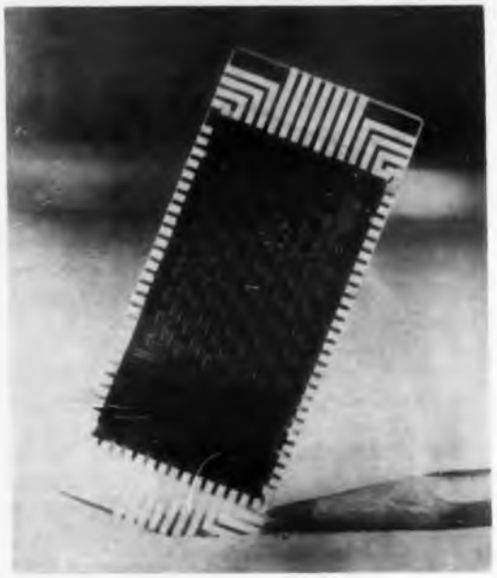
Of the Fieldata units being developed for the Army, one was displayed and four others were discussed. Sylvania parked its Mobidic A outside the convention hotel and revealed that it plans to be testing the first operational unit in Germany very early this year.

The company also disclosed that its M-64 air-transportable computer will be used in the Army's MPQ-32 artillery locator radar system.



Vocoder audio spectrum analyzer provides analog voltages, representing spoken words, for conversion into 18-digit octal numbers at a rate of 50 per sec. Digits are combined to form a mask that is recorded in the computer memory. Other spoken words are analyzed in the same way, and compared with the stored masks, enabling the computer to recognize speech.

Random-access slide projector (left), developed by System Development Corp. for an automated teacher, can select any of 600 slides in less than 7 sec. An automated lesson in the binary number system is illustrated at right. The fast access projector works with a Bendix G-15 computer to present lesson material. Student uses a typewriter keyboard to answer questions posed by the system.



Experimental cryogenic thin-film memory plane consisting of 135 cryotrons was described by Robert R. Seeber, Jr., of International Business Machine Corp.'s Product Development Laboratory, at a technical session.

The M-64 uses Mobidic logic and, for the MPQ-32 system, will have two 400-word coreplane memories.

At the meeting, Philco Corp. reported that it would soon deliver its Basicpac Fieldata computer to the Army. This is a tactical, solid-state synchronous computer with a 1-mc clock rate and a core memory of 4,096 36-bit words.

Other Fieldata units, Philco's Compac and North American's Fadac are still in research and development.

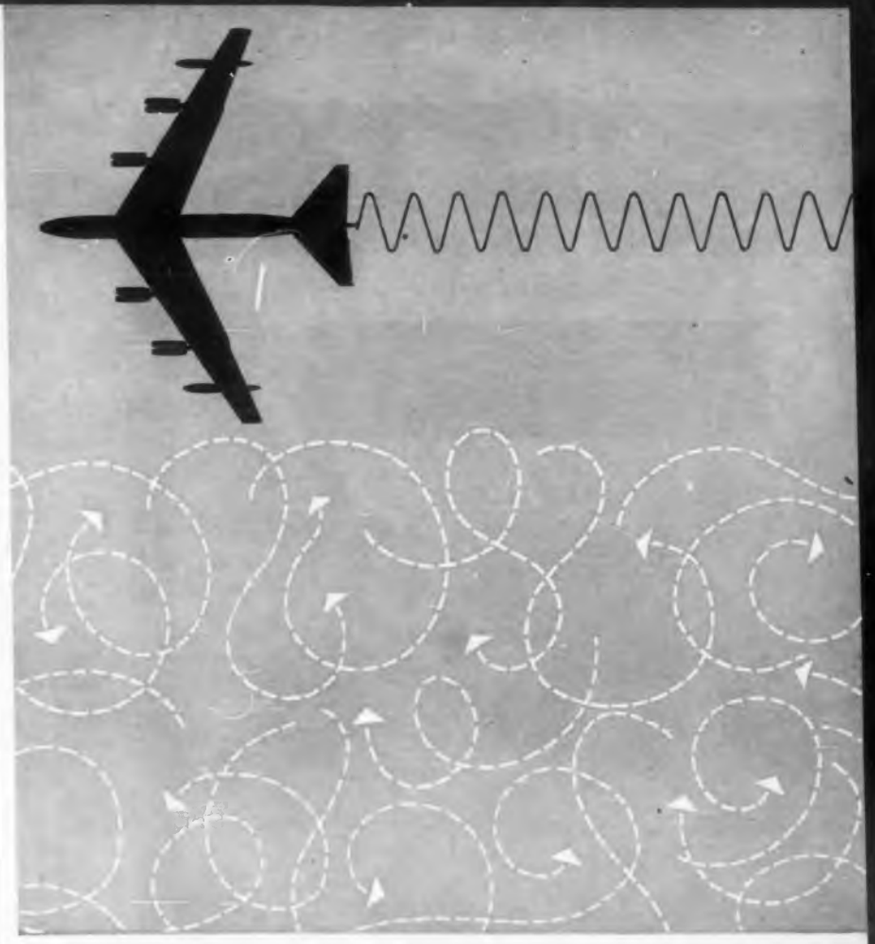
Two computers known to be in contention for the shipboard data-processing portion of the Transit navigational satellite program were on display.

The AN/UYK–1 computer, designed to Navy requirements by Ramo-Wooldridge Div. of Thompson Ramo Wooldridge, Inc., was displayed at the TRW booth in prototype form. The first operating model is scheduled for delivery by mid-year.

This will be a "stored logic" machine, allowing the user to select the word length, order structure, and instruction repertoire most suitable for the problem to be solved.

Although the machine is being designed for use with the Navy Tactical Data System, it may be turned to other shipboard computation tasks, such as the Transit program, later.

The PB250 computer, displayed by Packard Bell Computer Corp., is also a contender for the Transit contract. This is a low-price computer using plug-in magnetostrictive delay lines for



Raytheon Subminiature Tubes Help Deliver The Message for Hughes Project Tattletale

Enemy atomic attack can scramble the ionosphere disrupting vital communications. The Air Force provides a solution in the form of Project Tattletale. A high altitude rocket containing a taped message and transmitting equipment is shot 300 miles up to provide a straight-line transmission requiring no ionospheric bounce.

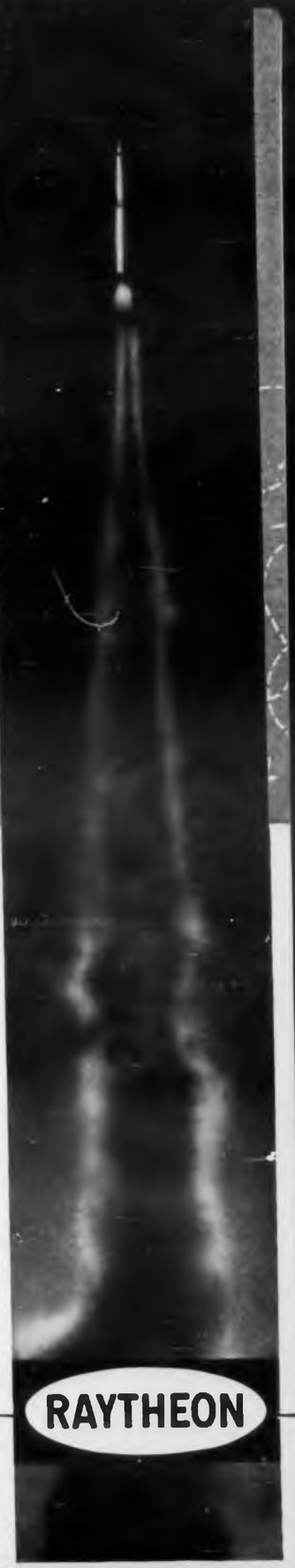
PROBLEM: How to assure maximum reliability during transmission.

SOLUTION: Hughes Aircraft Company, contractor, chose Raytheon 5702WA, 5703WA, and 6021 Reliable Subminiature Tubes.

If your designs require tubes featuring reliable operation, long life, and stable performance under severe conditions of high temperature and mechanical shock or vibration, Raytheon Reliable Subminiature Tubes can offer an immediate solution. For complete technical data, please write to Raytheon, Industrial Components Division, 55 Chapel St., Newton 58, Mass.

For Small Order or Prototype Requirements See Your Local Franchised Raytheon Distributor

RAYTHEON COMPANY



INDUSTRIAL COMPONENTS DIVISION

CIRCLE 5 ON READER-SERVICE CARD ➤

this .01% dvm is different!

Because...it has a unique self-adjusting stepping-switch drive which eliminates thyratrons, provides smooth, quiet, trouble-free operation for longer life...it introduces Range Hold operation that restricts "stepping" when repeated readings on only one decade range are to be made...it comes as a space-saving half-rack module 8" square for portable use and side-by-side rack installation with a Beckman/Berkeley Printer, converters, etc., or as a full rack width model 5¼" high...it combines a fistful of other important features with recognized Beckman/Berkeley experience. *Write for Technical Bulletin 4011.*

- **automatic polarity**
- **automatic ranging**
- **print out**
- **$995**

The 4011 module with Beckman Printer (8¾" high)

The 4011 full width rack model (5¼" high)

Specifications

• Linearity: .01% of full scale • Range, from 0.001v to 999.9v dc • Fully automatic operation • Ratiometer function provided with existing internal circuitry • 4 digit in-line, in-plane display, and binary-coded output • Variable sensitivity control • Oven-regulated Zener power supply • Self-contained standard cell for accurate calibration

Beckman

Berkeley Division
Richmond, California

T28

CIRCLE 6 ON READER-SERVICE CARD

memory. Use of a nickel-cadmium battery, providing about 30 w, makes the memory nonvolatile. The battery, with an estimated five-year life, is trickle charged from an ac power line.

On display was an operating engineering model of General Electric's CVI-27 conditional variable increment computer, a modularized, solid-state modification of the Light Military Dept.'s never-sold GEVIC computer.

The CVI-27 mechanizes incremental mathematics and is said to be capable of replacing complex general-purpose, fixed-increment machines in airborne or other applications.

GE reports that the CVI-27 is best applied where rapid slew is required on initial engagement, but where, after settling, the computer can operate in a fixed increment or digital differential analyzer mode.

Capacity is 64 algorithms, iteration rate 130 per sec and memory capacity 40,000 to 70,000 bits, the company reports. The computer uses a 19-bit word length.

Propose Computer-Driven E-L Display For Satellite Tracking Systems

At EJCC, ELECTRONIC DESIGN learned that an electroluminescent display system, said to be capable of showing continuous position of up to six satellites, has been proposed to the Air Force by Sylvania Electronic Systems Div., Waltham, Mass. The solid-state system would replace mechanical-optical, projection, and cathode-ray-tube displays now used for satellite tracking.

The Sylvania system would use a screen 3 x 4 ft, or larger, composed of 5 x 5-in. electroluminescent panels. Computer data from the satellite tracking system would be used to luminesce a spot that would move on the display board under a map overlay.

Driving units would be Sylvania's combination e-l and photoconductive translator modules, which would convert binary to decimal for the coordinate system used in displaying position.

In development at the company are distribution networks expected to result in eliminating four of each five translator modules that would go into the display system. To implement the display system, the company has reportedly developed special holding circuits to reduce the load on the memory of the computer that would operate the system.

Report Computer Digitizes, Recognizes Speech With Vocoder

First details of an adaptive technique for automatic speech recognition were described at the

meeting by S. R. Petrick, Air Force Cambridge Research Laboratories, Bedford, Mass. Mr. Petrick, co-author of a paper with H. M. Willett of AFCRL, reported that good results in programing a computer to recognize speech has been achieved with a pattern-recognition method implemented by a special, 18-channel vocoder.

The technique requires that spoken words be broken into sequences of octal digits that describe instantaneous power levels in each of the vocoder's 18 frequency-band outputs. A sequence is taken every 20 msec. Each word, after being spoken several times, becomes a serial digital mask representing power-at-specific-time and frequency.

Each word to be stored is spoken several times so that recognition parameters can be optimized and an efficient mask constructed.

Each mask put into the 1,600 magnetic-drum registers of the computer's memory requires six words of storage, which limits the vocabulary of the system to 83 spoken words, each requiring 1,500 msec for recognition.

Almost 100 per cent accuracy in recognition has been achieved under the best conditions, Mr. Petrick reported. Research is underway to program the medium-sized, general-purpose computer used (a prototype Univac solid-state machine) to adapt masks in its memory to optimize recognition of speech by different speakers.

A new concept applied to automated teaching —using a computer-programed, random-access slide projector—was unveiled at EJCC by System Development Corp. of Santa Monica, Calif. In the system shown, a student seated at an electric typewriter types the answers to multiple-choice questions displayed on a large screen before him.

A Bendix G-15 computer accepts his answer and types out "Right" or "Good" if the answer is correct. If it isn't, the computer types "Sorry," then selects an appropriate slide to help the student understand the source of his error.

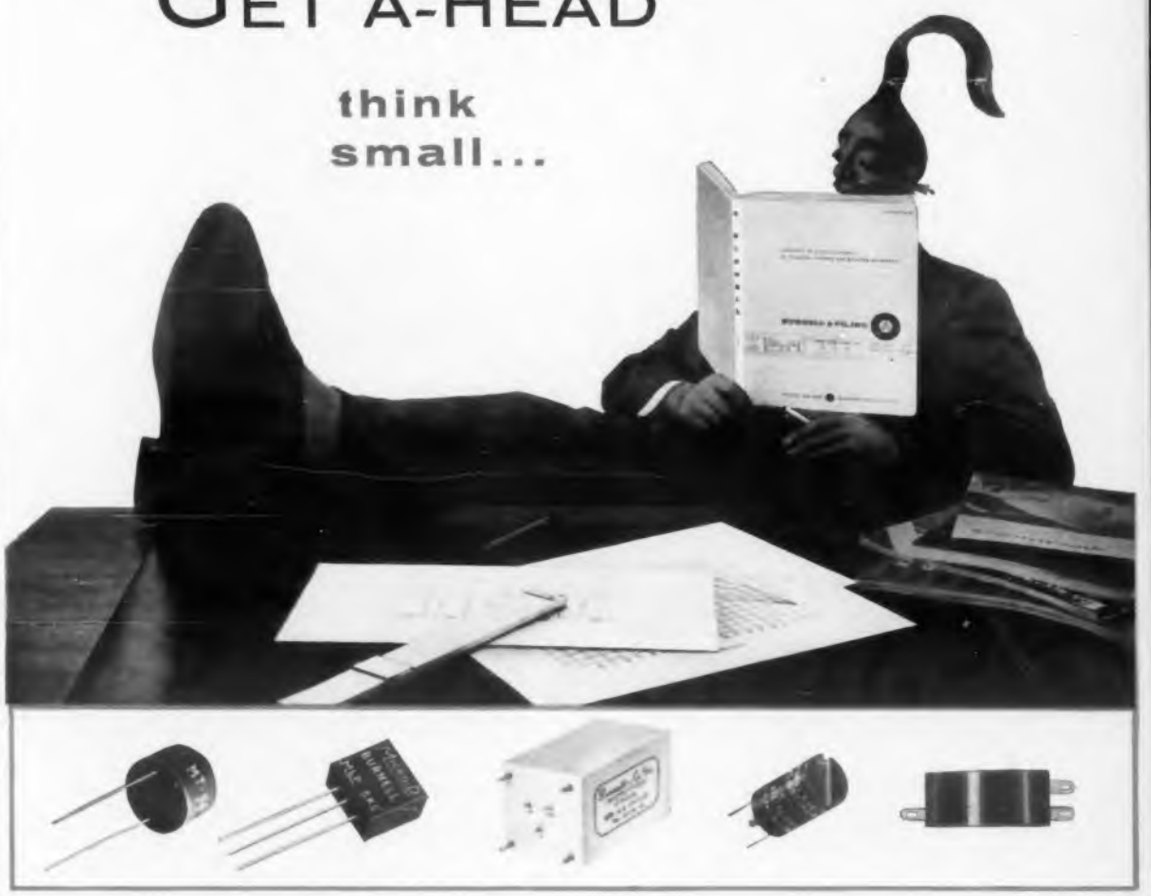
Even a small computer like the G-15 could work with as many as 100 students simultaneously and individually. In this particular automated teacher, the novelty lies in its random-access slide projector.

On command from the computer, the slide projector (extensively modified from a commercial, off-the-shelf unit), selects and projects any of 40 35-mm slides from a magazine within 4 sec. An auxiliary drum can be used to load any of 15 additional magazines into the projector within an additional 3 sec.

The system shown at EJCC is only one part of a larger SDC project headed by Mr. Harry Harmon, director of Systems Simulation Research Laboratory, a human-factors research laboratory using a Philco 2000 computer. ■ ■

GET A-HEAD

think small...



At Burnell & Co., our engineers devote a big part of their thinking to shrinking—reducing the size (and cost) of components to the least common denominator consistent with high performance standards. From this staff have come such components as:

The Kernel ATE Adjustoroid®—This variable toroid contains an actual complete toroid with all the excellent characteristics of the non-adjustable type. Valuable in oscillators, discriminators, variable tuned circuits, etc.

MLP and MHP MICROID ® Filters — Microminature counterparts of the popular Burnell TCL and TCH low pass and high pass filters, they range from .5 kc to 100 kc with a standard impedance of 10k ohms. Cascading the MLP with the MHP produces excellent response band pass characteristics.

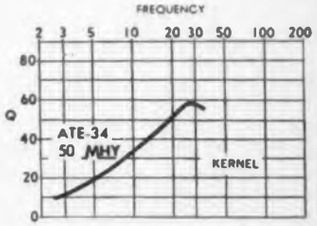
"Cheerio" Toroids — Subminiature high Q coils in a range of frequencies that make them ideal for transistorized equipment.

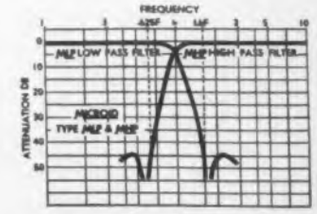
Crystal Filters—Advanced engineering techniques enable Burnell to offer at nominal cost, high selectivity, high attenuation crystal filters covering the extraordinary range of 1 kc to 30 mcs with considerable latitude in impedance.

Pulse networks, interference filters, active networks and magnetic amplifiers are among the newer additions to our product line.

Write for latest catalog.

Burnell & Co., Inc., has a number of positions available for engineers capable of thinking big and shrinking small. Inquiries are invited.





If you haven't already done so—send for your free membership in the Space Shrinkers Club.

COPYRIGHT BURNELL & CO. INC. 1960

Burnell & Co., Inc.
PIONEERS IN microminiaturization OF TOROIDS, FILTERS AND RELATED NETWORKS

EASTERN DIVISION
DEPT. ED-30
10 PELHAM PARKWAY
PELHAM, N. Y.
PELHAM 8-5000
TELETYPE PELHAM 3633

PACIFIC DIVISION
DEPT. ED-30
720 MISSION ST.
SOUTH PASADENA, CALIF.
MURRAY 2-2841
TELETYPE PASACAL 7578

Mfd. in Canada by Edo (Canada) Ltd., Cornwall, Ont. • WEllington 2-6774

CIRCLE 7 ON READER-SERVICE CARD

Remington Rand's announcement of a planned computer with a thin-film control memory, and the unveiling of the new Recomp III computer (right) by North American Aviation, Inc.'s Autonetics Div., were high points of EJCC. A thin-film memory plane for the planned Rem Rand 1107 computer (above) is inspected by Dr. S. M. Rubers, director of physical research.

Computer Plans, Peripheral Gains Featured at EJCC

IMPROVEMENTS in peripheral equipment and new computer announcements, were two major features of the Eastern Joint Computer Conference in New York.

The only commercial computer unveiled at the show was the Recomp III, a new low-cost machine designed by North American Aviation, Inc's. Autonetics Div.

Other computers, now under development, announced at the show, were the following:

- Univac 1107, which includes a small thin-film control memory, for delivery in 18 to 24 months. Also announced by Sperry Rand Corp.'s Remington Rand Div. was the Univac 490 Real-Time data-processing system, for operation with extensive data communications networks.
- Sylvania's 9400 data-processing system, particularly suited for operating many input-output machines, is being offered by Sylvania's Data Systems Div. Marketing is being aimed at government agencies and telephone exchanges.
- A 212 central processor for use in the Philco 2000 computer was announced by Philco Corp.'s Computer Div. This unit is said to be four times faster than the 211 processor it supersedes.

Recomp III is the latest, and lowest priced, entry in Autonetic's Recomp series. It will rent for $1,495 a month.

Autonetics also showed a paper-tape reader, the Facitape, which can be used with the Recomp III. It is a capacitance-type reader, not affected by ambient light, as a photoelectric reader. Reading speed of 600 characters per sec, however, puts the Facitape on a par with photoelectric readers.

Probably one of the most unexpected developments at EJCC was Remington Rand's plan to include a thin-film control memory in the Univac 1107 (*ED*, Dec. 21, 1960, p 12).

The thin-film memory will be a coincident-current type with 0.6 μsec cycle time. Although company spokesmen declined to divulge the number of thin-film substrate planes to be used in the new memory, a company photograph shows a plane with 288 spots, suggesting that 16 planes will be used in the complete memory unit.

The 1107 will also include from 16,384 to 65,536 words of ferrite-core memory with 4-μsec cycle time. The machine will rent for $40,000 to $60,000 per month.

The Univac 490 Real-Time system includes 14 input-output channels, two of them suitable for direct communication with remote computers. The main computer will feed 30,000 bits per sec to communications lines.

Sylvania 9400 Computer Stresses Input-Output Equipment Operation

Sylvania's 9400 data-processing system includes four satellite processors, each of which is capable of operating any one of a diverse group of peripheral machines.

When an "executive program" in the central processor reaches a point where input or output functions must be accomplished, it will instruct one of the satellite units to detach from the main problem to perform the peripheral function using a stored subroutine. Meanwhile, the central processor will continue work on the main program.

Sylvania feels the 9400 meets a special requirement which can not be served by standard computing systems. Use will be restricted to applications with many assorted peripheral devices.

Philco's improved central processor, the 212, use transistor-diode logic to attain 10-μsec multiplication speed, including access, for two 48-bit words. Maximum access time for a pair of instructions is 1 μsec, according to Philco.

Improved peripheral equipment on display included three mylar-disk memories shown by Laboratory for Electronics, Inc. The first of these Bernoulli-disk memories was shown at the 1959 EJCC in Boston. That unit, designated BD-100, had a paper-thin, 7.25-in.-diam disk which stored 100,000 bits on 50 tracks.

An experimental BD-500 was shown at this year's show. It should store 500,000 bits on a 12-1/4-in.-diam disk. LFE hopes to deliver BD-500's by June.

A smaller unit, designated BD-18 and using a 4-in. disk, has already been delivered for a sonar application. A 10,000-bit memory, it is intended as a shelf item selling for about $1,000, and deliverable in about 10 days.

Fast card readers also drew much attention at the show. National Cash Register Co.'s 380 photoelectric reader, designed for use with the company's 304 computer, was operating at about 2,450 cards a minute. The unit is nominally rated at 1,500 cards a minute. Each character

Control console, similar to one to be used for the Samos reconnaissance satellite data-reduction center, was shown by Thompson-Ramo-Wooldridge, Inc. The DC-400 allows an operator to withdraw desired data from a computer and position it on a slide-projector or other type display. The unit will be used in conjunction with an RW-400 computer, to be installed at the Samos site later this year.

Half a million bits can be stored on the flexible mylar disk of the BD-500, left, in development at Laboratory for Electronics, Inc. The BD-100, center, stores 100,000 bits, and the BD-18, right, stores 10,000 bits. The 4-in. diam disk in the foreground is part of the BD-18.

position is sensed twice, and other self-checking features are incorporated.

Uptime Corp., Bloomfield, Colo., showed its Speedreader 2000, which reads 2,000 cards a minute. A set of 80 horizontally positioned photodiodes read characters and a set of 26 vertically positioned photodiodes time reading intervals by sensing the change from light to dark as the card passes in front of them.

The company is working on another photoelectric reader with a stronger light source for high speed reading of cards with black marks on them, rather than punched holes. ■ ■

SPAT*

PHILCO ANNOUNCES A COMPLETELY NEW FAMILY OF PNP SILICON TRANSISTORS WITH HIGH VOLTAGE . . . HIGH BETA IN TO-18 PACKAGE

TO-18 CASE

Produced by the Exclusive New Philco Strip Alloying Process

	MAX. RATINGS		CHARACTERISTICS			
TYPE NO.	V_{CBO}	P_{DISS}	I_{CBO} (10v) MAX.	h_{fe} (6v, 1ma) MIN.	MAX.	f_α (6v, 1ma) MIN.
2N858	40v	150 mw	0.1 μa	15	75	5 mc
2N859	40v	150	0.1	30	120	6
2N860	25v	150	0.1	15	45	6.5
2N861	25v	150	0.1	30	100	7.5
2N862	15v	150	0.1	20	60	8
2N863	15v	150	0.1	40	120	10
2N864	6v	150	0.1 (6v)	25	125	18
2N865	10v	150	0.1	100	350	24

Completely new to the industry, these Philco Silicon Precision Alloy Transistors meet a widespread need for medium frequency, high voltage, high beta silicon transistors for both switching and amplifying applications. An exclusive new production technique . . . strip alloying . . . permits accurate measurement of the diode voltage rating and beta of every transistor during the manufacturing process. Never before has such close control in production been possible.

The new SPAT family offers low saturation voltage and high emitter base diode voltage rating. For complete information, write Dept. ED1461.

*Trademark Philco Corp. for Silicon Precision Alloy Transistor

Immediately available in quantities 1-999 from your Philco Industrial Semiconductor Distributor

PHILCO®

Famous for Quality the World Over

LANSDALE DIVISION • LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.

CIRCLE 8 ON READER-SERVICE CARD ➤

from this...

with **Tuf-Plate**

Miniaturization of electronic components put the pressure on circuitry to keep pace. Photocircuits took up the challenge and turned an idea into the space and weight saving reality of ***Tuf-Plate*** plated thru holes – *reliably* interconnecting conductor patterns on *both* sides of the circuit board.

Where even greater component density is required – up to 50% – Photocircuits now offers printed circuit boards with miniaturized conductor patterns using *landless* ***Tuf-Plate*** – another first by P/C.

The inset at left offers a visual comparison between outdated eyelets and *new* landless ***Tuf-Plate***. Get the whole exciting ***Tuf-Plate*** story today – it's likely that conventional or landless – ***Tuf-Plate*** can save you space, weight . . . . often at lower cost. *Write Department A-1590, Photocircuits Corporation, Glen Cove, New York.*

Photocircuits
CORPORATION

CIRCLE 9 ON READER-SERVICE CARD

NEWS

Heart Rate Is Measured

Device to Observe Fetal Heatbeats Integrated into Patient Monitor

A CARDIOTACHOMETER, which indicates heart rate on a logarithmic scale after each beat, is being used in a new patient monitoring system recently installed in New York's Roosevelt Hospital.

Variations in heart rate can be observed easily on the Cardiotach, an instrument developed by Epsco, Inc., with the assistance of Dr. Edward Hahn, formerly of Yale University.

The instrument was initially designed to detect fetal heart beats, according to Howard T. Sterling, chief engineer of Epsco's Medical Div. However, it was easily adapted to the automatic monitor for adult patients because it uses three of the same inputs as the electrocardiograph.

In its earlier application, Dr. Hahn used fetal heart rate as an indication of distress. It was also used to detect life during the earlier stages of pregnancy.

A new fetal monitoring unit designed by Epsco will soon be shipped to the College of Medical Evangalists in Los Angeles, where Dr. Hahn is continuing his work, Mr. Sterling said.

This unit will allow indication and recording of heart rate data and presentation of electrocardiograph waveforms on an oscilloscope.

A simple analog computer-type circuit is used in the Cardiotach to convert the period between heart beats into a rate measurement.

Input to the instrument is the potential difference between selected points on the body. The potential between the wrists is used in Epsco's unit, with the right leg serving as a reference.

A complex pulse occurs with each beat of the heart. Each separate pulse actuates a trigger circuit, which in turn operates a monostable multivibrator.

On the initial switch of the multivibrator, the Read switch is momentarily closed, putting capacitors C_1 and C_2 in parallel. Capacitor C_1, which has been discharging since the previous heart beat, now charges C_2, equalizing the voltage across the two capacitors. Since C_1 is very much larger than C_2, only a small amount of charge is transferred. Thus, the reading on the voltmeter is very close to the voltage across C_1 as the Read switch closed.

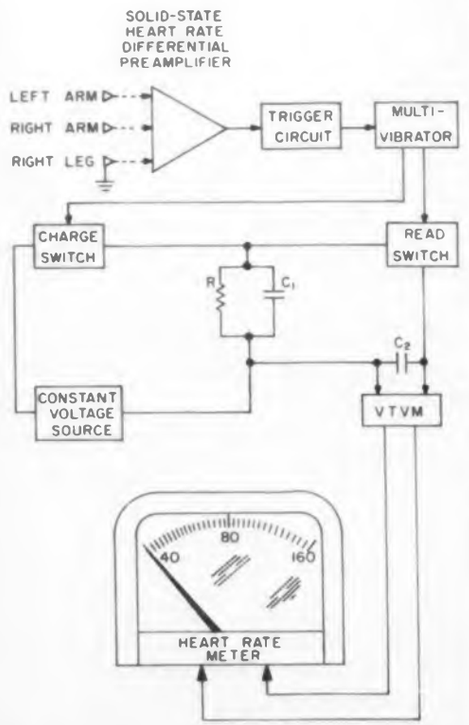
When the multivibrator switches off, the Charge switch is momentarily closed. This allows capacitor C_1 to charge to its full capacity, as dictated by the voltage across the constant voltage source.

After Each Beat

These events occur in a few milliseconds. For the rest of the cycle between heart beats, capacitor C_1 discharges through the resistor R. The voltage across the parallel RC combination decays exponentially with the time constant RC_1. Thus the longer the time between two heart beats, the lower the voltage across C_1 falls. Since the decay is exponential, the remaining voltage is logarithmically proportional to the heart rate, or the reciprocal of the period.

When the next heart beat occurs, the Read switch is again closed momentarily, shunting the small capacitor C_2 across the large capacitor C_1. The transfer of a minute amount of charge equalizes the voltage across the two, giving the voltage reading on the voltmeter.

As this process continues, the heart rate is indicated by the position of the needle on a logarithmic scale. The rate reading is adjusted with each heart beat, giving the doctor a quick picture of heart rate variation. This is an important indicator of a patient's condition. ■ ■



Two Heartbeats are sufficient to establish heart rate using this cardiotachometer designed by Epsco, Inc.'s Medical Div., Cambridge, Mass. Needle settles on new heart rate on logarithmic scale after each two beats.

+125c

NEW! Etched and Plain Foil Single-Case

Tantalex® Capacitors in Both Polar and Non-Polar Designs

When you specify *Sprague*, you pay no penalty in size and weight because of an extra outer shell on 125°C tubular foil tantalum capacitors!

Sprague's new family of foil Tantalex capacitors for 125°C operation uses only a single case. An improved end-seal construction does away with the need for a supplementary second outer case.

Manufactured to exceed the performance requirements of Military Specification MIL-C-3965B, this new series of capacitors sets new standards of reliability for all types of military and industrial applications.

Polarized capacitors are available under the designation Type 120D in plain foil construction and Type 122D in etched foil construction, while non-polarized units are listed as Type 121D in plain foil and Type 123D in etched foil designs.

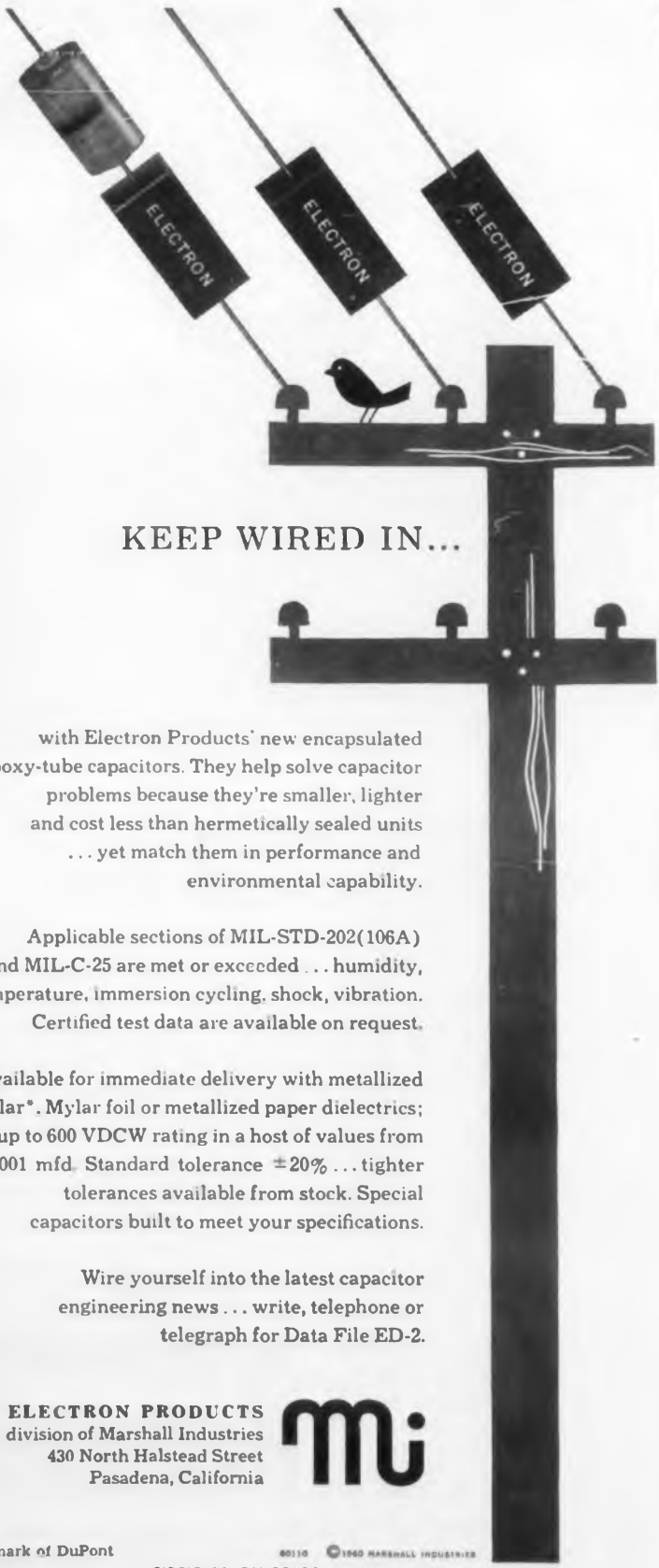
These outstanding new Tantalex capacitors are available promptly in production quantities. If you need small quantities overnight, key Sprague industrial distributors stock the more popular items in the Type 120D and 122D polarized designs. Non-standard ratings are also available for special applications.

For complete technical data on these new Tantalex capacitors, write for Engineering Bulletin 3602A to Technical Literature Section, Sprague Electric Company, 347 Marshall Street, North Adams, Mass.

SPRAGUE®
THE MARK OF RELIABILITY

SPRAGUE COMPONENTS:
CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES

CIRCLE 10 ON READER-SERVICE CARD



KEEP WIRED IN...

with Electron Products' new encapsulated epoxy-tube capacitors. They help solve capacitor problems because they're smaller, lighter and cost less than hermetically sealed units ... yet match them in performance and environmental capability.

Applicable sections of MIL-STD-202(106A) and MIL-C-25 are met or exceeded ... humidity, temperature, immersion cycling, shock, vibration. Certified test data are available on request.

Available for immediate delivery with metallized Mylar*, Mylar foil or metallized paper dielectrics; up to 600 VDCW rating in a host of values from 0.001 mfd. Standard tolerance ±20% ... tighter tolerances available from stock. Special capacitors built to meet your specifications.

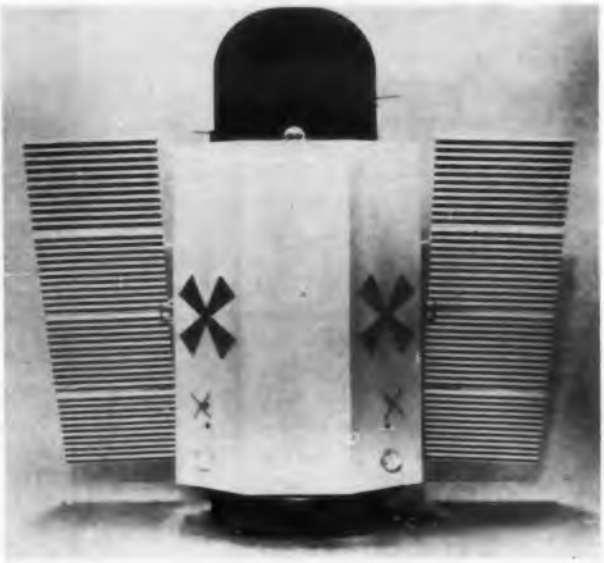
Wire yourself into the latest capacitor engineering news ... write, telephone or telegraph for Data File ED-2.

ELECTRON PRODUCTS
division of Marshall Industries
430 North Halstead Street
Pasadena, California

*Trademark of DuPont

60110 ©1960 MARSHALL INDUSTRIES

CIRCLE 11 ON READER-SERVICE CARD



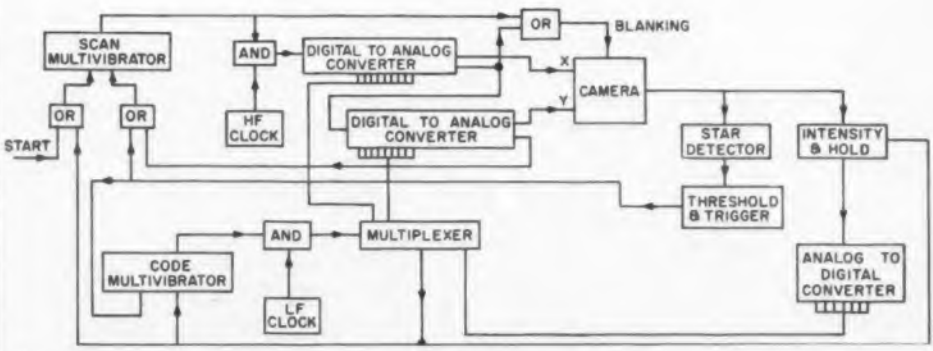
Model of Orbiting Astronomical Observatory. Eight-sided vehicle will carry four 8-in. telescopes to map the sky in ultraviolet light. Solar cells on paddles will generate 350 w. Reliability of one year is hoped for.

Digital TV to Be Orbited by NASA

NASA Orbiting Astronomical Observatory To Send UV Star Photos and Spectra to Earth

A DIGITAL-TELEVISION system will be flown on board the first of NASA's Orbiting Astronomical Observatories (OAO) to transmit ultraviolet star photos and spectra back to earth. An instrument payload being designed by the Smithsonian Astrophysical Observatory, Cambridge, Mass., for a scheduled launching in 1963 will also include a 1-million-bit core memory and newly developed ultraviolet-sensitive television tubes.

A separate analog TV system will also be used, not for backup, but because of the special nature of the photos to be transmitted and the short time that will probably be available for stellar mapping. The Smithsonian's Dr. Robert J. Davis, in charge of payload design, would like to achieve a reliability of one year



Digital encoder for the OAO. Design shown is being breadboarded by the Smithsonian Astrophysical Observatory. Unit provides fast scan until beam intersects a point of sufficient brightness (representing an ultraviolet-emitting star). The scan then stops and intensity is quantized. Up to seven bits of quantizing may be possible using new camera tubes being developed for the project. A second design being considered uses analog techniques to eliminate multivibrators and converts to digital signals at output end.

for the electronic equipment, but more reasonably expects an operating life of closer to six months.

With the shorter longevity, the information-handling problem for an all-sky survey becomes enormous. Three separate telescopes, each sensitive to a different portion of the ultraviolet spectrum between 1,220 A and 2,800 A will be in simultaneous use. A fourth telescope, functioning as a grating spectrometer will also be carried.

Astronomers expect that at least 100,000 uv stars will be revealed by the survey. Each star must be photographed three times and an average of 50 stars is expected in each TV frame. In addition, large diffuse areas of interstellar space may also emit ultraviolet radiation. Finally, images photographed during the satellite's orbit must be rapidly transmitted as it passes over the ground station. Thus, a combination of analog and digital TV could solve the problem of transmitting data consisting both of many small objects and of a lesser number of large objects—all in a relatively brief interval.

Variable Rate Scanning Speeds Data Transmission

The digital TV system will employ a unique, variable-rate scanning scheme. The scan will proceed at a very rapid rate until it intersects the image of a star. The scan will then dwell on that point long enough to quantize the brightness of the image. A typical star image would intersect something like five adjacent scan lines.

Each image will be coded as nine "Y" position bits, nine "X" position bits, seven intensity-level bits, and seven marking bits. On the average, 2 sec might be required to scan each frame. In this scheme, the intensity threshold that governs interruption of the scan would be set so as to ignore the dimmer images that might appear in interstellar space.

The vehicle's TV cameras are in continuous operation. When the OAO passes over the ground station, images are transmitted directly. Pictures taken during the rest of the orbit are stored for transmittal over the ground station. The present operational concept calls for the storage of 100 photographs, requiring a total memory of one megabit. Magnetic tape, while the most convenient storage medium, was rejected because of the potential long-term unreliability of mechanical transports.

Instead, Dr. Smith is consulting with data-equipment manufacturers on the design of a 1-megabit core memory that would weigh 20 lb and have a volume of 1/3 ft. Other all-electronic storage methods meeting operational requirements would also be considered, as the payload design is not yet frozen.

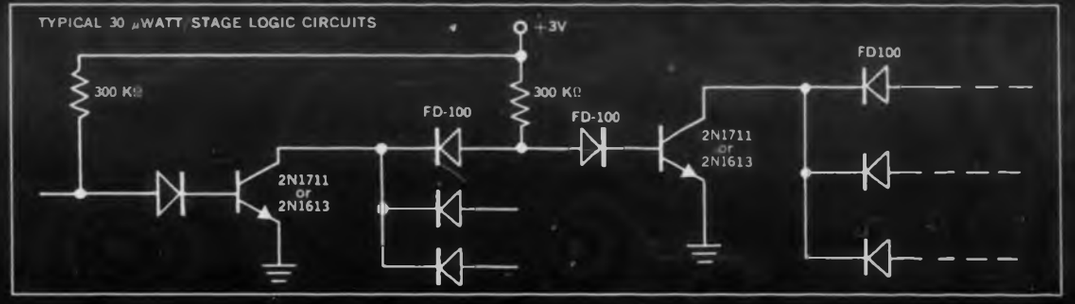
An analog-TV transmitter, programed to oper-

Low leakage and useful h_{FE} at very low collector currents permit low power operation — as low as 30 microwatts per stage. High performance PLANAR transistors and diodes use simplified circuitry (see illustration), keep costs down, reduce power requirements, and permit high-density packaging. Prime applications: missile and space vehicle guidance and instrumentation.

For your down-to-earth needs, where weight, space and power are less critical, similar logic circuits will operate with switching rates greater than 5 mc.

mμA leakage in FairchildPLANAR transistors and diodes permits

MICROWATT LOGIC FOR SPACE VEHICLES



MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS (25°C except where noted)

	Total diss.	V_{CBO}	V_{EBO}	h_{FE} (I_C=150mA) (V_{CE}=10V)	h_{FE} (I_C=0.1mA) (V_{CE}=10V)	C_{ob} (I_E=0) (V_{CB}=10V)	I_{CBO}	I_{CBO} (V_{CB}=60V) (T=150°C)	I_{CBO} (V_{CB}=50V) (T=125°C)
2N1613	3.0W	75V	7.0V	40-120	20 min.	18pf typ. 25pf max.	0.8mμA typ. 10mμA max. (V_{CB}=60V)	1.0μA typ. 10μA max.	—
2N1711	3.0W	60V	7.0V	100-300	35 min.	25pf max.	10mμA max. (V_{CB}=50V)		10μA max.

	W/V	P diss.	T_A	T_{stg}	I_R (V=−50V)	R_E (100 mc)
FD100	50V	250mW	−65° to +175°C	−65° to +200°C	0.1μA	45%

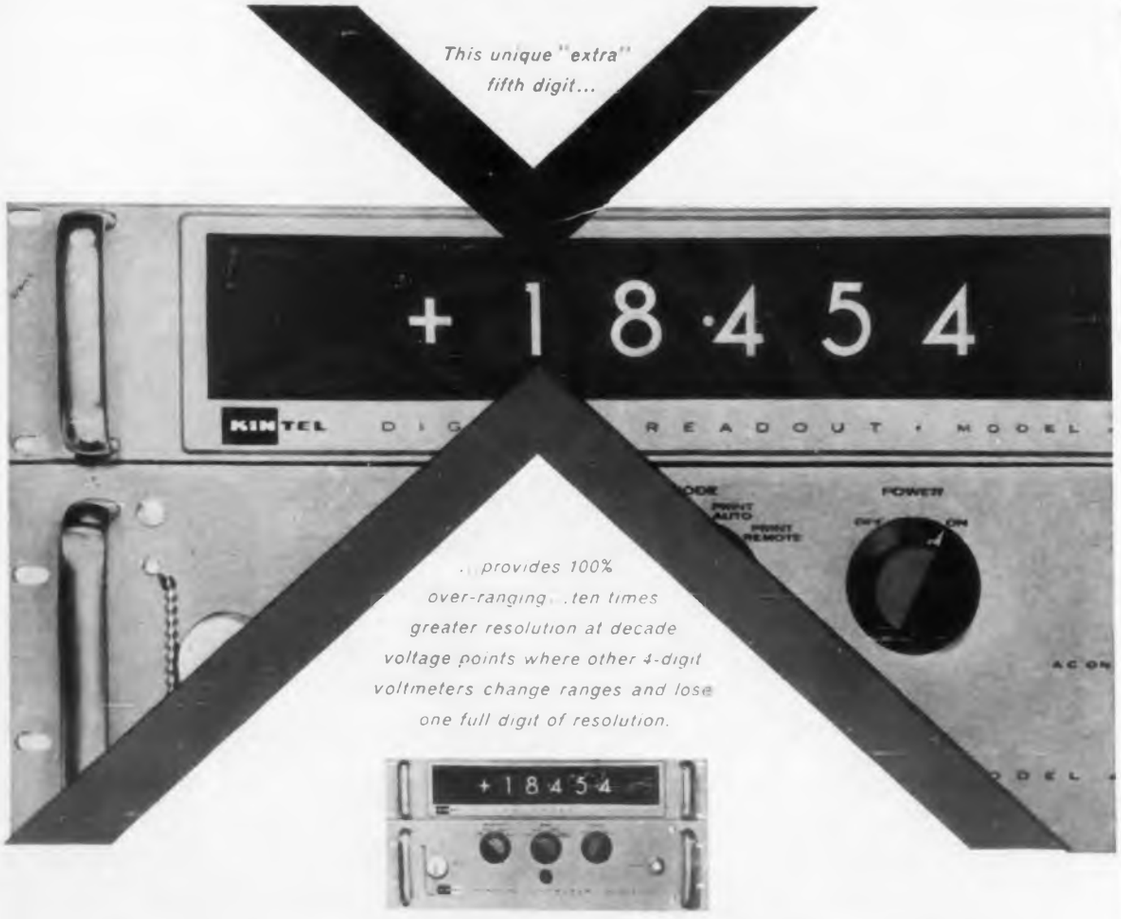
545 Whisman Road
Mountain View, California

FAIRCHILD SEMICONDUCTOR CORPORATION

YOrkshire 8-8161
TWX: MN VW CAL 853

A WHOLLY OWNED SUBSIDIARY OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

CIRCLE 12 ON READER-SERVICE CARD



The KIN TEL Model 501 4-digit, over-ranging digital voltmeter measures DC from ±0.0001 to ±1000.0 volts with 0.01% ±1 digit (of reading) accuracy. An extra fifth digit in the left decade indicates "0" or "1" to provide ten times greater resolution at decade (1, 10, 100) voltage points than standard 4-digit voltmeters. Ranging and polarity indication are entirely automatic. The measured voltage, decimal point and polarity symbol are displayed on an in-line readout in a single plane–no superimposed outlines of "off" digits.

An adjustable sensitivity control permits decreasing sensitivity to allow measurement of noisy signals. Ten-line, parallel input printers can be driven directly, and converters are available for driving other types of printers, typewriters, and card or tape punches. The input may be floated up to 25 volts DC above or below chassis ground with no degradation in performance, and up to 250 volts DC with slight decrease in accuracy. Stepping-switch drive coils are energized with DC as in telephone-type service to provide long, trouble-free operation.

The 501 is one of a complete line of KIN TEL digital instruments. Others include AC converters, AC and DC preamplifiers, ratiometers, and multi-channel input scanners.

IMPORTANT SPECIFICATIONS

Display...Six decades display 5 digits (Left digit "0" or "1" only), decimal point, polarity symbol. Ranging and polarity indication are automatic. Projection system readout employs bayonet-base lamps with 3000-hour minimum life rating. Readout contains no electronic circuitry and can be remotely mounted.

Automatic Ranges...±0.0001 to ±1000.0 volts DC in four ranges: 0.0001 to 1.9999; 02.000 to 19.999; 020.00 to 199.99; 0200.0 to 1000.0

Accuracy...0.01% ±1 digit (of reading).

Input Impedance...10 megohms on all ranges at null.

Reference Voltage...Chopper-stabilized supply, continuously and automatically referenced to standard cell.

Stepping-Switch Drive...DC voltage within stepping-switch manufacturers rating applied by transistor drive circuit at rate of approximately 20 steps per second.

Controls...Three: on-off; sensitivity; and mode of operation (standby, normal, print auto, print remote).

Printer Drive...Built-in for parallel input printers. Automatic or remote.

Dimensions and Net Weights...Control unit: 45 lbs, 5¼" H x 19" W x 16" D. Readout: 10 lbs, 3½"H x 19"W x 9"D.

Price: $2995

KIN TEL manufactures electronic instruments for measurement and control, and closed circuit TV. Representatives in all major cities. Write for detailed literature or demonstration.

KIN TEL
A DIVISION OF
COHU
ELECTRONICS, INC.

5725 Kearny Villa Road, San Diego 11, California, Phone: BRowning 7-6700
CIRCLE 13 ON READER-SERVICE CARD

ate over the ground station will pick up details of interstellar space ignored by the digital system. Since the operating time of the analog system would be limited to a small fraction of each orbit, many parts of interstellar space could not be mapped by the OAO. Accordingly, the Smithsonian Observatory would welcome suggestions for a suitable analog memory and readout system to enable all-sky interstellar mapping. Electrostatic storage tubes have been considered, but a satisfactory analog memory for the OAO has yet to be found.

A new type of uv-sensitive camera tubes for the OAO is being developed by Westinghouse. The new tube, termed the Ebicon (Electron Bombardment Induced Conductivity), is similar to the vidicon type in that photo electrons from a photocathode are imaged onto a target, which is then scanned.

The Ebicon target, however, consists of a thin conducting layer deposited over a thin insulating film. Photo electrons penetrate through the conductor and into the insulator where they generate a large number of lower-energy secondary electrons. These secondary electrons act as a conduction current to discharge the insulator (which is polarized by the previous scan). The result is an amplified charge pattern which is then read out by a scanning beam in conventional fashion. Charge gains of 200 are said to occur in the Ebicon target.

Photocathodes for uv-sensitive Ebicons may prove troublesome to manufacture. Materials such as barium fluoride, cesium iodide, and rubidium telluride have been tested. The last of these is sensitive to below 3,000 A, ideal for use in the OAO, but it deteriorates in the presence of air and must be manufactured and applied in a vacuum. The metallic coating normally applied to a photocathode must be exceptionally thin here to enable penetration of the ultraviolet into the emissive material itself. Aluminum films about 70 A thick appear to be necessary.

Design of the digital system is well along, and a laboratory breadboard is being assembled. The unit (see diagram) operates almost entirely in the digital mode. A second design, however, which operates in the analog mode with a final analog-to-digital converter is also being considered as it would eliminate more than 50 of the multivibrators required by the first unit. A beam encoder tube might be used at the output end of the second version.

The gray scale to be obtained with the Ebicon tubes and digital system is still in doubt. Five-

bit quantizing, giving 32 shades of gray, is well within the state of the art. Dr. Mario Grossi of the Smithsonian Observatory's electronics laboratory believes that six bits are possible in design with reasonable care and that seven-bit quantizing with presently known techniques may also be possible. Astronomers would like a gray scale of 1,000, Dr. Grossi said, but will be happy to settle for 100 at this time. One place they are willing to compromise for an improved gray scale is in scanning speed. "We don't mind having to transmit a field several times if it will improve the scale," Dr. Grossi said.

Electric Motors Will Control Altitude of Vehicle

Apart from the payload, the OAO will include a number of other electronic innovations. Angular positioning will be effected through transfer of angular momentum developed by motors. A 100-w motor for coarse positioning and a one-watt motor for fine control will operate on each of three axes, for a total of six control motors. When necessary, control will also be provided by gas jets and magnetic loops. It is expected that the entire vehicle can be oriented with an accuracy of one minute of arc.

Angular orientation of the vehicle will be accomplished by three separate, independent means.

- Monitoring of the uv image seen by the telescopes.
- Separate on-board tv finder.
- Mechanical star trackers.

Orientation will be by ground commands which can be executed upon receipt or stored for use at a later position in orbit.

Design of the space-to-ground transmitters calls for a 20-db carrier-to-noise ratio at a slant range of 2,500 nautical miles. It is expected that digital transmission will permit use of a 62-kc bandwidth at 400 mc for the data link with 2 sec required to relay each picture. Transmitter power should therefore not exceed 10 w.

An interesting feature of the OAO will be the inclusion of about 250 lb of lead ballast. This will be required to equalize moments of inertia about the three axes of the vehicle.

Design concepts for the OAO will receive their first test early this spring when an Aerobee-Hi rocket carrying an analog-TV camera will be launched from Wallops Island, Va., to make a brief uv survey of the sky. The pictures will be of commercial quality (525 lines and 30 frames), but will give astronomers some indication of what can be expected in the way of uv stars.

Just to make sure that nothing goes wrong (as the level of expected uv intensity is still being debated), the rocket will carry a small uv flasher to indicate that the camera is operating.

Now Eimac's 2C39A gives you more ruggedness than any other competitive tube. *Plus* a higher maximum temperature rating of 250°. . . and less dielectric loss at higher frequencies for increased efficiency, power output. *And all at no increase in cost!* Get the only ceramic tube built to 2C39A specifications. Get it only from Eimac...world leader in power tubes, microwave tubes, amplifier klystrons. Contact your local Eimac representative for quantity price quotations. Eitel-McCullough, Inc., San Carlos, California.

CIRCLE 14 ON READER-SERVICE CARD

LAMBDA
Transistorized Regulated Power Supplies

- **Convection cooled—no internal blowers to wear out.**
- **Guaranteed for a full 5 years.**
- **Compact. 1, 2, and 5 Amp only 3½" high, 10 Amp 7" high.**
- Ambient temperature 50°C.
- Excess ambient thermal protection.
- Special, high purity foil, hermetically sealed long-life electrolytic capacitors.
- Hermetically sealed transformer designed to MIL-T-27A.
- Remote sensing and DC vernier.

CONDENSED DATA ON LT SERIES

LT 1095M (with meters)	0-32 VDC, 0-1 AMP	$315
LT 2095M (with meters)	0-32 VDC, 0-2 AMP	395
LT 1095 (without meters)	0-32 VDC, 0-1 AMP	285
LT 2095 (without meters)	0-32 VDC, 0-2 AMP	365

MODEL	VOLTAGE BANDS
LT 1095, LT 1095M	0-8, 8-16, 16-24, 24-32
LT 2095, LT 2095M	0-8, 8-16, 16-24, 24-32

Regulation: Line: Better than 0.15 per cent or 20 millivolts (whichever is greater). For input variations from 105-125 VAC. **Load:** Better than 0.15 per cent or 20 millivolts (whichever is greater). For load variations from 0 to full load.

AC Input: 105-125 VAC, 50-400 CPS.

Ripple and Noise: Less than 1 millivolt rms.

Ambient Temperature: 50°C—continuous duty.

Remote DC Vernier: Provision for remote operation of DC Vernier.

Remote Sensing: Provision is made for remote sensing to minimize effect of power output leads on DC regulation, output impedance and transient response.

Size:
LT 1095 3½" H x 19" W x 14⅜" D
LT 2095 3½" H x 19" W x 14⅜" D

CONDENSED DATA ON LA SERIES

LA 50-03AM (with meters)	0-34 VDC, 0- 5 AMP	$425
LA100-03AM (with meters)	0-34 VDC, 0-10 AMP	540
LA 50-03A (without meters)	0-34 VDC, 0- 5 AMP	395
LA100-03A (without meters)	0-34 VDC, 0-10 AMP	510

MODEL	VOLTAGE STEPS
LA 50-03A, LA 50-03AM	— 2, 4, 8, 16 and 0-4 volt vernier
LA100-03A, LA100-03AM	— 2, 4, 8, 16 and 0-4 volt vernier

Regulation: Line: Better than 0.15 per cent or 20 millivolts (whichever is greater). For input variations from 100-130 VAC. **Load:** Better than 0.15 per cent or 20 millivolts (whichever is greater). For load variations from 0 to full load.

AC Input: 100-130 VAC, 60 ± 0.3 cycle. This frequency band amply covers standard commercial power lines in the United States and Canada.

Ripple and Noise: Less than 1 millivolt rms.

Ambient Temperature: 50°C—continuous duty.

Remote DC Vernier: Provision for remote operation of DC Vernier.

Remote Sensing: Provision is made for remote sensing to minimize effect of power output leads on DC regulation, output impedance and transient response.

Size:
LA 50-03A 3½"H x 19" W x 14⅜" D
LA100-03A 7" H x 19" W x 14⅜" D

LA 110

SEND TODAY FOR COMPLETE DATA.

LAMBDA ELECTRONICS CORP.
11-11 131 STREET • DEPT. 2 • COLLEGE POINT 56, N. Y. • INDEPENDENCE 1-8500

CIRCLE 15 ON READER-SERVICE CARD

NEWS

Invisible Light Is Used

Ranges Up to 2 Miles Reported; Beam Can Handle 100 Channels

MODULATION of ultraviolet fluorescent lamps at frequencies in the kilocycle range has led to the development of a multi-channel ultraviolet (UV) communication system by the International Telephone and Telegraph Laboratories, Nutley, N.J. As many as 100 4-kc channels can reportedly be impressed upon a single UV beam.

Recent tests of an experimental portable unit containing a 4-w lamp indicated that a voice channel could be received at ranges of 500 ft in high ambient fluorescent lighting and 250 ft in bright daylight. At night, however, ranges of 2 miles with a beamed signal and 1 mile with an omnidirectional signal are believed feasible. It is expected that these ranges can be extended considerably through the use of more powerful lamps and more sensitive receivers.

Mercury-Vapor Tubes Under Investigation

According to ITTL project engineer Frederick Beisel, lamp manufacturers have not fully investigated the modulation possibilities of mercury-vapor tubes and generally specify a limit of only a few hundred cps. Through a number of undisclosed techniques, lamps at ITTL could follow modulations of up to 500 kc. Commonly available UV phosphors are effective to about 100 kc. Mr. Beisel stated that with further development, the response of tubes and phosphors could probably be extended to 1 mc.

In the experimental transmitter, each channel is impressed onto the beam as a constant-frequency square wave. The amplitude of the square wave is then modulated in accordance with the data to be transmitted. The carrier frequency for the experimental, single-channel unit is 52.2 kc. Other channels can be spaced at regular intervals on each side of this carrier.

Conventional Circuitry Used At Receiving End

The receiver employs a 1P28 photomultiplier as the primary detector. Conventional tuned circuits (one for each channel), detectors, audio amplifiers, and a high-voltage supply for the photomultiplier comprise the remainder of the receiver circuitry.

Applications envisioned for the system include short-range data transmission in large crowded areas. Military uses could include short-range, secure night communications. ■ ■

For Walkie-Talkie Sets

Design of Infrared Telephone Achieves a $20 Retail Price

A FLASHLIGHT bulb, an aluminized mylar diaphragm, and reject transistors are the key design features of the Infraphone, a $20 IR handie-talkie recently introduced by Infrared Industries, Waltham, Mass.

The flashlight bulb, a 1-w PR-3 is the radiating source; the diaphragm, which is voice-actuated, modulates the IR beam directly; and the transistors, reject computer types available at about one third the cost of Japanese imports, are used in the receiver audio amplifier.

Ranges of 300 yd in bright sunlight and 500 yd under more favorable conditions are claimed for the Infraphone. "We consider the IR spectrum ideal for optical communication in that the effects of background radiation can be readily eliminated by filtering," Ernest Bivans, IR Industries, director of research said.

The Infraphone operates in this way: The flashlight bulb, located at the focus of a 2-in. parabolic reflector is beamed onto a flat, aluminized mylar diaphragm which reflects the beam out to the receiver. The speaker's voice impinging against the rear of the diaphragm alternately distorts it into concave and convex shapes, thereby varying the angular width and intensity of the beam. The modulation achieved in this manner is said to be approximately 40 per cent. The beam angle, however, is only 3 deg and requires some care in aiming the transmitter.

The signal is detected by a 0.020 in.-sq lead sulfide cell placed behind an IR-transmitting filter. An emitter follower and two audio stages, all consisting of npn germanium transistors complete the receiving circuit.

Infraphone short-range optical communication system operating in IR spectrum is a hand-held device retailing for $20. Small, lower circle at front of unit is transmitting aperture. Receiving element is behind larger aparture.

Thiokol PROGRAMS X-15 ENGINE TESTS WITH AMP PATCHBOARDS

To test the 50,000 pounds of whoosh in its new X-15 engine, Reaction Motors Division of Thiokol Corporation required versatile and reliable programming systems to connect instrumentation to six different test stands. With the assistance of AMP engineers, Thiokol installed six patchboard programming systems that can connect one set of test instruments of any of six test stands with a flick of the wrist—a saving of time, personnel and equipment. In addition to tremendous flexibility, AMP systems—either universal or shielded—provide a number of exclusive features including pre-cleaning of contact pins and springs, rugged take-a-beating construction, an almost unlimited range of sizes, plus electrical characteristics suited to the most sensitive applications—all contributing to top notch reliability. **For the complete story, write for our Patchcord Programming Catalog.**

Reaction Motors' technician switches instrumentation from one test stand to another with a flick of the hand.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • West Germany

CIRCLE 16 ON READER-SERVICE CARD

NEW...

®Regatron Programmable

CONSTANT-CURRENT POWER SUPPLIES

Extremely low ripple . . . 0.1% load regulation* . . . wide operating range . . . the well-known Regatron features are incorporated in these new constant-current power supplies. Transient response time is less than a millisecond. A modulation input is a standard feature. A vernier permits continuous zero-to-maximum coverage throughout each of 16 current ranges.

These c-c supplies are programmable too. Current output can be controlled by means of a remote resistor at any convenient location. Shunt the programming terminals with the resistor and the Regatron delivers a precise value of constant-current to your load. Voltage compliance, or load voltage capability, rises above the minimum values cited in the brief table below, with decreasing current settings.

BRIEF SPECIFICATIONS

105-125 V, 50-60 CPS LINE
(Prices are F.O.B. Eatontown, New Jersey)

MODEL	OUTPUT	VOLTAGE COMPLIANCE (MINIMUM)	DIMENSIONS H	W	D	PRICE
C612A	1 uA to 100 ma	100 V	3½	19	9¼	$289
C624A	2.2 uA to 220 ma	100 V	3½	19	9¼	$364
C621A	5 uA to 500 ma	100 V	5¼	19	15	$479
C620A	5 uA to 500 ma	50 V	5¼	19	15	$449

* Load regulation is 0.1% for all models except 0.2% on 1 and 2.2 uA ranges of Models C612A and C624A.

You'll find the programming feature, voltage compliance, and other performance data fully detailed in four-page Specification Sheet 3072A. Ask your local E M representative or write . . .

®Registered U.S. Patent Office. Patents issued and pending.

E/M ELECTRONIC MEASUREMENTS COMPANY, INCORPORATED
EATONTOWN · NEW JERSEY

CIRCLE 17 ON READER-SERVICE CARD

Maser Advances Herald

Two New Devices from Company Seen Able to Attain Cw Operation

INCREASING emphasis on the design of coherent-light radar and communication systems is due in the wake of IBM's double-barrelled breakthrough in optical masers. Scientists give the two recently-announced masers every likelihood of attaining cw operation—considered a "must" for system applications.

The new devices are similar in configuration to the original ruby optical maser, but employ calcium fluoride as the host crystal. One maser, doped with divalent samarium ions, generates 0.708 micron (deep red) light. The other, doped with trivalent uranium ions, generates 2.5 micron infrared radiation. As in the ruby maser, the crystals of the IBM masers are silvered at both their ends, thereby acting as Fabry-Perot interferometer mode selectors to intensify the output.

Pumping is by means of a pulsed xenon arc, as in the ruby maser, but relatively low pumping energy is required to achieve maser action in the new devices. Unlike the ruby maser, however, the IBM units must be operated at cryogenic temperatures. The laboratory models built thus far use liquid helium at 40 K. Future design refinements may permit operation at liquid-nitrogen temperatures, according to an IBM scientist.

USAF Wants Solar-Powered Cw Maser; Ruby Devices Won't Do

The use of rare earths and transuranic elements as maser dopants is not unique with IBM, though Drs. Peter Sorokin and Mirek Stevenson at the company's Yorktown Heights, N. Y., research center have obviously gotten there "fustest with the mostest." Other organizations known to be experimenting along these lines include the Bell Telephone Laboratories and Technical Research Group. Both companies attended a recent bidder's conference at which the Wright Air Development Div. announced plans to develop a solar-powered optical maser for space use.

Although the conference took place some time before the IBM disclosure, reports are that even at that date the ruby maser did not figure significantly in the Air Force's plans.

Because of its low efficiency, the ruby maser would require inordinately high pumping power

Coherent-Light Systems

for continuous operation. One WADD scientist has termed the prospects for cw ruby masers "Very marginal."

Pumping energy required by a cw ruby maser is on the order of 6 megawatts. IBM reports that its masers are at least 500 times more efficient than the ruby maser and have correspondingly better possibilities of cw operation. This, together with the present Air Force viewpoint on ruby masers, indicates that maser development for system applications will be dominated by solids other than ruby. Gas types now in development also appear favorable for cw use.

IBM's masers can be classified as three-level devices, while the ruby maser has only two levels. The first CW microwave masers were also three level devices, and it appears that optical masers may have a similar history.

In the IBM maser, visible light applied to the calcium-fluoride crystal raises the dopant ions from the ground level to a higher energy level. These ions then decay to a lower, metastable energy level by non-radiating transitions. Further energy decay from the metastable level to a terminal level results in emission of the desired radiation. The ions return to the ground level by a second non-radiating transition.

The important feature here is that the terminal level, which is above the ground level, is comparatively depopulated at cryogenic temperatures. Thus, the population inversion needed for masering is obtained between the metastable level and the empty terminal level. ■ ■

Calcium fluoride optical maser is prepared for experiment by IBM scientists Peter Sorokin (left) and Mirek Stevenson. The maser crystal is at the bottom of the assembly. Above it is a liquid helium-filled dewar flask.

CANNON MS PLUGS

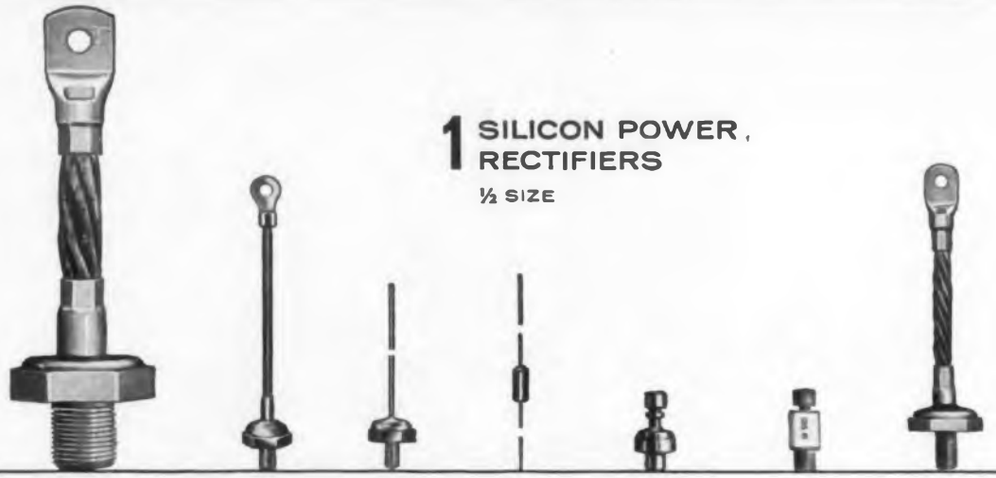
MEET THE MOST SPECIALIZED AND STRINGENT DEMANDS•Cannon MS Plugs are built for rugged service! From general duty ground use to specialized missile applications, these plugs fulfill the requirements of MIL-C-5015...are also suitable for many commercial and industrial applications where quality and dependability are required. Our full line of environmental resisting MS plugs gives you the optimum in interchangeability, variety of contact arrangements, and shell types and sizes. The MS series, MS-A, MS-B, MS-C, MS-E, MS-R, MS-K, are available from authorized Cannon Distributors everywhere; or write:

CANNON PLUGS

CANNON ELECTRIC COMPANY • 3208 Humboldt St., Los Angeles 31 Calif.

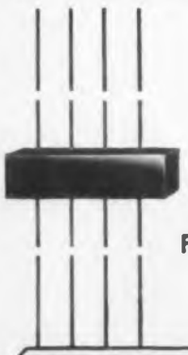
CIRCLE 18 ON READER-SERVICE CARD

Now...5 designers' lines from Sarkes Tarzian



1 SILICON POWER RECTIFIERS
½ SIZE

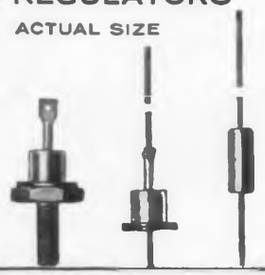
Over 100 types for low, medium, and heavy current applications, with ratings from 150 ma to 1000 amperes; 50 to 2800 piv.



2 MODULAR SILICON RECTIFIERS
ACTUAL SIZE

For printed circuits or terminal strips—2, 3, and 4 section modules of 500 ma diodes, 100 to 600 piv.

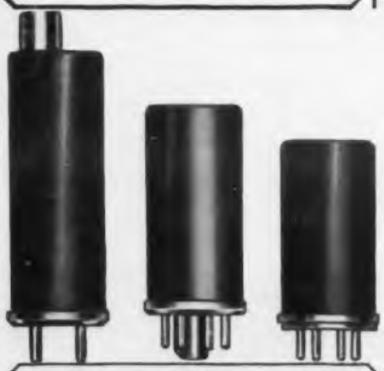
3 SILICON VOLTAGE REGULATORS
ACTUAL SIZE



Over 90 units in three power classifications—¼, 1, and 10 watts; 5.6 to 100 volts breakdown.

4 HIGH VOLTAGE SILICON CARTRIDGE RECTIFIERS
½ SIZE

Ferrule mounted and axial lead series, each in 18 different types; 600 to 16,000 piv.



5 SILICON TUBE REPLACEMENT RECTIFIERS
½ SIZE

Nine standard tube replacement units directly interchangeable with more than 95% of all vacuum tube rectifiers; two full-wave replacement units for Citizen's Band radios. Special types on request.

In selecting and specifying these silicon rectifiers and voltage regulators, you can depend on Tarzian experience and ingenuity in manufacturing to deliver high performance devices at realistic prices in the quantities you require, whether for testing or full production.

Competent application engineering service is offered without obligation.

Catalogs and data sheets on all products are available, and will be sent promptly on request.

SARKES TARZIAN, INC.

World's Leading Manufacturers of TV and FM Tuners • Closed Circuit TV Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices

SEMICONDUCTOR DIVISION • BLOOMINGTON, INDIANA

In Canada: 700 Weston Rd., Toronto 9 • Export: Ad Auriema, Inc., New York

CIRCLE 19 ON READER-SERVICE CARD

NEWS

Largest Automatic Relay Station Can Process 275,000 Messages Daily

The world's largest automatic relay station, the Strategic Army Communication (STARCOM) East-coast control center at Fort Detrick, Md., is now operating. The 200-line system designed by the Signal Corps and Automatic Electric Co. is capable of processing about 275,000 messages a day. It is the third and final switching link in the Army's continental relay system, which is designed to operate efficiently even when any one of the three stations is knocked out.

Features of the $25-million station are:

- It has central storage—that is, normal arriving messages are switched to a cross-office position to keep incoming lines free for high-precedence messages.
- The system is designed to differentiate among six degrees of precedence in arriving and departing messages.
- Multiple-call messages going to more than one station are handled independently of each other so that their priorities can be adjusted for each station.
- Transmission speed can be either 60 or 100 wpm, and may be increased to 115 wpm in the near future.

The relay station is linked to the Army's receiving site 68 miles away by a 1-kw quadruple-diversity system consisting of two transmitters and four receivers with diplexers for frequency separation. It operates in the 1,700-2,400-kc government band.

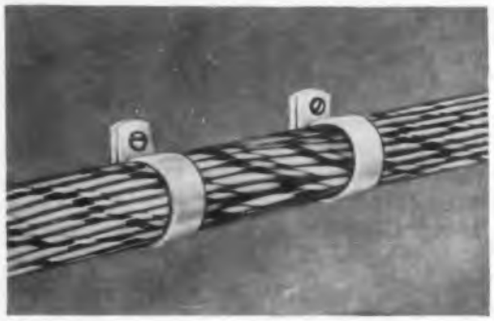
Terminal-to-terminal communication between receivers and transmitters is provided by a 100-mw frequency diversity microwave link consisting of two separate channels operating on two frequencies but on the same signal path through a common antenna system. The 7,128-8,500-kc band is used for this 16-mile link.

Collins Radio Co., Dallas, designed and built both radio links.

View of largest relay station shows only one-quarter of control room. Up to 275,000 messages a day can be automatically processed at speeds of 60 to 100 words per minute.

(Advertisement)

NYLOCLIP



NYLOCLIP®, a product of the Burndy Corporation's Omaton Division, is a pre-formed molded nylon cable hanger which has been time-proven and widely accepted by industry.

NYLOCLIPS weigh only 30% as much as comparable metal clips and yet have high tensile strength. In addition to their light weight, the cable hangers are temperature resistant from −60° F to 250° F for sustained periods and they are unaffected by oils, gasoline, alcohol, or hydraulic fluids, including non-inflammable types.

NYLOCLIPS are available in seventeen standard diameter sizes, accommodating single cables or groups of cables from 1/8″ to over 2″. Their flexibility makes them easy to install because they are pre-formed in an almost closed position allowing them to be snapped onto cable and stay in place until mounted. Cable insulation is protected by rounded edges and matte-finish on inside surfaces prevent slippage of cable under vibration, without injuring insulation. Inside serrations provide positive alignment when screw is tightened.

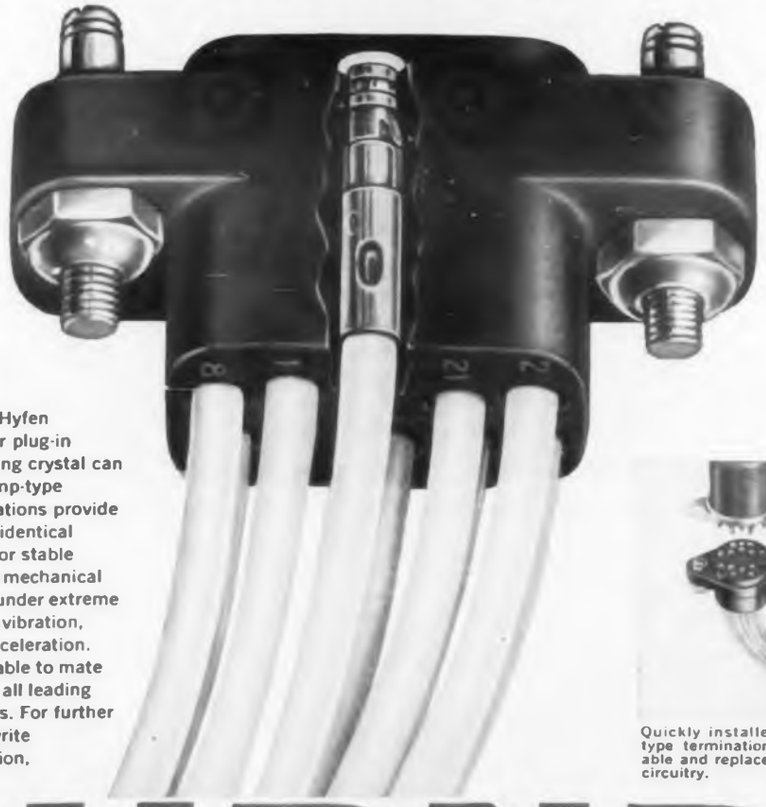
BURNDY type HP-N NYLOCLIPS are self-insulating and thus cannot cause grounds or shorts, and are free from hysteresis losses. One, two, and three hole tongue types give maximum efficient diameter range with each size cable hanger.

Burndy Corporation,
Norwalk, Connect.

CIRCLE 20 ON READER-SERVICE CARD

PLUG-IN HYFEN® SOCKET

WITH CRIMP-TYPE, SNAP-LOCKED TERMINATIONS



a new line of Hyfen connectors for plug-in relays, including crystal can relays . . . crimp-type Hyfen terminations provide thousands of identical installations for stable electrical and mechanical performance under extreme conditions of vibration, shock, and acceleration. Sockets available to mate with relays of all leading manufacturers. For further information write Omaton Division.

Quickly installed individual crimp type terminations are easily removable and replaceable for flexibility of circuitry.

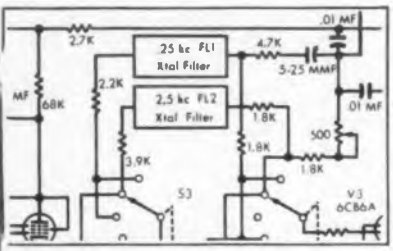
BURNDY

NORWALK, CONNECT. • BICC—BURNDY Ltd., Prescot, Lancs., England • In Continental Europe: Antwerp, Belgium • TORONTO, CANADA

CIRCLE 21 ON READER-SERVICE CARD

FIRST Continuous Tuning
Variable Selectivity
Voltmeter Uses
HERMES CRYSTAL FILTERS

Sierra Electronic Corporation's new Frequency-Selective Voltmeter, Model 125A, uses Hermes Crystal Filters, Models 2215KA and 2215KB.



Schematic of FSV showing two Hermes Crystal Filters, one at .25 kc, the other at 2.5 kc.

Hermes Crystal Filters, Models 2215KA and 2215KB. Shown approximately ½ size.

In the Frequency-Selective Voltmeter produced by Sierra, a division of Philco, crystal filters provide selective bandwidths of either 250 cps for analyzing complex waves, or 2.5 kc for general carrier system measurements. Versatility of the FSV is increased further by addition of a broadband a-c vtvm flat from 1 kc to 620 kc.

Hermes Crystal Filters, Models 2215KA and 2215KB were selected for this instrument because they provided steep-skirted i-f bandwidths, made possible single conversion, and virtually eliminated spurious responses. Specifications for these Filters are:

	Model 2215KA	Model 2215KB
Center Frequency	2215 kc	2215 kc
Bandwidth at 6 db	2800 cps	250 cps
Bandwidth at 60 db	12 kc	1000 cps
Max. Insertion Loss	3 db	3 db
Impedance	4000 ohms	4000 ohms

If you have a filtering problem, call on Hermes engineering specialists to assist you in the design of your circuitry and in the selection of filter characteristics best suited to your needs. *Write for Crystal Filter Bulletin.*

A limited number of opportunities are available to experienced circuit designers. Send Résumé to Dr. D. I. Kosowsky.

Itek Electro-Products Co.

75 CAMBRIDGE PARKWAY CAMBRIDGE 42 MASSACHUSETTS

A DIVISION OF Itek

CIRCLE 22 ON READER-SERVICE CARD

WASHINGTON REPORT

Ephraim Kahn

DESIGNING FOR "MAINTAINABILITY" is being stressed by the Air Force in its weapons and support systems. This is to be done in part through mandatory design simplification. Specific standards for maintainability will be established, and items that do not meet them may have to be redesigned in order to be acceptable. One aspect of simplified maintainability is the desire to hold down needs for special equipment, facilities, training, etc.

EXPENSES OF "MAINTAINABILITY" are "inherent in the over-all production system cost for the delivery of an operationally effective system," the Air Force says. It has given the Air Research and Development Command the job of finding new techniques for measuring and predicting maintainability of equipment from the design stage on up.

SIMPLICITY IS THE KEY to proposed maintenance standards. They will be geared to the skills of the average Air Force users, and equipment must conform. The "skill level" to be sought in maintenance is that of "an average airman with a background of high-school graduate, four years of military service, completion of basic technical school and one advance technical school of approximately three months duration." Some equipment has required far more user background in the past, according to the Air Force. Maintenance data will be channeled from users in the field to designers and evaluators of new weapons and support systems.

NEEDS OF THE AIR FORCE are summed up this way: the Air Force will insure that the systems purchased possess those maintainability requirements which result in a minimum expenditure of resources and maintenance efforts to meet operational requirements. This means placing greater emphasis on the design and pre-production development phase of new materiel to attain sound maintainability design and to insure necessary corrective changes.

ELEMENT OF SUBSIDY in government-sponsored R&D has received some comment from the Congressional Joint Economic Committee. The study draws no conclusions, and stresses that its objective is not to stigmatize, since no effort is made to appraise the desirability or relative merits of subsidies and subsidy-like payments. The Congressional group notes that the federal government has been rapidly increasing its R&D funds, especially for military purposes. Federal R&D money went from $1,390,000,000 in 1948 to $4,430,000,000 in 1958, "and there is every indication that this expansion will continue." It then says: "Inevitably many of the firms receiving research and development contracts have been able to derive substantial commercial benefit from the results of this research. Small business as a whole has found it very difficult to participate effectively in the federal government's research and development program."

WAR CONTRACTS, in general, are also tagged as subsidized by the economic experts. The committee's evaluation notes that both letting and termination of war contracts—despite provision for renegotiation—"often resulted in providing a return to contract holders that could be construed to involve a subsidy." It observes that "substantial subsidized returns to individual contractors were inevitable" since speed was stressed in placing and terminating these agreements. Even under current procedures, "it does not appear possible to avoid entirely a subsidy element in the letting of defense contracts," the report states. By way of explanation, it points out that "it should be stressed that almost always whatever subsidy effect results from war contract performance is incidental and is not planned or anticipated in the course of negotiating such contracts." Current provisions to favor critical areas of high unemployment and, to a limited extent, small business in defense contracting "may be interpreted to have an economic impact comparable to that of a subsidy, although no direct subsidy is involved."

TECHNICAL COMPETENCE OF CONTRACTORS will be the foundation for the Navy's efforts to integrate its complex weapons systems. Rear Admiral Stroop, head of the Navy's BuWeap, makes the point that this dependence will not extend to management control of weapons systems. Although the Navy is "depending more upon a single contractor to pull all technical aspects of a complex weapons system together," it continues to rely upon its own R&D laboratories for "technical direction."

CENTRALIZED MANAGEMENT of government-owned tools and other production equipment has been recommended to the Pentagon by the General Accounting Office. After a review of the Defense Department's management of the federal inventory of idle production equipment, the Accounting Office suggested that responsibility for tool management be given to the Office of the Secretary of Defense, instead of being left with the military's organizations.

MORE GAS-LUBRICATED BEARINGS are going to be used by the Navy, though high development costs may slow their introduction. Bu Ships thinks the biggest potential for these bearings lies in systems which must rotate at high speed or under extreme temperatures, such as inertial-guidance system components and certain electronic devices. Because design and development of gas-lubrication equipment is costly, they will normally be used only when conventionally lubricated bearings are unsatisfactory. Development programs are already under way.

AIR FORCE RESEARCH CRITERIA probably will be modified in the near future, primarily to clarify its "specific requirement" policy and to meet some industry objections. "More sophisticated management" is needed in "specific requirement" procedures, which are designed to eastablish the current state of the art in a given technical field and to point to the best way of applying advanced technique to Air Force needs. Changes in store for this procedure, according to Courtland D. Perkins, Assistant Air Force Secretary for R&D, probably will include elimination of so-called unpaid studies (which are eventually paid for by the government through overhead charges), imposition of strict limitations on the membership of industry teams which participate in specific requirement studies, and providing "fewer but better" research objectives to industry by the Air Force.

Modulator Users:

Q. Why does Temco's solid-state radar modulator use the G-E Silicon Controlled Rectifier?

A. "Use of General Electric's Silicon Controlled Rectifier rather than conventional thyratron switching reduces jitter and package size, increases efficiency and reliability."

The first truly solid-state radar modulator, developed by Temco Electronics, a division of Temco Electronics and Missiles Company, Dallas, Texas. Another example of advanced equipment design made possible by use of the General Electric SCR.

Features of the Temco modulator include:

- **Pulse jitter will not exceed 50 μsec.**
- **No adjustment needed before or during use.**
- **Easily meets MIL specs for shock, vibration and temperature.**
- **Automatic fault sensing and reset.**

Now lower-priced than ever before, the SCR opens new areas for engineering development. *Can you afford to wait any longer?* Write today for application data. Rectifier Components Department, Section R23A83, General Electric Company, Auburn, New York.

GENERAL ELECTRIC

CIRCLE 181 ON READER-SERVICE CARD

Power Control System Users:

Q. Why do the newest universal power control units from Magnetic Amplifiers Division of The Siegler Corporation use G-E Silicon Controlled Rectifiers driven by magnetic gating amplifiers?

A. "General Electric Silicon Controlled Rectifiers provide an almost perfect combination of magnetic amplifier and SCR, making possible exceptionally reliable and efficient control of either a-c or d-c power."

Reliability through solid-state design is achieved in small, light weight power control units developed by Magnetic Amplifiers Division. Another example of advanced equipment design made possible by use of the General Electric SCR.

Features of universal power control units include:

- **Precise Control.**
- **High power units up to 2½ kilowatts at a fraction of size and weight of conventional units.**
- **Response of entire system within 1 cycle of supply frequency.**
- **High reliability "designed-in", with no tubes, no moving parts or fragile elements.**
- **Input circuits designed to accept multiple control signals.**

Now lower priced than ever before, the SCR opens new areas for engineering development. *Can you afford to wait any longer?* Write today for application information. Section R23A84, Rectifier Components Dept., General Electric Company, Auburn, N. Y.

GENERAL ELECTRIC

CIRCLE 182 ON READER-SERVICE CARD

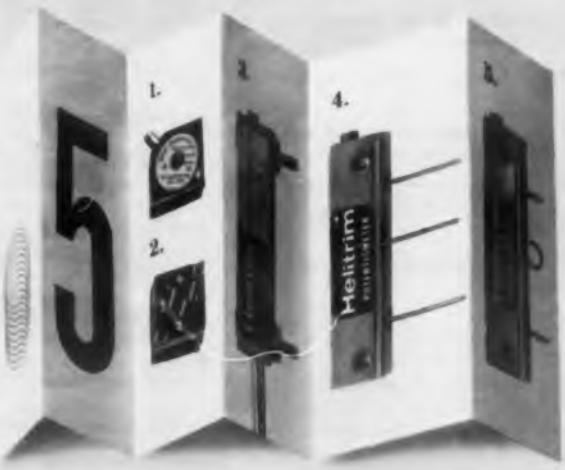
FIVE NEW TRIMMERS FROM HELIPOT! Picking a trimming pot for a troublesome application? Helipot says, "Take *five*, they're small"... and each Helitrim® trimming potentiometer is designed to solve a particular predicament!

1. Take the new Model 70, low-priced ½" square trimmer that offers Teflon leads, humidity resistance, and slip clutch stop as *standard*! (With center tap as spec!)
2. Take the new Model 71, another ½" square trimming pot that's outfitted with all-metal housing and gold-plated pins to pamper printed circuits.
3. Take the stubbornly stable Model 50 with resistances of 50 to 50K ohms. Its cermet resistance element scoffs at environmental stress and strain... even at 200°C!
4. Take the new Model 53. Cermet construction and essentially same electrical specs as the nifty 50... but with pins.
5. Take the Model 54, another 200°C cermet unit, with solder lug terminals!

When you're at the end of your rope, tie your trimming requirements to this line... it's a good one. And remember—whatever your potentiometer needs—trimmers, single-turns, multi-turns, dials or delay lines—call Helipot first, *fast* and always.

More details are available in our new catalog.

Ask for it.



Beckman® / Helipot®

POTS : MOTORS : METERS

Helipot Division of
Beckman Instruments, Inc.
Fullerton, California

©1966 Beckman Instruments, Inc.

CIRCLE 199 ON READER-SERVICE CARD

Advertisement

Servomotor 200

Smallest size 8 is 0.84-in. long

Said to be the smallest size 8, 115 v servomotor sold, the Model 8 SM 461 is 0.840-in. long, weighs 1.1 oz. A precision-control component, it has a rotor inertia of 0.18 gm-cm² coupled with a stall torque of 0.22 oz-in., providing acceleration at stall of 86,500 rad per sec²—three times greater than any equivalent unit, asserts the company. Using stainless-steel and Teflon as insulation throughout permits an ambient temperature rating of −55 to +130 C. Maximum unit operating temperature is 200 C.

Helipot Div. of Beckman Instruments, Dept. ED, Fullerton, Calif.

Precision Potentiometer 201

Has matching 7/8-in. turns-counting dial

Model 7216, 7/8-in. diam precision pot has standard resistance of 10 to 125,000 ohms and ±0.5 per cent standard linearity. A 7/8-in. diam 2600 series turns-counting dial is also offered for users desiring a precision pot-and-dial package, counts full turns and hundredths. The model 7216 is a ten-turn potentiometer with 1/4-in. diam shaft and 3/8-32 bushing mount. It is rated at two w at 25 C with a minimum operating temperature of −55 C. The pot has a molded diallylpthalate housing, bronze front lid and stainless-steel shaft.

Helipot Div. of Beckman Instruments, Dept. ED, Fullerton, Calif.

Panel Meters 202

Built to MIL specs

Built to exact conformity with MIL-M-10304A, 4-1/2-in. round, sealed panel meters have plug-in terminal construction, easy disassembly and good linearity. All-metal construction and modern appearance make the 92 standard models suitable for a variety of applications. Available as volt-meters, ammeters, milliammeters and microammeters.

Helipot Div. of Beckman Instruments, Dept. ED, Fullerton, Calif.

Availability: 30 days.

Here are sixteen standard models of BECKMAN® Size 8 & 11 Servomotors...all precision built by Helipot. You'll find complete mechanical and electrical specs in the new 24 page catalog. There are outline drawings, and Torque-Speed curves for every model...including servomotors and motor generators. For the theorist there's an added attraction; a full discussion of Electromagnetic Damping, with applicable transfer function equations.

To get the complete BECKMAN Size 8 & 11 Servomotor story at no cost, just write to us.

Beckman® / Helipot®

POTS : MOTORS : METERS

Helipot Division of
Beckman Instruments, Inc.
Fullerton, California

© 1961 Beckman Instruments, Inc. 61105

EDITORIAL

The Biggest Challenge of All for '61

Some exciting and serious challenges face electronics engineers, as the Design '61 report on pp 26-65 of this issue shows. Yet, as we get ready for the new year, the biggest challenge of all—the challenge of research for peace—is not among the list of problems to be tackled.

Nevertheless, technology must show the way if there is to be peace by any means other than the runaway arms race. The challenge of disarmament through inspection controls is first an engineering problem and secondly a negotiation problem.

To an extent larger than we would like to think, the Geneva talks on nuclear-test bans have been jeopardized by early unscientific estimates by scientists. Early estimates of the kind of inspection control necessary were far short of those later deemed necessary and more research is still needed. As a consequence the U. S. was accused of stalling efforts.

Arms control is a concept that is not discredited. Eighty-two nations of the United Nations in November of 1959 resolved to achieve disarmament under effective U. N. inspection and control. But more important than the resolution is the conviction on the part of some of our leading engineers and scientists—Lloyd Berkner, James R. Killian Jr., Hans Bethe, George Kistiakowsky, Jerome B. Wiesner—that if the same amount of research were put into the area of inspection and control as is now being put in weapons development a solution would be found.

It is not likely that engineers will get an opportunity to work on the problem under a contract or a grant for some time. President-elect Kennedy is committed to the concept of research for peace and Dr. Wiesner, director of MIT Research Laboratory for Electronics, has been figured to play a key role in the effort. The financial commitment at the outset may be small. Various citizens groups seeking disarmament ask for an allocation of at least 1 per cent of the present arms budget for disarmament research. Such meager finding means engineers will have to make a contribution through voluntary means.

A professional group on peace research similar to the IRE professional group in medical electronics may be engineering's answer to the challenge. Such a group could publish information on detection, measurements, and monitoring. Many reports of the kind published by ad hoc committees for the National Science Foundation are needed. Answering the challenge of arms control may be an extracurricular activity but the payoff might be self-survival.

James G. Lippke

NOW an ac voltage divider CERTIFIABLE to 1/2 PPM BY THE National Bureau of Standards

MODEL DT-72 DEKATRAN Decade Voltage Divider

The Model DT-72 Dekatran can now be certified by the National Bureau of Standards for use as a primary ratio standard. NBS certification has shown the Model DT-72 to have a three-year calibration accuracy starting at ½ ppm linearity at the larger dial settings, and improving to better than $\frac{1}{100}$ ppm at small settings.
Write for Catalog C-25 and additional engineering information.

Price: $795 f.o.b. factory Availability: 30 days

esi®

Impedance Bridges and Accessories
Decade Voltage Dividers
Decade Resistors and Capacitors
ESIAC Computers

Electro Scientific Industries
7524 S.W. MACADAM • PORTLAND 19, OREGON
CHerry 6-3331

formerly **ELECTRO-MEASUREMENTS, INC.**

CIRCLE 24 ON READER-SERVICE CARD

design '61

THE LOOK AHEAD

An ELECTRONIC DESIGN Staff Report

The months ahead shape up as a period of consolidation for the electronic industry. They promise to provide a time in which engineers can catch up technically with the real and sometimes surprising technical breakthroughs which have been accomplished in the past few years.

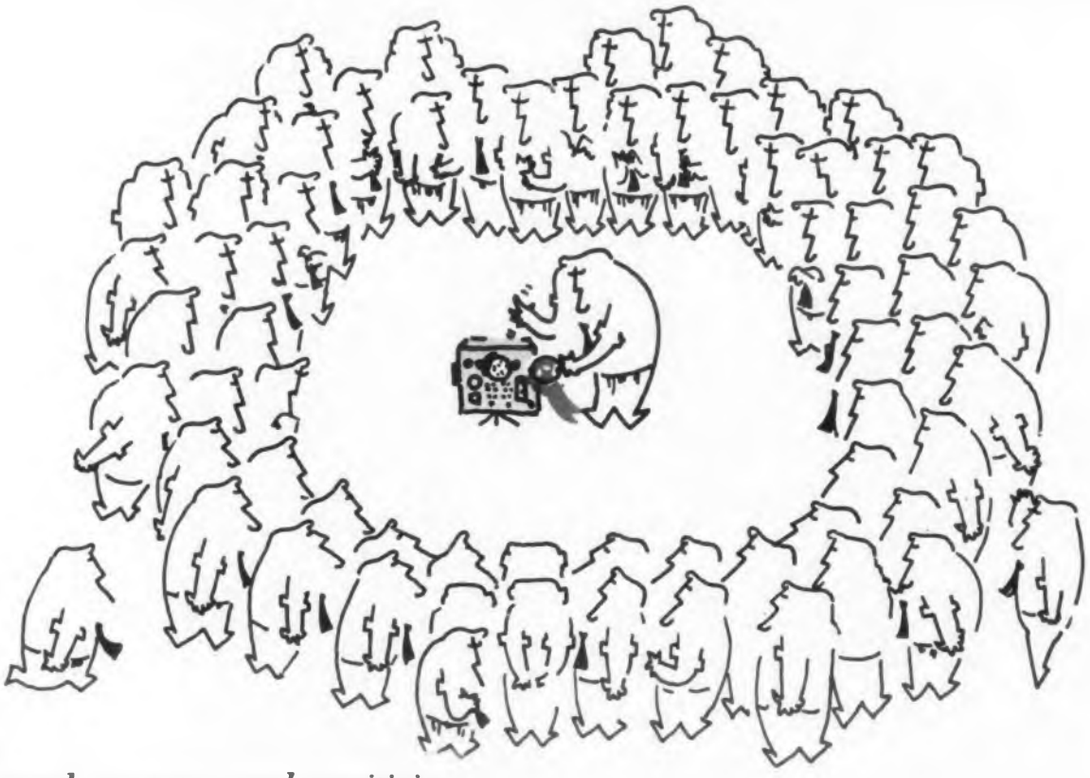
This is not to say that 1961 will be a time of idleness, or even retrenchment, for the industry. Design engineers will have plenty of work in nearly every segment of the electronic complex.

The consolidation will provide a challenge. Frontiers have been reached, now they must be settled and cultivated. For example, in the field of tunnel diodes, designers must seek ways to use last year's breakthrough in circuitry. In test equipment and instrumentation, new demands for accuracy and sensitivity will be made; engineers will try to meet them.

In this period of consolidation, sophisticated systems must be integrated into the broadened fields of application where they are or will be in use. Services to users of hardware will be designed and put into operation.

To bring readers these general predictions, as well as specific and detailed ones for 22 areas of electronics, the editors of ELECTRONIC DESIGN surveyed hundreds of engineers and administrators in the field. When the answers were in, they were correlated and to the results were added the estimates of our editors, each one dealing with his own specialized fields.

In general, the forecasts were for a year of growth and a year of challenge. In the Staff Report which follows, the editors explain just how and where the growth and the challenge will come.



TEST EQUIPMENT

straining for higher speed, accuracy, and sensitivity

AS THE electronic industry moves forward, its test-equipment segment marches forward, too—but at an accelerated pace. While others are squeezed against frontiers of knowledge and capabilities, the test-equipment designers are squeezed harder and sooner.

Almost every manufacturer of test equipment now finds himself straining to reach new heights of performance—greater accuracy, higher stability, faster writing speeds (for recorders), wider measurement ranges, more sensitivity, better environmental immunity, and greater freedom from noise.

More Versatility, Maintainability, Digital Readout Coming

In addition, manufacturers will find themselves designing more versatile instruments and they will be paying more attention to maintainability of test equipment. They will also be providing more digital readout in conventional analog instruments.

One after another, test-equipment manufacturers testify to the pressures for extended performance. In the field of voltage measurements, Robert Most, a sales manager for Sensitive Research Instrument Corp., points to the demand for 1/2 per cent accuracy in measuring voltages up to 100 v at frequencies from dc to higher than 10 mc. Today's best equipment provides such accuracy over that frequency range to a maximum of 3 v.

At the Weston Instruments Div. of Daystrom, Inc., E. G. Nichols emphasizes the need for higher accuracy, particularly in measuring ac voltage. While manufacturers can now measure to within 0.05 per cent up to a frequency of 1 kc, customers want 0.01 per cent to 10 kc.

Mr. Nichols poses a vital question here. "How do we know when we have 0.01 per cent accuracy? The National Bureau of Standards won't certify such accuracy levels."

He points to strong pressures for higher accuracy in voltage measurement, less strong pressures in current measurement, and still less pressure in power measurement.

Manufacturers of power supplies will face another important challenge—reliability.

Julian Polis of Sorensen & Co. points to increasing military demands for mean-time-between-failure data for power supplies. Power-supply manufacturers, he points out, will find themselves more and more involved in reliability evaluation.

More Reliability Needed and Still More

Max Kupferberg of Kepco voices the same sentiment. "People want more reliability," he says, "and they're getting it." He points out that Kepco has been conducting reliability studies based on transistorized equipment in the field for three years. "After a 100-hour transistor burn-in without failure," Mr. Kupferberg notes, "one can predict power-supply operation for at least 10,000 to 15,000 hours without failure."

In the field of oscillographic recorders, the demands are different, but they are still tough. Paul Foster of Sanborn Co. points out that people want pen recorders with the writing-speed capabilities of photographic types and without the disadvantages of either.

Pen recorders are relatively slow, as they suffer from the mechanical limitations of the galvanometers that drive the pens. But they give good permanent records on inexpensive paper. Photographic records using ultraviolet light require fixing or they fade.

Engineers at Brush Instruments point to the same needs—5-kc, direct-writing speeds, rather than the 100-cps speeds practical today.

In the field of digital-readout devices, pressures will come from many directions. At Kintel, engineers point to demands for 0.01 per cent, true-rms-reading, digital voltmeters with reading time of 0.3 sec. The state of the art, they feel, is reflected in an $8,500 instrument providing 0.1 per cent accuracy over the full range.

Users will demand smaller, more rugged packages with higher sensitivity and greater freedom from noise.

At Non-Linear Systems, Thomas Nawalinski cites other factors that will affect digital-readout devices and their manufacturers. "Customers will demand more application-engineering services, he points out, to help them select and apply the proper instruments." He feels there will be more emphasis on continuous application services starting when initial contact is made and ending only after a system has been operating properly under actual conditions of use.

The need for wider and wider bandwidth is perhaps most graphically illustrated by the success of the traveling-wave oscilloscope offered by Edgerton, Germeshausen & Grier; and by the success of sampling oscilloscopes offered by Lumatron, Hewlett-Packard, and Tektronix.

Bernard Roberts, senior engineer at EG&G comments that, when EG&G introduced a 2-Gc, traveling-wave oscilloscope a few years ago, engineers greeted it with, "Who needs a 2-Gc scope?" In 1961, with the accelerated work in high-speed semiconductors, magnetic thin films, and high-speed computers, engineers will be looking for 5-Gc scopes. They will demand higher sensitivities, wider bandwidths, and larger display sizes.

MARKETS

forecasters are reluctant to make predictions

BY HOW much will industry sales grow in 1961? No two forecasters agree. The effects of last year's business slowdown are expected to hold back sales growth temporarily. But to what extent, no one is saying.

Despite the slowdown, a greater value of electronic goods may be sold in 1961 than in any previous year. This is because the industry has a large degree of built-in stability. More than half of this year's anticipated factory sales will be accounted for by already-budgeted military procurement. Another large percentage of sales will result from general industry's need to modernize and automate.

Together, these factors might enable 1961 to end with a gain of about 5 per cent in factory sales over 1960, despite what might happen in the unpromising segments of consumer products and replacement parts.

Sales of consumer electronic products are expected to be lower in the first half of 1961 than in the corresponding portion of 1960. They may be as disappointing as sales volume recorded in the second half of 1960, which was less than predicted at the beginning of the year.

The same is true of replacement parts.

The key component market of semiconductors in many ways typifies the industry in general. This fast-growing segment of the industry, now accounting for sales of more than a half-billion dollars a year, grew substantially in 1960 from the less-than-$400-million volume reached at the end of 1959.

But each quarter of last year saw the marketers of semiconductor products sell a smaller volume of products than was sold during the previous quarter. The downturn is expected to continue until later this year.

One estimate of semiconductor sales breaks down this way (figures are for factory sales in millions of dollars):

Year	*Total*	*Transistors*	*Diodes, Other*	*Rectifiers*
1960	538	300	146	92
1961	626	360	157	109

Optimism, Marketing Importance Expected to Grow in 1961

The semiconductor picture in 1961 is not expected to be materially affected by technological developments like replacement of standard parts

by tunnel diodes or epitaxial transistors. Nor is any major shift in use of silicon or germanium looked for. Production cost, however, is expected to continue growing in importance as a competitive factor.

The two main features expected to characterize the industry this year are the promise of improved prospects beyond 1961 and continued growth in the importance of marketing.

Most observers are interpreting the activities of the new administration as good news for marketers of military electronics equipment. Although spending for such equipment is relatively fixed for 1961, larger amounts of money are likely to be spent in 1962 and beyond than have been disbursed recently. The promise of expanding military markets could easily color the 1961 research and development effort in the electronic industry.

In marketing, each quarter seems to be bringing a sharpening of sales techniques in the industry—management appears to be growing more conscious of the role marketing plays in keeping their companies healthy and competitive.

Smaller firms, made vulnerable in the current business climate by financing uncertainties, are reported to be looking to their technical flexibility as the basis of their marketing programs. Larger companies appear to be marketing service and quality. In general, the industry seems to be growing more consumer and less engineering oriented.

Another aspect of marketing that may color the electronic year just beginning is the continued expansion of operations abroad. To maintain and increase their foreign sales, more and more United States electronic companies are organizing operations abroad. Through subsidiaries, affiliates and licensing agreements, American firms are insuring that the protective walls being built or implied by the newly formed European economic unions will not reduce their markets.

The Sixties May Yet Soar

Despite uncertainties for 1961, continued, steady, relatively rapid growth of the electronic industry is anticipated by forecasting specialists. Here is one admittedly conservative estimate of industry growth to 1970. Figures in billions of dollars.

	1960	1965	1970
Total	15.11	21.48	27.28
Military	5.20	7.80	10.50
Broadcasting Revenues	1.74	2.35	3.00
Industrial, incl. Dist. Revenues	2.82	4.60	6.30
Service	5.35	6.73	7.48

NUMBER 6—APPLICATION SERIES

Bourns Trimpot® Instead of a Fixed Resistor?

Yes, these units meet the same Mil-Specs that fixed resistors meet and give you the added advantage of adjustability! Because of their design and construction, Trimpot potentiometers are virtually unaffected by the most severe shock and environmental conditions—a fact proven repeatedly in major missile and space programs.

Trimpot units offer several kinds of savings. They minimize the need to maintain stocks of close-tolerance resistors—you can adjust to compensate for the variances of fixed components. Production labor costs are cut, too, for Trimpot units eliminate trial-and-error matching of fixed units to the system. Savings also carry over to maintenance because the technician can adjust equipment quickly in the field—no time and dollars spent to replace components.

Before you specify fixed units, investigate all the advantages offered by Trimpot potentiometers. Over 20 basic models (wirewound and carbon)—in four terminal types and three mounting styles—are available on short notice from stocking distributors or factory. Get the facts...write for the new Trimpot brochure and list of distributors.

Exclusive manufacturers of Trimpot®, Trimit® and E-Z-Trim®. Pioneers in transducers for position, pressure and acceleration.

CIRCLE 25 ON READER-SERVICE CARD

INFRARED

better electronics scanning and detectors

SEVERAL improvements in infrared are being watched for by the industry during 1961. Designers can expect to see new long-wavelength detectors, better methods for cooling the detectors, electronic scanning devices, and a larger variety of commercial applications than has been apparent in previous years.

According to R. W. Powell, vice president and general manager of Electronic Systems Div. of Telecomputing Corporation, activity in the development of detectors is fast and furious. The past year has seen the announcement of such units as gold-doped germanium (Hughes Aircraft), indium antimonide (announced by Texas Instruments and Philco for long-wavelength detectors) and improved lead selenide.

In addition, ELECTRONIC DESIGN has learned of a British achievement during the past year—a practical detector capable of response in the 50 to 100 micron range. Germanium, selectively doped with trace elements and cooled to liquid-hydrogen temperatures, turns out to be more sensitive than a bolometer. Industry sources predict the U. S. manufacture and marketing of these detectors during 1961.

Coherent Infrared Radiation May Bring I-R Communications Systems

The past year has also provided announcements from Hughes Aircraft, Bell Telephone Laboratories, Raytheon and WIT's Lincoln Laboratories of a ruby laser, which has great significance in the infrared art. The device points the way to coherent infrared radiation. When the radiation used in a system comes from an incoherent heat source, the IR system must be passive. But, if coherent radiation (photons in phase and of same frequency) can be generated in a transmitter, active systems can be built. This means infrared communications systems and very-narrow-beam infrared radar systems should start on the drawing boards in 1961, industry experts say. But some three years will probably elapse before any practical, working systems can be manufactured.

Cooling infrared detectors to the temperature of liquid nitrogen or hydrogen has always been a problem. New insulation has been developed (Norden Abrasive) to keep liquefied gases in a tank for several days. This year may see even better insulation. But more to be expected are improvements in liquid transfer systems. These new cooling devices, announced during 1960, transfer a liquid gas to the detector by first heating the gas in its insulated tank until it begins to percolate. As it does so, drops of liquid gas sizzle down the transfer tube, bouncing from wall to wall like a drop of water on a hot stove. The drop of gas is in contact with the tube wall for such a short period of time that very little evaporates before it arrives at the detector to saturate the absorbent material in which the detector is packed.

Other improvements will appear in heat-engine devices, where a piston moves back and forth, extracting energy from the gas in an endothermic reaction.

Problems to be solved in cooling detectors include the contamination of the liquid gas (usually nitrogen) if oxygen and carbon-dioxide are present they freeze and clog the system. Organic materials cannot be used under pressure since they are likely to outgas, releasing oxygen and carbon-dioxide.

Electronic scanners are a promising field for the designer. One development, announced by Philco this year, eliminates the mechanical scanners, wheels, mirrors, and apertures heretofore necessary. The new Philco device scans with an electronic beam on silicon film. According to some industry spokesmen, this represents the same advance in infrared as the transition from mechanical scanners to the iconoscope represented for TV.

Infrared Industries' announcement of a $30 communications set may be the first in a series of commercial developments to come forth in 1961. The IRI device, shown at the Infrared Information Symposium in Boston, is a hand-carried unit about the size of a flashlight which requires only that the user aim it, pull the trigger and start talking. Range is about 1,000 yd.

Infrared devices for counting traffic, checking hotboxes on railroad cars and the like are expected to appear on the market in 1961.

Detector Mosaics to Yield More Detailed Information

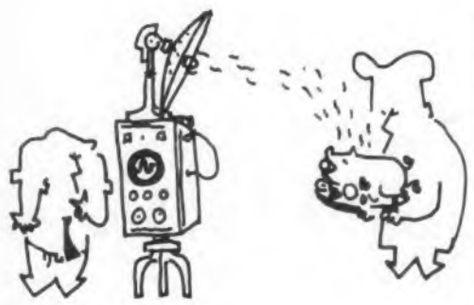
Recently, techniques have been developed for constructing detector mosaics. The designer can confidently anticipate more advanced units during 1961. Great numbers of detectors can be used, each with its own amplifier, as demonstrated by Infrared Industries, Electronics Corp. of America, and the Santa Barbara Research Laboratories Div. of Hughes Aircraft. With detector mosaics, much more detail can be obtained in a short time, since each detector has a given bandwidth, it is limited to a certain information capacity; with detectors arranged in parallel, more information can be recorded per unit time. In scanning, both wide field and more detail can be obtained.

The wide field is one of the principal advantages of infrared over radar. Quite aside from its being a passive technique, for search and reconnaissance, the wide visual field of infrared systems is particularly useful. During the next year, designers can look for greater applications in military search and surveillance. One example is the Midas satellite, in which infrared is used for detecting intense moving heat sources (such as missile exhausts) in a wide field of view.

Search and Surveillance with I-R to Continue as Paramount Challenge

Unquestionably, long-range search and surveillance is the principal field for infrared in the near future. This is where much government money is being spent; this is where industry is doing much research and development. Any declassified developments with fringe applications —such as the I.R.I. communications system— will find adaptations in the commercial field, but only if practical and inexpensive and obviously marketable.

For space use—another province of military interest—infrared will be very important. At one



time, man could detect and range in only two ways—eyesight and radio (radar). Now navigation can easily be handled by passive systems requiring no human interpretation, especially in space where gyroscopes and other gravity-dependent inertial devices cannot function. All material objects emit infrared radiation or reflect light.

One of the limitations of infrared for which no immediate solutions are available is the inability of electromagnetic radiation of these high frequencies to penetrate clouds and other atmospheric opacities. Water vapor and carbon-dioxide in the air absorb large bands of radiation. However, there are bands where "visibility" is very clear—3 to 5 microns, for example, though there is a carbon-dioxide absorption band at 4.3 microns and 8 to 13 microns. Indeed, in these bands, transmission is better than in the visual range. In smog, or with dust particles in the air, infrared behaves superlatively. The wavelength is so much larger than the particles that it does not transfer energy to them through resonance phenomena. More sensitive detectors at the "window" wavelengths can be looked for in 1961.

The large-scale military use of infrared creates problems, according to Aerojet General's project engineer, Stanley C. Vandeburgh. "Military classification is one of the largest deterrents to progress in the infrared art. Classification sometimes allows a company or engineer to go overboard in withholding data and information from his fellow engineers," he says. "In infrared, for example, the only state-of-the-art information available is through IRIS, the Infrared Information Symposium." All proceedings of the society are classified. There is little opportunity for the imaginative and "amateur" engineer designer to work in the IR field.

NOW

In the Model CM-100, Mincom's latest instrumentation recorder/reproducer, the series elements

THE MINCOM CM-100

before data storage have been reduced to recorder and mixer only, one step from the antenna.

IS PERFORMING

With the CM-100's 1-megacycle response and constant phase equalization at all speeds, an original

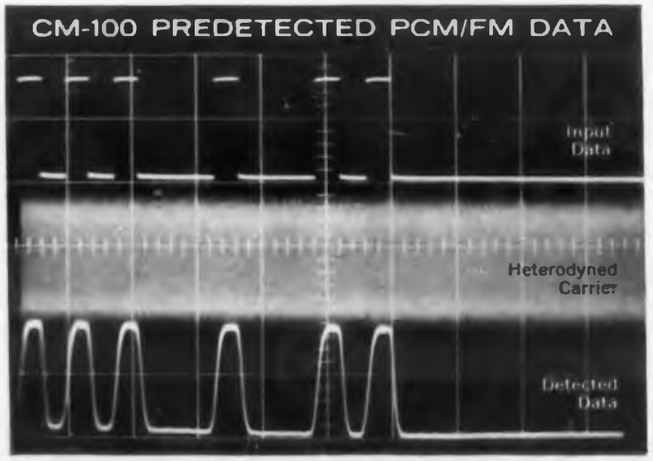
OPERATIONAL

IF signal of 5.0 megacycles thus can be heterodyned so that the carrier swing and its sidebands

PREDETECTION RECORDING

fall within the Mincom CM-100's frequency range – in FM, FM/FM modulation, PCM and PCM/FM.

...and actually doing it at defense facilities as you read this page.



5.0-mc IF carrier heterodyned down to 750 kc. Random-spaced pulses, 20 μs on-20 μs off-type information. Sweep rate: 50 μs/cm.

Write for brochure.

...WHERE RESEARCH IS THE KEY TO TOMORROW 3M COMPANY

MINCOM DIVISION **M**INNESOTA **M**INING AND **M**ANUFACTURING COMPANY

2049 SOUTH BARRINGTON AVENUE, LOS ANGELES 25, CALIFORNIA • 425 13th STREET N.W., WASHINGTON 4, D.C.

CIRCLE 26 ON READER-SERVICE CARD

NEW LB SERIES LATCH RELAY

the relay with a memory!

The new LB Relay has the ability to remember its last input and will maintain the latched or unlatched position without continuous power drain, resulting in lower power dissipation. An effective magnetic latch system has been incorporated to provide greater stability and longer life. The LB Series features balanced armature construction, with extreme mechanical ruggedness as found on all Hi-G relays.

Type: DC Microminiature Latch Relay Style No. 2LB-1B and 2LBC-1B

Size: 2LB-1B: .400 x .800 x .875" max. 2LBC-1B: .400 x .800 x 1.275" max.

Contacts: 1PDT and 2PDT dry circuit to 2 amps resistive at 32 VDC

Life: 100,000 cycles, standard

Sensitivity: 2LB-1B: 2PDT-Standard DC sensitivity to latch and unlatch, 300MW or better at 25°C. 1PDT-150 mw or better.
2LBC-1B: 2PDT-Standard DC sensitivity to latch and unlatch, 40MW or better at 25°C. 1PDT-25 mw or better.

Temperature: −65°C to +125°C

Dielectric Strength: 1000 VRMS at sea level

Insulation Resistance: 1000 megohms min.

Optional Terminals: Long or short leads for printed circuit application or hook type for standard wiring.

Mounting Provisions: Brackets, studs or straps available.

Send your relay requirements for prompt engineering evaluation — today.

Hi-G INC.

BALANCED Hi-G ROTARY

THE ONLY COMPLETE LINE OF BALANCED ROTARY RELAYS

BRADLEY FIELD, WINDSOR LOCKS, CONN.

CIRCLE 27 ON READER-SERVICE CARD

MICROWAVES

pivotal year upcoming

IN MANY companies, plant and personnel expansion have been carried out in anticipation of vast microwave developments. In other cases, new microwave departments have been formed and even entire new corporations have been built around these new microwave concepts.

During 1960, little was forthcoming in the way of production contracts while the government agencies first tried one approach and then another. In 1961, quite the reverse can be expected. Policy decisions (such as shifting of the telemetry band to microwave frequencies and opening new microwave bands to private business), and the translation of advanced theory into hardware (as in phased-array antennas), are now accomplished facts. It is not surprising, then, that a check of microwave exhibitors at NEREM in Boston last fall confirmed that the microwave companies fully expect 1961 to be a boom year.

Phased Array Antennas Multiplying Component and Tube Requirements

The breakaway from the traditional optical or geometric basis for antenna design promises to make fundamental and far-reaching changes in the microwave industry. This is a large statement, but anything less would be an underestimation of so large a development.

The amount of power that can be put into the air, once determined by the breakdown voltage and current capacity of a single tube, will now be multiplied by the use of hundreds and even thousands of tubes driven in synchronism. This is the approach taken in the 8-Amplitron, 50-megawatt modulator, recently delivered by FXR to Sperry Rand. It is also the approach taken in the 250-Amplitron power-transmission system

proposed by Raytheon to keep a helicopter aloft. Other phased arrays will be built with the output of a single tube divided and fed to many elements and steered by phase-shifting.

Such techniques will, in 1961, cause an increase in demand for the early-phased TWT's, a greater shift toward designs using a master oscillator and many small amplifiers rather than a single huge bottle (which, by the way, could improve reliability through redundancy) a large increase in demand for microwave hardward and switching devices (W. L. Maxson's AHSR-1 phased-array antenna uses 30 miles of waveguide and 250,000 directional couplers), and some slackening in demand for rotary points, rotating antenna mounts, large parabolic antennas and, perhaps, airborne radomes. In the antenna business, this year, it will be more important to understand transmission-line theory than structural techniques.

The fall of 1960 saw the issuance of historic ruling by the FCC. For reasons of spectrum squeeze and technical considerations such as penetration of plasma sheath during re-entry, the telemetry channels were shifted into the microwave band. At the same time, the band above 12 Gc was opened for use by private business. With considerable fanfare that rose above the din of criticism, companies announced equipment available for these new markets. Motorola and GE were ready with equipment announcements within weeks of the ruling.

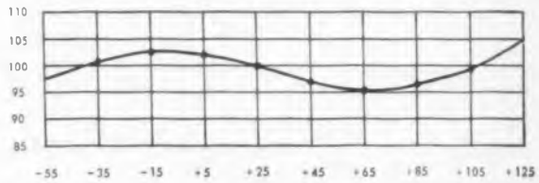
Estimates vary, but one such estimate puts the effect of private business' entry into the microwave-user category as increasing the number of private microwave stations from the present 3,000 to 18,000 by 1976. This adds up to $500 million worth of new microwave business. One sure output of all this is anguished complaints from the common carriers. The impact of the telemetry shift is harder to judge, but an indication can be had from the telemetry requirements of our first

over a 180° C range with Centralab's temperature stable Ceramic Capacitors

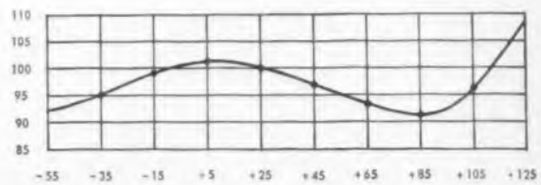
These low-cost Type CE ceramic disc Hi-Kaps® have been extensively tested over an 18 month period by prime contractors in the missile and radar fields. Their findings: *the excellence of the* CENTRALAB *design parameters for standard commercial units permits the identical capacitors to be used in military applications.*

In radio-TV as well as military usage, these units operate from —55° C to +125° C without derating. They last longer than paper or mica capacitors, and their small size makes them economical to work with. Semi-stable Type CF CENTRALAB Hi-Kaps® offer similar advantages.

TYPE CE—% of 25°C Capacity vs. Temperature in °C



TYPE CF—% of 25°C Capacity vs. Temperature in °C



SPECIFICATIONS

CAPACITIES: 150-6200 mmf
SIZE: .290"—.920" diameter, .156" thick
WORKING VOLTAGE: 500 VDC
LEAKAGE RESISTANCE: Initial, 10,000 Megohms minimum; after humidity test, over 1000 Megohms
POWER FACTOR: 2% Max. at IKC
TOLERANCES: GMV, ±20%, ±10%, +80—20%

Detailed information on these and many other CENTRALAB ceramic capacitors can be found in Catalog 42-857. Write for your free copy.

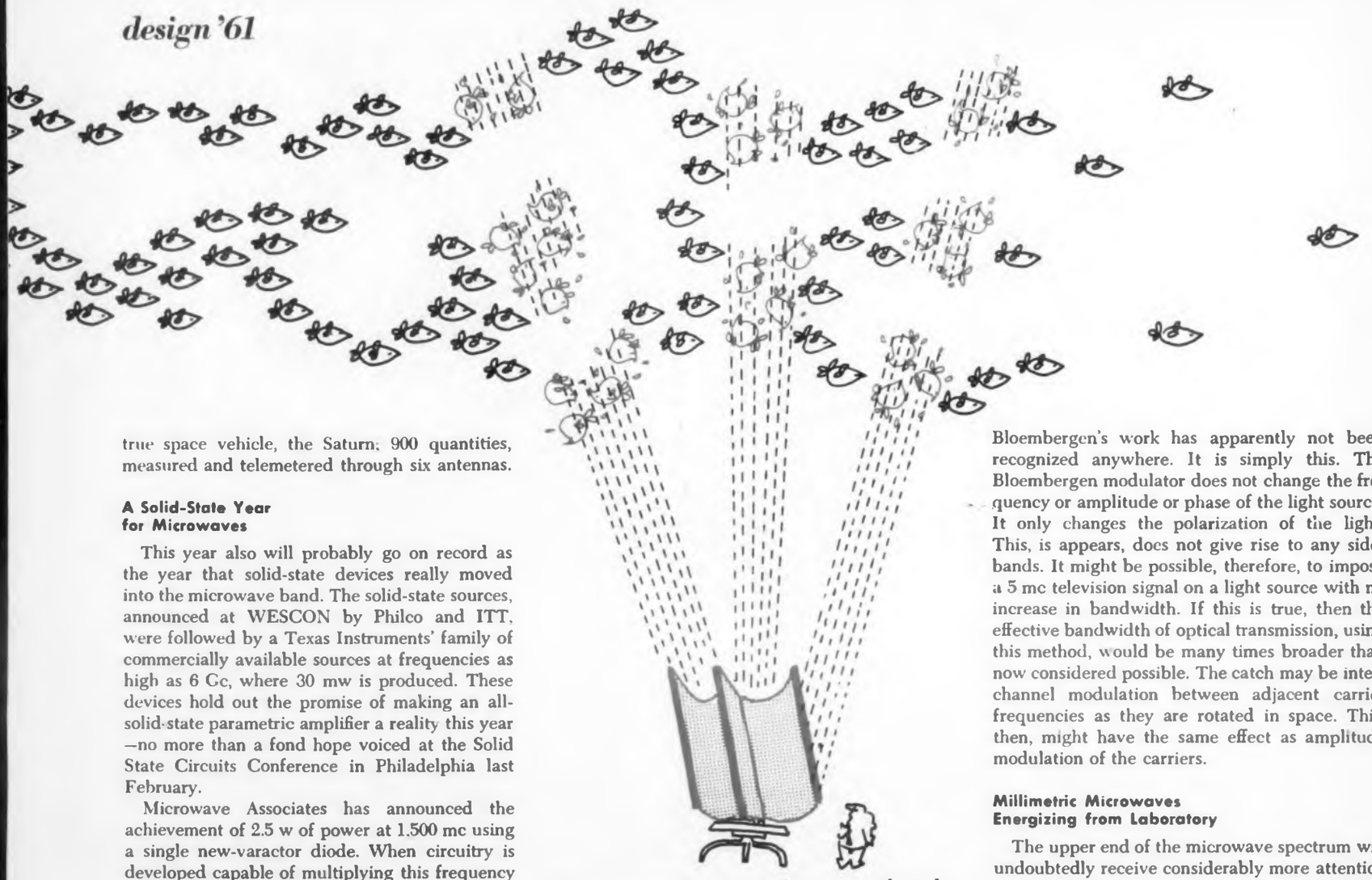
Centralab®

D-6036

The Electronics Division of Globe-Union Inc.
960A E. Keefe Ave., Milwaukee 1, Wisconsin
Centralab Canada Limited • Ajax, Ontario

ELECTRONIC SWITCHES • VARIABLE RESISTORS • CERAMIC CAPACITORS • PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

CIRCLE 28 ON READER-SERVICE CARD



true space vehicle, the Saturn; 900 quantities, measured and telemetered through six antennas.

A Solid-State Year for Microwaves

This year also will probably go on record as the year that solid-state devices really moved into the microwave band. The solid-state sources, announced at WESCON by Philco and ITT, were followed by a Texas Instruments' family of commercially available sources at frequencies as high as 6 Gc, where 30 mw is produced. These devices hold out the promise of making an all-solid-state parametric amplifier a reality this year —no more than a fond hope voiced at the Solid State Circuits Conference in Philadelphia last February.

Microwave Associates has announced the achievement of 2.5 w of power at 1,500 mc using a single new-varactor diode. When circuitry is developed capable of multiplying this frequency further up into the microwave band, the solid-state source will have definitely moved from the receiver to the transmitter end of the business.

The impact on system designs and on the manufacturers of small klystrons and other tube sources will be felt this year. A Varian spokesman was quoted at NEREM as fully expecting to lose one-third of its small klystron market over the next three years. This loss, however, will be more than made up for by the gain in large tubes, as a result of normal expansion and of phased array and linear accelerator progress. Also, as in the case of other tube manufacturers, Varian maintains a sizable solid state effort of its own.

In what seems to be a sudden recognition of the true versatility of microwaves, people with problems from all corners of technology are beating a path to the door of the microwave engineer. What is more, they are coming away with workable solutions of such variety that microwave engineers themselves are being forced to revise their estimates of the potential for their specialty. Many of them are now actively seeking problems that need solving.

Microwave Marriage with Optics Possible in Bloembergen Modulator

One of the highlights of the NEREM sessions last fall was a talk by Dr. Nicholas Bloembergen of Harvard, in which he described his success in modulating coherent light by the application of microwave energy. Since the optical spectrum is so very much broader than the microwave spectrum, a marriage between optics and microwaves could mean a way out of the spectrum squeeze for many applications.

One of the most interesting implications of Dr. Bloembergen's work has apparently not been recognized anywhere. It is simply this. The Bloembergen modulator does not change the frequency or amplitude or phase of the light source. It only changes the polarization of the light. This, is appears, does not give rise to any sidebands. It might be possible, therefore, to impose a 5 mc television signal on a light source with no increase in bandwidth. If this is true, then the effective bandwidth of optical transmission, using this method, would be many times broader than now considered possible. The catch may be interchannel modulation between adjacent carrier frequencies as they are rotated in space. This, then, might have the same effect as amplitude modulation of the carriers.

Millimetric Microwaves Energizing from Laboratory

The upper end of the microwave spectrum will undoubtedly receive considerably more attention during 1961 than ever before. Already, in 1960, 8-mm radars were demonstrated realities. Amperex is marketing such a device, developed by Philip's Lamp, for use in airport surveillance, short-range navigation radar for small boats, and similar applications. While there is a window (area of reduced atmospheric attenuation) at 8 mm, the attenuation is still high enough so that, combined with the low available power (25 kw from Amperex's Magnetron) that range is extremely limited.

This limitation may change somewhat for four reasons. First, a new magnetron, the type 35M30/LD505, developed by Nippon Electric Co. Ltd., generates 180 kw of 8-mm peak power which will permit longer-range systems to be designed this year. Other breakthroughs can be expected to follow. Secondly, Loral Electronics, and perhaps other groups, are looking for other

windows at higher frequencies. Because of a lack of shorter millimetric power sources and hardware until recently, experiments of this type were impossible. The limit now is 2 mm. FXR may develop 1-mm components soon, which will allow probing of transmission characteristics up to the very door of infrared.

The third reason for a change in range limitation is the advent of parallel-feed techniques. If this can be successfully applied to millimetric systems, power available from a single tube will no longer be the limiting factor. A fourth reason is the increased work with "private atmospheres" inside circular waveguides. Microwave Dynamics Corp., Division of Talley Industries, is developing Millimetric circular waveguides for Bell Laboratories. Finally, the obvious environment for millimetric radar is space, outside the atmosphere. It seems possible that during 1961 such a system might be completed and tested in an actual satellite, or at least in a high-altitude environmental chamber.

High Power
Some Quantum Jumps Coming

The push for higher power tubes has ceased to be a trot and is breaking into a canter. Up to now, power increase has been achieved primarily by improving on the convergent-type gun principle, more accurate focusing and the use of alumina-ceramic window material. Tubes in development now have turned to some quite different approaches. Some of these will make their appearance in 1961 tubes.

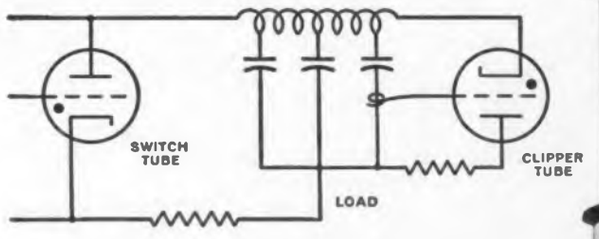
Two new approaches to gun design may be incorporated in power tubes announced in 1961 or soon after. One is the hollow-beam structure. As the name implies, no electrons exist at the center of the beam, and beam-field interaction is much improved. A somewhat similar design is the multiple-beam gun, recently announced by GE, which provides increased power by essentially the same means—generating a large-beam current without the usual drawbacks of inefficiency and poor focus. A bonus in this type of construction is the fact that lower voltages are involved. These can reduce radiation hazard as well as power-supply bulk.

The past three years have seen an order of magnitude jump in available CW X-band power. It is possible that a similar power increase could result with the development of one of these low-perveance-gun tubes, perhaps this year.

It is also possible that the single-tube power race, like the automobile horsepower race, may be nearing a peak. Although development contracts are still being let for higher power tubes, the multiple-feed approach may make it more desirable to raise power through the use of many

End-of-line clipper

Clipper tube is connected across the far end of the pulse-forming network in series with a resistive load whose value approximates the network impedance. When the clipper tube is triggered, the pulse-forming network terminates in its characteristic impedance thereby reducing the inverse voltage to zero.



Positive protection against destructive voltages with Tung-Sol Clipper Thyratrons

Line-type radar modulators require clipper protection against excess inverse voltages, which can destroy costly components and increase equipment downtime. Clippers also perform valuable circuit service by regulating pulse amplitudes and reducing switch tube loading.

But until Tung-Sol developed these high-reliability hydrogen-filled clipper triodes previously used clipping devices brought some serious disadvantages to the job.

Now, however, you can be sure of *perfect* clipping action when you design Tung-Sol clippers into your equipment. More rugged and less costly than solid state devices, more efficient with a much lower dynamic impedance than vacuum clippers, and faster acting and more resistant to arc-back than gas diodes, the new Tung-Sol thyratron clippers are designed and built to deliver uncompromised performance.

The low "firing" voltage and the ability to carry large peak currents make these hydrogen clipper thyratrons ideal for this application. These tubes also feature hydrogen reservoirs which promote long life by providing an automatic mechanism for replenishing hydrogen lost by "cleanup".

Circuit requirements are simple whether the Tung-Sol thyratrons are used as "end of the line" clippers, "across switch" clippers or "tail biters".

Write for complete technical details on the new 7454 and 7455 Clipper Thyratrons. Tung-Sol Electric Inc., Newark 4, N. J. TWX:NK193.

TUNG-SOL®

Technical information available through ATLANTA, GA.; COLUMBUS, OHIO; CULVER CITY, CALIF.; DALLAS, TEXAS; DENVER, COLO.; DETROIT, MICH.; IRVINGTON, N. J.; MELROSE PARK, ILL.; NEWARK, N. J.; PHILADELPHIA, PA.; SEATTLE, WASH. IN CANADA: ABBEY ELECTRONICS, TORONTO, ONT.

CIRCLE 29 ON READER-SERVICE CARD

PICK THE PCA SOLUTION TO YOUR PULSE TRANSFORMER PROBLEM ...on the job, in your plant!

NOW AVAILABLE IN KIT FORM! Wide variety of sample pulse transformers — ready to use — for research, test, design, breadboarding and prototype experiments. Get the kit you need from the PCA Rep-engineer closest to you!

Bardwinch Engineering Sales Co. Braintree (Boston 85, Mass. Victor 3-0845 (Maine, Vermont, R.I., Mass., N. Hamp., Conn.)	**W. O. Brouillette & Assoc.** 1358 Newcastle Westchester, Ill. Fillmore 5-6500 (Chicago, No. Ill., Wis., Ohio, Ind.)	**Burgess-Cowan & Co.** 22128 Grand River Ave. Detroit 19, Mich. KEnwood 3-7700 State of Michigan	**Sage Corporation** 219 E. 44th St. New York 17, N.Y. MUrray Hill 2-6755 (Territory outside continental U.S. See ELECTRO-DESIGN for Canada)	**Sears Electronics, Inc.** 1575 Laurel St. San Carlos, Calif. LYtell 1-4423 (Calif. no. of San Luis Obispo, Kern & San Bernardino counties.)
J. K. Bosley Co. 3215 Western Ave. Seattle 1, Wash. AT 4-8313 (Washington & Oregon)	**Harry B. Edmiston** 2717 Swiss St. Dallas, Texas TAylor 7-2853 (Tex., Okla., Ark., La., Miss.)	**Fryon Eng. Reps.** 478 N. Scottsdale Rd. Scottsdale, Ariz. Whitney 5-3281 (Ariz., N. Mex., El Paso, Tex.)	**Wilbur Gill** 10511 W. 56th Terrace Shawnee, Kansas RAndolph 2-2528 (Iowa, Mo., Kan., Neb., No. Ohio, Madison & St. Clair Counties, Ill.)	**Humphrey, Inc.** 2805 Canon St. San Diego, Calif. ACademy 3-1654 (San Diego and Imperial Co., Calif.)
H. C. Johnson Agencies, Inc. 111 Mount Hope Ave. Rochester 20, N. Y. HAmilton 6-1090 (N.Y. state except Metropolitan N.Y. & counties of Westchester, Putnam, Duchess, Ulster.)	**Marvin H. Kirtsby** 204 Sunnyridge Lane Minneapolis 22, Minn. FRanklin 7-3239 (Minn., N. & S. Dakota)	**R. P. Lane & Co. Inc.** 7 Beechwood Rd. Summit, N. J. CRestview 3-9250 (Metro. N.Y., L.I., Duchess, Ulster, Westchester and Putnam counties, N.J., Philadelphia, Pa., Baltimore, Md., Wash., DC., Eastern Penn., all counties in Delaware, Virginia - counties of Fairfax and Arlington, Eastern Md.)		**E. C. Raymond & Assoc.** P.O. Box 8215 Medora Beach, Fla. Waverly 1-9735 (Fla., Alabama, Ga., N.C., S.C., Tenn.)

TT LIMIT KIT
28 Subminiature Transistor Transformers

End limit transformers in 1:2 and 5:2:1 winding ratios. Useable with pulses ranging from approximately .05 to 5 microseconds.

MPT KIT
18 Miniature Pulse Transformers

Complete set of open circuit inductance values. Winding ratios of 1:1:2 and 5:2:1. Useable with pulses ranging from approximately .01 to 25 microseconds.

TT RANGE KIT
40 Subminiature Transistor Transformers

A variety of 2, 3, and 4 windings transformers. Provides a sampling of typical winding ratios. Useable with pulses ranging from approximately .2 to 3 microseconds.

PCA ELECTRONICS, INC.

16799 SCHOENBORN STREET, SEPULVEDA, CALIFORNIA, EMpire 2-0761

CIRCLE 30 ON READER-SERVICE CARD

smaller tubes. Raytheon has apparently already concluded so in using Amplitron.

Low Noise Receiving Devices in for an Interesting Year

This will be a year of decision in low-noise receiver technology. Recently, RCA announced the achievement of a 3-db noise figure from a low-power TWT amplifier. If this proves out as practically realizable in customer tests, it could pose a serious threat to the parametric amplifier, especially if the price gap, now in favor of the TWT, becomes wider.

On the other hand, the fast-developing availability of solid-state sources suitable for paramp pumps, could eliminate what is probably the biggest single cause of high price and complexity in the parametric amplifier—the vacuum-tube pump with its complex power supply. It may be that the paramp will greatly extend its economic applications as an all solid-state device.

Coming over the horizon is the parametric transistor, the joint Hughes-Lenkurt development, announced at WESCON. Still in the development stage, this potentially 10 dollar low-noise amplifier could become available in limited quantity in 1961.

There is coming along a "component of the year" in microwaves, dominating papers and discussions at the annual PGMMT meeting. In 1959 it was the maser; in 1960 it was the parametric amplifier. What it will be in 1961 is anyone's guess.

There are a few contenders now for the spotlight at the spring meeting. One possibility is the solid-state source, especially if a variable frequency version can be developed. Another is the phased-array antenna, which, until this year, was classified, except for theory. Still another is the parametric transistor or the tunnel diode, especially a cryogenic version. It still seems a bit too soon for a coherent plasma generator.

A dark-horse contender is a microwave-optical device, such as the Bloembergen modulator.

One informed guess is that it will be a solid-state source and/or amplifying device. The effect of high-power, high-frequency, high-efficiency solid-state microwave devices on the microwave art can be extrapolated from similar experiences at lower frequencies.

One thing is certain—microwaves will continue to unfold as a basic and versatile technique that will broaden its application with every component development.

INDUSTRIAL

preparing for computer control

THE AMBITIOUS attempts by more than two-dozen firms to apply digital-computer control to entire industrial processes will gain increased momentum during 1961. A number of new computer-controlled plants will be added to those started during 1960 and more systems will be under design.

Contrary to widely held opinion, the new equipment demands will not be for the computers themselves, but for the "missing links" which are needed to tie the computers to the processes. The variety of the "missing links" will be almost as great as the variety of industries. These range from steel mills to oil refineries, which are likely candidates for automation.

Among the types of equipment needed will be: better gas-stream analyzers, digital sensors, digital actuators, and more reliable computer-output recording devices, particularly typewriters.

Computer-System Designers Want More Freedom

Though there are available some excellent lines of pneumatic and solid-state electronic recorder-controllers (they are being used on some of the first installations), computer-system designers want more freedom. They want to be free, for example, to design all-digital control loops and hybrid, digital-analog control loops. In many cases the ideal systems solution cannot be achieved by mere adaptations of existing equipment.

This lack is becoming particularly glaring in the end point transducers and actuators which tie the control system directly into the processes. Transducer faults which have been mentioned are:

- The transducers are not sufficiently accurate.
- There are no transducers for new measurements, such as mixture ratios of slurries or catalyst activity. Such measurements are needed by the computer to perform its optimizing routines.
- The transducers are not sufficiently reliable.
- The tranducers' analog signals are not compatible with the computer's digital language.

There are similar objections to actuators.

Accompanying the systems approach to computer control will be a definite shift away from price consciousness towards reliability and performance, according to those in computer-control groups. After all, they say, it would be foolish to save a few pennies on a $100 or $1,000 "missing link" which could affect the total operation of a computer control system costing hundreds of thousands of dollars.

NUMBER 8 — NEW PRODUCTS SERIES

Newest, Smallest Bourns Trimpot® —with the square configuration

Now... Bourns reliability is in an even smaller package; these new wirewound units measure just ½" x ½" x 3/16". In addition, they offer you a choice of two terminal types—insulated stranded leads or printed circuit pins.

Because of unique package design, Model 3250 withstands the most severe environmental conditions... meets or exceeds Mil Spec requirements. Its 25 turn adjustment permits precise balancing, while the shaft head size makes possible the use of a standard screwdriver. Moreover, Bourns' exclusive clutch design, combined with positive end-stops, eliminates any possibility of damage to internal parts.

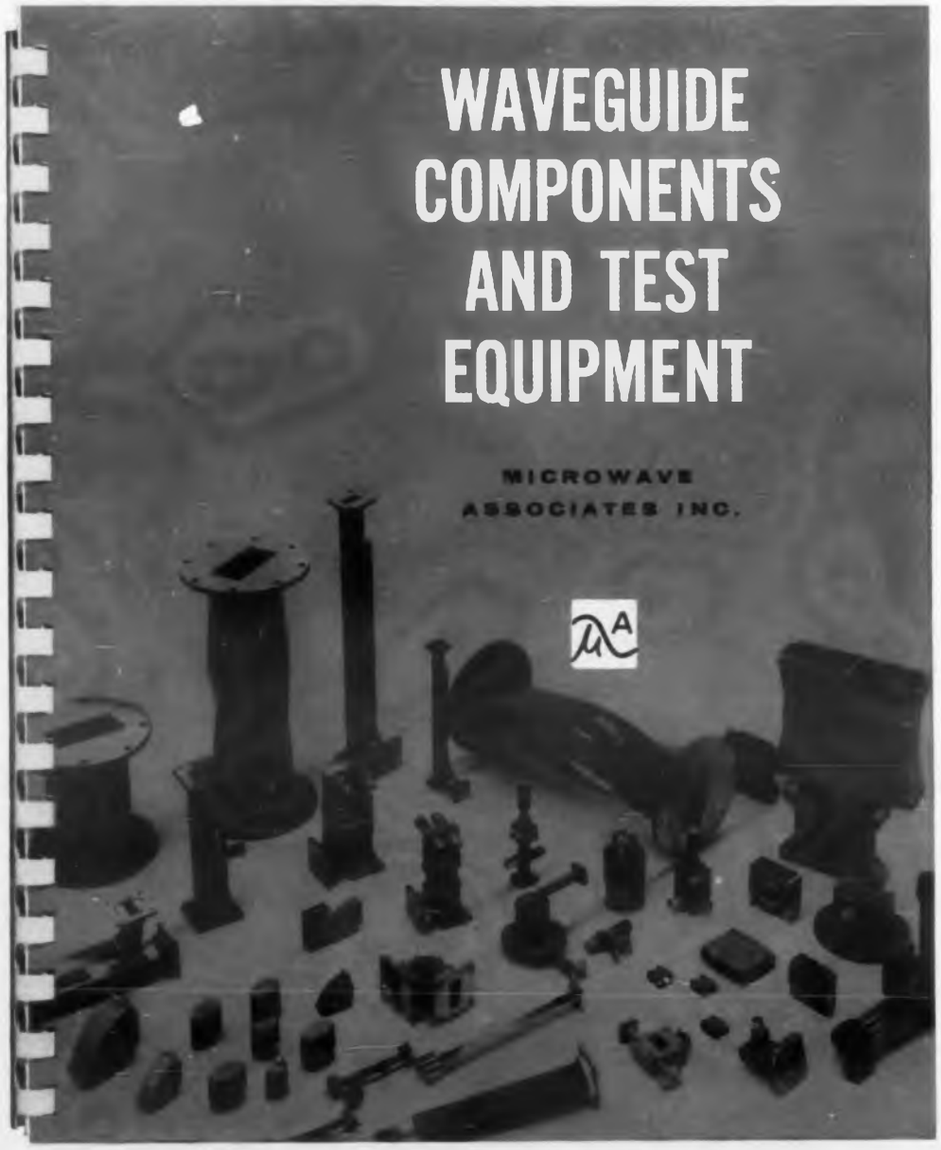
Like all Trimpot potentiometers, this new model is designed, built and tested to give you performance you can count on.

Max. Operating Temperature	Power Rating	Resistances
+175°C	1 Watt @ 70°C	100Ω to 50K

Write for complete data and list of stocking distributors.

Exclusive manufacturers of Trimpot®, Trimit® and E-Z Trim®. Pioneers in transducers for position, pressure and acceleration.

CIRCLE 31 ON READER-SERVICE CARD



AVAILABLE NOW!

Detailed specifications, application notes, photographs, and outline drawings on more than 750 Waveguide Components and Devices. Request your copy of this new 116 page catalog on your company letterhead today.

MICROWAVE ASSOCIATES, INC.
COMPONENT DIVISION
Burlington, Mass. • BRowning 2-3000 • Western Union FAX
TWX Burlington Mass. 942

CIRCLE 32 ON READER-SERVICE CARD

RFI
heightened interest

"MORE PROGRESS will be made toward controlling radio-frequency interference in the next two years than has been made in the past 10," says Henry Randall, staff assistant in the Office of Defense Research and Engineering at DOD and one of the guiding forces in the government's RFI program. Mr. Randall makes this confident statement because of three factors which have entered the RFI arena rather recently. Put bluntly, these factors are:

- More interest
- More money
- More effort

More interest was hurriedly shown when military men painfully realized that it was interference which was causing their missiles to abort, their airborne-electronics systems to counter measure themselves, their computers to malfunction, and their communications to fail. With this new interest came more appropriated money, and this, in turn, brought the greater effort currently being expended.

Effort in the year to come will continue at an increased pace the government's RFI Compatibility Program announced last June. And, there is the possibility that a single agency—a two-man Defense and Electronic Compatibility Board—will be created within the Department of Defense to coordinate and supervise the government work. Whether or not this board will be set up depends on just how opposed the government is

to establishing still another agency to do its work. However, this delayed decision should not affect the progress being made in the RFI program.

Work will continue on accumulating a library of equipment spectrum signatures (*ED*, July 6, 1960, p 4) which will be housed in the new government analysis and prediction center. To be located in the Washington, D.C. area, the center will be run by the Air Force for all the services. It will store geographical electromagnetic environment data for use in predicting the interference present at a given location.

More Specific Procedures to Implement MIL STD 449

Of considerable value to engineers in the field will be the Spectrum Signature Plan which makes more specific the broad outlines of MIL STD 449. This plan provides, for the first time, limits and numbers required for measurement procedures and techniques. Also welcomed is the plan for more clearly specifying the environmental data required for use by the analysis center.

An already apparent problem, and one of great concern, is the great length of time required to make the measurements called for by the new standards. According to John Chappell of the U. S. Army Signal Corps Research and Development Labs., Fort Monmouth, N.J., it takes 180 technician-man-hours to obtain a receiver spectrum signature according to MIL STD 449, and 100 man-hours to obtain one for a transmitter. Obviously, ways will have to be found to make these measurements more quickly. The acceptance of panoramic sweeping techniques is a strong possibility. These would be used as a "first shot" approximation and would tell rather rapidly just where spurious emissions are located.

Also to be worked on are specific standards for measuring conducted susceptibility, conjugate impedance and intermodulation distortion. The year to come may well see these standards established. And MIL STD 449 will undoubtedly be modified to reflect the knowledge gained through a year of use and application.

small

smaller

smallest

VARIAN ORTHOMODE® BALANCED MIXERS

X-Band C-Band S-Band

V-8302 A Orthomode® X-Band Balanced Mixer

Let's assume your particular design calls for the services of one of the smallest hybrid microwave mixers in the world. Must be rugged... perhaps you plan to fly it in a missile, or hook it into a back-pack radar system. Must be lightweight... something like ⅓ the weight of conventional magic-T or short-slot mixers. And must perform as well or better than big mixers.

Varian's new line of miniaturized Orthomode mixers beautifully meets these demands. Available in X, S, and C-bands, they're particularly suitable to airborne radar and missile applications where difficult packaging problems are always cropping up. And they include convenient lug terminals which permit crystal current monitoring without additional filtering.

FEATURES

- Models Cover 3.95 To 10.8 kMc Range
- Low Noise Figure
- Unusually Small Size and Weight
- Wide Band Without Adjustment
- Withstand Extreme Environments
- Simple To Install and Use

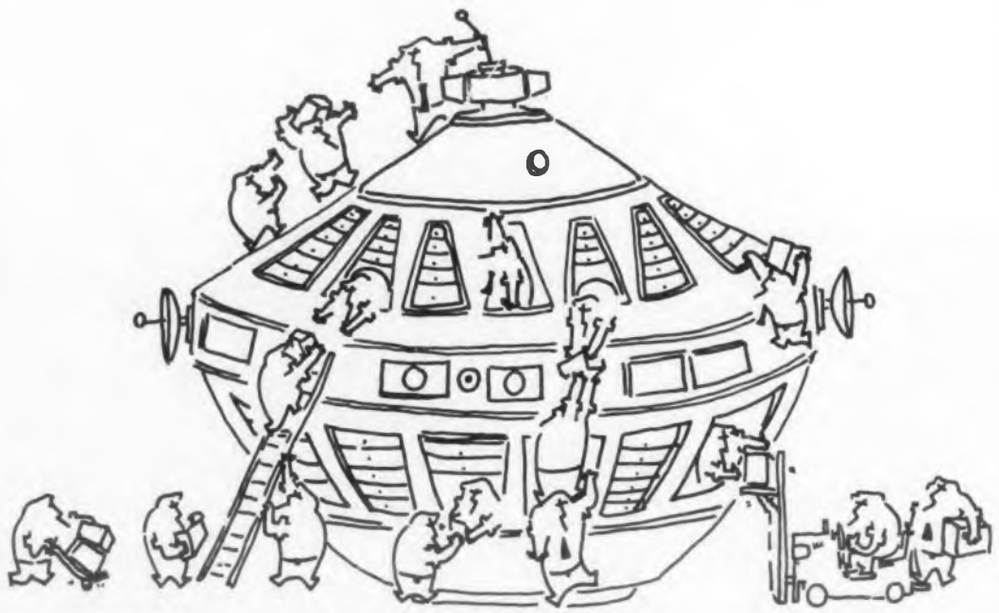
We'll be happy to provide additional technical data as to how this unique family of miniature Orthomode hybrid mixers can aid you. Just address Radiation Division.

VARIAN associates

PALO ALTO 21, CALIFORNIA

BOMAC LABORATORIES, INC.
VARIAN ASSOCIATES OF CANADA, LTD.
S-F-D LABORATORIES, INC.
SEMICON ASSOCIATES, INC.
SEMICON OF CALIFORNIA, INC.
VARIAN A.G. (SWITZERLAND)

CIRCLE 33 ON READER-SERVICE CARD



SATELLITES

more reliable electronics in heavier payloads

THIS promises to be a vintage year in the design of satellite electronics. New launch vehicles having greater payload capacities and the prospect of improved power sources will combine to give engineers a freer hand in the design of electronics for space.

The industry is now at the point where satellite payload need not be examples of the watchmaker's art. But with weight no longer the major consideration, a new design factor now assumes increasing significance.

That factor is reliability. Until now, satellites have served primarily as carriers for scientific instruments. Equipment failure was inconvenient, but a second payload could be orbited later.

The present emphasis, however, is on operational satellites which are a part of a larger system. Communication, navigation, meteorological, and reconnaissance satellites are aloft or in advanced stages of design. With entire systems dependent on satellites, failure of on-board electronic gear can have far-reaching consequences.

Thus, the elbow room available with greater payloads will very likely be devoted to more reliable components and systems rather than to extending operational capabilities through microminiaturization. The modular designs afforded by microminiaturization can be considered reliable only if there is someone available on the spot to plug in a new circuit package.

Automatic switching, the alternative to in-person maintenance, was attempted in Courier, an example of the "put-in-two-of-everything" school of design. In accordance with the principle of perverse probability, failure occurred in a switching unit. In satellites, redundancy per se does not constitute reliability.

Auxiliary power sources, including fuel cells, gas turbines, nuclear packages, and thermoelectric generators are distinct possibilities for 1961. With this in mind, designers can more freely specify tubes and other power-draining components in their payloads.

The reliability status of tubes and semiconductors in satellite applications has yet to be fully determined. Improved semiconductors are tending to be less vulnerable to radiation damage. In addition, compensating circuits that take into account the possibility of such damage are coming off the boards, but it appears that in many applications tubes still retain a definite reliability edge over semiconductors.

Design Challenges Call for New Engineering Specialty

There are real opportunities ahead for designers who can master the challenges of cost, reliability, and operational requirements in satellite electronics. The novelty of satellites has just about worn off and they are assuming the role of workaday vehicles. A separate and distinct area of design, with all its attendant challenges and opportunities, is rapidly coming into being and will require its own complement of design specialists.

A brief look at the 10-year program of the National Aeronautics and Space Administration, the keystone of our satellite activities, indicates the scope of work open to such specialists. These are the figures:

- 62 launchings for the development of launch vehicles.
- 41 launchings for missions related to manned space flight.
- 96 launchings for scientific satellites.
- 33 launchings for lunar and planetary scientific missions.
- 28 launchings for satellite applications.

This is only the civilian aspect of the U. S. satellite program and does not include such military programs as Midas, Samos, Transit, Advent, Saint, and Spad.

Satellite launchings during the coming decade should thus average about two per month. Payloads, which increased from about 10 lb in 1958 to about 300 lb in 1960, are expected to top 50,000 lb by 1967.

In all future space missions, two systems requirements will become increasingly important—communications and control. Data loads from earth orbiters, whether manned or unmanned, will be heavy. Communications relay and reconnaissance transmissions will have to be reliable, jam-proof, secure and letter-perfect.

Digital television, with its inherently high performance even with high-noise signals is a likely choice for reconnaissance vehicles, whether they transmit views of enemy missile sites or of the other side of the moon.

Traffic density for communications satellites will lead to shifts into the millimeter-wave region. Present attempts to reserve channels below 10 Gc for commercial satellite telephone links may not prove entirely successful. In any event, anticipated traffic growth will probably outstrip the capacity of low-frequency channels that are made available.

Traveling-wave tubes, rapidly improving in life and power, may soon be aboard satellites.

Their use, however, would require development of reasonably light-weight high-voltage power supplies.

Development of Optical Masers Would Aid Interplanetary Radio, Radar

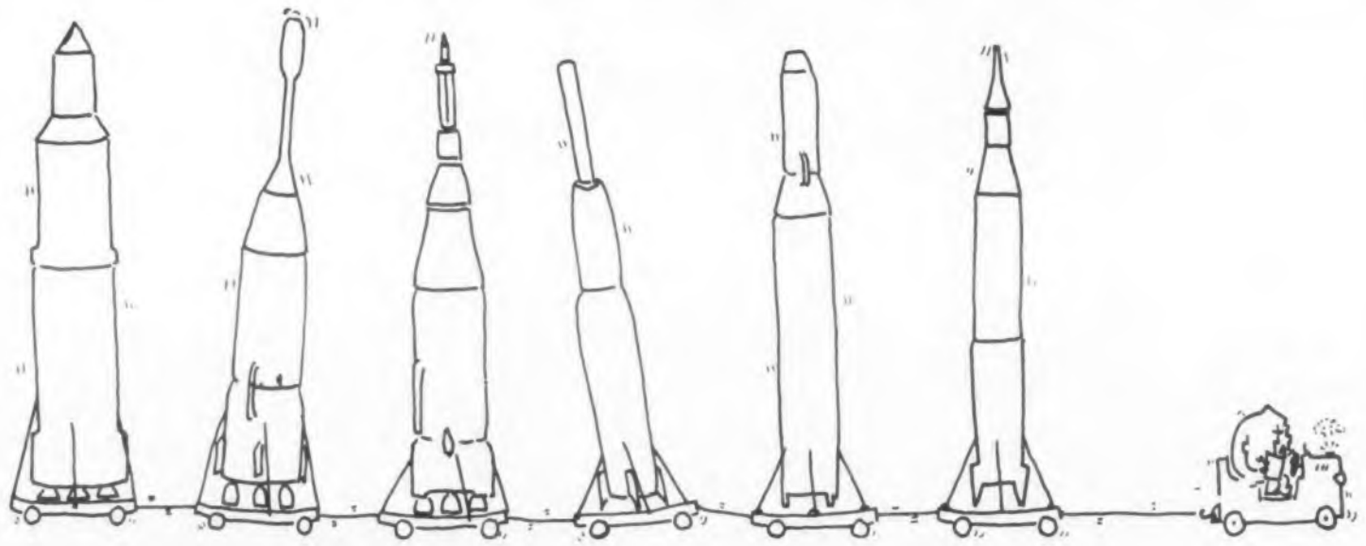
Optical-communications systems are another possibility for satellites. Optical masers and solid-state light modulators show promise of system application in the reasonably near future. Such devices would be a "natural" for satellites because of their inherently high powers and narrow beam widths. Optical masers would be most suitable for communication at interplanetary distances. Various means of modulating sunlight are also being investigated and would likewise be applicable for very-long-range transmissions.

Control of satellites in orbit and mid-course and terminal guidance of space vehicles are prime considerations in the design of upcoming space systems. The United States and the Soviet Union are both looking into weapons capable of destroying reconnaissance and early warning satellites. Without the capability for evasive action, a "spy in the sky" may not be able to accomplish its mission. Anti-satellite weapons may well be ready by the time our more sophisticated military satellites go aloft.

Maneuverable scientific satellites would unquestionably be more versatile as efficient data gatherers than would vehicles in fixed orbits. The military, however, is more likely to achieve a maneuvering capability first, with scientific satellites, and then to employ variations of such systems later.

Whether on-board or ground-based reference systems are most suitable for control of maneuvering vehicles has yet to be determined. The advantages of an independent, self-contained on-board system (if sufficiently accurate) are obvious. On the other hand, the accuracy requirements may require ground-based computers and a radar command system to effect satellite maneuvers.

Given existing lead times, 1961 appears to be the year in which systems concepts will be established for satellites to be launched well into the '60's. Lunar orbiters, lunar landers, Mars orbiters, manned vehicles, deep-space probes, and a considerable number of earth satellites will soon have their basic designs frozen. By the end of 1961 designer should have a rather clear picture of the electronic equipment that is to be on board such vehicles.



GROUND SUPPORT EQUIPMENT

services will increase their priorities

IN THEIR frantic race to close the so-called "missile gap," the armed services have generally given second priority to the design and procurement of Ground Support Equipment. The predictable result of this policy—a potentially operational missile handicapped by the quality or quantity of its associated GSE—is by now an old story.

In recent months, however, the missile-gap panic button has been turned off and the armed services are taking a close, second look at the design and procurement of GSE. The result may be a boost or a blast—depending on performance records to date—for companies in this design area. Here are a few candid comments by an Air Force officer who supervises procurement of GSE:

"Characteristically, in the past, GSE has been the forgotten stepchild, an afterthought. With the advent of ballistic missiles, the requirement for concurrent development, procurement, delivery, installation, and checkout of GSE with the flight vehicle has become mandatory for operational readiness. This means that the Air Force and industry alike must insure that management attention is given to GSE from the beginning and throughout any system's development to assure concurrent development and acquisition.

"The Air Force in 1961 will be working with industry in the following four areas:

- Better prediction and control of costs.
- Early identification of GSE requirements with the end items supported.
- Improved reliability and maintainability.
- Value engineering.

"The interface between missile and GSE requires the highest order of design integration. The increasing sophistication of the end items to be supported is requiring comparable sophistication in the GSE. The basic trend from manual operations to semi-automatic and automatic will

continue both to save time and to reduce complexity for operators."

In pushing for early design of GSE, the Air Force's major effort will be in educating industry in the latest provisions of specification MIL-D-9412, which provides the orderly means for timely identification of GSE requirements by end-item contractors.

Particular attention will be given to straightening out contract procedures for electronic equipment. According to an Air Force spokesman, late action and too little attention have been given to providing for test equipment to keep electronic end items operational.

Increasing pressure for maintenance and operation by relatively unskilled personnel will also be evident in 1961. Too often, missile sites are staffed by civilian engineers and contractor's personnel. This may be acceptable when the system is emerging from R & D to the operational phase, but is definitely unacceptable to military planners as a routine way of keeping things going.

The Air Force wants numerical predictions and proofs of reliability and maintainability. Designers will be expected to develop answers to such questions as: "What failure rate can be expected and with what confidence level?" "What will it cost to maintain equipment in terms of manpower and material?"

Value-engineering provisions will be written into large contracts and specific procedures will be established for contractor proposals for cost reductions through value engineering. Designers will do well to keep this in mind as provisions will be included by which the company will share in resultant dollar savings.

Specifications for automatic and semi-automatic checkout equipment will emphasize solid-state circuitry and magnetic tape. These requirements are based primarily on convenience of operation and maintenance as well as on power limitations in the field. Economy of space and weight are, as a rule, secondary to low power consumption. The services are not demanding the ultimate in miniaturization for GSE—and particularly not at the expense of reliability.

Solid-State Designs and Standardization Favored

Power in the field, despite much talk of fuel cells and thermoelectric generators, is still a problem, especially for mobile units. Solid-state circuitry, with its low power demands and its ability to function without air conditioning is therefore preferred for mobile GSE equipment.

Still another design trend in 1961 will be towards standardization of GSE among several missile systems. Each missile will, of course, have its own required series of tests, but computers, programers, and test instruments may approach some degree of standardization. An indication of this is the Air Force's GJQ-9 ground checkout set for the Skybolt air-launched missile. An Air Force spokesman indicated that the programer-comparator in the GSE (using solid-state circuitry and magnetic tape) could become standard equipment in all Air Force GSE. This thinking is reflected in the descriptive document for the unit, Specification MIL-P-26664.

GSE to Become AGE; Increased Funding Seen

A further indication of things to come is the new nomenclature to be adopted by the Air Force for its GSE. Henceforth, it will be designated as AGE (Aerospace Ground Equipment). This, in turn, will be functionally subclassified into OGE (Operating Ground Equipment) and MGE (Maintenance Ground Equipment).

Funding for GSE will continue its upward trend in 1961. A survey of the field indicates a total missile GSE market in FY 1962 of more than $4 billion—a $1 billion increase over the last fiscal year. The electronic share of this jackpot will top 75 per cent. Much of this money will be

CONSUMER PRODUCTS

can the u.s. designer sell them in an international market?

IMPORTING foreign radios, tape recorders, dictating machines, and other electronic items has put a serious dent in the production output of American manufacturers. Fortunately, they have created, and managed to maintain, a keen interest in audio equipment; active sales have made it possible to offset losses due to European and Far East products.

Several years ago, "high-fidelity" monophonic amplifiers, record cartridges, and tape recorders were the rage. When sales began to droop, stereophonic equipment, with its captivating appeal to the mass public, flooded the market. Salesmen claimed that the units almost sold themselves; several minutes listening to a catchy tune (with one channel output per ear) would move even the most skeptical buyer. To reduce the "false" effect created by two-channel stereo, manufacturers later included a center or "phantom" channel containing some portion of the two separate channels.

Sales again lagged but reverberation was offered early last year. An artificial echo effect, created by an electromechanical time-delay unit, was added to high-fidelity stereophonic units to achieve "concert hall" realism.

Coming— Monaural Stereo?

Stereo is a true boon to consumer-product manufacturers and their suppliers. Not just one, but two amplifier sections, speaker combinations, and other basic components are used. The only problem of serious consequence has been space in the customer's home. To overcome spouse resistance, stereo units are being offered with speakers for separate channels spaced closer and closer together. This close spacing, some adver-

for the hard-sited Titan and Minuteman missiles. There will be considerable emphasis, however, on mobile GSE for all services. Minuteman trains, Polaris, and Army tactical missiles from Lacrosse to Pershing will absorb a healthy share of the GSE budget.

Anti-missile systems, both of the Zeus and satellite types will constitute additional GSE markets in the very near future. Another potentially large client is the National Aeronautics and Space Administration, which will spend up to 25 per cent of its budget on GSE for satellites and space probes. Still further in the future is the "ultimate" in GSE—equipment for lunar bases. Design '71 may well include a section on "MSE"—Moon Support Equipment.

But for GSE designers who prefer to stay on terra firma, the future holds still another challenging prospect—no ground support equipment at all. Scientists at the Diamond Ordnance Fuze Laboratories are considering missiles with "built-in" GSE. The only external GSE would be a pocket-sized automatic monitor and programer.

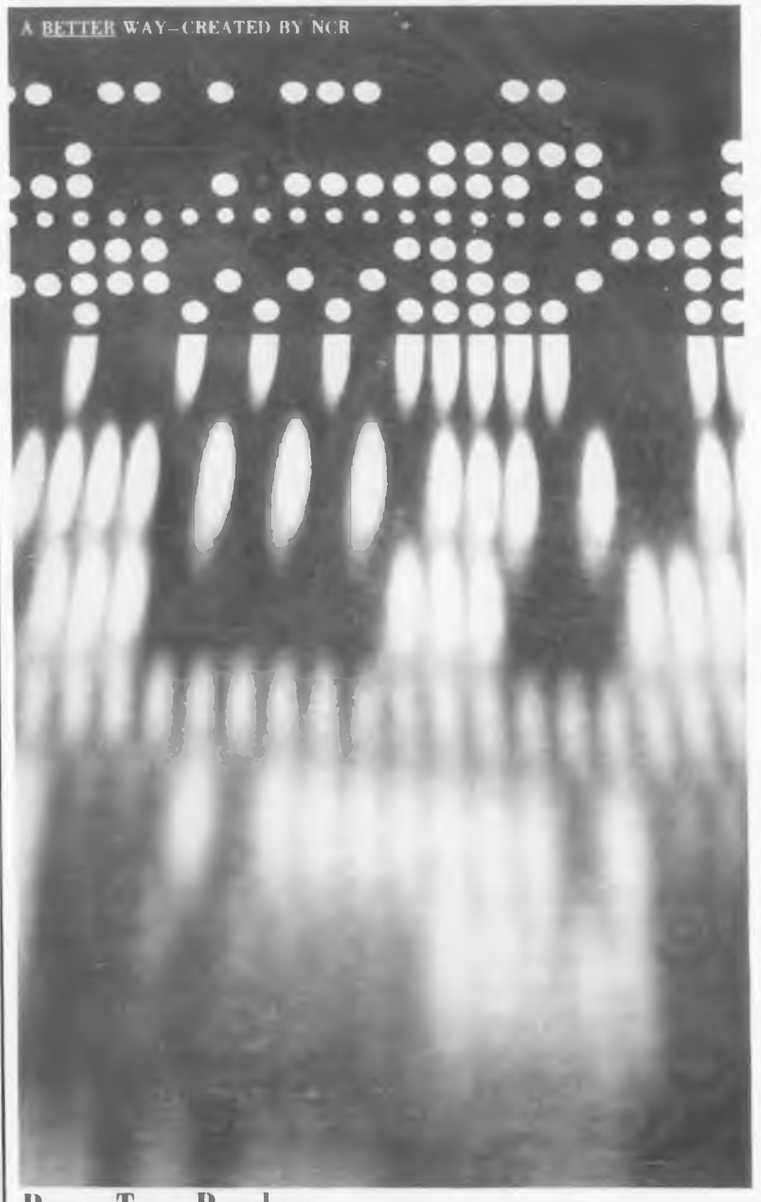
This design concept could result in missiles of instant readiness. There would be no field check-out, no manual inputs, and no test checks in the conventional sense. Several consoles of electronic gear now present in GSE would be eliminated and the missile could be reprogramed remotely up to the instant of firing.

---

tisers claim, eliminates the artificial novelty effect and brings realism closer to the listener. With speaker spacing growing smaller, industry wags are suggesting that any more creative design steps in this direction may culminate in the use of a single speaker, right in the middle.

Stereo broadcasting, soon due for an FCC decision, is eagerly awaited by the consumer-product manufacturer. Whether an AM-FM, FM-FM, or AM-AM scheme wins out is of importance, of course, but the prospect of winning additional sales in multiplex adapters, conversion units and kits or new equipment is of prime concern to the manufacturer.

Color TV shows signs of finally emerging from its cocoon and has received acclaim in many homes throughout the country. As sales increase still further, many black-and-white set makers will enter the market now covered only by RCA. When the volume reaches the wide demand of monochrome TV, design engineers with major TV manufacturers will be expected to supply clever methods to reduce circuitry, installation, and service complications. Based on past performance, costs will be sharply reduced and performance will be improved, rather than degraded, as major efforts are applied.



Paper Tape Puzzler: Start It, Read It, Check It, Stop It— At 1800 Characters Per Second!

Paper tape skims through National's transistorized 360 photoelectric reader at the unprecedented speed of 15 feet per second. Starting and stopping instantaneously at this rate without tearing the tape was an electromechanical problem of the first order.

In solving it, NCR Electronics Division engineers developed a unique direct drive which has independent "bang-bang" servo motors for feed and take-up reels. Conventional clutching is eliminated. A 3-foot section of tape remains slack for safe, low-inertia starts, and a photoelectric system reads and checks data at high speed. Once the last character in the desired record is sensed, the sapphire-hard Sanfordized aluminum brake stops the tape without permitting overshoot to the next character.

To create advanced digital systems, NCR scientists and engineers probe every promising area of technology. If you can make imaginative contributions in any of the pertinent fields, it may well be to your advantage to investigate the expanding opportunities at The National Cash Register Company Electronics Division now.

CIRCLE 34 ON READER-SERVICE CARD

DIGITAL COMPUTER ENGINEERS—

COMMERCIAL EXPANSION AT NCR CREATES OPENINGS IN LOS ANGELES FOR:

COMPUTER ENGINEERS
Seniors & Intermediates

Experienced graduate E.E.'s with 3 to 5 years in logic design and transistorized circuit design of digital equipment. Assignments will entail logic and circuit design of buffer storage units and digital peripheral equipment.

TRANSISTOR CIRCUIT ENGINEERS
Seniors & Intermediates

Highly creative positions are available in circuit analysis and design. Duties include: advanced mathematical studies in transistor circuitry, evaluation of transistor circuitry, component studies and keeping abreast of computer circuit advances. Circuit analysis ability and solid understanding of transistor theory essential. E.E. degree required.

PRODUCT ENGINEERS
Seniors & Intermediates

Assignments entail design analysis and technical liaison to develop a producible product; establishment of design requirements from a standpoint of cost, product ability and standardization; recommendation of changes for ease of manufacture. Positions require substantial knowledge of manufacturing methods, practices, shop equipment and facilities; solid background in electronic design of digital equipment; E.E. degree.

SYSTEMS ENGINEER

Experience required in formulating functional design specifications for digital computer systems (buffer storage, punch card, paper tape, magnetic tape, random access devices, system organizations, command structures). Training in logical design, data-handling methods and programming techniques desirable. Assignments entail formulating functional specifications for business computers.

SYSTEMS TEST ENGINEERS

A responsible position entailing co-ordination of scheduling and utilization of both unit and systems test programs. Originate and analyze test requirements; supervise testing and analysis; recommend changes in design specifications and requirements. Determine validity of test data. Requires E.E. degree plus good knowledge of mechanical engineering, instrumentation, and design engineering.

TRANSISTOR POWER SUPPLY ENGINEER

For assignment in specifying power supplies for both large and small digital systems, supervising the design of supplies internally or by vendors, and evaluating supplies to determine conformance to specifications. Requires knowledge and design experience in solid state computer power supplies, their specification, and associated transistor circuitry. Requires experienced graduate E.E. or man with formal training and appreciable practical transistor power supply experience.

Please submit resume to
Norval E. Powell, Personnel Manager

National*
The National Cash Register Company
ELECTRONICS DIVISION
1401 E. El Segundo Blvd.
Hawthorne (Los Angeles), California
PL 7-1811
*TRADEMARK REG. U.S. PAT. OFF.

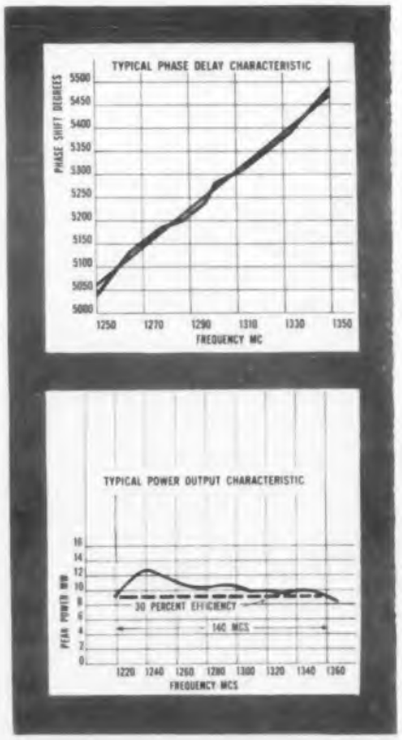
New Broadband Klystrons

140 MEGACYCLES - (1db) BANDWIDTH AT L-BAND
10 MEGAWATTS - PEAK POWER OUTPUT

New additions to the Litton Industries Broadband Klystron family extend broadband performance to even higher power levels as shown in the typical performance curves to the right. These tubes, like all those produced by Litton Industries, are conservatively designed and rated; and rigorously processed to provide many thousands of hours of reliable operation. Using Litton developed broadbanding techniques, it is now possible to achieve wide bandwith, high peak and average rf power output and linear phase shift versus frequency characteristics simultaneously. This latter feature enables the radar equipment designer to utilize pulse compression techniques to attain improved system performance.

Litton Klystrons providing these outstanding performance characteristics can be supplied in both the L and S-bands at peak rf power levels ranging from 2 to 20 megawatts. Typical of the performance obtained with Litton Klystrons is that of the L-3035, a 2.2 megawatt L-band Klystron, whose average operating life in field service is approaching 3,000 hours. Some of these tubes are continuing to provide excellent service after having operated for more than *17,000* hours.

Should you require high power broadband amplifier tubes to satisfy your system requirements, please write to us at Litton Industries, Electron Tube Division, 960 Industrial Road, San Carlos, California. Our telephone number is LYtell 1-8411.



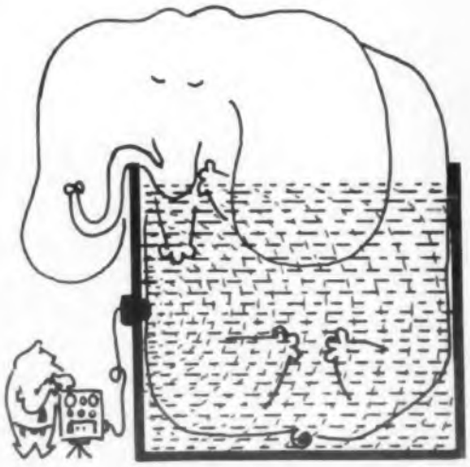
LITTON INDUSTRIES
Electron Tube Division
MICROWAVE TUBES AND DISPLAY DEVICES

"Capability that can change your planning"

CIRCLE 35 ON READER-SERVICE CARD

ULTRASONICS

on top, other uses coming



THE fastest-growing portion of ultrasonics during 1961 will be industrial cleaning, according to a survey of well-known firms in the field. Those in this $10 million-sales-per-year field believe they have reached a turning point—today's ultrasonic cleaners really work.

As one spokesman put it, "Five years ago only one half of our installations really ended up doing the cleaning job they were sold to do. Now we know enough and have the equipment to make almost every job successful, and industry wants our equipment."

The improvements in cleaning ability have been accomplished in different ways by different companies. Branson Ultrasonics of Stamford, Conn., one of the largest manufacturers in the field, has gone to lower frequency (25 kc) operation with lead-zirconate-titanate (PZT) transducers. With these, they achieve conversion efficiencies of 90 per cent, and by better bonding of the transducer assemblies to the tanks, and better use of the liquid cleaning mediums, they have correspondingly improved the cleaning action.

Gulton Industries, Inc., Metuchen, N.J., which up to this time has been mainly a ferroelectric transducer supplier, is coming out with a 24-in.-

by-24 in. lead-titanate-lead zirconate transducer capable of producting 10-kw outputs at 90 per cent efficiency.

Dr. Leslie K. Gulton, president, agrees that there is an industry trend toward cleaning-equipment manufacturers purchasing transducers as assembled packages. But he believes that ultimately users will attach external units to the outside of their cleaning tanks. "This will be a direct result of the ease of installing larger, single-piece transducers," Dr. Gulton said.

Another trend in the cleaning field has been toward large ($10,000-$100,000) cleaning units complete with material-conveying systems.

Expanded Use Seen in Welding-Machine Instrumentation

Elsewhere in ultrasonics, the interest is distributed among a very wide variety of applications. Ultrasonic welding of thin films, medical therapy and instrumentation, burglar alarms, and remote TV tuning are some of these.

Many in the field believe that, among these many application possibilities for ultrasonics, those applications which will grow fastest during 1961 will be in areas of industrial and military control. Ultrasonics appears to be able to do some sensing jobs (and do them in unfavorable environments) which cannot be accomplished by other means. The fact that these transducers are solid state and can operate in digital manners may make them attractive for some of the "missing links" mentioned in this report's section on industrial computer control.

A list of possible ultrasonic sensor and actuator applications will indicate how extensive these could be:

- Flowmeters for radioactive or corrosive liquids.
- Vibration actuators to cause powders to flow down pipes.
- Catalyst-activity promoters.
- Burning rate promoters (control for solid rockets).
- Emulsifiers.
- Controls for crystal formation during metal solidification.

One example of a field where this type of equipment could be useful is food processing. Here the lack of non-direct-contact, end-point transducers has been an obstacle to electronic control.

SPECIALISTS IN THE 3 C's OF ELECTRONICS

CABLES

Complete versatility of design plus extra reliability characterize Bendix® Cable Assemblies. Types include encapsulated or braided missile control cable, thermocouple harness, fuel cell, ground cabling, high temperature, and flat conductor cable.

CAPACITORS

Count on Bendix High Temperature Capacitors for premium performance on missile and high-speed aircraft applications. Proved operation from −55°C. to +400°C. with no voltage derating and low capacitance variation.

CONNECTORS

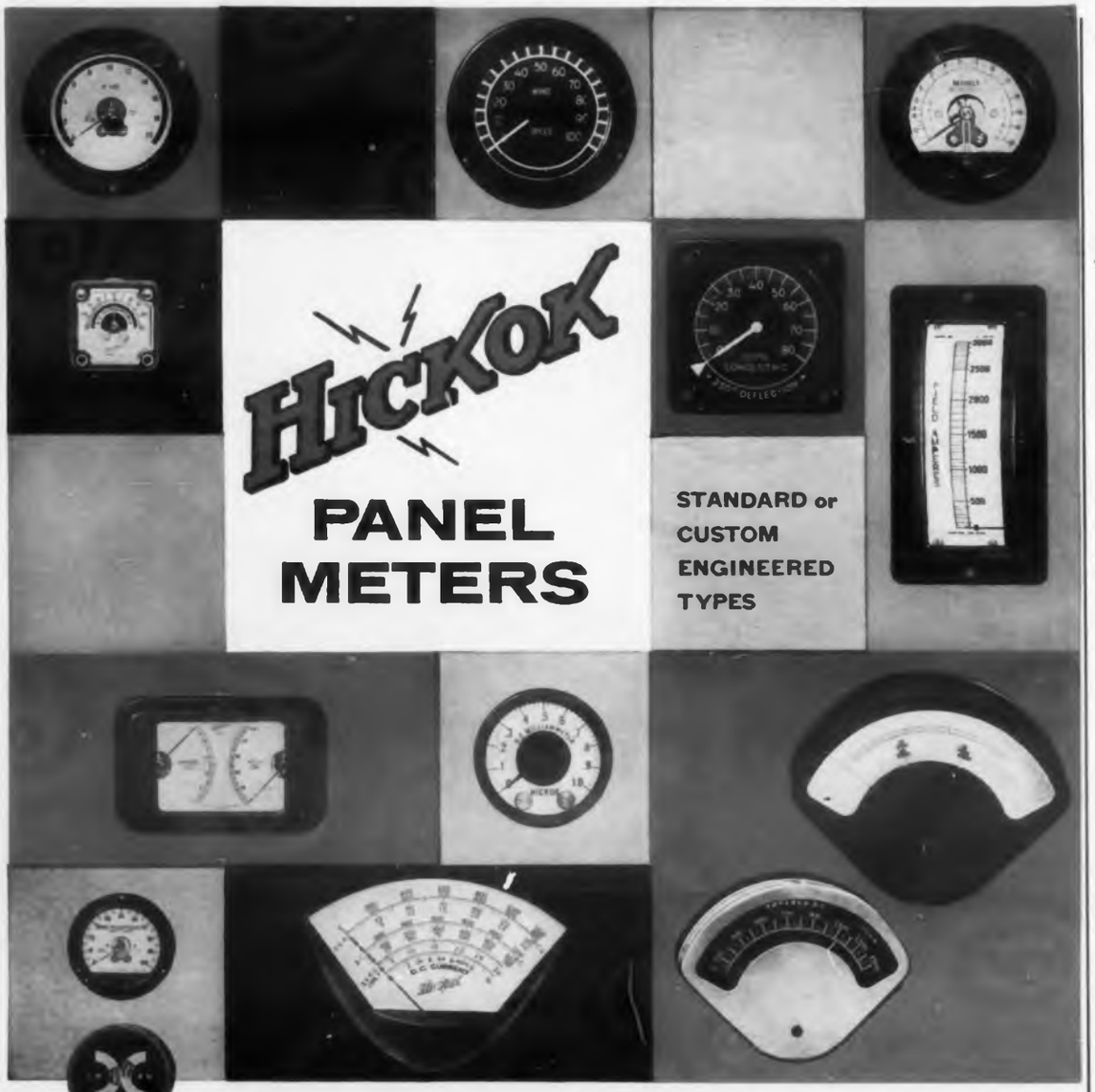
Can you use the finest electrical connectors in the business? Then try ours. Wide range of sizes and types available, including Pygmy® Miniature, Rack and Panel, QWL, and MS-R, and connectors for special applications.

For fast service on Cables, Capacitors, and Connectors, contact:

Scintilla Division
SIDNEY, NEW YORK

The Bendix Corporation

CIRCLE 36 ON READER-SERVICE CARD



Over the past half-century, HICKOK-pioneering in electrical indicating meters has resulted in such important developments as . . .

- √ **Perfection of the internal pivot movement**
- √ **Development of the miniaturized long-scale (250° angular deflection) panel meters**
- √ **Origination of the sub-miniature (1" diameter) long-scale ruggedized meter**
- √ **. . . and, the latest break-through . . . ultra-sensitive class 0.5 Hickok Taut-Band Suspension (friction-free) panel meters.**

In close cooperation with leading engineers in the aeronautical, nucleonic and electronic fields, Hickok has repeatedly produced meters of the highest reliability in unique, complex designs for custom instrumentation requirements.

Whether your instrumentation requirements involve meters of standard or special, custom engineered design, a Hickok Engineer is ready to help you. There is no obligation. Write for full technical information.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY | **10525 Dupont Avenue Cleveland 8, Ohio**

CIRCLE 37 ON READER-SERVICE CARD

RELIABILITY

'pay now, save later'

THE "pay-now-save-later" philosophy will be taking hold of those responsible for providing reliability in both military and commercial equipment.

Among the motives behind this trend are:

- The ever-increasing- complexity of electronic equipment.
- The ever-increasing performance capabilities demanded of military equipment.
- The growing realization that maintenance and replacement costs, compared with the initial cost of a piece of equipment, are usually very high.
- The continuing need to avoid the loss of extremely costly aircraft and missiles through malfunctions.

Those in industry who are deeply involved with reliability are looking for two important developments in 1961.

- Suppliers who have actual reliability programs in effect will be in a much better position to satisfy the military reliability market.
- Customers will seek more guarantees of engineering competency in design parameters, in inherent reliability of circuits, component ratings and end-product performance.

There will be greater recognition of the role of maintainability in promoting systems worth and the capacity for down-time reduction via designing for ease of maintenance. Along with this, there will be a greater emphasis on knowing, understanding, measuring, and controlling failure modes.

Although reliability experts agree that much progress has been made, they readily admit there is still much to do. Their estimates of which are the most important problems vary. These two, however, are among the most often mentioned:

Further understanding has to be developed of the Parts Specifications Management for Reliability (PSMR) report to DOD.

The PSMR report must be implemented. It is now being reviewed by the military departments as well as by such industry groups as the AIA and EIA. The military departments have each designated two people to work with the Office of the Secretary of Defense, to plan the necessary implementation actions.

SYSTEMS

a new era of complexity

THE BIGGEST noise ever heard in the state of Florida will be the blast-off of the first U. S. true space vehicle, Saturn C-1. Although all but the booster stage will be dummy, the sight and sound of this 18-story building moving up from its pad at Cape Canaveral next fall will undoubtedly be the most awe-inspiring takeoff in history.

With the hoisting of the million-pound marvel beyond the earth's atmosphere, a new era of system complexity will begin. For the first time, a digital computer which can achieve at least limited flight objectives with up to four engines inoperative will be in command of the complex gimbaling and tank-feed switching operations of an eight-engine space vehicle. Telemetry for

200th Birthday

OF A.W.FABER-CASTELL ...

1761-1961

Producers of the nearest thing to perfection in a drawing pencil

It is customary, on the occasion of a company's bicentennial, to talk about the traditions that made it great.

Nothing would make us happier than to talk about A.W.FABER-CASTELL's distinguished history. But it may be more important if we pointed out how CASTELL drawing pencils can further your career.

CASTELL's Black Gold graphite allows a creative man to express his profoundest ideas. It gives such a bold, black image, such density saturation, that sharp, crisp drawings are assured. Its light-proof adhesion produces the highest number of sharp prints per drawing — without loss of detail even after hundreds of reproductions.

CASTELL's low index of friction gives you smooth, chisel-point strokes and needlepoint for the most exacting detail. Its close-textured lead has great strength. The lead won't crumble, the wood won't splinter, even under heavy pressure.

CASTELL is consistently uniform — identical in every degree, from 8B to 10H. You can go back to an unfinished drawing months — even years later — without change in line width or color.

Because of this unvarying excellence, CASTELL is the nearest thing to perfection man has ever put into a drawing pencil. For the sake of your own career, you'd be wise to join the A.W. FABER-CASTELL family.

For those who prefer a lead holder, **#9800 SG Locktite Tel-A-Grade,** *with no-slip, functional grip gives you smooth traction and blessed comfort to your tired fingers* ■ **Castell Drawing Leads #9030,** *of identical quality and grading as Castell drawing pencils* ■ *Usable in all standard holders, but a perfect mate for Locktite* ■ *Available in a full range, from 7B to 10H, and a kaleidoscope of colors* ■ *Draws perfectly on all surfaces, including Cronar and Mylar base films* ■

A.W.FABER-CASTELL Pencil Co., Inc., Newark 3, N. J.

OUR BICENTENNIAL YEAR — 1761 - 1961 ★ 200 YEARS OF UNINTERRUPTED MANUFACTURING EXPERIENCE.

CIRCLE 38 ON READER-SERVICE CARD

this first flight will not include the 900-parameter transducing complex of the completed system, but will be formidable enough.

With a lead time incredibly short for so large a system, the 50-ton BQQ-1 long-range sonar is expected to make ASW history in fleet trials aboard the SSN Tullibee this year. The transducers form a stem-to-stern phased array of lead-zirconate-titanate that is reportedly capable of 70-mile ranges. What such a system will mean to the operations research of submarine search is that a good part of the enemy submarine's advantage of invisibility will have been overcome. The awesome threat of an enemy missile-firing nuclear submarine will have lost some of its deadliness by the end of 1961.

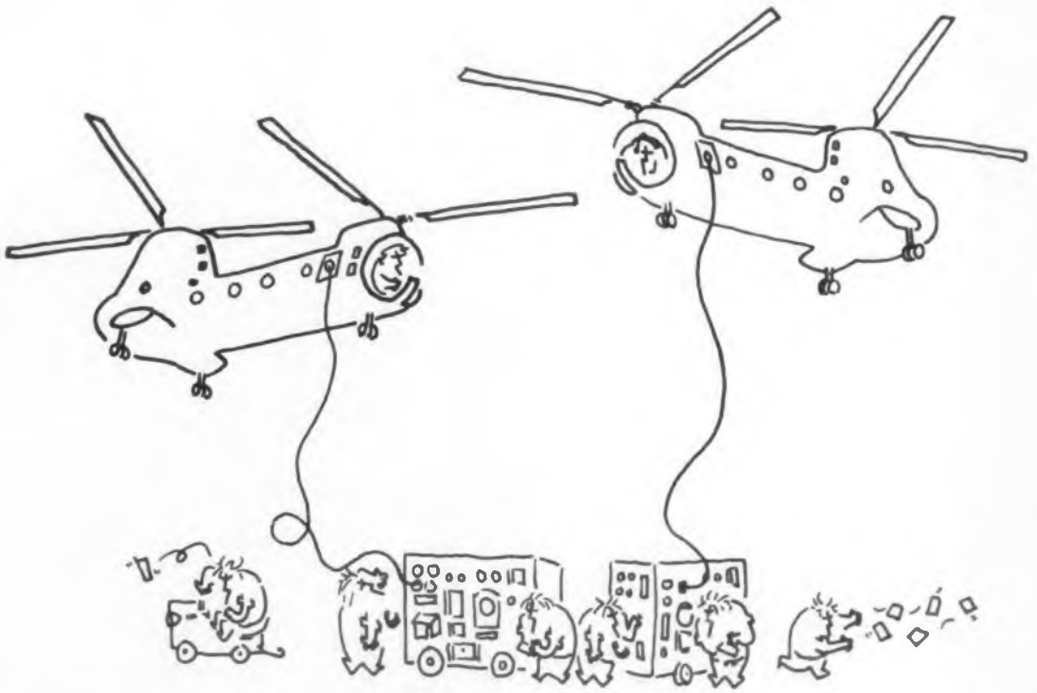
Progress in non-acoustic detection systems is expected to rise sharply this year as well. Work on airborn-magnetic anomaly detection and infrared detection systems, which can cover a lot of the ocean surface by virtue of aircraft speed, will be pressed forward during 1961. Indications are implicit that some substantial detector breakthrough has been made or is expected to be made shortly.

The prediction by Rear Adm. L. M. Mustin, antisubmarine-warfare readiness executive of the Navy, of increased spending in ASW electronics will be felt this year. Missouri Sen. Stuart Symington's views on the importance of ASW are well known, as is Vice President-Elect Lyndon B. Johnson's attitude toward defense.

Space Guidance Systems Of Many Types to be Tested

An enormous variety of system approaches will be in evidence in space navigation systems tested this year. Many exotic systems will be "ripening" from advanced study programs. One that might be reduced to hardware by year-end, at least in part, is a Raytheon advanced doppler system designed for soft landings on planets. Frequencies used are 10 to 14 Gc and 34 to 36 Gc. A range of 100 nautical miles at 25,000 fps velocity is planned. To obtain a reasonably narrow return spectrum under these conditions, a spectrum-compression scheme involving frequency sweep in synchronism with forward motion is used. This approach also aids in getting through the plasma sheath at high-speed passage through planetary atmosphere.

The gyroless all-optics guidance systems, studied by Perkin Elmer during 1960, may reach the hardware stage this year. Any corner of technology, it seems, may appear in this year's space navigation and guidance systems.



CHECKOUT EQUIPMENT

universal, low-cost, mobile systems needed

TRENDS to be watched for during 1961 include the increasing demond for inexpensive, "almost universal" checkout equipment, the move toward mobile testing gear and more reliability in the test and maintenance equipment itself.

According to a recent survey of policymakers in the Army Rocket Missile Agency (ARMA), NASA, WADD and the Pentagon, special-purpose test equipment is ending its heyday. Managers are looking toward multipurpose checkout equipment for future systems. "Every program seems to end up with different checkout equipment," says Consolidated Systems Corp's electromechanical systems manager, Wayne Whistler. "When a prime contract is let, automatic checkout is usually part of the contract. Now project engineers and managers are beginning to get unhappy. They want standardization of checkout equipment which can be used for many systems rather than just one."

But a prime obstacle is expense. So far multipurpose test equipment (MTE) has proven expensive. Systems managers are looking for a middle-road basic checkout equipment that can be purchased for low prices with facilities for connecting to it "adaptive" units to check out more exotic types of systems.

During 1961, the design engineer will hear more about mobile test equipment. Formerly, missile pads were so few that all test gear could be enclosed in stationary sites at the firing location. But with more missile bases being built, it is no longer economical to set up a test center at each pad. Mobile equipment will move from pad to pad on hard sites.

This trend poses problems for designers in making precision equipment to operate under severe conditions, an environment must be provided for the operators and for the equipment or the equipment must be made impervious to shock, vibration, and road conditions and able to operate from available power sources.

With solid-fuel missiles gaining favor among military men, new kinds of checkout equipment must be evolved. The main point here is that while mechanical parts of the test units—fuel valves, pressurized tanks, mechanical transducers, stainless-steel piping, and the like—consumed

a large part of the alloted funds checkout equipment. Now the electronics part will be the major expense.

Up to this point, the main consideration in military contracting was reliability for the missile itself. According to Mr. Whistler, this will still be true but a great deal more emphasis will be put on the ground-support equipment itself, which will be made more reliable during 1961.

TELEMETRY

even greater challenges ahead

NEW SYSTEMS approaches and techniques will greatly affect telemetry in the year to come. The impetus for these changes is the shift from missile system to spacecraft instrumentation and communications. Standardized approaches, adequate for missile guidance and most industrial applications, are inadequate for the problems of outer space.

Current technical trends in space communications as pointed out by J. F. Koukol, head of Jet Propulsion Laboratory's Communication System Development Section, include the tendencies to:

- Perform the command, ranging, data transfer, and tracking functions over a simple two-way radio link, rather than over a number of separate links
- Develop more powerful mathematical-analysis techniques for obtaining near optimum design for maximum communication efficiency.
- Apply coding theory to obtain improvements in communication efficiency.
- Minimize spacecraft system complexity and put most of the instrumentation in the ground receiving station.
- Rely on "on-board" data processing, which promises to increase the useful data transfer by a factor of more than 1,000.

Max Lowy, chief systems engineer of Data Control Systems, Inc., Danbury, Conn. adds to this list when he foresees that ground receiving stations will soon be using parametric and maser amplifiers to increase the range of space probes without appreciably increasing their radiated power. He also sees tunnel diodes being used to help reduce component complexity and anticipates the use of pre-detection and frequency-translation techniques with presently available tape recorders.

As equipment reliability increases, adaptive techniques will be used to reduce the bandwidth and power requirements for data transmission. Self-adaptive systems will require methods now used by computers to make decisions on which

SILICON NEWS from Dow Corning

(PART 1)

The Untouchables

Hyper-Pure Silicon... Silicon So Pure Just a Touch Contaminates Its Quality

The highest purity attained in any element refined by man . . . purer than any element found in nature! That's Hyper-Pure Silicon.

With less than one part per billion of boron, Dow Corning Silicon is so pure that just the touch of a finger tip causes contamination — destroys its high quality.

To assure this untouchable purity when you receive them, Dow Corning polycrystalline rods are wrapped in special unbleached cellophane and sealed in airtight polyethylene envelopes.

Purity pays off in quality — in uniformity of properties . . . in relatively flat resistivity and lifetime profiles for the entire length of single crystal silicon grown from Dow Corning polycrystalline rod and chunk . . . in maximum yield.

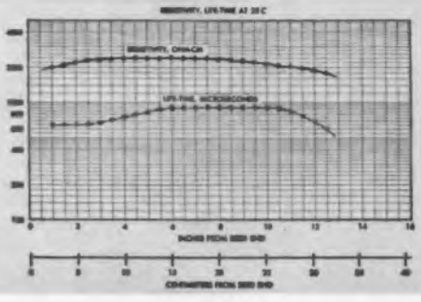
Specify polycrystalline rod if you use the zone refining process for conversion to single crystal — polycrystalline chunk if the Czochralski method is used. Both are of the same high quality.

Why is Dow Corning able to supply this untouchable quality?

Dow Corning has nearly twenty years experience in the production and purification of trichlorosilane, a chemical basic to both *Silicones* and *Hyper-Pure Silicon*. This experience, plus a fully integrated production facility, assures uniformly high quality — minimizes batch to batch variations.

For more information contact our nearest regional office, or write direct.

Typical properties of Dow Corning polycrystalline silicon, together with resistivity and life-time curves for an evaluation crystal, are shown below.



Typical Properties of Polycrystalline Silicon

Acceptor Impurity Content:	0.15 part/billion
Donor Impurity Content:	0.5 part/billion
Rod Diameter:	up to 26 mm (1.0 in.)
Rod Length:	up to 450 mm (17.7 in.)
Resistivity (vacuum zoned evaluation crystal):	>1000 ohm cm
Lifetime (vacuum zoned evaluation crystal):	>400 micro sec.

Free brochure — "Hyper-Pure Silicon for Semiconductor Devices." Write Dept. 3313.

HYPER-PURE SILICON DIVISION
Address: HEMLOCK, MICHIGAN

Dow Corning CORPORATION
MIDLAND, MICHIGAN
ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

CIRCLE 39 ON READER-SERVICE CARD

data should be transmitted and at what time. Data would not be transmitted during periods when it is not of interest. This will, therefore, allow a system to measure many more parameters without extending the bandwidths.

Electronic Multiplexing to Replace Mechanical Methods

With the growing availability of high-quality switching transistors at lower prices will come the increased application of electronic, rather than mechanical multiplexing. Walter O. Frost, deputy chief of the Telemetry Systems Section of the George C. Marshall Space Flight Center, Huntsville, Ala. cites this development as presenting a lucrative opportunity for telemetering-equipment manufacturers to produce solid-state subcarriers and multiplexers at moderate cost.

At current prices, using transistorized subcarriers instead of the tube-type subcarriers, and solid-state multiplexers instead of mechanical sampling switches in an FM-FM telemetering system, typically adds 25 per cent to the system cost.

As far as system concepts are concerned, FM-FM telemetry and its variations—PAM-FM-FM and PDM-FM-FM—will continue to be work horses in the telemetry field. There will, however, be an increasing trend toward the use of digital-transmission techniques, particularly where greater accuracy is required, or where data originates in digital form. The PCM system is highly suited for these applications but presents problems of system complexity. Future systems will tend to incorporate PCM techniques into hybrid systems. Such a hybrid could incorporate high-frequency, 2 to 3 per cent accuracy, FM channels; 1 per cent-accuracy, low-frequency, pulse-amplitude channels, and 0.1 to 0.5 per cent accuracy, low-frequency, pulse-coded, channels.

A new telemetering system will also be available in 1961. Designated the SS-FM (single sideband subcarriers on an FM carrier), the system will provide transmission capacity for vibration and wideband data. It permits transmission of approximately 45,000 cycles of data bandwidth at an accuracy of 5 per cent on the same carrier bandwidth now used by an FM-FM link. Engineers at the Marshall Space Flight Center, who developed the system, cite this as a 10-fold improvement in bandwidth utilization efficiency.

Insulation of "Mylar" gives capacitors longer-lasting stability under high humidities

Punishing, hot, humid atmospheres like those in the test chamber above have little effect on capacitors insulated with "Mylar"* polyester film. These capacitors have remarkable stability and longer life, because "Mylar" is much less sensitive to high temperatures, changing humidity and aging than other commonly used insulating materials.

Capacitors made with "Mylar" meet the highest standards of reliability, yet are frequently smaller and less costly than other units. Thinner insulation can be used, because of the exceptionally high dielectric strength of "Mylar". And "Mylar" reduces the need for costly encapsulation because of its remarkable resistance to moisture.

Whether you manufacture or buy electrical products, you can get improved performance with "Mylar". And, figured on a square-foot basis, "Mylar" will often cost you less than your present material. For full facts on "Mylar", write for free booklet. E. I. du Pont de Nemours & Co. (Inc.), Film Department, Rm. No. 14, Wilmington 98, Del.

Tough, thin "Mylar" has this unique combination of properties for superior insulating performance:

- Average 4,000 volts per mil dielectric strength (Per ASTM D-149). Average power factor of 0.002 at 60 cycles.
- Thermal stability from -60°C to Class B range.
- Chemical and moisture resistance.
- Resistance to aging, abrasion, tearing and rotting.

IN MOTORS — Insulation of "Mylar" cuts size and weight, improves moisture resistance . . . at no increase in cost.

*"Mylar" is Du Pont's trademark for its brand of polyester film.

DU PONT

Better Things for Better Living . . . through Chemistry

DU PONT MYLAR POLYESTER FILM

CIRCLE 40 ON READER-SERVICE CARD

CIRCLE 41 ON READER-SERVICE CARD ➤

ASSEMBLE THIS PAGE INTO YOUR POCKET-SIZE SELECTOR FOR TRANSITRON SILICON RECTIFIERS

ASSEMBLY INSTRUCTIONS:
Tear this page, along the perforations, into 4 pieces. Fold the largest piece along the creases and glue flap to make chart sleeve. Slide the piece with the applications data inside sleeve, matching the peak inverse voltage rating numbers at top of each column.

Just tear along the perforations and assemble your own convenient sliding chart. It will help you select the quality Silicon Rectifier you want from industry's broadest line with ease and accuracy.

- **UP TO 100 AMPERES AVERAGE CURRENT**
- **PIV RATINGS TO 10 KV AND HIGHER**
- **TOP QUALITY AND RELIABILITY**
- **VOLUME PRODUCTION PRICES**

For more detailed information on the complete line of Transitron Silicon Rectifiers, fill in and send us the tear-out postcard.

For fast service, call on the Transitron distributor nearest you. He has a complete shelf-stock of Transitron Semiconductors, in quantities of 1-999.

Transitron
electronic corporation
Wakefield; Melrose; Boston, Massachusetts
Offices in principal cities throughout the U.S.

AVERAGE FORWARD CURRENT (Amperes)	TEMP C *	PKG	PEAK INVERSE VOLTAGE RATING (VOLTS)				
			50	100	150	200	250
.075	150A	G		1N676		1N678	
.150	150A	G		1N677		1N679	
.150	150A	G				1N645	
.200	150A	K	1N3072	1N3073	1N3074	1N3075	1N3076
.200	150A	J	1N2013	1N2014	1N2015	1N2016	1N2017
.200	150C	M1		1N340		1N337	
.200	150C	M1		1N349		1N346	
.250	150A	L	1N536	1N537		1N538	
.250	150A	L		1N440B		1N441B	
.250	150A	K	TK5	TK10		TK20	
.300	100A	L	1N599	1N600	1N601	1N602	
.300	100A	L	1N599A	1N600A	1N601A	1N602A	
.400	150C	M1	TM5	1N348		1N345	
.400	150C	M1		1N339		1N336	
.400	150C	M1				1N254	
.600	150C	M1		1N1115		1N1116	
.800	100‡	M1	1N607	1N608	1N609	1N610	
1.0	100C	M1	TM1	TM11		TM21	
1.0	100A	K				TK21	
1.0	150C	M1	1N2026	1N347		1N2027	
1.0	150C	M1	1N1537	1N1538	1N1539	1N1540	
1.0	150C	M1		1N338		1N1124A	
1.0	150C	M1		1N253			
3.0	150C	M1	1N1581	1N1582		1N1583	
5.0	150C	M2	1N1612	1N1613		1N1614	
6.0	150C	M2	1N2491	1N2492		1N2493	
6.0	150C	M2	1N1341	1N1342	1N1343	1N1344	
10.0	150C	R	1N248	1N249	1N2021	1N250	1N2022
12.0	150C	M2	TM9	TM19		TM29	
12.0	150C	M2	1N1199	1N1200	1N1201	1N1202	
20.0	150C	R	1N248A	1N249A	TR152	1N250A	TR252
20.0	150C	R		1N249B		1N250B	
35.0	150C	R	TR53	TR103	TR153	TR203	TR253
35.0	150C	R	1N1183	1N1184	1N1185	1N1186	
50.0 100.0	150C) 95C)	H	1N411B	1N412B	TH152B	1N413B	TH252B

Transitron FIELD OFFICES

BALTIMORE, Maryland
2519 Maryland Ave. Chesapeake 3-3220
BOSTON, Massachusetts
168-182 Albion St.
Wakefield, Mass. CRystal 6-5640
CAMDEN, New Jersey
227 S. Cuth St. WOodlawn 6-7877
CHICAGO, Illinois
6441 W. North Ave.
Oak Park, Ill. Village 8-5556
CLEVELAND, Ohio
14625 Detroit Ave.
Lakewood, Ohio ACademy 1-9191
DALLAS, Texas
P.O. Box 15003, 511 Branniff Airways Bldg.
Dallas 35, Texas FLeetwood 7-5448
DAYTON, Ohio
379 W. First St. BAldwin 4-9651
DENVER, Colorado
First National Bank Bldg.
621 Seventeenth St. AComa 2-1686
DETROIT, Michigan
2442 West Grand Blvd. TRinity 5-2440
KANSAS CITY, Missouri
Anthem Bldg.
31st and Troost Sts. Valentine 1-1819
TORONTO, Canada 1275 Commeway CLifford 9-5461
LOS ANGELES, California
6362 Hollywood Blvd.
Hollywood 28, Calif. HOllywood 2-2181
NEWARK, New Jersey
1060 Broad St. Market 3-5151
ORLANDO, Florida
2210 Jackland Bldg.
205 E. Jackson St. CHerry 3-4529
PHOENIX, Arizona
2727 North Central Ave. CRestwood 7-3368
ST. PAUL, Minnesota
Griggs Midway Bldg.
1821 University Ave. Midway 6-1891
SAN DIEGO, California
3620 30th St. CYpress 7-5708
SAN FRANCISCO, California
535 Middlefield Rd.
Palo Alto, Calif. DAvenport 1-7064
SEATTLE, Washington
3666 East Marginal Way Main 4-0783
SYRACUSE, New York
2360 James St. HOward 3-4502
WINSTON-SALEM, North Carolina
Nissen Building
310 W. Fourth St. PArk 3-6381

DISTRIBUTORS

ARIZONA, Phoenix
Kimball Distributing Co.
1079 N. First St.
ALpine 4-2529

CALIFORNIA, Gardena
Bell Electronic Corp.
306 East Alondra Blvd.
FAculty 1-5807

CALIFORNIA, Inglewood
Liberty Electronics Corp.
9817 Inglewood Ave.
ORegon 8-7163

CALIFORNIA, Long Beach 6
Dean's Electronics
7310 Long Beach Blvd.
NEvada 6-9314

CALIFORNIA, Menlo Park
Bell Electronic Corp.
1010 O'Brien Drive
DAvenport 3-9421

CALIFORNIA, Palo Alto
Liberty Electronics Corp.
2443 Ash St.
DAvenport 1-1965

CALIFORNIA, San Diego
Western Radio & T.V. Supply
1415 Eddie St.
BEnnett 9-0361

CALIFORNIA, San Francisco
Fortune Electronics Corp.
1321 Mission St.
UNderhill 1-2434

CANADA, Montreal
Atlas Wholesale Radio, Inc.
6985 Buchan St.
NEgent 3-7135

CANADA, Toronto, Ontario
Alpha Aracon Radio Co. Ltd.
555 Wilson Ave.
Downsview Post Office
MEdrose 5-6181

COLORADO, Denver
Kimball Distributing Co.
1874 California St.
AComa 2-6208

D.C., Washington
Silverne Industrial Sales Corp.
1400 Georgia Ave., N.W.
TUckerman 2-5000

(CONTINUED ON OTHER SIDE)

FREE! This NEW 8 page Silicon Rectifier Catalog from **Transitron**

MAIL THIS TODAY!

NAME _____

NAME OF FIRM _____

STREET _____

CITY _____ STATE _____

Fill out and drop in mail . . . postage paid.

ED

GLUE THIS EDGE

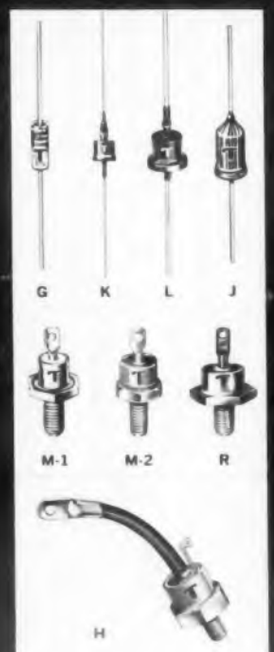
AVERAGE FORWARD CURRENT (Amperes)	TEMP. °C *	PKG.	PEAK INVERSE VOLTAGE RATING (VOLTS) 50	100	150	200	250

*Temperature at which forward current rating applies; "A" indicates ambient temperature rating of a lead mounted rectifier; "C" indicates maximum allowable case or stud temperature at the rated current for stud mounted units. ‡Indicates ambient temperature rating of a stud mounted rectifier on a specified heat sink.

NOTE: AT LOWER TEMPERATURES SIGNIFICANTLY HIGHER FORWARD CURRENT RATINGS ARE POSSIBLE. REFER TO CATALOG DATA SHEETS.

1N253 COLOR OVERPRINT INDICATES MILITARY TYPE.

Transitron
SILICON RECTIFIER SELECTION CHART

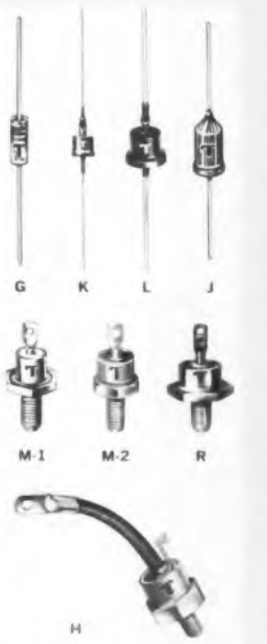


*Temperature at which forward current rating applies; "A" indicates ambient temperature rating of a lead mounted rectifier; "C" indicates maximum allowable case or stud temperature at the rated current for stud mounted units. ‡Indicates ambient temperature rating of a stud mounted rectifier on a specified heat sink.

NOTE: AT LOWER TEMPERATURES SIGNIFICANTLY HIGHER FORWARD CURRENT RATINGS ARE POSSIBLE. REFER TO CATALOG DATA SHEETS.

1N253 COLOR OVERPRINT INDICATES MILITARY TYPE.

Transitron
SILICON RECTIFIER SELECTION CHART



(CONTINUED FROM OTHER SIDE)

FLORIDA, Cocoa
Thurow Electronics, Inc.
540 Dr. Johns St.
NE 6-6331

FLORIDA, Miami
Thurow Electronics, Inc.
1800 N.W. 22rd St.
NE 5-0651

FLORIDA, Orlando
Thurow Electronics, Inc.
625 W. Central Ave.
CHerry 1-3695

FLORIDA, Tampa
Thurow Electronics, Inc.
621 So. Water St.
TAmpa 2-1885

FLORIDA, West Palm Beach
Goddard Inc.
1309 N. Dixie
TEmple 3-5701

FLORIDA, Miami
Goddard Inc.
4615 N.W. 37th Ave.
NEwton 4-4556

GEORGIA, Atlanta
Specialty Distributing Co., Inc.
763 Juniper St.
TRinity 3-2521

HAWAII, Honolulu
Industrial Electronics, Inc.
837 S. Queen St., P.O. Box 135
Tel. 506-095

ILLINOIS, Chicago 44
Radio Distributing Co., Inc.
5144 West Madison St.
ESterbrook 9-2121

INDIANA, South Bend 28
Radio Distributing Co., Inc.
1282 High St.
ATlantic 8-4664

IOWA, Cedar Rapids
Iowa Radio Supply Co.
719 Center Point Rd., N.E.
EMpire 4-6154

KANSAS, Wichita
Radio Supply Co.
115 Laura St.
AMherst 7-5218

MARYLAND, Baltimore 11
Kann-Ellert Electronics, Inc.
2050 Rockrose Ave.
TUxedo 9-4242

MASSACHUSETTS, Boston
Radio Shack Corp.
730 Commonwealth Ave.
REgent 4-1000

MASSACHUSETTS, Boston
DeMambro Radio Supply Co., Inc.
1095 Commonwealth Ave.
ALgonquin 4-9000

MASSACHUSETTS, Worcester
DeMambro Radio Supply Co., Inc.
222 Summer St.
PLeasant 7-5626

MICHIGAN, Detroit 27
Radio Specialties Co., Inc.
12775 Lyndon St.
BRoadway 2-4200

MINNESOTA, St. Paul 1
Gopher Electronics Co.
370 Minnesota St.
CApitol 4-9666

MISSOURI, Kansas City
Burstein-Applebee Co.
1012-1014 McGee St.
BAltimore 1-1155

MISSOURI, St. Louis 15
Interstate Supply Co.
4445 Gustine Ave.
FLanders 1-1585

NEW MEXICO, Albuquerque
Rimball Distributing Co.
1307 San Mateo, N.E.
AMherst 5-0644

NEW YORK, Binghamton
Federal Electronics, Inc.
Vestal Parkway, East
Pioneer 8-8211

NEW YORK, Buffalo 3
Radio Equipment Corp.
187 E. Genesee St.
TL 6-1415

NEW YORK, Long Island City 6
H. L. Dalis, Inc.
35-35 24th St., EMpire 1-1100

NEW YORK, New York 7
Harrison Radio Corp.
225 Greenwich St.
BArclay 7-7777

NEW YORK, New York 13
Milo Electronics Corp.
580 Canal St.
BEekman 3-3980

N. CAROLINA, Winston-Salem
Electronic Distributors
823 S. Marshall Park 4-0541

OHIO, Cincinnati
Hughes-Peters, Inc.
1128 Sycamore St.
DUnbar 1-7625

OHIO, Cleveland 15
Radio & Electronic Parts Corp.
3235 Prospect Ave.
UTah 1-8060

OHIO, Dayton 2
The Stotts-Friedman Co.
108-112 N. Jefferson St.
BAldwin 4-1111

OKLAHOMA, Tulsa
Radio, Inc.
1000 S. Main St.
Gibson 7-9124

PENNSYLVANIA, Philadelphia
Radio Electric Service Co. of Pa., Inc.
701 Arch St. WAlnut 5-5840

RHODE ISLAND, Providence
DeMambro Radio Supply Co., Inc.
90 Broadway
JAckson 1-5600

TEXAS, Dallas 7
Contact Electronics, Inc.
P.O. Box 10303
2403 Farrington St.
Riverside 7-9831

TEXAS, Houston 19
Busacker Electronic Equipment Co.
P.O. Box 13204
1216 W. Clay
JAckson 6-4661

UTAH, Salt Lake City
Rimball Distributing Co.
350 Pierpont Ave.
EMpire 3-5613

WASHINGTON, Seattle
C & G Electronic Co.
2221 3rd Ave.
MAin 4-4355

WASHINGTON, Tacoma
C & G Electronic Co.
2502 Jefferson Ave.
BRoadway 2-3181

AVERAGE FORWARD CURRENT (Amperes)	TEMP. °C *	PKG.	PEAK INVERSE VOLTAGE RATING (VOLTS) 300	350	400	500	600
.075	150A	G	1N681		1N683	1N685	1N687
.150	150A	G	1N682		1N684	1N686	1N689
.150	150A	G	1N646		1N647	1N648	1N649
.200	150A	K	1N3077	1N3078	1N3079	1N3080	1N3081
.200	150A	J	1N2018	1N2019	1N2020		
.200	150C	M1	1N335		1N333	TM56	TM66
.200	150C	M1	1N344		1N342		1N256
.250	150A	L	1N539		1N540	1N1095	1N547
.250	150A	L	1N442B		1N443B	1N444B	1N445B
.250	150A	K	TK30		TK40	TK50	TK60
.300	100A	L	1N603		1N604	1N605	1N606
.300	100A	L	1N603A		1N604A	1N605A	1N606A
.400	150C	M1	1N343		1N341	TM55	TM65
.400	150C	M1	1N334		1N332		
.400	150C	M1			1N255		
.600	150C	M1	1N1117		1N1118	1N1119	1N1120
.800	100‡	M1	1N611		1N612	1N613	1N614
1.0	100C	M1	TM31		TM41	TM51	TM61
1.0	100A	K			TK41		TK61
1.0	150C	M1	1N2028		1N2029	1N2030	1N2031
1.0	150C	M1	1N1541		1N1542	1N1543	1N1544
1.0	150C	M1	1N1125		1N1126A	1N1127	1N1128A
1.0	150C	M1					
3.0	150C	M1	1N1584		1N1585	1N1586	1N1587
5.0	150C	M2			1N1615		1N1616
6.0	150C	M2	1N2494		1N2495	1N2496	1N2497
6.0	150C	M2	1N1345		1N1346	1N1347	1N1348
10.0	150C	R	1N2023	1N2024	1N2025	TR501	TR601
12.0	150C	M2	TM39		TM49	TM59	TM69
12.0	150C	M2	1N1203		1N1204	1N1205	1N1206
20.0	150C	R	TR302	TR352	TR402	TR502	TR602
20.0	150C	R			1N2135A		
35.0	150C	R	TR303	TR353	TR403	TR503	TR603
35.0	150C	R	1N1187		1N1188	1N1189	1N1190
50.0 100.0	150C) 95C)	H	TH302B	TH352B	TH402B		

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY MAIL
First Class Permit No. 8, Wakefield, Massachusetts

POSTAGE WILL BE PAID BY—

TRANSITRON ELECTRONIC CORP.
168 Albion Street
Wakefield, Mass.

Improvement in signal-to-noise performance of up to 30 db can now be realized.

Active and Passive Systems Vie for Leading Role

Still to be decided in the development of satellite-communications systems is whether the systems should be active or passive, synchronous or non-synchronous. (Courier, though not synchronous, exemplifies the active satellite, and Echo, the passive. Advent, not yet launched, will be the first truly active synchronous satellite.)

Proponents of active satellites stress the very expensive ground-terminal equipment required for passive types. It is necessary because passive satellites cannot provide any signal gain and are limited in information bandwidth. Passive-system terminals, thus, would require greater transmitter power, greater antenna gain and lower-noise receivers—all contributing to increased cost.

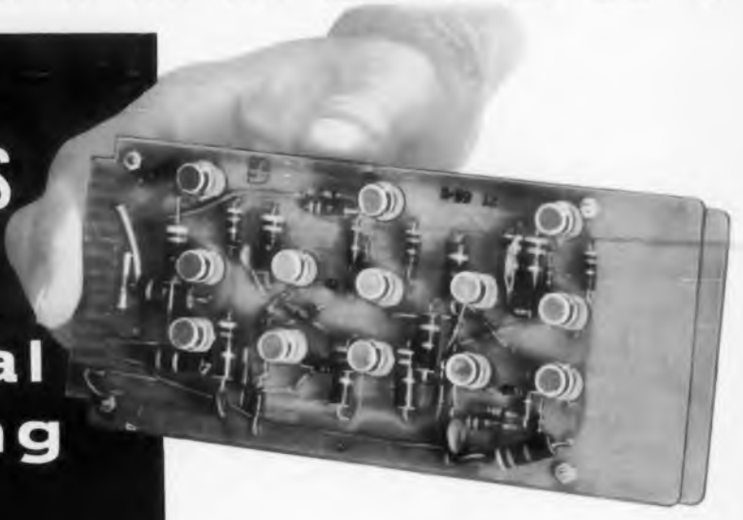
Those on the other side of the issue generally concede that cost of the ground equipment for a passive satellite will be greater but doubt that over-all cost of the system will be higher from a long-term standpoint. They point out that the active satellite itself is much more expensive and complex and note that repairing one in orbit will be unthinkable for some time to come. Uncertainty as to the effects of radiation on electronics equipment is cited. Finally, there is skepticism about maintaining a truly synchronous orbit without long-term, post-launch corrections.

Regardless of which system is finally used, there still remain a number of difficult problems for the electronic industry to solve before global satellite communications can become a reality. One is interference control. If satellite communications are to exist with present radio services on a frequency-sharing basis, and if satellite terminals are to work through surface frequencies without mutual interference, high-gain antennas with excellent side-lobe suppression are necessary. Even so, a tremendous co-ordination problem involving aircraft, radar, and the like, will still be present. Circuit routing, or switching techniques require further study to achieve compatibility and to allow eventual switching of signals between orbiting satellites.

One of the greatest challenges to the telemetry industry, however, will be the task of meeting the system reliability requirements of the space age. Extreme reliability—approaching that of the human brain, according to JPL's Mr. Kuokol—will be necessary if the complex instrumentation of space communications systems are to function for reasonable lengths of time. If the systems are to have this reliability, great effort in evolving the proper manufacturing and quality control techniques, in addition to the use of redundancy, will certainly be necessary.

BREAKTHROUGH!

100 Mc/s *Direct* Decimal Counting



Announcing a major advance in the art of counting . . .

Eldorado's Model 1050 **Solid State** Gated Counter — a triple purpose instrument for

- **100 Mc/s Direct or Gated Counting of random or continuous events**
- **Time Interval Measurements with 10 nsec resolution***
- **Frequency Measurements without heterodyne conversion to 100 Mc/s***

BASIC DATA

Counting and Frequency Measurement

STORAGE 10⁹ counts (9 digits)
MAX. COUNTING RATE 100 Mc/s
DOUBLE PULSE RESOLUTION Better than 10 nanoseconds
TYPICAL INPUT PULSE REQUIREMENT +4 volts into 50 ohms
TYPICAL START/STOP PULSE REQUIREMENT −4 volts into 50 ohms

For Time Interval Measurement

EXTERNAL TIME REFERENCE Trigger requirements same as for input pulse above or will operate on 5 volt peak-to-peak 100 Mc sine wave

APPLICATIONS — The multipurpose Model 1050 is particularly suited for use in weapon or satellite systems, advanced electronic measurements, and nuclear research. Among specific areas of application are studies of missile velocity, acceleration and trajectory; space vehicle tracking; shock wave investigations; radar, telemetering, and communications; frequency stability, phase, and phase shift measurements; pulse width, rise, fall and duty cycle measurements; semiconductor studies; astronomical measurements; nuclear flight time, coincidence, and particle burst studies.

NEW LOGIC — KEY TO 100 Mc/s — The high counting rate of Eldorado's 100 Mc/s instrumentation is made possible by new decimal counting logic developed by Eldorado engineers — specialists in nanosecond pulse techniques.

For details on the new logic, contact your Eldorado engineering representative for Bulletin D-1050, or write us direct. Demonstrations at your convenience.

*When used as a time interval meter, Model 1050 requires an external oscillator for time reference; when used as a frequency meter, it requires an external time base. Eldorado can supply both. The Eldorado Model 1060 Time Interval Meter with same resolution has a built in oscillator for time reference.

Eldorado Electronics

Dept. 36 2821 Tenth Street • Berkeley 10, California • THornwall 1-4613

20

CIRCLE 42 ON READER-SERVICE CARD

◀ CIRCLE 41 ON READER-SERVICE CARD

COMMUNICATIONS

tightened spectrum squeeze demands new techniques

THIS YEAR, more than ever before, communications specialists will be trying to handle more bits with fewer errors at lower costs.

The problems of diminishing spectrum, increasing interference, and the need for greater speeds and more control seem to be multiplying faster than designers are developing improved techniques in order to keep the communication nets efficient.

In military communications, where these problems meet and combine into a nearly intolerable situation, bold new steps are being taken to keep the channels open. This year, the Defense Communications Agency will assume control of its first facilities. This agency was created to assure defense administrators of control of its extended chain of command. One effect of the creation of the new agency is expected to be less duplication in facilities, with eventual savings in systems and equipment cost. Though its first steps are expected to be organizational ones—giving it control over certain facilities and networks, with operation remaining in the hands of the individual services—DCA is expected eventually to recommend for and against system designs.

Creation of the agency is one of many steps the military is taking to solve what it considers to be the most important current problem—maintaining command and control. As tactical units disperse more widely around the globe and as their roles become more complex, the problem of maintaining central control over them grows more acute.

For this reason, existing long-haul troposcatter links and ionoscatter networks like the Pacific scatter net will be extended this year. For this reason also, the Aircom Air Force global network is being modernized by conversion to single-sideband and installation of additional microwave and other channels and new monitoring equipment. In addition, the Army is pushing its Advent stationary-satellite system for reliable global communications.

Unusual communications projects slated for some military support in 1961, in hopes of maintaining control, include research into the possibilities of using atmospheric ducts as communication-signal waveguides, of using ground currents for secure communications, and of using optical frequencies for communications systems.

Other Problems: Interference, Speed, Spectrum Space

One of the most vital problems in both military and commercial communications—interference—will be attacked on two different but connected fronts in 1961. This year will be the year of typical operation of the ambitiously planned electromagnetic environmental test facility near the Signal Corps proving grounds in Arizona. At this range, 150 miles long, newly designed communications and other equipment can be tested for interference generation and susceptibility. Completion of the range is not scheduled before 1965, however.

Under another program designed to reduce interference, testing centers and libraries of spectrum signatures will be set up to help designers know the environment their new equipment must work in.

A third major communications problem—moving mesages faster—will be the focus of much attention in 1961 because of the development of automatic data-processing equipment suitable for handling message traffic. New digital techniques designed to speed traffic, such as varying the transmission rate of information, compressing digital data, using statistical methods to predict oncoming bits, and other tetchniques, are being pursued as part of this effort.

Many of the problems of moving traffic faster are closely connected with the fourth major area of concern in communications—vanishing spectrum space. Not only does the spectrum now have to support the needs generated by normal growth of communications traffic, but it must satisfy the ravenous appetites of booming mobile traffic, data-processing traffic, and space traffic.

In this area the requirements for new services are clearly outstripping developments in conserving spectrum and in opening new frequencies for exploitation. Allocation of frequencies is expected to make as much news in 1961 as it did in 1960. The shortage of spectrum is growing more acute almost daily.

ENERGY SOURCES

new materials raise hopes

PROGRESS in the development of thermoelectric generators and coolers will be slow and evolutionary, specialists in this field predict. The bulk of research funding is being applied to the search for materials possessing a high figure of merit. Low electrical resistivity, high thermal conductivity, and high Seebeck coefficient characterize a high-figure-of-merit material.

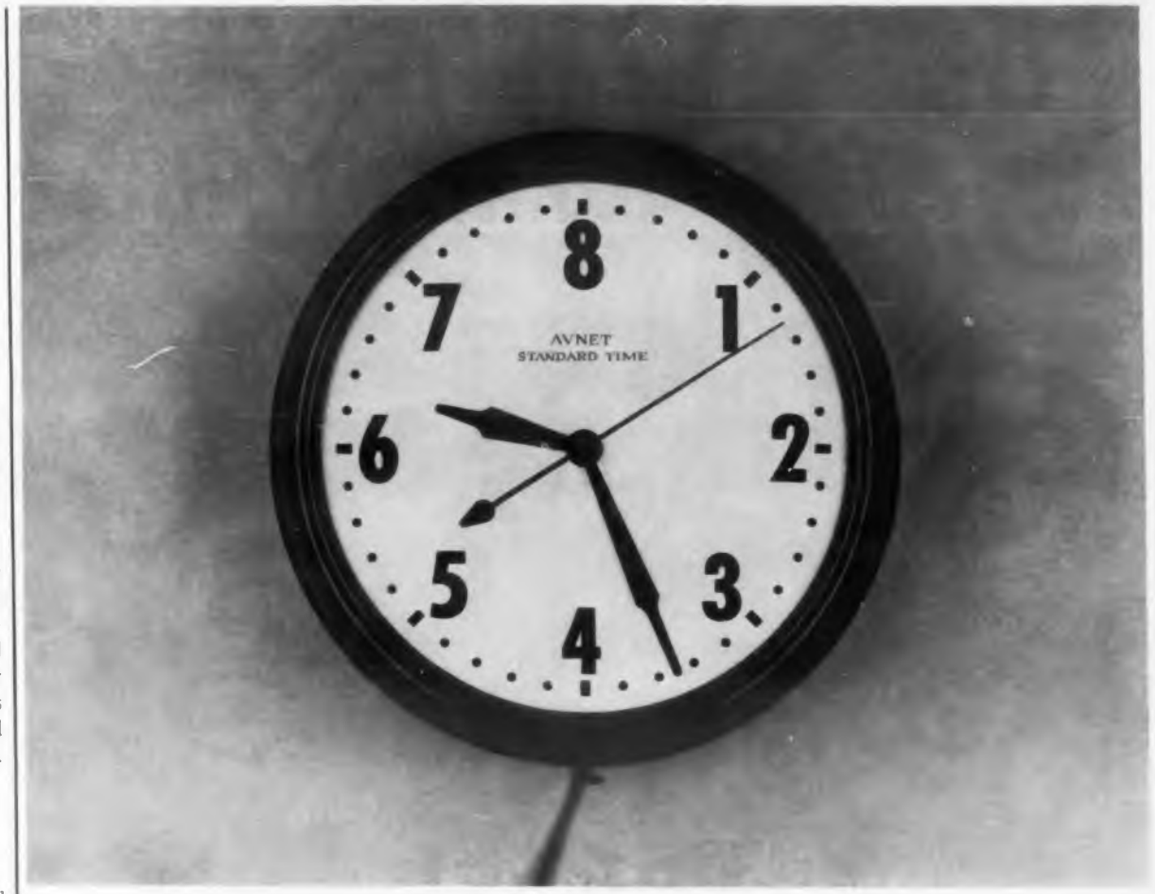
Although years of intensive study have borne little in the way of a major break-through, within the past few months a gadolinium-selenide material has been announced which has a reported figure of merit 50 times greater than currently available types. The Navy's Bureau of Ships is engaged in evaluating the compound developed by the Research Chemicals Div. of Nuclear Corp. of America.

High-Efficiency Generators May Arrive Soon

Should the reported figure of merit, 50×10^{-3}, be accurate, the commercial possibility of high-efficiency generators and refrigerators, having no moving parts, may arrive years sooner than expected. The coming year likewise holds promise for other material developments resulting from extensive studies over the past decade.

Solar cells, providing power for many vehicles in space, have reached efficiencies in the order of 12 to 14 per cent. Unfortunately, the response of now-available photovoltaic cells does not match the solar spectrum. A greater percentage of the solar spectrum can be used by gallium-arsenide cells. The cost of the raw material, however, coupled with low-production yields present a formidable problem in power-supply economy. The coming year, according to solar-cell designers, should provide a very definite answer to the practical usefulness of gallium-arsenide photovoltaic converters.

Thermionic converters, long in the laboratory stage, are now showing promise of emerging into the design of portable, noiseless military-communication equipment. Low-wattage devices are being delivered to the military with promise of low-cost, high-output units for industrial applications in the near future.



The Avnet System

creates a new Concept of Time

A normally expedient shipping time for your order would be 9:27, as shown by the hands on the clock above. *The Avnet System* would ship at 6:18. The few hour difference (or few day difference) might not be crucial. But if time *is* an important factor, use The Avnet System. Avnet Standard Time and Avnet Standard Procedures ship your order faster than any other major source for electronic components.

This new Concept of Time is one of the many advantages in The Avnet System. *Avnet maintains a network of Sales Engineers traveling the U.S. Each engineer has his counterpart in a Service Center Expediter. Tremendous stocking facilities are maintained strategically throughout the country. Avnet maintains and operates complete assembly facilities for Connector Prototype requirements.* Avnet's Concept of Time may gain you minutes, hours, days, money. Contact your nearest Service Center in The Avnet System.

AVNET

THE AVNET SYSTEM
Men / Methods / Materials / Management
AVNET ELECTRONICS CORP

Avnet Service Centers and Stocking Facilities are located in Los Angeles, Cal.; Sunnyvale, Cal.; Chicago, Ill.; Dayton, Ohio; Westbury, L. I.; Burlington, Mass.

Avnet distributes from its stocking facilities: BENDIX SCINTILLA CONNECTORS, SPERRY SEMICONDUCTORS, RHEEM SEMICONDUCTORS, ELECTROSNAP AND HETHERINGTON SWITCHES, GREMAR CONNECTORS, CLARE RELAYS, ROBERTSON SPLICE & CONNECTOR CASES, BABCOCK RELAYS, KING SUBMINIATURE HI-TEMP CERAMIC CAPACITORS, TIC PRECISION TRIMMERS, VIBREX FASTENERS by GENERAL TIRE & RUBBER CO., U. S. SEMCOR SEMICONDUCTORS, SANGAMO CAPACITORS, SPRAGUE CAPACITORS

CIRCLE 43 ON READER-SERVICE CARD

New Random Access Memory Package...

uses only 18.75"
IN STANDARD 19" RACK

GENERAL CERAMICS, continuing its leadership in the memory packaging field, has made available double and triple bay random access memories with up to 4096 characters x 32 bits per character at cycle times up to 6 micro-seconds. Now you can get design economy since the basic G-C package requires only 18.75" of standard rack space—a reduction of up to 80% over typical units requiring a full six feet.

General Ceramics offers space-saving random access memory designs with varying number of characters, word lengths and logic.

Optional design features include parity checking, test cycles, indicator lights and power supply locations.

Write on your company letterhead for additional information.
Please mention your requirements; address inquiries to Section ED.

DIVISION OF INDIANA GENERAL CORPORATION

APPLIED LOGIC DEPARTMENT

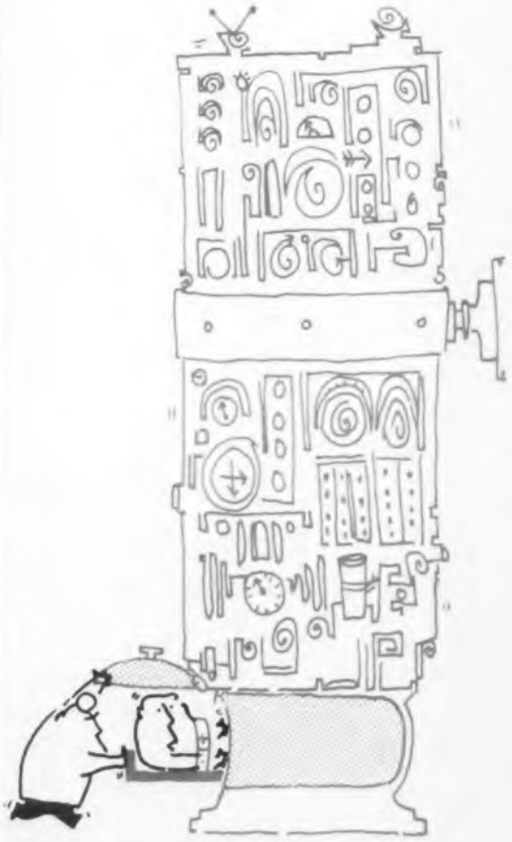
GENERAL CERAMICS

KEASBEY, NEW JERSEY, U.S.A.

TECHNICAL CERAMICS, FERRITE AND MEMORY PRODUCTS

CIRCLE 44 ON READER-SERVICE CARD

MEDICAL ELECTRONICS
more biomedical engineering



THE MOST important trend in medical electronics is probably the growing number of universities that are establishing programs to promote work in the interdisciplinary art of biomedical engineering. Most of the efforts are being financed by grants from the National Institutes of Health.

Another trend, which became more apparent within the last year, is the entry of many major companies into biomedical engineering. Computer manufacturers, for instance, have shown increasingly more interest, stemming, according to John E. Jacobs, Professor of electrical engi-

neering at Northwestern University, from two motives. In the first place, manufacturers want to "create a need for computers in large-scale medical applications," he says. Also, they want to "simplify the design of existing computers by the incorporation of conceptual approaches arising from biological and physiological studies," he goes on to say.

Use of Computers in Hospitals Called Economic Necessity

Use of computers to monitor and diagnose patients' ills is now more a necessity than a dream. The general hospital of the future cannot continue to operate in the traditional pattern if it is to maintain its pace and keep abreast of developments in the whole field of therapy and care, according to George Radcliffe, director of Office of Development at Columbus Hospital, Newark, N. J. Hospitals, Mr. Radcliffe says, must consider the rising spiral of costs confronting patients and also the difficulties of securing adequate personnel at the technical level.

In hospitals, a continuing trend is that of installing systems that automatically monitor patients. Most devices now in use are combinations of existing equipment that has been slightly modified, Mr. Jacobs says. Therefore, he adds, "One of the trends will be to evolve a second generation, so to speak, of these ward-monitoring systems." To do this will require more work in studying the human organism to ascertain the exact body parameters to monitor.

Progress in medical electronics depends heavily on advances in other areas of the electronics industry. At present, most people working in medical electronics are waiting for developments in areas such as solid-state technology and microminiaturization. They watch developments in telemetering physiological and psychological data, and related data-reduction systems, which have moved forward with help from the military and man-in-space programs.

Financing Research Is Major Problem

A big, if not the biggest problem is financing research in the field. "The magnitude of expenditure required on the part of a private enterprise to effectively operate in biomedical engineering is staggering," Mr. Jacobs says. The Federal government, through the National Institutes of Health, is trying to overcome this economic problem.

"A company contemplating work or a product line in biomedical engineering would be well advised to associate itself with one of these university centers," Mr. Jacobs says.

You are looking at the semiconductor industry's guaranteed and first certified rectifiers

Here is the most sweeping assurance ever offered on the reliability of complete standard lines of silicon and selenium rectifiers.

Every Syntron Semiconductor is certified to have passed a specific program of tests and inspections (spelled out in the Certification, below)—and is *guaranteed* to perform to these certified levels for 18 months after shipment!

The savings to manufacturers in minimizing their own incoming tests and inspections are obvious. Designers now can specify rectifiers tested to standards which match those of virtually any mass manufactured product in the electronics industry.

Exclusive manufacturing techniques, plus rigid quality control levels, enable us to introduce Certified Semiconductors. Every month we produce millions of square inches of selenium rectifiers by our unique vapor deposition method. Our exclusive gaseous double diffusion method produces identical silicon diodes in which the depth of the P and N layers is controlled to a very few microns.

Syntron Certified Semiconductors are described in Catalog 100, and Bulletin 200 details the Certification tests. Use the coupon below for your immediate copies.

SYNTRON
certified SEMICONDUCTORS

SYNTRON CERTIFIED SEMICONDUCTORS

All Syntron semiconductors have been tested and inspected to AQL level of 1.0, Inspection Level II, and are so certified. Electrical and mechanical tests include:

- Inspection to the appropriate JEDEC outline drawing.
- Stated PIV for specific current ratings over a range of diode or cell temperatures.
- Forward drop at rated current and a diode or cell temperature of 25°C.
- Testing of all rectifier assemblies at rated load conditions.

We guarantee that our semiconductors will meet their certified AQL performance levels for up to 18 months after shipment provided they are not misused or misapplied. All Syntron semiconductors found to be defective in materials or workmanship will be replaced at no charge upon return to our plant.

SYNTRON COMPANY, Semiconductor Div., Dept. ED-1, Homer City, Pa.

Please send me Silicon and Selenium Rectifier Data (Catalog 100) and Semiconductor Certification (Bulletin 200).

name

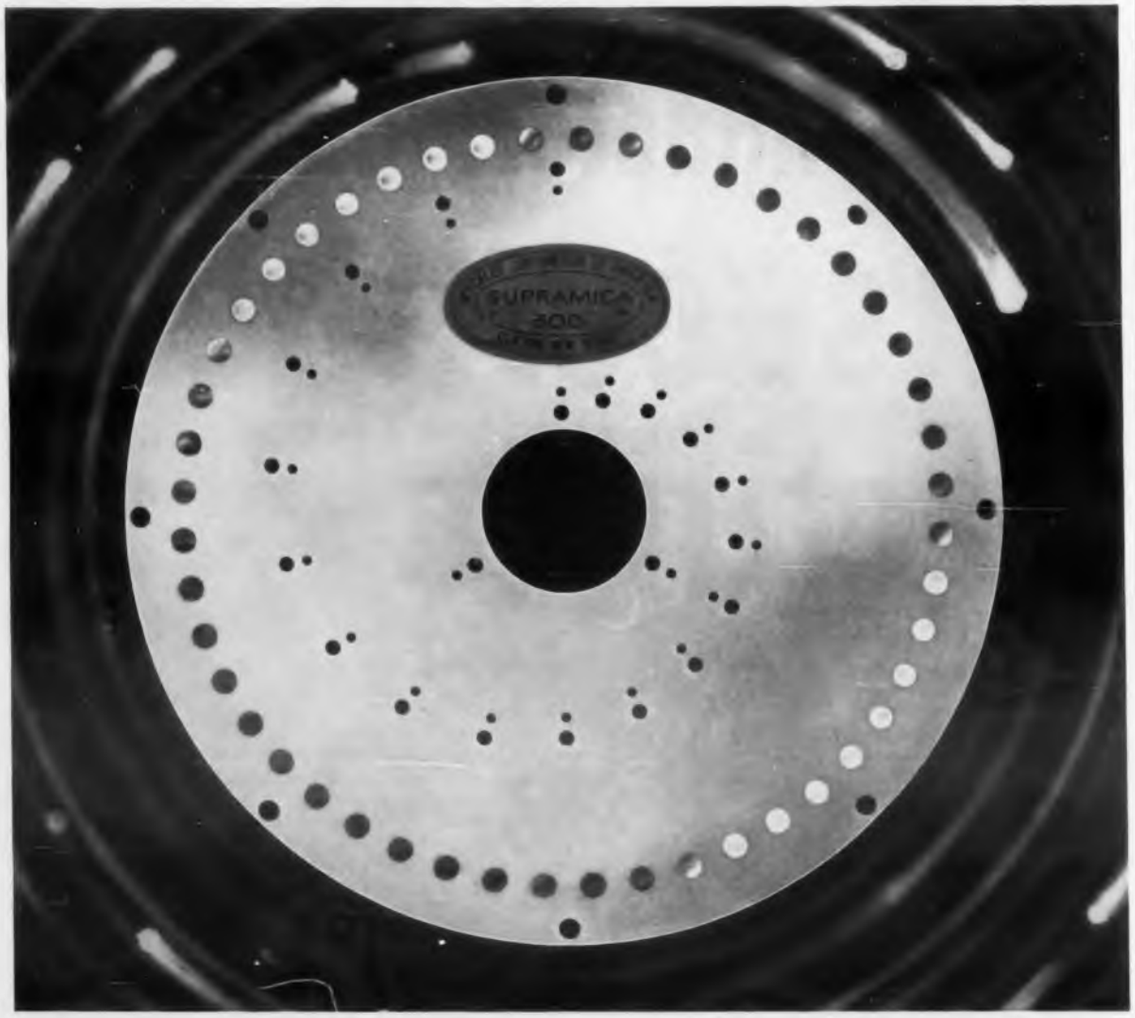
title

company

address city state

CIRCLE 45 ON READER-SERVICE CARD

When the requirements seem impossible...



48 precious metal contacts on a 12" circle... maintaining .0003 T.I.R. planar tolerance

To SEE under the sea takes a scanning commutator with seemingly impossible tolerances to insure reliability in ship sonar. That is why compression-molded SUPRAMICA® 500 ceramoplastic machinable insulation was chosen . . . a proud example of MYCALEX CORPORATION OF AMERICA craftsmanship.

The specifications are most demanding, the requirements highly critical . . . plates must be flat within .0003" and embody precision-machined recesses to accept 48 pure silver contacts. The angular displacement of the contacts is held to ±1 minute. The combination of contacts and SUPRAMICA 500 together must accept a 2 micro inch surface finish. The application requires that these tolerances are guaranteed for the life of the commutator during which the environmental conditions run the gamut of humidity and temperature.

The MYCALEX fabricating facility is not only fully qualified to furnish the fabrication of such parts but will design and provide required hardware. For gauge-like specifications on large production runs or short prototype quantities . . . our engineers are ready, capable, and equipped to assist you with your design and production requirements. Write for information on SUPRAMICA ceramoplastics offering maximum temperature endurance (unstressed) up to +1550°F. and SYNTHAMICA® synthetic mica with maximum temperature endurance (unstressed) up to +2000°F. . . . the family of the world's most nearly perfect insulation materials.

General Offices and Plant:
121 Clifton Boulevard
Clifton, N. J.

SYNTHAMICA® SUPRAMICA® MYCALEX®

MYCALEX
CORPORATION OF AMERICA

Executive Offices:
30 Rockefeller Plaza
New York 20, N. Y.

World's largest manufacturer of glass-bonded mica, ceramoplastics and synthetic mica products

CIRCLE 46 ON READER-SERVICE CARD

SEMICONDUCTORS

tunnel diodes seeking a role

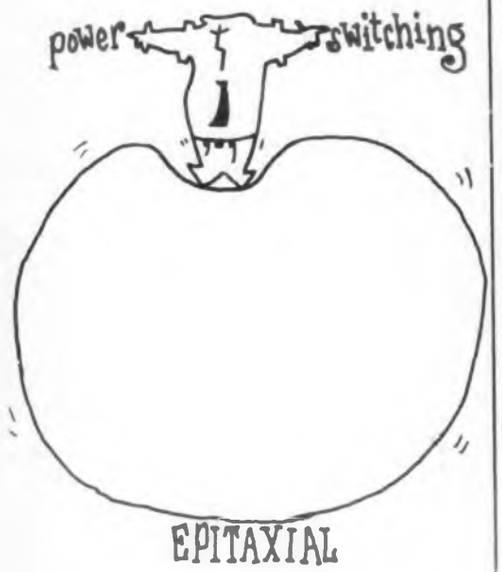
SKEPTICISM is mounting on the predicted role of tunnel diodes in future electronic-equipment designs. The coming months should provide an initial evaluation concerning the devices' future potential. Tunnel diodes, available in production quantities for more than a year, still have not found their place in equipment. Semiconductor application engineers are being pressed to deliver suitable circuitry for use in computers and test equipment.

Computer designers are hard at work applying the devices to future high-speed machines. Engineers working on current versions of medium- and relatively-low-speed computers are apparently content with the operation, reliability, and price of available switching transistors. Why, they argue, spend considerable time and effort to apply a new device with high-speed characteristics to a medium-speed machine when pricing will probably go up and reliability will have to be proven?

The coming year should see tunnel diodes appearing in space-vehicle computers where radiation effects are a serious hazard to transistors, and in specialized test equipment requiring high-speed switching.

Epitaxial Transistors Stir Enthusiasm Despite Production Problems

During the latter part of 1960, several manufacturers announced the availability of germanium- and silicon-epitaxial transistors. The devices were being offered only months after Bell



Laboratory's introduction of the epitaxial growth technique offering an order of magnitude increase in switching speed, low collector resistance and high breakdown voltage compared with conventional transistors.

Production problems involved in the deposition process are being rapidly overcome. With the higher-yield output envisioned for epitaxial devices, industry spokesmen indicate that the price of epitaxials will be no higher, and perhaps lower, than that of conventionally fabricated transistors. Thus, immediate and widespread applications are expected in the near future.

By virtue of the low collector resistance exhibited by the epitaxial transistor, higher power outputs can be handled by a particular device modified with an epitaxial growth. This leads to the prediction that one "universal" transistor, capable of fast switching and high-power output, can be designed into equipment in place of several different devices. Inventory costs, requisitioning, purchasing and replacement parts problems can be greatly reduced without sacrifice in performance.

Electronic Products NEWS
by CARBORUNDUM®

Smallest sub-miniature time delay relay made by Wheaton Engineering Corp. relies on GLOBAR® Thermistors

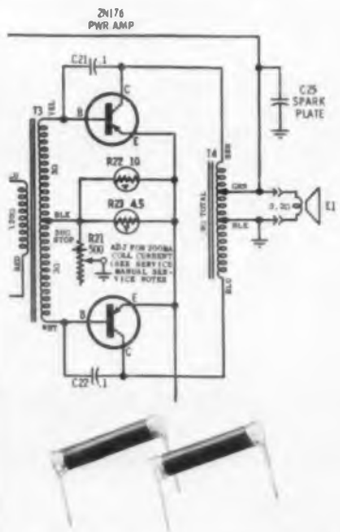
The ½-ounce postage stamp sized unit shown here is probably the ultimate in miniaturization of electronic time delay relays. It is a product of Wheaton Engineering Corporation, 920 Manchester Rd., Wheaton, Ill.

High precision time delays over a broad range of operating temperatures are produced by utilizing the negative temperature coefficient characteristic offered by GLOBAR Type 997F Thermistors. Contributory factors influencing their use are small size, extreme ruggedness and closely controlled quality and uniformity. "Were it not for your Thermistors," says Wheaton, "many of our precision timing devices would not be as easily or readily available."

If you have any problems involving temperature compensation, temperature sensing and control, time delay or surge current suppression, perhaps GLOBAR silicon carbide Thermistors can help. For more details, write Globar Plant, Refractories Division, Department **EDT-11,** The Carborundum Company, Niagara Falls, New York.

CIRCLE 804 ON READER-SERVICE CARD

Transistor current controlled by GLOBAR® Thermistors in Motorola Auto Radios



The latest auto radio produced by Motorola Inc. contains a push-pull transistor output stage and 5 tubes designed to operate directly from the car battery.

Transistors are designed to draw ½ amp. Without control, this current would change with operating temperatures. Normal current must, however, be held within reasonable limits to maintain proper impedance, matching and low audio distortion. Motorola uses GLOBAR Thermistors of correct resistance and temperature coefficients to control the current through the operating range of −20 C to +65 C.

This application is another example of the growing use of Thermistors in transistorized circuits. For information on types and ratings, write Globar Plant, Refractories Div., Dept. **EDT-11,** Niagara Falls, New York.

CIRCLE 805 ON READER-SERVICE CARD

Critical requirements met in ceramic-to-metal sealed components

The various units above are typical examples of problems involving ceramic-to-metal assemblies solved by Carborundum's Latrobe Plant.

Of particular interest is the assembly at right center. The threaded monel metal housing is attached to the ceramic by an intermediate KOVAR® flanged eyelet, which compensates for expansion differentials. The center electrode is beryllium copper—brazed to a KOVAR alloy washer which is sealed to the ceramic. The unit on the right is a rectifier housing. The bottom flange and the cap are copper-plated steel bonded to the ceramic. A copper stud is brazed to the cap. Correct design avoided expansion stresses which would damage the ceramic or break the bond.

For assistance in solving similar problems, write Latrobe Plant, Refractories Div., Dept. **EDC-11,** The Carborundum Co., Latrobe, Pa.

CIRCLE 806 ON READER-SERVICE CARD

Latest information on ceramic INSULATING TUBING

A new technical bulletin is now available on Carborundum's insulating tubing for thermocouples and other applications. Tubing is offered with single and multiple holes in a wide variety of dimensions and shapes. For your copy of the bulletin, write Latrobe Plant, Refractories Div., Dept. **EDB-11,** Latrobe, Pa.

CIRCLE 807 ON READER-SERVICE CARD

For ceramic parts and metallized assemblies, Kovar alloy, ceramic resistors, varistors and thermistors . . . count on **CARBORUNDUM®**

CIRCLE 804, 805, 806, 807 ON READER-SERVICE CARD

ADC TRANSFORMERS · FILTERS · REACTORS JACKS & PLUGS · JACK PANELS

Military Standard POWER Transformers Types MS-90016 through MS-90036.

Military Standard AUDIO Transformers Types MS-90000 through MS-90008.

Sub-Miniature, hermetically sealed, low frequency inductors and transformers.

Transformers and filters for TRANSISTOR and PRINTED CIRCUIT applications to meet MIL-T-27A Grade 5, Class R or S.

Toroids. Hermetically sealed or open units for all frequency ranges.

Filters. Sub-Audio to 1.5 mcs.

Telephone Coils. Mechanically and electrically interchangeable with Western Electric.

Broadcast Quality Transformers. Standard of the industry.

Magnetic Amplifiers and Saturable Transformers. For servo motor control; DC-DC Power Supplies, and switching silicon controlled rectifiers.

Balanced Modulators. Designs over a wide range up to 500 kcs.

Encapsulated Transformers—Using custom epoxy compounds for military and commercial applications.

Terminal Blocks. Molded to your specifications. Six popular sizes in stock.

Jack Panels. Several size panels in stock.

Plugs, Patch Cords and Jacks—Standard in the communication industry. Long frame telephone type jacks; wide variety; two and three conductor.

PACIFIC BRANCH
7247 Atoll Avenue
North Hollywood, Calif.
Phone: TRiangle 7-7169

Government Approved Qualification Testing Laboratory.

Choose from over 500 stock items or let ADC design to your requirements

25th Anniversary Year

ADC INCORPORATED
2835-13TH AVENUE SOUTH • MINNEAPOLIS 7, MINNESOTA
PACIFIC BRANCH *North Hollywood, California*
TRANSFORMERS • REACTORS • FILTERS • JACKS AND PLUGS • JACK PANELS

CIRCLE 48 ON READER-SERVICE CARD

COMPONENTS

smaller, lighter, more reliable

IN THE field of standard components during 1961, design engineers will see a continuation of past trends—smaller size, lighter weight, higher temperature capability, and increased reliability. If any area is singled out for special emphasis, it will most likely be reliability. Those are the conclusions drawn from an ELECTRONIC DESIGN survey of industry leaders long associated with component developments.

Standard components will still receive much attention because they remain largely the backbone of the electronic industry. In addition, they have the advantages associated with familiar items, their performance capabilities have been evaluated over and over again and are well known.

A related trend will be to take these standard components and combine them to get highly reliable and very small functional packages.

New Connections To Use Many Forms

As for connecting components, engineers will see (1) an increased use of high-temperature, extreme-reliability connecting devices, and (2) a considerable increase in the use of novel microminiature connecting devices and weldable interconnections developed during the past year. This is the view of R. M. Soria, vice president, Research & Engineering, Amphenol-Borg Electronics Corp., who also offered some components specifics. This year, he said, engineers will be designing components to withstand temperatures ranging from absolute zero to 1,500 F, and pressures as low as 10-12 mm Hg, found in outer space.

While standard components are improved, work will continue in solid-state technology, providing design engineers with devices of increased and advanced capabilities. Thin-film techniques are seen as highly important. "In 1961, we shall probably see the beginning of important applications of thin-film components and circuits," says

L. J. Varnerin, component-development engineer at Bell Telephone Laboratories.

Like most new developments, solid-state technology will require both alertness and flexibility on the part of the user. Many important considerations exist in adapting these newer technologies to systems.

Attention in 1961 will undoubtedly be focused on important problems which must be solved before important forward steps can be taken by the component industry. According to P. S. Darnell, now with Bell Telephone Laboratories and a former chairman of IRE's Professional Group on Component Parts, such problems include:

- Deciding what new concepts and methods of approach, money, and manpower should be spent to provide new kinds of components for practical use.
- Increasing to necessary levels the liaison between the component developer and the engineer responsible for system functions.
- Manufacturing components based on new technologies which may be developed.

Components Progress Depends Heavily on Further Materials Research

As in the past, progress in improving standard components will depend heavily, if not exclusively, on materials, said Archer N. Martin of Corning Glass Works. New and better uses of materials are constantly being sought, he said.

Why will components be improved? First, there is industry's normal desire to improve its wares. Second, it is generally felt that the requirements made on space devices and information-handling equipment will spur improvements in standard and solid-state components. There is a continuing surge in the use of computers and data-handling equipment and a desire to miniaturize these equipments. Also, space devices will be operating in more tough environments.

On the basis of the component industry's past performance, everyone agrees that this year will bring breakthroughs. But because it is impossible to know what inventors are working on, there are few who will risk a guess on where the breakthroughs will occur. Amphenol-Borg's Mr. Soria, however, suggests one possible breakthrough will be a "synthesis of materials to achieve multiple electrical functions by means of homogeneous materials." Looking beyond this year, he predicts "a successful generation of monochromatic (single-frequency) coherent radio signals (electromagnetic waves) at frequencies above the highest microwave frequencies presently usable, and extending through the visible spectrum, and at sufficient power levels should be possible within a few years. This will create a whole new generation of radio components probably dependent on new, or not presently used, physical principles."

NEW!

TRUE RMS Voltmeter with

1/4% ACCURACY

measures wide range of Waveforms

BALLANTINE model 350

features:

- High accuracy achieved on waveforms in which peak voltage may be as much as twice the RMS. **Not limited to sinusoidal signals.**
- Left-to-right DIGITAL READ-OUT. Fast, simple nulling operation consists of selection of decade range by push-button, and adjustment of four knobs for minimum meter indication. These operations attenuate the input signal to a predetermined value, causing a bridge circuit to be balanced by changing the current through a barretter.
- Temperature-controlled oven contains the barretter and an ambient temperature compensating resistor. Effect of ambient temperature changes is less than 0.005%/° C from 20° C.
- Proper NIXIE® digit is lighted automatically while bridge is being balanced. No jitter.
- Rugged, accurate. Doesn't require the extreme care of many laboratory standard instruments. No meter scales to read. Useful for laboratory, production line, and in the field.

$720

specifications:

VOLTAGE RANGE: 0.1 to 1199.9 v

FREQUENCY RANGE: 50 cps to 20 kc

ACCURACY: ¼% 0.1 to 300 v, 100 cps to 10 kc; ½% 0.1 v to 1199.9 v, 50 cps to 20 kc

INPUT IMPEDANCE: 2 megohms in parallel with 15 pF to 45 pF

POWER: 60 watts, 115/230 v, 50 to 400 cps

Available in Cabinet or Rack Models

Write for brochure giving many more details

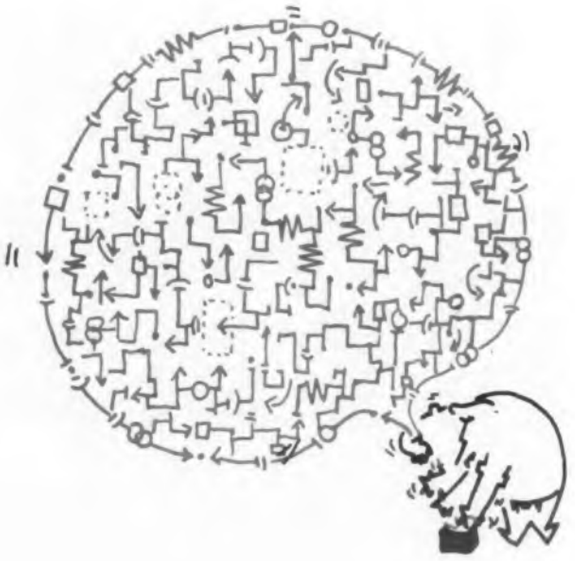
— Since 1932 —

BALLANTINE LABORATORIES INC.

Boonton, New Jersey

CHECK WITH BALLANTINE FIRST FOR LABORATORY AC VACUUM TUBE VOLTMETERS, REGARDLESS OF YOUR REQUIREMENTS FOR AMPLITUDE, FREQUENCY, OR WAVEFORM. WE HAVE A LARGE LINE, WITH ADDITIONS EACH YEAR. ALSO AC/DC AND DC/AC INVERTERS, CALIBRATORS, CALIBRATED WIDE BAND AF AMPLIFIER, DIRECT-READING CAPACITANCE METER, OTHER ACCESSORIES. ASK ABOUT OUR LABORATORY VOLTAGE STANDARDS TO 1,000 MC.

CIRCLE 49 ON READER-SERVICE CARD



MICROMINIATURIZATION

boom for high-density packaging will pace efforts

THE USE of any "exotic" approach to microminiaturization in operational designs during the coming year is highly doubtful, according to many industry observers. However, they do expect 1961 to mark the beginning of a boom in the use of high-density packaging techniques in place of conventional printed-circuit modules.

The high-density methods cited are of two basic types. One is the component cluster stacked between a pair of printed-circuit boards, forming a sandwich-like module. Flow-solder methods suitable for making many joints at once are used to connect leads to the boards. The second approach is a welded package, in which nickel ribbon is used to interconnect components.

The welded module will move into the design spotlight in the coming year as the Polaris missile system moves into production and an advanced Titan inertial-guidance system moves toward the production line. Both systems make extensive use of welded circuits (*ED*, Sept. 28, 1960, p 4).

Estimates of the total current market for these high-density modules range from a few million up to $10 million in 1960. This is expected to pick up significantly with use of welded modules on operational missiles, reaching to more than $100 million by 1965, according to some market observers.

The commercial availability of many subminiature components is expected to contribute to the increase in size-reduction programs.

The MICRAM (Microminiature Individual Component Reliable Assembled Module) program makes use of these tiny parts soldered onto small wafers. Cleveland Metal Specialties Co., which is experienced in microsoldering jewelry, is assembling these circuits using parts from many component manufacturers.

The Army is using MICRAM circuits in classified fuse and infrared equipment, and further applications are expected as reliability is shown.

Micromodule Receiver to be Built, Transmitter, Field Computer Planned

A more advanced wafer approach using new forms of components tailored to the wafer approach is represented by the Army Signal Corps-RCA micromodule program. A prototype radio receiver made from micromodules will be built during the coming year, and a radio transmitter and field computer will be designed using this approach. Micromodules are encapsulated cubes, about 1/3-in. square, using components either deposited on, or built into a ceramic wafer.

The first operational use for these modules, oddly enough, may be in Navy infrared equipment, rather than Army equipment. Micromodules have been chosen to extend the capability

of an existing system without increasing its size. RCA feels that many other applications of this type will be found when micromodules reach suitable reliability and performance levels.

Advanced printed-circuit concepts also appear ready to move into the design picture in the coming year. Multi-layer printed circuits, for example, are just beginning to be used in airborne computers. Until recently, dimensional stability of the plastic used in making printed boards made it difficult to line up contact points with component leads. If holes left in the upper layers of laminated boards do not line up perfectly it is impossible to contact the right points on circuits deposited on inner layers. It appears that much progress is being made on this contact problem and further applications for this technique seem assured.

The use of pellet or leadless components, and components with radial or co-planar leads, also shows signs of becoming a strong contender in the design spotlight. These components can be inserted into recesses or holes in printed-circuit boards, allowing decreases in the over-all thickness of the boards and mounted components.

Thompson-Ramo-Wooldridge, Inc., Los Angeles, has worked out a complete packaging approach using these imbedded circuits. Hughes Aircraft Co.'s Semiconductor Div., Newport Beach, Calif., has developed diodes and experimental transistors suitable for this approach, and P. R. Mallory & Co., Inc., Indianapolis, is preparing a line of pellet components. Pilot-line units should be available from Mallory by the end of the year, according to Stanley M. Stuhlbarg, corporate staff engineer on the company's microminiaturization program.

Integrated circuits, and functional and molecular electronics will not be ready for operational equipment in 1961, most observers agree. Some prototype units, demonstrating the feasibility of these techniques, are expected, but the characteristics of this equipment will not be comparable to operating units made by more conventional methods, it is felt.

Generally, predictions of the future of these methods indicate a sales spurt about 1965, followed by a fast rise a few years later as operating effectiveness is demonstrated.

MICROMODULAR COMPONENTS

NEWEST DIVISION OF GROWING LING-TEMCO ELECTRONICS, INC.

Ling-Temco Electronics, Inc., is pleased to announce the establishment of a new Micromodular Components Division. This division is housed in a new 22,000 square foot modern plant at Anaheim, California. The staff comprises a corps of industry-qualified, applications-minded engineer-scientists intimately familiar with the stringent performance and high reliability requirements imposed by today's "Electronic Systems Manufacturers." This newest Division will specialize in the manufacture of subminiaturized high and low-voltage rectifiers, semi-conductor logic circuits and custom miniaturized modular packaging. Design counseling, relative to circuit configuration, choice of component, subminiaturization and reliability problems, will be provided at no additional cost.

The Micromodular Components Division welcomes your inquiries and assures you immediate response to any requests. Write or phone for prices, product data sheets, quotations, and deliveries. MICROMODULAR COMPONENTS, a Division of Temco Electronics & Missiles Co., P. O. Box S-1, Phone JEfferson 4-6000, Anaheim, California.

LING-TEMCO **ELECTRONICS, INC.**

The Ling-Temco Group • Widening Circles of Influence in Electronics

Altec Lansing Corporation, Subsidiary • Altec Service Company, Subsidiary • The Calidyne Company, Inc., Division • Continental Electronics Manufacturing Company, Subsidiary • The Electron Corporation, Subsidiary • Fenske, Fedrick & Miller, Inc., Subsidiary • Ling Electronics Division • Peerless Electrical Products Division • Temco Electronics & Missiles Company, Subsidiary • Micromodular Components Division • Temco Overhaul & Aerosystems Division • Temco Electronics Division • Temco Missiles Division • Temco Industrial Division • United Electronics Company, Subsidiary • University Loudspeakers, Inc., Division.

CIRCLE 50 ON READER-SERVICE CARD

THERE'S A BETTER WAY

... to cool a transistor. In fact, I've got a customer or two who tell me they actually prefer Birtcher heat radiators. Imagine that. They even wax enthusiastic, like a kid drooling over the thoughts of a cool cone. They tell me that using a transistor radiator they can get 25% to 27% better transistor efficiency. I should argue? And as for that old devil Thermal Runaway — he's gone thataway. Would you dare to debate the matter? Shucks, I can overwhelm you with all sorts of cunning material, like qualification test reports, hardsell catalogs or a personal dithyramb on the subject. Address your inquiry (or diatribe) to: **Charles F. Booher, Secretary, There's a Better Way Society of America, Inc., The Birtcher Corporation** — Industrial Division, 745 S. Monterey Pass Road, Monterey Park, California. Or even call me at ANgelus 8-8584. I'll send you an **Honorary Membership Certificate** to my select Society. (But no cones.)

Cool!

Write for our new and daring Transistor Radiator Catalog.

Sizes available for every commonly used transistor If you've got any uncommon ones, we might even make a radiator for those, too. But no cones.

CIRCLE 51 ON READER-SERVICE CARD

BIONICS

assimilation of '60's gains

BIONICS, the infant science of applying knowledge of biology to the solution of engineering problems, is heading into a year of consolidation. Although designers this year will continue their many attempts to adapt nature's technology to electronic design, much activity will be centered on assimilating basic research and other data brought to light in quantity in 1960.

Expectations are that in 1961 many laboratories in industry and schools will board the bionics bandwagon while organizations already active in the field will base new programs on the research and development reported widely for the first time last year.

Standards, New Devices, Interconnections to be Among Highlights of Year

Three features are expected to characterize the bionics effort this year. First, attention will be paid to establishing working standards and criteria. Such questions as when is a system adaptive and when is it self-regulating need to be discussed broadly. So far, no more than one or two levels of adaption are being discussed generally, though as many as six or seven are known to be possible. The general problem is one of establishing criteria of all types so that various functions, devices, and systems can be compared and evaluated properly. But, formal action toward this end is not expected.

A second feature of the bionics year now starting is expected to be the emergence of a new generation of bionic devices. Now that details of the first pioneering simulations of neurons, retinas, and other biological systems are known, improved devices should be forthcoming, especially pattern recognition units and memory cells in which much work is going on.

A third feature is expected to be a shift in emphasis from components to interconnections and systems. Under Air Force direction, researchers are being encouraged to think in terms of systems that might do the job rather than of components that might be made use of.

What the military needs are adaptive high-performance systems to handle a variety of tasks that are not being done well enough now. They would like designers to develop systems that might do these jobs and then find the means to implement them. The emphasis in 1961 may shift from components to interconnections.

Mark II Perceptron, Electroluminescent Neuron Due for More Attention

Two specific projects due for attention in 1961 are the Mark II Perceptron at Cornell Aeronautic Laboratories and the electroluminescent neuron being developed for the Air Force by General Electric.

Design of the Mark II, now in early stages, is expected to be relatively fixed some time this year. This unit, larger than the Mark I, may be used for solving actual problems in photo interpretation and character and speech recognition. The next step in the perceptron effort may be to interest some organizations in backing development of special-purpose perceptrons for particular jobs. The Mark II, however, is being planned as a general-purpose machine.

The General Electric neuron, which has run into developmental difficulties, is now scheduled for delivery to the Air Force in June, several months late. It is expected to be the most advanced mechanical realization of a biological system.

Other bionics systems that may make design news in 1961 are Aeronutronic's new adaptive decision-maker with property-filter input, and the perceptron-type adaptive unit being enlarged at the University of Illinois. One of the bionics pioneers, Ross Ashby, is joining the staff at Illinois this year.

Because bionics as a formal concept, was, in effect, born in 1960, through the efforts of the Office of Naval Research and the Wright Air Development Division, at their pioneering symposiums on self-organizing systems and bionics, information has started flowing in quantity only recently.

NEW FROM
THOMAS A.
EDISON

miniature thermostat drifts less than 1.5°c in 500,000 operations

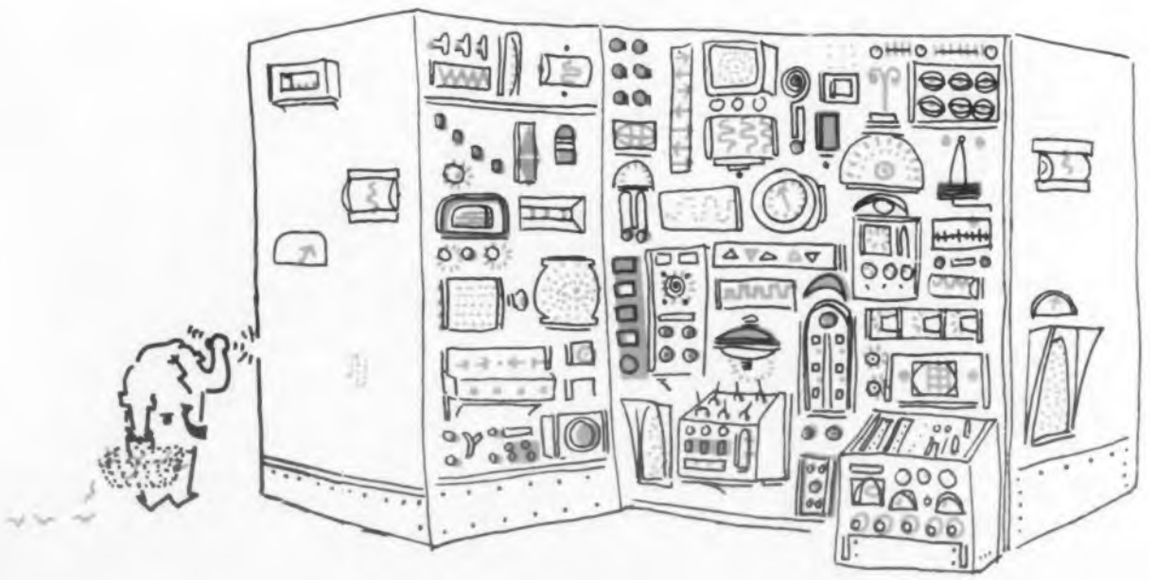
Miniaturization, close control and inherent stability are the outstanding characteristics of Edison's *new* model 292 miniature thermostat. Designed specifically to meet the requirements of solid state electronic packages, this thermostat is ideal for use in small crystal and oscillator ovens, computers and electronic packages of all types.

Only 0.317" in diameter and 1.325" long, this Edison thermostat features long operational life with little drift from the original temperature setting—prolonging the useful life of the electronic components it controls. Set to a manufacturing tolerance of only ± 1°C., it has an operating differential of less than 2°C at a rated load of ½ ampere at 115 V. a.c. or 28 V. d.c. Available either unset or factory preset to a specified temperature, Edison's *new* model 292 miniature thermostat will control temperatures from 0°C to 180°C.

Edison's mass production techniques and many years' experience permit producing this superior thermostat at a remarkably low cost. For complete information write for publication 3009C.

Thomas A. Edison Industries
INSTRUMENT DIVISION
55 LAKESIDE AVENUE, WEST ORANGE, N. J.

CIRCLE 52 ON READER-SERVICE CARD



COMPUTERS

the accent will be on selling and services

THERE is virtually no field of business or technology that digital computers will not invade in the next few years. They will share a greater and greater part of the routine paperwork burden; they will control more processes and machine tools; and they will play a more and more important role in engineering calculations and management functions. On these points all industry spokesmen agree.

But on the questions of what computers will look like—what kind of circuits they will use and what components, how large they will be or how small—on these questions, there is controversy aplenty.

There are those who feel that the bright star on the horizon is the tunnel diode. They feel that the tunnel diode will answer the needs for faster and faster computation. Indeed, they feel the tunnel diode will fill the needs of tomorrow's gigacycle machines and will take over even in low-speed machines.

They see only a temporary lull while computer designers learn to orient their thinking to the use of two-terminal components.

Others see high-speed transistors answering the immediate need for fast computation and see gigacycle machines in the dim distant future only.

Lacy Goosetree, marketing manager for General Electric's Computer Dept., speaks for many in the industry when he pictures tunnel diodes, magnetic thin films, cyrotrons, and thermoplastic films finding their way slowly into commercial machines in the next five years. Mr. Goosetree further reflects industry attitudes when he views cost of new circuits as determining the extent of their use and the timing.

All-Magnetic Logic May Raise Computer Reliability

Others in the industry are looking to entirely different approaches. Umberto F. Gianola of Bell Telephone's Murray Hill Laboratories, for example, sees the possibility of all-magnetic logic in some special-purpose computers of the future. He points to the success of magnetic cores in memories despite the problems involved in using multiturn windings on cores to match their impedances with the much higher impedance levels of the associated semiconductor circuitry.

Simpler and more reliable circuits can result, he says, from the use of all-magnetic logic. Mr. Gianola recognizes the fact that magnetic-logic circuits are considered relatively slow, but he points out that core materials with higher coercivity (and higher cost) can be used to speed up their operation. He recognizes also, that the temperature rise due to hysteresis losses at higher speeds may add another problem.

Still another approach to faster core-logic and memory lies in the use of smaller cores. Cores used in the memories of vacuum-tube machines had inside diameters of 50 mils, outside diam-

eters of 80 mils. Some of the most up-to-date transistorized computers use 30-50 mil cores. Despite the added wiring costs associated with smaller cores, memory designers are now talking of 19/30 mil cores and even of 13/18-mil cores.

For high-speed machines, thin films may provide advantages over cores as they require smaller drive signals at frequencies higher than about 10 mc.

Transmission Delays Limit Speed of High-Speed Computers

The basic storage device is not yet the principal barrier to higher speeds, however. Transmission delays in sense amplifiers, drive circuits, and decoders can account for a large portion of the total cycle time. W. L. Shevel Jr. of IBM's Research Center indicates that the switching time of memory elements in today's high-speed machines accounts for less than half the total cycle time.

Most industry observers see no real breakthroughs in the offing by computer designers though they see problems which must be solved. They see a need, for example, for reducing the cost and size of input and output equipment and for increasing the speed. J. C. Fulton, computer sales director of Royal McBee Corp., points to the need for more work in developing faster line printers to keep pace with internal computer speeds. He sees applications like order writing, billing, and payroll preparations becoming even more practical than they are today when faster peripheral equipment enters the picture.

Thomas Bradshaw, a spokesman for RCA's Electronic Data Processing Div., sees other areas needing work. Recognizing the importance of faster input/output equipment, he points specifically to the need for greater effort in developing and improving document readers and non-impact printers. Like others, Mr. Bradshaw sees a trend to more integration of data processing with manufacturing phases of a company's operations and to improved communications systems for data transfer between distant points. He sees still more work needed in self-organizing systems.

'Software' and Systems Thinking will Replace Hardware Emphasis

When it comes to the application of computer systems, a completely new emphasis comes into view—an emphasis on "software"—compilers, programs and services. Computer manufacturers in 1961 will be selling much more than just computing machinery and peripheral devices.

They will offer more help in the field of management science and they will knit a closer link between business and industrial computer systems in many factories and businesses.

Commenting on the accelerated demand expected for digital-control computers, Dr. Joseph Manildi, general manager of TRW Computers Co., points out that the computer hardware now available is more than adequate for the job of on-line control. "It is not a question of breakthrough in design," he says, "but of applying the present equipment to the needs of industry."

Some feel that computers have already satisfied the most obvious applications, that they've already skimmed the "cream of the crop." Nicholas Pensiero, marketing administrator at Philco's Computer Div. for example, feels that future applications will require far more intensive study based on the need for far more extensive cost savings.

Small Machines and Data Links to Broaden Computer Market Further

Two very important developments are certain to have a profound effect on computer sales and on computer applications. One is the introduction of many medium and small-scale computers whose low prices will open doors to hundreds of companies which couldn't afford larger machines.

The second development, a younger, more dramatic one from a technical viewpoint, lies in the rapid growth of systems to help computers "talk" to each other and to their peripheral equipment. An important contribution to this trend is the Dataphone system announced by A.T.&T. just a few months ago.

This system allows a card reader or papertape reader in a company's branch office, for example, to transmit data directly to the company's large computer installation at the main office. Transmission is over regular, dial-system telephone lines. The user is charged only at regular telephone call rates.

Near-Future Computer Sales to Top One Billion

Systems like this one are expected to extend computer usage and sales substantially. Today's estimates of the dollar-value of computer hardware alone—not counting military equipment, and not counting services like maintenance and consulting—all show that computer manufacturers expect to enjoy very rapidly growing sales in the years ahead.

GE's Lacy Goosetree sees industry sales of $700 million in 1961 and $1.4. billion in 1965 compared with $625 million in 1960. Philco's Nicholas Pensiero sees a billion dollars worth of computer sales (including services) this year. At Royal McBee, J. C. Fulton estimates a doubled dollar volume for Royal McBee every year for at least the next four years.

Higher Accuracy, Wider Bandwidth Needed for Analog Computers

In the analog-computer field, the growth is by no means as rapid or dramatic. Industry sources picture a modest growth of about 30 per cent in the next five years. But here, too, there is a great deal of effort in extending computer performance. Designers are trying to extend computing frequency without losing accuracy. Toward this end, they are developing electronic components (like multipliers) to replace slower (but less costly) servo-mechanical components.

Phillip Rafield, computer products manager of Reeves Instrument Corp., points to a number of improvements needed to extend analog-computer accuracy beyond the 0.01 per cent range to the 0.005 and 0.003 per cent accuracies which are already available with both resistors and capacitors.

The principal limitation, he indicates, rests with nonlinear elements such as diode-function generators, electronic multipliers, and electronic resolvers. At best, these are available with tolerances of 0.01 to 0.05 per cent.

Mr. Rafield suggests that analog-computer manufacturers could take a giant step forward if, electronic multipliers, for example, were available with practical accuracies of 0.005 per cent within today's phase-shift limits of 0.1 deg at 100 cps.

NOW...AN INDUSTRY FIRST FROM FAIRCHILD

A REVOLUTIONARY PRESSURE TRANSDUCER WITH 5V. D-C OUTPUT

TRIPLE **S-G**

SOLID-STATE STRAIN GAUGE TRANSDUCER

OTHERS MAY HAVE PROMISED IT... STILL OTHERS MIGHT HAVE HINTED THEY'RE ON THE VERGE OF GETTING IT... BUT ONLY FAIRCHILD HAS IT!...THE INDUSTRY'S FIRST 3S-G

The Fairchild 3S-G combines the best overall characteristics of both strain gauge and pot-type transducers, has none of their inadequacies. It has a semiconductor strain-gauge sensor. It possesses extraordinary accuracy and environmental capabilities. It produces a 5-volt d-c output signal that eliminates the need for impedance-matching or signal amplification. In its utter simplicity (only two mechanically-functioning parts) it is extremely reliable. It also incorporates a resistive calibration device.

The Fairchild 3S-G is responsive to both static and high-frequency dynamic pressures. It is fully compatible with existing military ground telemetry and industrial systems. It is competitively priced, measures all media and is insensitive to case distortions.

The Fairchild 3S-G is only 3" long, $1^1/_8$" diam., and weighs only 5 ounces. It meets and exceeds MIL-E-5272B. Pressure ranges from 0-100 to 0-10,000 psig full scale now available, below 100 psig will be available soon. Better than ± 0.1% linearity and 0.1% hysteresis over temperature range of −65 to +250 F. Both zero and full range sensitivity change less than 0.5% over any 100 F excursion within the rated temp range. It has infinite resolution.

Fairchild components... built and tested beyond the specs for Reliability in Performance.

FAIRCHILD CONTROLS CORPORATION

225 Park Ave., Hicksville, L. I., N. Y. • 6111 E. Washington Blvd., Los Angeles, Cal.
A Subsidiary of Fairchild Camera and Instrument Corporation

TRANSDUCERS
RATE GYROS
POTENTIOMETERS
ACCELEROMETERS

CIRCLE 53 ON READER-SERVICE CARD

Radiation Detector Responds To All Electromagnetic Energy From 200 to 10,000 Mc

HAND-HELD and simple to operate, this radiation detector provides a rapid and sure means for checking power density from 200 to 10,000 mc. Model B86B1 responds to all electromagnetic energy over the band specified regardless of polarization, therefore, all such energy is integrated and total field is read on the meter. This feature is particularly useful where radiation from several sources may be incident on the area. It obviates the necessity for summing a series of measurements at a number of frequencies and modes of polarization.

The Detector Will Respond To All Polarizations

The unit's antenna detects any power density field from 0 to 20 mw per sq cm within its design frequency range. By virtue of its design, it will respond to all polarizations . . . right-hand circular, left-hand circular, linear or any combina-

tion thereof. The thermistor detectors integrate the pulsed, or modulated, received energy and the average power density is displayed on the meter.

Simplicity of operation is the basic safety feature of the radiation detector. To operate, it is only necessary to scan the meter about the horizontal and vertical axis for maximum meter reading. The field intensity level, as indicated, is the integrated reading of all the electromagnetic energy in that particular area.

Since the one antenna covers the entire frequency range from 200 to 10,000 mc and provides the same average power density regardless of polarization, the possibility of selecting an improper antenna is eliminated, according to spokesmen for the manufacturer, the Sperry Microwave Electronics Division of the Sperry Rand Corp., Clearwater, Fla.

Passive Mode of Operation Provides Reliability

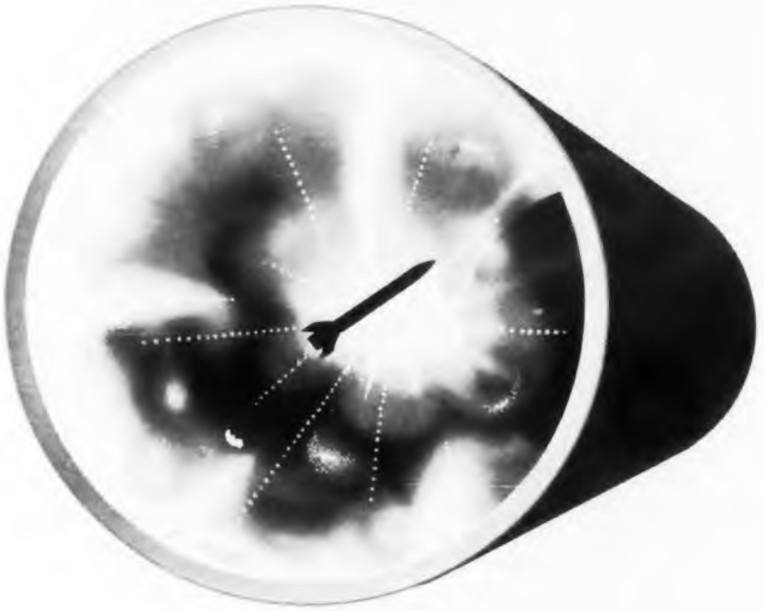
The zero point of the unit can be checked out and reset at any time by placing it face-down on the ground, or by otherwise directing it away from the radiation source. The only control is a combined on-off, zero-adjust knob for use before exposing the instrument to an rf field.

The circuitry is simple and inherently reliable, both through the selection of proven components, and its passive mode of operation. Battery failure is immediately apparent when it is no longer possible to zero the meter. Zeroing of the meter before making a reading functionally checks all elements of the circuitry.

Unit Detects Power Levels As Low As 0.5 Mw Per Sq Cm

The radiation monitor presents a 7-in. diam aperture to the power source. The instrument is mounted in a high-impact strength plastic housing with an integral handle. Over-all dimensions are 7-1/2 in. wide x 9-1/2 in. high x 6-1/2 in. deep. Total weight is less than 2 lb. It contains a thermistor bridge assembly, batteries and output meter. The price for the B86B1 is $525 and is available for purchase from the manufacturer.

For further information on this broadband electromagnetic radiation detector turn to the Reader-Service Card and circle 251.



You name the environment ...TENNEY will simulate it!

Altitude, heat, cold, explosion, vacuum...whatever environment you need, there is an extensively-tested Tenney prototype already built that is very near your specifications. By adjusting the prototype to fit your particular requirements, we can make delivery in a surprisingly short time. In operation, your Tenney chamber will reach ideal environmental conditions quickly, maintain them efficiently throughout the test run, and provide accurate data for quick, simple evaluation.

Tenney, pioneer in the science of environmental testing, is today the world's largest, most experienced creator of environmental testing equipment. Write today for literature describing Tenney's complete line of prototype chambers, or for information on Tenney's research and development, engineering consultation, and design services.

Tenney ENGINEERING, INC.
1090 SPRINGFIELD ROAD, UNION, N. J.

PLANTS: UNION, N. J. AND WILMINGTON, N.C. • THERE IS A TENNEY CHAMBER TO SIMULATE ALTITUDE, HEAT, COLD, HUMIDITY, VACUUM, EXPLOSION, SAND, DUST, FOG, AND MOST OTHER ENVIRONMENTAL CONDITIONS.

CIRCLE 54 ON READER-SERVICE CARD

NEW PRODUCTS

Covering all new products generally specified by engineers designing electronic original equipment. Use the Reader's Service Card for more information on any product. Merely circle number corresponding to that appearing at the top of each description.

Multiple-Octave Filter Analyzes Audio Spectrum 454

Octave band filters, paralleled with rms meters, give a measuring range of 46 db from 37 cps to 9,600 cps in the model 358, or to 19,200 in the model 359. Dynamic range is 76 db; input level is 1 v for maximum range. Attenuator provides 3 steps of 10 db each. Filter attenuation is 40 db per octave. The 55-lb unit, 10-1/2-in. high by 15-in. deep, mounts in a standard rack. Amplifiers are transistorized for non-microphonic operation.

Allison Laboratories, Inc., Dept. ED, 11301 E. Ocean Ave., La Habra, Calif.

Price: *Model 358, $2,635; Model 359, $2,990.*

Availability: *4 weeks.*

10-Mc Counter-Timer Is Flexible and Stable 453

Operating in any of 9 functional modes, the model 365 counter-timer offers an over-all stability of 0.05 ppm per week. It will total random events over time intervals from 0.1 μsec to 100 sec, perform straight counts, measure time interval, period, phase angle, and pulse width. The range as a counter is 1 cps to 10 mc (sine wave) and 0 to 10 million pps. It provides sine waves of 1 mc and 10 mc, and square waves from 0.1 cps to 100 kc. Resolution is 0.1 μsec.

Transistor Specialties, Inc., Dept. ED, Terminal Drive, Plainview, L. I., N. Y.

Price: *$2,650.*

Availability: *30-day delivery.*

2-Channel Oscilloscope Has 0.4 Nsec Risetime 455

The model 112-9 dual channel sampling oscilloscope has a rise-time of 0.4 nsec, calibrated sensitivities to 2.5 mv per cm, and a noise level of less than 0.6 mv. It will measure delay times and time separations as small as 0.02 nsec. Two separate waveforms, or a single waveform, may be displayed at 2 different sweep speeds. Each input can be separately controlled as to sweep speed, vertical gain, and vertical and horizontal position. Signals from 2 mv up to 30 v can be displayed.

Lumatron Electronics, Inc., Dept. ED, New Hyde Park, L. I., N. Y.

Price: *$5,330.*

Availability: *4-week delivery.*

Differential Amplifier Tolerates 10-μf Load 451

The differential amplifier, model 602, amplifies microvolt signals and sends them over miles of cable. Output is ±10 v at 200 ma into a 50-ohm load; up to 10 μf of capacitive loading can be tolerated without oscillation. The chopper-stabilized unit is a differential amplifier, with fully isolated input and output. Common mode rejection is 100,000,000 to 1 at dc, 1,000,000 to 1 at 60 cps. Zero stability is better than 0.05% of full scale for 1,000 hr. There is an internal regulated power supply.

Video Instruments Co., Inc., Dept. ED, 3002 Pennsylvania Ave., Santa Monica, Calif.

Price: *$550.*

Accelerometer **452**
Linearity Is ±1%

The model EM900 general-purpose piezoelectric accelerometer has a range of 0.05 to 10,000 g at a linearity of ±1%. No measurable hysteresis has been observed. Sensitivity is 15-mv peak per g peak; ambient temperature range is −100 F to 500 F. Transverse sensitivity is 3%. Mounting stud is mechanically isolated; housing and shell are of stainless steel. The unit weighs 35 g.

Raytheon Co., Industrial Components Div., Dept. ED, 55 Chapel St., Newton 58, Mass.

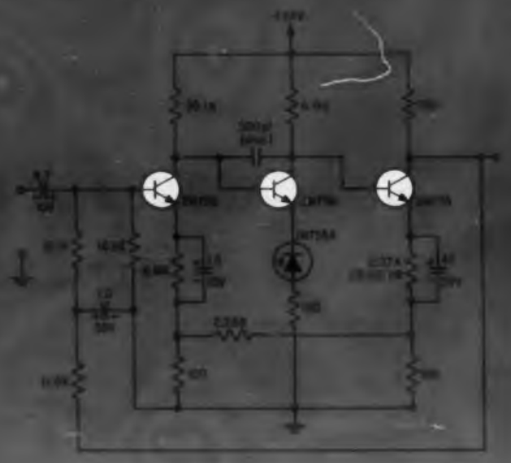
Price: *$145 ea, 1 to 9; $135 ea, 10 to 24; $128 ea, 25 to 100.*

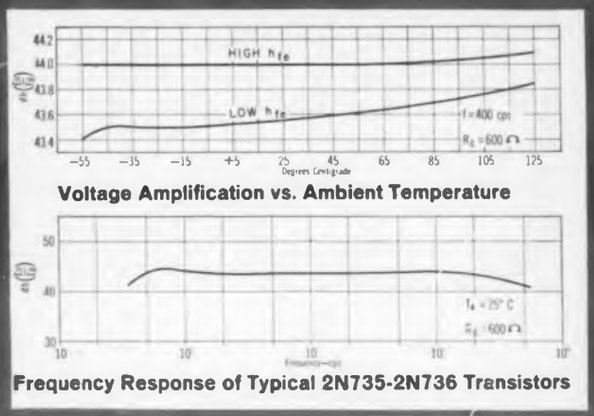
Availability: *30 days.*

CIRCLE 55 ON READER-SERVICE CARD ➤

HOW TO GET FLAT FREQUENCY RESPONSE

FROM 37 CYCLES TO 45 KC





Voltage Amplification vs. Ambient Temperature

Frequency Response of Typical 2N735-2N736 Transistors

Specify TI 2N734 Series Silicon Transistors for Your Amplifiers!

For your audio/servo amplifiers, power supplies and medium-speed switches, design in TI 2N734 Series Silicon Transistors. Obtain a flat frequency response of ±1.5 db from 37 cycles to 45 kc . . . guaranteed beta at 25°C (1 ma at 1 kc) (5 ma at 1 kc) (5 ma at 30 mc) and at −55°C (5 ma at 1 kc) . . . guaranteed 500-mw free-air dissipation . . . reduced equipment size and weight with TO-18 package.

For even greater power dissipation, investigate the design flexibility of the equivalent TO-5 packaged 600-mw TI 2N1564 Series Silicon Transistors.

Write for complete specifications on 2N734 and 2N1564 Series Today!

SPECIFY TI FOR ALL YOUR SILICON TRANSISTOR REQUIREMENTS • Small Signal • Switchers • Medium Power • Power • Order TODAY from your local TI Sales Office or TI Distributor.

GUARANTEED MINIMUM BETAS

Symbol	Parameter	Test Conditions	2N734	2N735	2N736
h_{fe}	A-C Common-Emitter Forward Current Transfer Ratio	V_{CE}=5v I_E=5ma f=1 kc T_A=25°C	20	40	80
h_{fe}	A-C Common-Emitter Forward Current Transfer Ratio	V_{CE}=5v I_E=1 ma f=1 kc T_A=25°C	15	30	60
h_{fe}	A-C Common-Emitter Forward Current Transfer Ratio	V_{CE}=5v T_A=-55°C I_E=-5 ma f=1 kc	12	20	40
$\lvert h_{fe} \rvert$	A-C Common-Emitter Forward Current Transfer Ratio	V_{CE}=5v I_E=5 ma f=30 mc T_A=25°C	1	2	2

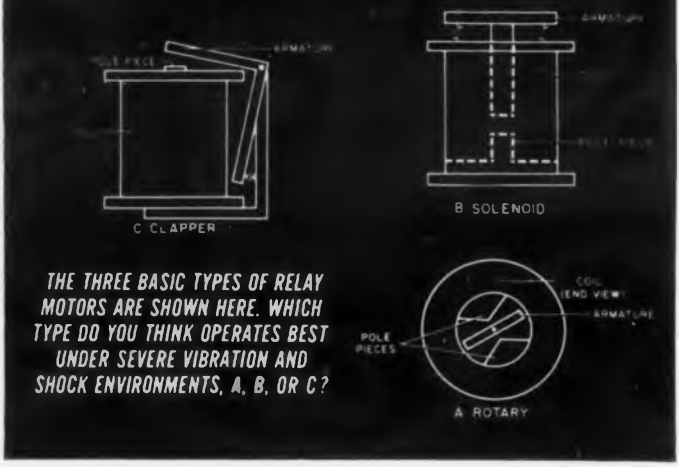
IN TI DISTRIBUTOR STOCKS 3D DEPTH · DELIVERY · DEPENDABILITY

SEMICONDUCTOR-COMPONENTS DIVISION

TEXAS INSTRUMENTS LIMITED — INCORPORATED

DALLAS ROAD • BEDFORD, ENGLAND — 13500 NORTH CENTRAL EXPRESSWAY • DALLAS, TEXAS

HOW DO YOU RATE AS AN ELECTRONICS DESIGN ENGINEER?



The clapper type (C) usually has two moment arms, the clapper itself and the spring arm, in two different planes through which acceleration forces act to cause chatter. The solenoid (B) is sensitive to acceleration forces along the pole-piece axis, and acceleration forces directed normal to the pole piece can also cause it to bind. The balanced armature of the rotary motor is practically insensitive to vibration and shock forces. The answer is A.

WHAT DOES THIS MEAN IN TERMS OF RELAY CIRCUIT DESIGN?

It means that if you require system reliability under severe environmental conditions, you should always specify a rotary motor in all relays used in the system. All relay manufacturers are aware of the superiority of the rotary configuration, and for relays designed for military applications, most manufacturers incorporate the principle of the balanced armature in their design.

The principle of the balanced armature is incorporated in all of Filtors' relays the latest of which is the new "Pillbox" configuration shown here. It is the only relay of this style with a rotary relay motor. The Pillbox is made for printed circuit applications where high density packaging is required. Before the Pillbox, relays were adapted to circuit boards by bending them 90 degrees and setting them in epoxy; this process increased the size and weight of the relay. The Pillbox is tough (30 g's vibration to 3,000 cps, 150 g's shock), versatile (dry-circuit to a 5-ampere loads), as well as small and light.

FILTORS, INC., SPECIALISTS IN THE DESIGN AND MANUFACTURE OF SUBMINIATURE AND MICROMINIATURE RELAYS.

Makers of the most efficient microminiature relay motor in the industry—the powerful new Sensi-Tork rotary relay motor, used in the J-series relays, the "Pillbox" printed circuit relay, and in the first premium quality microminiature relay, the Golden G.

FILTORS, INC. RELAYS

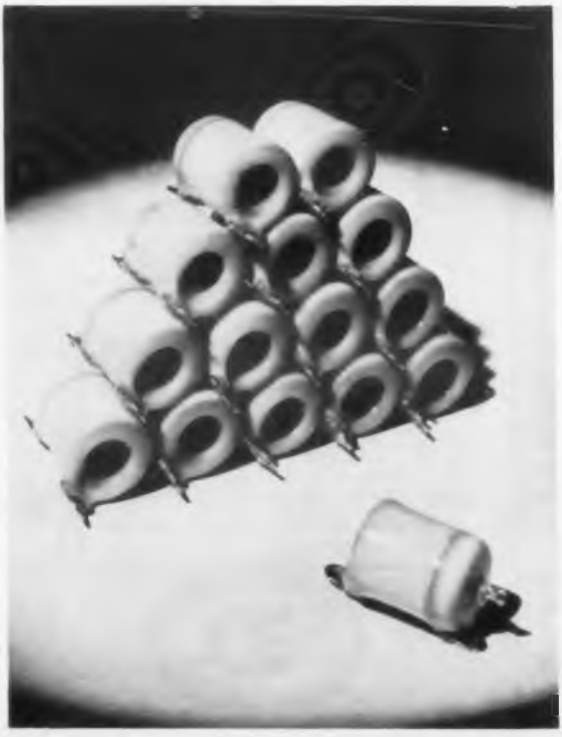
PORT WASHINGTON/NEW YORK/POrt Washington 7-8220

CIRCLE 56 ON READER-SERVICE CARD

100,000-Bit Drum Memories For Sale at $750

IT'S HARD to believe that a 100,000-bit drum memory could sell for as little as $750. Normally, one would expect a 100,000-bit drum to carry a price tag of at least $3,000.

But a new memory, manufactured by Bryant Computer Products, 852 Ladd Road, Walled Lake, Mich., is available at the $750 price in quantities of 10. Even the single-unit price of $900 was low enough to astonish many visitors to last month's Easter Joint Computer Conference where the drum was shown for the first time.



Cold-Cathode Tube Switches 18 J at 3 Kv

The Z-5362, a miniature ceramic cold-cathode tube, can switch 18 J of energy at 3 kv. Designed to switch a single stored energy system into low-impedance loads, the tube acts in 1.0 to 1.5 μsec. Main gap voltage is 2 to 2.6 kv, max; nominal peak main gap current is 1,500 amp. The main gap will hold off 3 kv indefinitely, 3.6 kv for 10 min. The tube has been used at up to 4,000 amp. Main gap pulse duration is 10 μsec max. Trigger firing voltage is 500 v min; peak trigger firing current is 5 amp.

General Electric Power Tube Dept., Dept. ED, Schenectady 5, N.Y.
Price: $55.

Availability: *Delivery from stock in limited quantities.*

With 33 tracks and heads, the drum (Utility Model C-105), stores 3,000 bits per track. At a quantity price of $950, a 150,000-bit drum is available with 50 tracks.

The drum in the C-105 rotates at 3,600 rpm and provides a maximum access time of 16.7 msec. An 1,800-rpm speed is optional. Like many other such memories, the C-105 features a hard, oxide coating on the drum and sealed bearings which should provide a 10-year life in average use.

Depending on the pulse-packing density, the heads require from 100 to 200 ma of write current. They provide a read voltage of at least 50 mv peak-to-peak. Head-to-drum spacing is 1 mil.

The manufacturer, questioned on the price break at the computer conference, attributed it to anticipated high production of a standardized design. "This new memory," he pointed out, "should find wide application in the fast-growing market for small computers."

Starting in March, the new drum will be available from stock.

For more information on this drum memory, turn to the Reader-Service Card and circle 252.

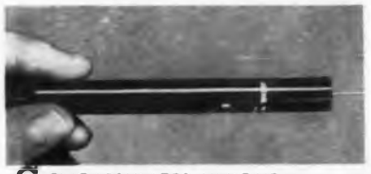
DC Voltmeter **411**
Accurate to ±0.01 % +5 μv

This transistorized differential dc voltmeter, the model DC 200AR, is accurate to +0.01% +5 μv. Potentiometer accuracy is ±0.002%; temperature stability is 2 ppm per deg C, 10 C to 40 C, and regulation is ±0.001% for a 10% line change. Range of the meter is 0 to 1,000 v dc. Self-calibration and complete warm-up take less than 30 min.

Calibration Standards Corp., Dept. ED, 1025 Westminster Ave., Alhambra, Calif.
Price: $985.

GENERAL INSTRUMENT SEMICONDUCTOR REPORT

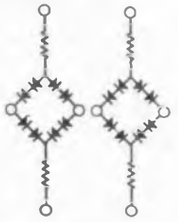
Design Notes...



G ENCAPSULATES UNIQUE HOLD-OFF DIODE

Problem: A well-known systems manufacturer needed a series hold-off diode for use in a dc resonant charge radar modulator. Conditions: PIV of 12KV. Operating temperature, 100° C; Inverse current at PIV, 150 μa; Average current, 120 ma; Peak charge current, 260 ma. *In addition*, specifications called for a transient capability of 21 KV dc for .07 second.
Solution: G produced a unit which far exceeded these requirements. The G CIRCUIT CAP (pictured above) is only ½" in diameter and 4½" long. It is capable of continuous operation beyond maximum required parameters.

ENCAPSULATED ASSEMBLIES BUILT TO SPEC MEASURES 1 CUBIC INCH

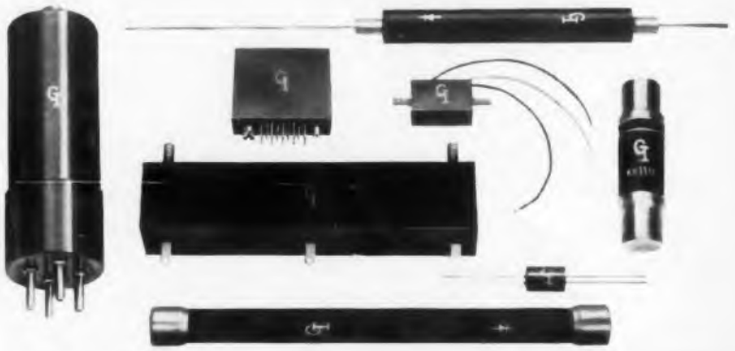


G recently designed a comparator bridge for missile use, which contains 4 resistors and 16 diodes (print at right). The entire bridge is encapsulated within a 1 cubic inch module, has 8 studs for plug-in mounting. The unit meets customer requirements, and is capable of continuous operation in ambients up to 150° C.

MICROMINIATURE DIODE DESIGNED FOR 1,500 PIV SERIES OPERATION

General Instrument Engineers solved another customer problem in a diode that measures .08" diameter by ¼" long. Space requirements made it necessary to assemble an "electrically cold" unit. This specially designed diode was produced with the rigid requirements of 1,500 PIV, leakage of less than .02 μa, and a forward drop of less than 2V @ 100 ma.

G Offers Reliability on the Circuit Level



GENERAL INSTRUMENT CIRCUIT CAPS DESIGNED TO YOUR SPECIFICATIONS . . . SAVE COST OF
• Engineering • Production • Quality Control

General Instrument offers circuit modules with the exact parameters needed for your specialized applications . . . regardless of configuration, electrical or environmental requirements. Typical applications include: rectifiers, amplifiers, comparators, bridges, limiters, blocking and flip-flops.

These packaged assemblies provide proved reliability for the entire circuit . . . feature high resistance to vibration, shock, moisture and humidity, combined with high heat dissipation. These assemblies range from printed circuit boards, ultra-high PIV microminiature diodes, minimal size encapsulations, as well as packages weighing hundreds of pounds.

• **ENGINEERING:** Experienced General Instrument Engineers study your specifications, draw on G research, development and production facilities in making an assembly to exceed your most stringent requirements.

• **PRODUCTION:** Years of General Instrument experience in volume semiconductor manufacture is applied to the production of "G CIRCUIT CAPS". G saves you the expense of stocking, testing, selection and encapsulation. Maximum use of welded connections assures excellent resistance to vibration and shock.

• **QUALITY CONTROL:** Components, as well as completed "G CIRCUIT CAPS" are subjected to 100% electrical and environmental testing . . . exceeding the most stringent industrial and military specifications. Finished units are *guaranteed* to surpass your most rigid requirements.

CONTACT GENERAL INSTRUMENT for full information on the services offered by the Special Products Division. Our engineers will work closely with you—in your own plant, if necessary—to produce a "G CIRCUIT CAP" designed for your modular applications or complete circuit needs.

SEMICONDUCTOR DIVISION
GENERAL INSTRUMENT CORPORATION
65 Gouverneur St., Newark 4, New Jersey

IN CANADA: General Instrument—F. W. Sickles of Canada Ltd., P.O. Box 408, 151 S. Weber Street, Waterloo, Ontario, Canada. Sherwood 4-8101.

CIRCLE 57 ON READER-SERVICE CARD

ēlin

instrumentation
is the only
answer

WHERE PRECISION COUNTS...!

You can depend on ELIN to meet your precision AC power requirements on gyros, bridge-type transducers, synchros, servo systems, resolvers and many other AC devices.
Ask about the new load-regulated amplifiers for production line testing. External sync. provides master-remote features without sacrifice in over-all stability.
Complete power systems available for your specific needs.

Ultra-stable AC Power Sources

Multi-Phase

Voltage Calibrators

Single-Phase

Write for NEW 1960 Catalog

ēlin DIVISION

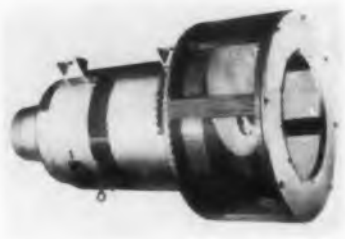
INTERNATIONAL ELECTRONIC RESEARCH CORPORATION
135 West Magnolia Boulevard, Burbank, California • Victoria 9-2481

CIRCLE 58 ON READER-SERVICE CARD

NEW PRODUCTS

Frequency Source 739

Model AR-200 60-cps frequency source can stand shock up to 15 g. It operates at altitudes up to 100,000 ft. The heart of the unit is model FS17900 3.84-kc, high-precision quartz crystal. It has a minimum life of 5,000 hr. Hill Electronics, Inc., Dept. ED, Mechanicsburg, Pa.



Motor-Generator 742

This motor-generator is rated at 5 kw, 6.25 kva, 0.8 factor, 120 v ac, one phase, 50 cps. The 10-hp motor is 208 to 416 v ac, 1,500 rpm, 50 cps, 3-phase, wound rotor induction type. If normal electric power fails, it keeps fluctuation to a minimum until the standby power plant is cut in. Kato Engineering Co., Dept. ED, Mankato, Minn.

Micro-Jack 747

Model TR-2 micro-jack is a 2-conductor, single, closed-circuit design usable as a 2-conductor open circuit type. Opening for plug is 0.101 in. It mounts in panels with maximum thickness of 3/32 in. This audio jack for transistorized radios is suited for miniaturized applications. Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chcago 30, Ill.

Solid-State Display Assembly 748

This unit is for decimal display of a binary-coded-decimal parallel signal. Model 2060 is a 3-1/2-in. high, rack-mounted unit which visually displays up to six decimal digits derived from any of six four-bit codes. Binary input may be static or parallel pulses. Storage capability is provided in the converting circuitry. Hermes Electronics Co., Dept. ED, 75 Cambridge Parkway, Cambridge 42, Mass.

Crystal Filter 741

This 1-kc crystal filter is for use in missile applications. Insertion loss is 6.2 db at 10 v. Attenuation is 3 db at 3.8 cps and 6 db at 4.7 cps. Input is 500 ohms. Output impedance is 500,000 ohms. Burnell & Co., Inc., Dept. ED, 10 Pelham Parkway, Pelham, N.Y.

Vibrator 743

Type 1619 vibrator, for photoflash applications, measures 2-3/32-in. long, 1-3/16 in. in diameter, and weighs 1.2 oz. This non-synchronous vibrator has a frequency of 115 ±7 cps and a maximum load of 3 amp. It can be supplied in 3, 6, 12, 24 or 32 v ratings. P. R. Mallory & Co., Inc., Mallory Electromagnetic Co. Div., Dept. ED, Du Quoin, Ill.

Miniature Bellows 395

Precision instrument bellows and diaphragms, with wall sections of 0.0005 in. to 0.005 in., for high temperature, high pressure and non-magnetic applications are available in a wide selection of sizes, shapes and proprietary alloys.

The Kinemotive Corp., Dept. ED, P. O. Box 386, Huntington Station, L. I., N Y.
Price: *$30 to $90 ea.*
Availability: *21-day delivery.*

Slide Rule 396

A pocket-sized circular slide rule will be sent free of charge to engineers or executives. Write on business letterhead.

General Industrial Co., Dept. ED, 1788J Montrose Ave., Chicago 13, Ill.

Magnet Wire Cables 397

Ribbon-type cables of Formvar insulated magnet wire are available with any number of conductors from 2 to 30, gauges from 26 to 44.

Spectra-Strip Wire & Cable Corp., Dept. ED, Box 415, Garden Grove, Calif.
Availability: *Ten days to 2 weeks.*

Printed-Circuit Tape Kits 398

These kits contain plastic strips and dots for making patterns on copper-clad Fotoceram circuit grid contact. Ten 9 x 1/8 in. strips and forty 3/16 in. dots are supplied.

Corning Glass Works, Dept. ED, Corning, N.Y.
Price: *75c.*
Availability: *Stocked by distributors.*

Nickel-Cadmium Battery 399

This 5-amp, nickel-cadmium battery is for military and space applications. The hermetically sealed unit operates for 20,000 duty cycles.

Gulton Industries, Inc., Dept. ED, 212 Durham Ave., Metuchen, N.J.

Dielectric Capacitor 400

Type TH Teflon dielectric capacitor operates in a temperature range of −55 to +200 C. This hermetically sealed unit is claimed to have high insulation resistance and low dielectric absorption.

Efcon, Inc., Dept. ED, Patterson Place, Roosevelt Field, Garden City, L.I., N.Y.
Price: *From $0.73 to $22.08 in quantities of 1,000.*
Availability: *Made on order, delivery 15 to 30 days.*

Toggle Switch 401

Type T-203 swivel-type toggle switch has a toggle throw of 20 deg in any direction. Life is 25,000 operations min at rated load. Ratings are 2-circuit at 10-amp resistive and 5-amp inductive or 3-amp lamp, 28 v dc.

Controls Co. of America, Control Switch Div., Dept. ED, 1420 Delmar Drive, Folcroft, Pa.

ESC's new miniature Transponder Delay Line fits into just 6 cubic inches!

For modern airborne equipment, where space and weight are critical, ESC has created a new **Miniature Transponder Delay Line** —Model 52-44...which embodies the most advanced techniques of weight and space reduction. It measures just 6 cubic inches total!

Specifications — Model 52-44, Lumped Constant Delay Line:

Impedance — 470 ohms
Delay Time — 20.3 ±.1
Rise Time — .6 (max.)
Temperature Coefficient — 65 ppm or better over a temperature range of −55°C to +125°C
Attenuation — 4 db
Size — 1" x 2" x 3"
Weight — 6 ounces
Tapped as required

Custom variations available to your exacting specifications.

WRITE TODAY FOR COMPLETE TECHNICAL DATA.

exceptional employment opportunities for engineers experienced in computer components...excellent profit-sharing plan.

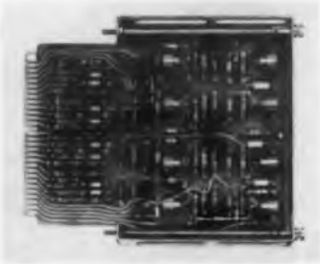
ESC ELECTRONICS CORP. 534 Bergen Boulevard, Palisades Park, New Jersey

Distributed constant delay lines • Lumped-constant delay lines • Variable delay networks • Continuously variable delay lines • Step variable delay lines • Shift registers • Video transformers • Filters of all types • Pulse-forming networks • Miniature plug-in encapsulated circuit assemblies

CIRCLE 59 ON READER-SERVICE CARD

Flip-Flop Module 374

For use at 1 mc



Model FS-20 1-mc static flip-flop module accepts standard MIL-T-PAC signals and may be used as a logical element, an output package and a relay driver in shift-register applications. It operates within a temperature range of 0 to +65 C. Humidity maximum is 95%. It meets MIL-T-17113 for shock and MIL-STD-167, type 1 for vibration. Dimensions are 5-1/4 x 5/8 x 6-3/8 in.

Computer Control Co., Inc., Dept. ED, 983 Concord St., Framingham, Mass.
Price: *$242.*
Availability: *From stock.*

Regulated Power Supply 592

Furnishes 0 to 50 v dc

The T50-750 power supply furnishes 0 to 50 v dc at 0 to 750 ma. It provides both constant voltage and constant current to within 0.05%. Ripple for voltage is less than 0.5 mv and for current, less than 0.01%. Because the unit is adjustable down to the low-millivolt region, it is suitable as a supply for tunnel-diode applications.

Trygon Electronics Inc., Dept. ED, 111 Pleasant Ave., Roosevelt, L. I., N. Y.
Price: *$199.50.*
Availability: *Four weeks.*

Isolation Transformer Kit 587

Output is 90 to 130 v

Model IP-10 isolation transformer provides complete isolation from the ac power line and allows exact control of line voltage to the equipment under test. Output voltage is variable from 90 to 130 v in 0.75-v steps by means of heavy-duty, eight-position switches. Power rating is 300 w, continuous duty, or 500 w, intermittent duty. Output-voltage accuracy is ±1 v.

Daystrom, Inc., Heath Co., Dept. ED, Benton Harbor, Mich.
Price: *$54.95 direct from factory.*
Availability: *Immediate.*

Tape-to-Card Converter 593

Is solid state

Basically a block-tape reader and decoder, this system consists of type 55 tape-to-card converter and a standard IBM summary punch. Coding is numeric. Speed is 100 cards per sec. Block length is 22 to 44 digits on 5 to 8 channels. Tapes with sizes of 11/16, 7/8 or 1 in. can be used. An input of 105 to 120 v at 60 cps, 8 amp, is required.

Telecomputing Corp., Dept. ED, 12838 Saticoy St., North Hollywood, Calif.
Price: *$14,500 fob Hollywood.*
Availability: *90 days.*

RF Interference Filters 531

For airborne defense systems

There rf interference filters are designed for use in airborne defense weapons. Three types, designated 41045, 41046 and 41066, have a minimum attenuation of 100 db with 500 ma dc bias, 80 db with 3 amp dc bias and 130 db with 800 ma dc bias, respectively. Working voltage is 300 v min from −55 to +125 C. The filters have been tested over a frequency range of 18 to 1,000 mc in accordance with MIL-STD-220 and meet all applicable portions of MIL-E-5400 and MIL-F-15733.

Sky-Borne Electronics, Inc., Dept. ED, 13013 Los Nietos Road, Santa Fe Springs, Calif.
Availability: *Two to three weeks.*

Translatory Potentiometer 539

Output is accurate to ±0.05%

Model PT37-1 translatory potentiometer has a non-linear output that is accurate to ±0.05%. Specifications include: standard resistance range, 50 ohm per in. to 50 *k* per in.; independent linearity, ±0.5% for 5 in. or more stroke, ±1% for 1 to 5 in. stroke, ±3% for 1 in. stroke; temperature coefficient, 20 parts per million per deg C; ambient temperature range, −55 to +125 C; equivalent noise resistance, 100 ohms max; dielectric strength, 1,000 v dc breakdown test, 5-sec duration.

Accuracy, Inc., Dept. ED, 4 Gordon St., Waltham 54, Mass.
Price: *$750 to $1,500 ea, 1 to 6 units.*
Availability: *45 days.*

Sealed Switch 392

For space applications

This dpdt, sealed switch for space applications offers the performance characteristics of a relay. It is based on the contact structure of the firm's contaminant-free, balanced-armature relay. Specifications include a rated load, at 28 v dc and at 115 v ac: resistive, 2 amp; inductive, 1 amp; motor, 0.5 amp; lamp, 0.3 amp. Operating life is a minimum of 50,000 cycles. Maximum weight is less than 1 oz.

Leach Corp., Relay Div., Dept. ED, Avalon Blvd., Los Angeles, Calif.

Pressure-to-DC Transducer 393

Linearity is ±0.5%

Model DC-2000 Deeceeducer combines a variable-reluctance diaphragm pressure transducer with an all silicon, solid-state, synchronous modulator-demodulator. Excitation is from an unregulated 28-v dc supply. The unit is available in pressure ranges from 5 to 5,000 psi in gage, absolute and differential pressure types. Response is 2,200 cps. Hysteresis is low.

Solid State Electronics Co., Dept. ED, 15321 Rayen St., Sepulveda, Calif.

Price: *$750.*

Availability: *30 days.*

Precision Oven 534

Temperature stability is ±0.1 C at 70 C

Model 1201 precision oven has an internal temperature stability of ±0.01 C at 70 C over an ambient temperature range of 0 to 50 C. The internal chamber has a volume of 20 cu in. It can be used to house tuning forks, filters, oscillators and other electronic circuitry. The proportional controller is transistorized and is powered from a 28-v dc supply.

Airtronics, Inc., Dept. ED, 5522 Dorsey Lane, Washington 16, D.C.

Availability: *45 to 60 days.*

CIRCLE 60 ON READER-SERVICE CARD ▶

WHY THIS IS A BETTER *LATCHING* RELAY

Better? Yes, in several ways. Bifurcated Contacts, for example, give improved reliability, especially in dry circuits. Contacts will not open during vibrations of 30Gs, 55 to 2500 cps. A special method of sealing cover to base eliminates flux contamination of the contacts. And there are more. Here is Potter & Brumfield's newest member of a distinguished family of micro-miniature relays: the FL Series.

Expressly designed for printed circuit applications, this DPDT, 3 amperes (@ 30V DC) latching relay lies parallel to the mounting surface. Its height, when mounted, is only .485", thus circuit boards may be stacked closer. Mounting can usually be accomplished without studs or brackets, simplifying installation.

The FL will remain firmly latched in either armature position without applied power, a significant advantage where power is limited and long relay "on" times are required. This relay may be operated by:

1. Pulsing each coil alternately (observing coil polarity), or
2. Connecting the coils in series and operating from a reversing (polarized) source.

Write for complete information or call your nearest P&B representative.

FL SERIES SPECIFICATIONS

Shock: 100 Gs for 11 milliseconds. No contact openings.

Vibration: .195", no contact openings. 10 to 55 cps. 30 Gs from 55 to 2500 cps.

Pull-In: 150 milliwatts maximum (standard) at 25° C. 80 milliwatts maximum (special) at 25° C.

Operate Time: 3 milliseconds maximum at nominal voltage at 25° C.

Transfer Time: 0.5 millisecond maximum at nominal voltage at 25° C.

Temperature Range: −65° C to +125° C.

Terminals: Plug-in pins.

Dimensions: L. 1.100" Max.—W. .925" Max H. .485" Max. Hermetically sealed only.

SC 11 D

SCG 11 DC

SL 11 DB (Latching)

SLG 11 DA (Latching)

Other P&B micro-miniature relays include conventional and latching models in crystal cases with a wide range of terminals and mountings. All are made in a near-surgically clean production area under the exacting requirements of our Intensified Control and Reliability program.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

YOUR BEST SINGLE SOURCE FOR ALL MICRO-MINIATURE RELAYS

POTTER & BRUMFIELD

DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY • PRINCETON, INDIANA

IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

NEW PRODUCTS

Acceleration-Integrating Switch 549

Weighs 6 oz

Model 2357A acceleration integrating switch, weighing 6 oz, is designed for applications such as telemetering and missile guidance. It provides precise switching operation at a preset value of gravity-time product for such operations as missile guidance and telemetering. Accuracy is ±8% of gravity-time value, shock resistance is 50 g for 0.011 sec without integration and range is 1.5 to 25 g-sec.

Giannini Controls Corp., Dept. ED, 1600 S. Mountain Ave., Duart, Calif.

Transistors 500

Have ribbon leads

The Microbloc transistors can be furnished with ribbon leads in the T design. They can be made to order in the 120-deg design, Y configuration and other styles. The units with ribbon leads have the same electrical characteristics as units with conventional leads.

Rheem Semiconductor Corp., Dept. ED, P.O. Box 1327, Mountain View, Calif.

Magnetic Reed Relay 550

For printed circuit applications

Class 101 Magnereed magnetic reed relay is adaptable to most mounting requirements including printed circuit applications. Contacts are spst, normally open; rated 12 w, resistive load, at 1 amp max. Contact resistance is 50 milliohms max. Breakdown voltage is 200 v ac rms, min. Coil power is 100 mw nominal and 50 mw min. Operating time is less than 1 msec and release time is less than 0.5 msec.

Magnecraft Electric Co., Dept. ED, 335 W. Grand Ave., Chicago 51, Ill.

SILICONE NEWS from Dow Corning

To Speed Production

Make Flexible, Durable Molds With Easy-to-use Silastic RTV

For production short-cuts and economies, look to Dow Corning Silicones. Here's just one example: Shallcross Manufacturing Company, Selma, N. C., makes molds for encapsulating electronic components with epoxies —they are made from Silastic® RTV, Dow Corning fluid silicone rubber.

Shallcross has found that it's easier to make molds with Silastic RTV because it sets up quickly and cures without heat. The previous mold making material required a 300 F cure and distorted on aging. Per cavity cost is substantially less with molds made of Silastic RTV.

Shallcross engineers also found Silastic RTV molds are easier to handle . . . have 400% longer production life . . . don't distort, shrink or alter their shape during storage . . . give finer detail. Flexible, multiple cavity molds are used for a variety of electronic components including delay lines, precision resistance networks, and shunts — like those pictured above.

Here's the simple procedure Shallcross follows:

Step one: Make the mold. Silastic RTV is poured over the mold forms . . . flows smoothly around the form. Result: a void-free flexible mold that withstands temperatures to 500 F . . . doesn't shrink or distort on aging.

Step two: Components to be encapsulated are placed in the mold and the encapsulating material is poured over the component. After the encapsulant sets up, parts are ready for removal.

Step three: Parts release quickly and cleanly from the flexible Silastic RTV multiple cavity form. The form is clean — ready for next use.

CIRCLE 800 ON READER SERVICE CARD

For 12-page manual "Silicones for the Electronic Engineer" Write Dept. 3313a.

first in silicones

Dow Corning

. . . Specify Silicones

Heat Loosened Terminals No Problem

Production of flyback transformers for RCA "Living Color" TV sets is expedited by the use of terminal boards made from silicone-glass laminates. Bonded with a Dow Corning silicone resin, these laminates easily withstand 250 C continuously . . . much higher temperatures for shorter times. Soldering heat doesn't loosen terminals or slow production. Good electric and physical properties, ease of fabrication, and resistance to creep-under pressure of terminal fasteners add up to a top quality high voltage laminate that lends itself to mass production techniques.

CIRCLE 801 ON READER SERVICE CARD

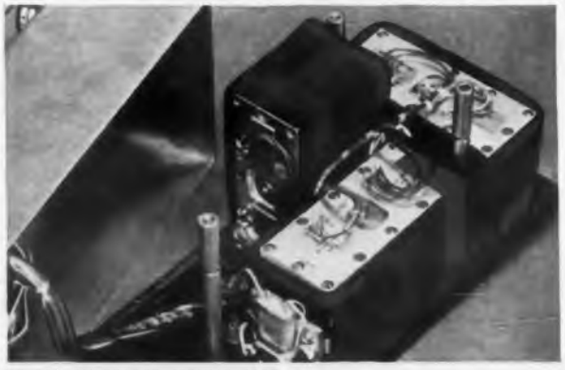
Faster Pump Down, More Cycles

Dow Corning silicone diffusion pump fluids offer a combination of properties that add up to high production rates and long runs without maintenance. These properties provide heat stability, low vapor pressure, high vacua in the range of 10^{-5} to 10^{-7} mm of Hg, rapid recovery, quick pump down, inertness to air and metals and resistance to gamma radiation. Silicone diffusion pump fluids are nontoxic and chemically inert . . . pump vacuum can be released without first cooling the boiler . . . decomposition does not occur when hot fluid is exposed to air.

CIRCLE 802 ON READER SERVICE CARD

Tape-On Heater Where It's Needed

A new, easy-to-install, flexible strip heater developed by Electro-Flex Heat of Hartford, Conn., consists mainly of a spread-out coil of resistance wire sandwiched between layers of Silastic®, the Dow Corning silicone rubber. Only 0.04" thick and very flexible, the unit can be taped to any shape and will pinpoint controlled heat to any desired location. Silastic brand silicone rubber was chosen because the heater elements are completely sealed against moisture and current leakage. Silastic also withstands temperatures as high as 260 C without loss of insulating efficiency or flexibility.



CIRCLE 803 ON READER SERVICE CARD

CORPORATION MIDLAND, MICHIGAN

branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

CIRCLE 800, 801, 802, 803 ON READER-SERVICE CARD

Power Supplies 570

Two units occupy the space of one

This dual laboratory supply has two meters for voltage setting or continuous monitoring of the two output currents. Output voltages are continuously adjustable from 5 to 30 v at 0 to 100 ma with a load regulation of 0.2% or 20 mv. Line regulation is better than 0.2% for line variations from 105 to 125 v. Ripple is less than 1 mv rms.

Straza Industries, Electronic Div., Dept. ED, 790 Greenfield Drive, El Cajon, Calif.

Precision Potentiometers 407

Torque is 0.003 to 0.025 oz-in.

The Micro-torque, models 85111, and the Minitor-que, model 85151, potentiometers divide an electric current or voltage in proportion to shaft rotation up to 354 deg. They can be furnished with linear and sine-cosine functions. Useful angles up to 360 deg in a toroid form can be provided. The units stand vibration at 10 g to 1,000 cps and meet MIL-E-5272, Proc II. Both models use precious-metal resistance elements; standard resistances are 100 to 100,000. Linearity is ±0.5%; resolution is up to 0.05% for the higher resistance units. The design is compact.

Giannini Controls Corp., Dept. ED, 1600 S. Mountain Ave., Duarte, Calif.

Turn Switch 408

Is vibration resistant

This turn switch combines the life and reliability features of conventional, telephone-type lever keys with the positive operation and anti-vibration of the rotary-wafer switch. Switch rotation for three positions is through 140 deg. Double cam and latching movement prevent false operation. Over-all size, including shaft and terminals, is 4-5/8 x 1-1/4 in. with a shaft length of 15/16.

Switch-Trol, Inc., Dept. ED, 726 S. Washington St., Park Ridge, Ill.

NEW PRODUCTS

Miniature Transformers 413

Operating level is 22 dbm

These miniature transistor transformers have primary impedance ratings of from 4,000 to 25,000 ohms, center-tapped, and secondary impedances of 150 to 1,500 ohms, center-tapped. Operating level is about 22 dbm with a frequency response of 200 to 15,000 cps. The units can be furnished in hermetically-sealed cases with high-compression glass terminals or in epoxy-molded construction or open-frame design with channel mounting.

Microtran Co., Inc., Dept. ED, 145 E. Mineola Ave., Valley Stream, N. Y.
Price: *$2.90 to $10.*
Availability: *Immediate, from distributors.*

Plastic Tape 394

Flexibility at −50 F is claimed for black plastic tape No. 295. The pressure-sensitive tape has a thickness of 8.5 mils, 135% elongation, and will remain serviceable up to 180 F.

Permacel, Dept. ED, New Brunswick, N. J.

Photoconductive Cadmium Cells 612

Act as noiseless resistors

ORP 60 photoconductive cadmium cells are suitable for use in computers as noiseless resistors and in light-operated flip-flop circuits. They are housed in sealed, all-glass transistor envelopes measuring 0.59-in. long and 0.25 in. in diameter. Dissipation rating is 70 mw.

Amperex Electronic Corp., Semiconductor and Special Purpose Tube Div., Dept. ED, 230 Duffy Ave., Hicksville, L. I., N. Y.
Price: *$0.35 to $0.75.*
Availability: Immediate, in production lots.

Synchronous Motor 540

For timer applications

This synchronous motor combines the features of hysteresis motors and shaded pole motors. The basic design involves the permanent magnetization of both ends of an induction motor, giving the rotor a combination of synchronous and induction torque. The motor permanently locks into synchronous speed and is free from slip. Applications include: timer applications, data processing and equipment associated with recording charts and graphs.

The Alliance Manufacturing Co., Dept. ED, Alliance, Ohio.
Availability: *Made on order.*

Stack Switch Kits 417

Working samples of stack switches may be built from these experimental kits. Kit No. K-101 consists of springs, contacts, and other hardware for making switches with 1/4 in. or 3/8 in. mounting centers. Kit No. K-102 contains parts with 1/4 in. centers; Kit No. K-103, 3/8 in. centers.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.
Price: *$9.90 each.*

Electrolytic Capacitor 418

Type BMT miniaturized tubular electrolytic capacitors are available in size ranges for all transistor applications. Diameters are from 3/16 up to 5/8 in. Capacitances are from 1 to 2,000 uf. Voltages are 3 to 50 v, inclusive. Operating range is −30 to +65 C. The unit has low impedance at −30 C.

Illinois Condenser Co., Dept. ED, 1616 N. Throop St., Chicago 22, Ill.

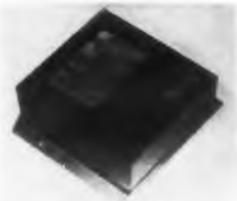
Cathode Ray Tube 420

Type 5DEP cathode ray tube is for use in oscilloscopes and kits. It is available in P2, P7 and P11 phosphors. Vertical deflection sensitivity is 24.5 and horizontal deflection sensitivity is 42.

Waterman Products Co., Dept. ED, 2445 Emerald St., Philadelphia 25, Pa.

Silver-Zinc Battery 468

For missile applications



Incorporating an internal chemical heating device, this silver-zinc battery needs no preheating from external sources yet heats up to full-power temperature several minutes faster than conventionally heated batteries. It delivers an average of 10 to 12.5 w-hr per lb and operates in ambient temperatures down to −65 F. Types 88-19 and 88-78 deliver a 20-amp current; type 88-80, 10 amp; and type 88-89, 50 ma to 17.5 amp.

The Electric Storage Battery Co., Missile Battery Div., Dept. ED, P. O. Box 11301, Raleigh, N.C.

Soft Solder Foil 469

This soft solder foil is available in 50 alloys with melting points from 100 C to 400 C, widths up to 6.00 in., and thicknesses down to 0.0005 in. with tolerances to ±0.0001 in.

Accurate Specialties Co., Inc., Dept. ED, 340 Hudson St., Hackensack, N. J.
Availability: *1 to 2 weeks.*

Turns-Counting Dial 604

With indication to 1/100 of a turn

Model 30 turns-counting dial indicates shaft position in increments of 1/100 of a turn. The unit measures 1-13/16 in. in diameter and 1-in. deep; it is designed for 1/4-in. shaft mounting. The bevelled window allows for reading at extreme angles.

Spectrol Electronics Corp., Dept. ED, 1704 S. Del Mar Ave., San Gabriel, Calif.
Price: *$5.75.*
Availability: *Immediate.*

Crystal Switch 421

Operates at 25 mc

This spdt, solid-state crystal switch, designated model SNB203A, is designed to operate at 25 mc with a bandwidth of ±5 mc. It can be factory-tuned to operate from below 10 mc to about 75 mc. Closed insertion loss is less than 2 db; isolation is greater than 50 db.

American Electronic Laboratories, Inc., Dept. ED, 121 N. 7th St., Philadelphia 6, Pa.

Availability: *21 days.*

Bounce-Free Switches 424

For high-speed components

The 1PB2000 series bounce-free switches are designed to eliminate spurious voltage pulses caused by contact bounce. They are for use with high-speed electronic components that operate in less than 1 usec. One unit in the series produces a positive voltage output with resistive loads from 100 to 500 ohms; another produces a positive voltage output from resistive loads over 500 ohms; and the other two produce negative output voltages with these same resistive loads.

Micro Switch, Minneapolis-Honeywell Regulator Co., Dept. ED, Freeport, Ill.

Availability: *14 days.*

Double Triode 432

High-mu, high-perveance type

Type 6EA7 double triode is for vertical-deflection oscillator and amplifier applications in TV receivers. It contains both a high-mu triode and a low-mu, high-perveance triode. Section one (high-mu) has a maximum plate rating of 350 v, a peak grid voltage of —400 v and a plate dissipation of 1 w. Section two, with a maximum plate voltage of 550 v dc, is rated at 10-w plate dissipation and 175-ma peak cathode current.

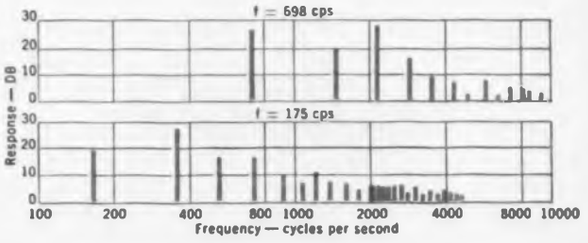
General Electric Co., Receiving Tube Dept., Dept. ED, Owensboro, Ky.

Availability: *From stock.*

One of a Series

You capture the power with RCA-7027-A ...the high-power-sensitivity audio output beam power tube with extremely low distortion

The tonal complexity of the trumpet is indicated in these power-frequency spectra, which show 12 perceptible overtones above a fundamental high-range note (698 cps), and 24 above a low-range note (175 cps). You capture the full dynamic range and tonal range with the RCA-7027-A in your audio output circuits.



Here is the top performer in audio power output tubes: RCA-7027-A! It's a high-perveance beam power tube with high power sensitivity and extremely low distortion, designed especially for top-quality audio systems. Two 7027-A's in Class AB, push-pull can deliver up to 76 watts power output with total harmonic distortion of only 2%!

Special design features help assure cool operation: new S-311 plate material, large grid-No. 1 radiating fins, and short stem leads. Double-base-pin connections for grids No. 1 and No. 2 provide flexibility of circuit arrangement, and assure cool operation of the grids to minimize reverse grid current.

For audio power output that does credit to your best designs, specify RCA-7027-A. For information check with your RCA field representative, or write: Commercial Engineering, RCA Electron Tube Division, Harrison, N. J.

RCA Electron Tube Division—Field Offices

EAST: 744 Broad Street, Newark 2, New Jersey, HUmboldt 5-3900
MIDWEST: Suite 1154, Merchandise Mart Plaza, Chicago 54, Ill., WHitehall 4-2900
WEST: 6355 E. Washington Blvd., Los Angeles 22, California, RAymond 3-8361

RCA The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA

Moisture-Proof Switches 433

For ground support equipment

These moisture-proof, pushbutton switches are designed for applications in ground support and aircraft equipment. Type J3136 is a push-push, two-circuit switch rated at 5 amp, inductive or 10 amp, resistive at 28 v dc and at 120 v ac. The 1-19 32-in. unit has a life of 25,000 operations min at rated load. Type J3336 is a dpdt switch rated at 1 amp at 28 v dc or 120 v ac, resistive.

Controls Co. of America, Control Switch Div., Dept. ED, 1420 Delmar Dr., Folcroft, Pa.

Pneumatic Shock Tester 434

Yields 50g for 11 msec

This pneumatic shock tester determines the amount of shock a missile component can stand before it fails. It produces a short duration pulse with square wave characteristics which apply constant acceleration for a fixed time. The unit can determine peak shock in a part before failure. The shock wave is calibrated to yield a 50-g load for 11 msec, 100-g for 7 msec or 500-g for 1 msec.

General Dynamics Corp., Convair Div., San Diego 12, Calif.

Tapped Delay Lines 617

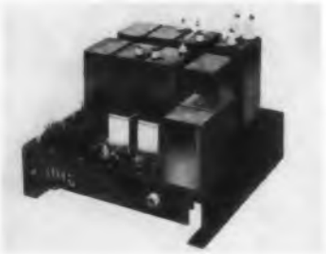
Total delay of 1 to 100 μsec

Series N delay lines are available in total delay times of 1 to 100 μsec and in impedance levels of 50 to 2,000 ohms. Rise time is 3% to 4% of delay time. Standard tolerance on delay is 2% and temperature coefficient of delay is 0.005% per deg C.

The Artronic Instrument Co., Dept. ED, 11232 Triangle Lane, Silver Spring, Md.
Availability: *One week.*

Radar-Pulse Modulator 435

Is compact in size



Model 30-116-0 solid-state modulator is claimed to offer a size reduction of 50% to 60% and increased operational life over tube-type modulators. Designed to drive a 4J52-A magnetron, the unit has two output channels. Pulse width is 0.12 μsec at 3,000 pps and 0.4 μsec at 750 pps. Voltage rise time is 0.1 μsec. Peak power output is 225 kw.

Magnetic Research Corp., Dept. ED, 3160 W. El Segundo Blvd., Hawthorne, Calif.

Impulse Relay Control 436

In module form

The model 10A-RA impulse relay control module is a spdt power switching device permitting an electrical impulse or momentary contact to control on-off power to projectors, recorders, lights, etc. Triggering may be local or remote. Coil voltage is 110 to 120 v, 50 to 60 cps; contacts are rated for 10 amp at 115 v. The 1.5-lb module is 5-1/4-in. high, 3-in. wide, and 9-1/4-in. deep.

TelePrompTer Corp., Dept. ED, 311 W. 43rd St., New York 36, N. Y.
Price: *$70.*
Availability: *30-day delivery from stock.*

Trimmer Potentiometer 608

For hermetically-sealed instruments

Type B329 potentiometer is for trimming adjustments on hermetically sealed instruments and is available to manufacturers of aircraft and missile instrumentation. Weighing 1/2 oz, the unit is easily installed and is encased in a nickel-plated brass housing. Resistance range extends to 8,400 ohms, power rating is 1/3 w at 85 C and operating ambient temperature range is −50 to +100 C. Sealed-metal-to-metal construction is used.

The Liquidometer Corp., Dept. ED, Long Island City, N. Y.

Transistorized Choppers 443

Are germanium type

These epoxy-encapsulated choppers utilize germanium transistors. They are capable of linearly switching or chopping voltages from a fraction of a millivolt to 10 v, and can be driven from dc to 100 kc. The model 50 is 1.25-in. long and 0.45-in. in diameter. Model 60 is 0.5 in. long and 0.25 in. in diameter.

Solid State Electronics Co., Dept. ED, 15321 Raven St., Sepulveda, Calif.
Price: *Model 50, $29 ea; Model 60, $42 ea.*
Availability: *1-day delivery from stock.*

Data Simulators 388

For analog systems test

The Dator series of data simulators generate signals simulating synchros, resolvers, tachometers, and other transducers. Providing greater accuracy than the simulated transducers, they are used in the testing of analog systems. A typical configuration simulates a 3-wire synchro transmitter at increments of 5 deg from 0 through 360 deg. The device is useful for data input to servo systems in production test, ground support, and laboratory applications.

Angler Industries, Dept. ED, 3 Lexington Drive, Metuchen, N.J.
Price: *$285.*
Availability: *4 to 6 weeks.*

Repeat-Cycle Timers 444

Are automatic type

Automatic repetition of on and off cycles is provided by this series of cycle timers. On-time intervals are independently variable over ranges from 0.01 sec to 200 sec. Contacts are dpdt and spdt; contact ratings range from 5 amp to 15 amp at 105 to 120 v ac. Panel-mounting, machine, explosion-proof, and dc timers are also available.

G. C. Wilson & Co., Dept. ED, P. O. Box 5525, Huntington, W. Va.
Price: *From $34 to $125.*
Availability: *From stock.*

AVAILABLE FROM STOCK!

C. I. C.
PRECISION FILM POTS

You can have any of these precision film pots on their way to you within hours. No need to wait for "custom" pots.

LINEAR SINGLE TURN FILM POTENTIOMETERS

Diameter	Resistance	Linearity
1/2"	1K	± .5%
	10K	± .5%
	50K	± .5%
7/8"	1K	± .5%
	10K	± .5%
	50K	± .5%
	1K	± .25%
	10K	± .25%
	50K	± .25%
1-3/32"	1K	± .5%
	10K	± .5%
	50K	± .5%
	1K	± .25%
	10K	± .25%
	50K	± .25%
2"	5K	± .25%
	20K	± .25%
	50K	± .25%
	5K	± .1%
	20K	± .1%
	50K	± .1%
3"	5K	± .1%
	20K	± .1%
	50K	± .1%
	5K	± .05%
	20K	± .05%
	50K	± .05%

SINE-COSINE SINGLE TURN FILM POTENTIOMETERS

Diameter	Resistance	Conformity
1-3/32"	10K	± .75%
	20K	± .75%
2"	10K	± .25%
	20K	± .25%
3"	10K	± .15%
	20K	± .15%

LINEAR MOTION FILM POTENTIOMETERS

Size	Resistance	Stroke	Linearity
1" Sq.	10K	1" Stroke	± .5%
	20K	1" Stroke	± .5%
	10K	2" Stroke	± .25%
	20K	2" Stroke	± .25%
	10K	3" Stroke	± .1%
	20K	3" Stroke	± .1%

WRITE OR CALL IN YOUR ORDER! POTENTIOMETERS WILL BE IN YOUR PLANT WITHIN 24 HOURS!

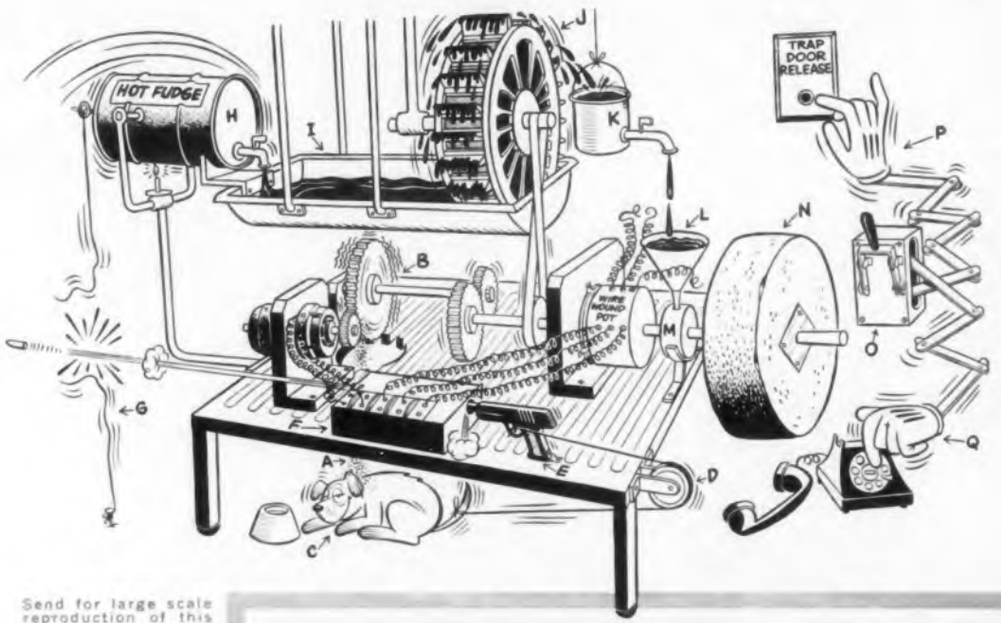
FIRST IN FILM POTS

CIC

COMPUTER INSTRUMENTS CORPORATION
92 MADISON AVE., HEMPSTEAD, L. I., N. Y.

CIRCLE 62 ON READER-SERVICE CARD

HERE'S ONE WAY TO SOLVE SERVO "HUNTING" PROBLEMS...



Send for large scale reproduction of this unique Servo System.

ENERGIZED SERVO SYSTEM IMMEDIATELY STARTS "HUNTING" AS A RESULT OF POOR RESOLUTION WIRE-WOUND POT. METALLIC DUST (A), CREATED BY WEARING DOWN OF OSCILLATING GEARS (B) IN "HUNTING" SERVO SYSTEM, FALLS UPON HEAD OF OFFICE DOG (C). DOG ENJOYS PLEASANT SENSATION AND PROCEEDS TO HAPPILY WAG TAIL. STRING ATTACHED TO DOG'S TAIL RUNS AROUND PULLEY WHEEL (D) AND ACTUATES TRIGGER OF "AUTOMATIC GAIN KILLER" (E) ATTACHED TO AMPLIFIER (F). [FIRST STEP IN REDUCING SERVO HUNTING.] PROJECTILE, AFTER LEAVING AMPLIFIER, BREAKS STRING (G) THEREBY ALLOWING DRUM (H), FILLED WITH SPECIAL VISCOUS DAMPING FLUID, TO TILT FORWARD. FLUID FLOWS INTO TROUGH (I). DAMPING PADDLE WHEEL (J) TAKES EFFECT. [SECOND STEP IN REDUCING SERVO HUNTING.] EXCESS FLUID ON PADDLE WHEEL DRIPS INTO RESERVOIR (PAINT CAN—K), THEN PASSES THROUGH FUNNEL (L) INTO FLUID CLUTCH (M) CONNECTING SCIENTIFICALLY SELECTED INERTIAL LOAD (GENUINE MILLSTONE, ON LOAN FROM SMITHSONIAN INSTITUTE—N.) [FINAL STEP IN REDUCING SERVO HUNTING.] IF SYSTEM STILL "HUNTS"—ENGINEER THROWS EMERGENCY SWITCH (O) ACTIVATING HAND (P) WHICH PRESSES TRAP DOOR RELEASE, DUMPING ENTIRE SYSTEM INTO LOCAL RIVER (NOT SHOWN). HAND (Q) PROCEEDS TO DIAL C.I.C.'S PHONE NUMBER (IVANHOE 3-8200) FOR AN INFINITE RESOLUTION "NON-HUNTING" FILM POT.

- INFINITE RESOLUTION
- INHERENT RELIABILITY
- PRECISION LINEARITY
- LOW OPERATIONAL NOISE
- MULTI-MILLION CYCLE LIFE
- VIDEO FREQUENCY OPERATION

BUT THE BEST WAY YET...

Use C. I. C. Film Pots for High Performance Servo Systems!

Not only do **C. I. C.** Film Pots offer the infinite resolution necessary to eliminate servo hunting problems, but they guarantee you the greatest linearity possible in any given size or diameter. They provide the reliability inherent in a single broad band film element as opposed to the high failure rate of today's wire wound pots. **C.I.C.** Film Pots do even more... They actually run as high as 1000 rpm and still retain reliability, while assuring many millions of cycles of operation.

COMPUTER INSTRUMENTS CORPORATION
92 MADISON AVENUE • HEMPSTEAD, L. I., NEW YORK

FIRST IN FILM POTS

CIC

CIRCLE 63 ON READER-SERVICE CARD

2 IMPORTANT TOOLS FOR HIGH VACUUM PRODUCTION—

Kinney®

PW-600 HIGH VACUUM PUMPING SYSTEMS

Speedy evacuation of chambers, tanks, bell jars, tubes, furnaces or other equipment to pressures in the low micron region plus maximum utility and flexibility signalize these KINNEY Pumping Systems. Readily moved from one station to another, PW Pumping Systems, because of a unique Rotatable T-Manifold, may be quickly converted to High Vacuum Evaporators. Factory tested to attain pressures to 5×10^{-6} mm Hg. without coolant in the cold trap . . . pressures below 5×10^{-7} mm Hg. with coolant in the trap.

Ask for Bulletin 4000.1

Kinney®

R-2H HIGH VACUUM EVAPORATOR

A superior unit for performing highly specialized work in optical filming and research investigations. The conventional flat base plate is replaced by a cylindrical stainless steel chamber—permitting introduction of many more and varied feed-throughs, such as: precise optical measuring equipment. This is an advanced design evaporator with extra pumping capacity and liquid nitrogen cold trap, attaining ultimate pressures of 5×10^{-6} mm Hg. It is capable of producing multi-layer films under monitored control of reflection and transmission.

Ask for Bulletin 4100.1D

KINNEY VACUUM DIVISION
THE NEW YORK AIR BRAKE COMPANY
3561A WASHINGTON STREET • BOSTON 30 • MASS.

WRITE FOR NEW LITERATURE ON KINNEY PUMPS AND EQUIPMENT

Please send me ☐ Catalog on Kinney Pumps
☐ Pumping System Bulletin 4000.1
☐ Evaporator Bulletin 4100.1D

Name_____
Company_____
Address_____
City_____ Zone_____ State_____

CIRCLE 64 ON READER-SERVICE CARD

NEW PRODUCTS

Digital Readout 629

Is sub-panel mounted

Series 120000 digital readout, for sub-panel mounting, is designed for use with digital computers, control equipment, instruments, aircraft equipment, production and inventory controls, and electronic test equipment. The viewing screen is not an integral part of the readout and may be quickly swung out of position. The character displayed measures 5/8-in. high. The light source comes from sub-miniature lamps. No. 327, 328 or 330. Voltage is 6 to 28 v.

Industrial Electronic Engineers, Inc., Dept. ED, 5528 Vineland Ave., North Hollywood, Calif. ***Price:*** $35.
Availability: *30 days.*

Torque Transducer 536

Ranges are from 0.5 to 10,000 lb-in.

Type TF torque transducer is a precision electronic torque measuring instrument for static or dynamic testing operations. The unit is available in nine standard ranges from 0.5 to 10,000 lb-in. Speed ranges are 0 to 6,000, 0 to 25,000, 0 to 50,000 and 0 to 75,000 rpm. The TF uses variable permeance design for operation with frequencies between 400 and 3,000 cps. It can be operated into the firm's 83F translator or other conventional recorders and amplifiers that employ ac bridge circuitry. Linearity is 1%; temperature range is −60 to +450 F. The unit stands 50% of full scale overload.

Crescent Engineering & Research Co., Dept. ED, 5440 N. Peck Road, El Monte, Calif.

300% FASTER ULTRASONIC CLEANING*

WITH THE NEW SELF TUNING AUTOSONIC BY POWERTRON

Powertron Autosonics are the only cleaners that continuously tune themselves electronically to give you peak cleaning efficiency. Regardless of load changes, liquid level, liquid temperature, or operator inattention, you get top cleaning performance hour after hour with no controls other than a single switch

The Powertron self tuning feature is available in a complete line of Autosonic tank units, consoles, cabinet models, immersible transducers, and vapor degreasers that...

ELIMINATE OPERATOR TRAINING AND MONITORING
IMPROVE QUALITY
REDUCE REJECTS
CUT LABOR AND SOLVENT COSTS

*Case histories on file show up to 900% faster cleaning consistently and savings as high as $3,000 a month in labor costs under ideal conditions.

Send for Powertron's free booklet 60-1, "How to Clean Ultrasonically with Self Tuning."

POWERTRON ULTRASONICS CORPORATION
DEPT. ED-1 • PATTERSON PL., ROOSEVELT FIELD
GARDEN CITY, L.I., N.Y. • Pioneer 1-3220
CIRCLE 65 ON READER-SERVICE CARD

ACTUAL SIZE

Amazing, New, High Inductance

WEE-DUCTOR

The R.F. Choke that's so small you can pack 200,000 to a cubic foot

Tiny, new, WEE-DUCTOR covers a full range of inductances from 0.10 μH to 56,000 μH yet it measures only 0.157" x 0.375".

Unique ferrite sleeve and core construction provides 560,000 to 1 inductance range in a tiny package . . . and yet when assembled side-by-side, exhibit less than 2% coupling.

Essex WEE-DUCTORS are available immediately from stock. WEE-DUCTORS are the latest addition to Essex's broad line of Standard R.F. Choke Coils.

Essex Electronics Standard Line of R.F. Chokes

ESSEX PART NO.	WEE-DUCTOR	RFC—S	RFC—M	RFC—L
L μH	1-56,000	.1-100	1.0-1,000	1.0-10,000
Max. Res. Ω	.035-499	.02-6.0	.04-21	.03-80
I Max. mA	3000-26	4000-220	2700-125	4000-80
Dia.	.157	.188	.250	.310
Length	.375	.440	.600	.900

WRITE TODAY
Free Descriptive Literature Available

ESSEX ELECTRONICS
DIVISION OF
NYTRONICS, INC.

550 Springfield Ave., Berkeley Heights, N. J.
CRestview 3-9300

CIRCLE 66 ON READER-SERVICE CARD

447

448

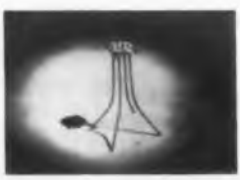
Identification Light 447

The back-lighted head of this indicator light can accomodate two 1/2 in. or three smaller digits or letters. The light is 1.6 in. long; its plastic head measures 5/8 in. by 15/16 in. It uses 6, 12, or 28 v. Glar-Ban Corp., Dept., ED, 118 Glar-Ban Bldg., 3807 Harlem Road, Buffalo 15, N. Y.

Price: $1.10 to $1.75 ea.

Pushbutton 448

This oil-tight, illuminated pushbutton can operate with multiple contact blocks in any combination of normally open or normally closed contacts. It incorporates a molded transformer designed for immunity to voltage surge lamp damage. Available for 110 to 550 v applications. Cutler-Hammer, Dept. ED, 538 N. 12th St., Milwaukee, Wis.



449

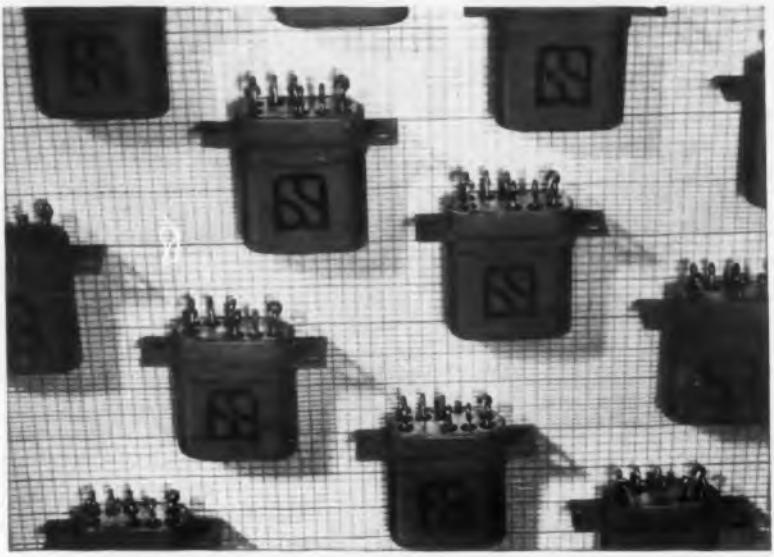
450

Glass-Mica Substrates 449

These printed-circuit substrates are slabs of glass-bonded mica with leads molded in position and surfaces lapped to a 10 in. finish. They are supplied blank or with 0.0005 in. thick deposited copper circuits. A stacking device is molded in. Electronic Mechanics, Inc., Dept. ED, 101 Clifton Blvd., Clifton, N. J.

Terminal Block 450

A subminiature terminal block featuring slotted nut and threaded stud terminals, the type 409-1802 can accommodate 21 terminals, plus mounting holes, in an overall length of 4 3/8 in. The molded-barrier block is 5/16 in. wide. MIL-M-14 specifications are met. Kulka Electric Corp., Dept. ED, 633-643 S. Fulton Ave., Mount Vernon, N. Y.



This is the new Union Crystal Case Relay

The UNION 2-PDT General Purpose Crystal Case Relay is designed to consistently meet the requirements of MS 24250, Mil-R-25018, Mil-R-5757C. Use it where minimum size and *optimum reliability* are esssential—in control systems, computers, airborne and guided missile electronic equipment.

To provide vibration immunity, we have incorporated a unique feature in this relay's armature suspension system. A torsion wire is anchored to the armature and backstrap. It acts as a biasing spring; supports the armature and eliminates end play. The relay uses the rotary principle of operation, found in the entire line of extremely reliable Union Switch & Signal miniature relays.

The 2-pole, double throw, bifurcated contact structure increases reliability and efficiency in dry circuit applications. UNION Crystal Case Relays are designed for continuous operations in the −65°C to +125°C range.

Union Switch & Signal's manufacturing capabilities and experience make it possible to provide these quality relays in quantity. Manufacturing techniques make it possible to provide the ultimate in reliability.

The new UNION Crystal Case Relay is available with the 0.2″ grid-spaced header or "S" type header, with solder lugs, plug-in terminals, or 3-inch leads, and for various operating voltages.

Contact Union Switch & Signal for additional information about this new Crystal Case Relay. Write for bulletin 1064.

Vibration: 20 G—2,000 cps
Shock: 50 G
Temperature Rating: −65°C to +125°C
Contact Rating: Dry circuit to 2 amp., 28-volt DC resistive load.

"Pioneers in Push-Button Science"

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA

CIRCLE 67 ON READER-SERVICE CARD

NEW PRODUCTS

Heat-Sink Fixture 415

For servo component testing

This standardized heat-sink fixture is for servo component testing. It tests units such as synchros, resolvers, motors, generators and potentiometers with close repeatability of thermally affected parameters.

Angler Industries, Dept. ED, Metuchen, N.J.
Price: *$57.50 ea, fob Metuchen.*
Availability: *1 week.*

True RMS Voltmeter 438

Measures complex waveforms to 1/4% accuracy

Model 350 voltmeter has a range of 0.1 to 1,199.9 v. The frequency range of the input signal is from 50 cps to 20 kc with harmonic content to 50 kc. A wide range of waveforms, from sinewaves to square waves, can be measured to an accuracy of 1/4%. Accuracy is 1/2% for frequencies below 100 cps and above 10 kc and for voltage over 300 v.

Ballantine Laboratories, Inc., Dept. ED, Boonton, N.J.
Price: *$720.*
Availability: *December, 1960.*

Canine cleaning, to be candid, is one of the few jobs that stump Circosonics — the amazing equipment that bombards dirt with sound, yet never harms your product. Circo ultrasonic units, however, clean almost everything else and clean them absolutely in mere minutes or less!

Yes, the list of proven Circosonic applications is vast and varied and grows longer each day. They star in swift, sure removal of solder flux, fingerprints, polishing compounds, rust or oxides, lubricants, salts and many other contaminants from lenses, relays, ceramics, printed circuits, glass, gears and gyro components — to name but a few.

In a nut shell, wherever absolute cleanliness is a must, or where the problem of cleanliness creates a production bottleneck — there's a need for Circosonics.

The above partial list of applications must suggest a use for Circosonics in your business. Circo — for 37 years the leader in planning, engineering and installing cleaning equipment — pioneered the ultrasonic cleaning field. And Circo offers you the widest line of such units to be found. Thus, Circo is your best and logical choice, whether you need a small bench model or a huge custom-designed conveyorized unit.

Remember, you'll clean-up with Circo in every way — in precision cleaning, quality and economy!

Here are two examples of Circo's leadership . . .

CIRCO CORPORATION • CLARK, NEW JERSEY

CIRCO
REALLY GETS AROUND!

No matter what you make — Circo ultrasonic units will solve your cleaning problems. They've chalked-up success after success — in a vast number of different fields — by swiftly, safely and economically licking the toughest cleaning jobs. It will well pay you to put amazing Circosonics to work for you.

"WHITE ROOM" WIZARD!

Specifically designed for industrial "white rooms," hospital, dental, or other critical work areas, Circosonic Model US-WR-20 is a star performer where absolute cleanliness is a prime consideration. This compact, self-contained unit has automatic wash and rinse as well as dryer.

PUTS MORE "GET" IN A JET!

This Agitating Washer — another Circo first! — removes carbon, grease and oil from Pan American Airways jet engines in their overhaul, cleaning and inspection system. First of its kind, it super-cleans while it slashes time and labor costs.

Clean Up with CIRCO

CIRCO CORPORATION

ULTRASONICS • WASHERS • DEGREASERS
Solvents

51 TERMINAL AVENUE • CLARK, N. J.

CIRCLE 68 ON READER-SERVICE CARD

Transistor Test Socket 542

Power factor is less than 0.0003

This transistor test socket, called the Transocket, has a power factor of less than 0.0003 over the frequency spectrum from 60 cps to 30,000 meg. The electrical properties remain essentially unchanged up to +400 F. Dielectric strength ranges from 1,000 to 2,000 v. The unit can operate and be used from −100 to +500 F.

Atlantis Electronics Corp., Dept. ED, 3322-26 Broadway St., Garland, Tex.

Telemetering Device 445

Transmits integrated data

Transmission of integrated data over existing analog telemeter channels is possible with this digital telemetering system. The transmitter accumulates pulse signals and sends data to the receiver at intervals programed by a built-in timer.

General Electric Co., Dept. ED, Schenectady 5, N. Y.

Price: Approximately $2,000 for basic equipment.

Multiple Connectors 572

Have up to 82 contacts

The Cal-Met connectors are offered in sizes with 10, 15, 18, 22, 25, 38, 43 and 82 contacts. Basically a connector receptacle, one of these units accepts the terminal edge of standard etched-circuit boards the same way the connector is received. Gold-on-silver-plated contacts minimize corrosion. Nominal resistance is 0.005 ohms; there is a 20-mv drop with 7.5 amp at 25 ±3 C.

Automation Electronics, Inc., Arnoux Corp., Dept. ED, 11924 W. Washington Blvd., Los Angeles 66, Calif.

NEW!
Solid State DISPLAY ASSEMBLY

for decimal display and storage of binary coded decimal data

accepts up to 24 bits of parallel BCD data

Hermes' new Solid State Display Assembly, Model 2060, is designed for use in any system requiring presentation in decimal display of a BCD parallel signal. For example, Model 2060 permits direct reading of Angular Shaft Encoders with BCD parallel output. Model 2060 accepts up to 24 bits of parallel BCD information in any of the following 4-bit Codes: Binary Code Decimal (1-2-4-8); Gray Code (Cyclic Code); Decade Counter Code (1-2-2-4) or (1-2-4-2); Binary Complement Coded Decimal; Binary Two Out of Five Code; Binary (1-2-4-7).

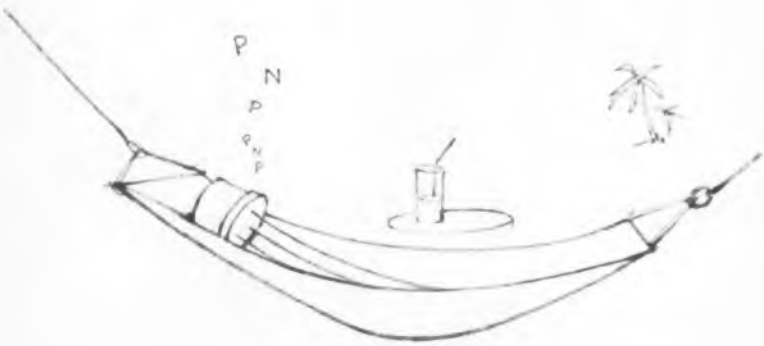
These signals are converted to 60-line decimal display using Burroughs-type Nixie tubes. Binary input to Model 2060 may be either static or parallel pulses.

Storage capability which can conveniently be retrieved through a multi-pin connector is provided in the converting circuitry. Converter Boards can be furnished which accept up to six bits of parallel information, converting to two decimal displays. *Write for Technical Bulletin 2060.*

Hermes

HE ELECTRONICS CO.
75 CAMBRIDGE PARKWAY, CAMBRIDGE 42, MASS.
A DIVISION OF Itek

CIRCLE 69 ON READER-SERVICE CARD



taking the overload off

The trouble with using fuses to protect transistors from short period overloads or fault currents is simple: the transistor is by far the better (and faster) fuse. It can also be called too much "thermal inertia" on the part of the fuse, but the transistor still ends up the same way.

As fate* would have it, a prominent relay manufacturer has now come to the rescue. We've devised a simple little 3-terminal device that will prevent destruction of transistors by DC overloads. It's working in customers' equipment, and

- — operates in 1 to 5 milliseconds
- — limits the transient, with a complete short circuit, to a maximum of 5 times the set value
- — interrupts currents up to 5 amperes
- — can be reset (locally or remotely) or designed to cycle
- — will operate a local or remote warning light, buzzer, etc.
- — can be supplied in a wide variety of set points
- — operates within +20% of its set point
- — doesn't cost all outdoors

*and our New Business Program

You do have to allow for the resistance this overload protector introduces into the circuit, but it's in the order of 1 to 5 ohms and the voltage drop is a few millivolts, less than one-tenth the voltage drop of the conventional circuit breaker.

To those who might question the economics of spending more than the transistor's cost just to protect it, keep the alternatives in mind. If the burned out transistor(s) lets a machine produce a carload of 4-foot yardsticks or causes a few hours of expensive down time, the protection is cheap. (Ever rented a computer?)

If you'd like some block diagrams of typical uses and an assortment of representative values and ratings, write to us, care of our Current Fault Division.

SIGMA

SIGMA INSTRUMENTS, INC.
91 Pearl Street, So. Braintree 85, Mass.

AN AFFILIATE OF THE FISHER-PIERCE CO.

CIRCLE 70 ON READER-SERVICE CARD

NEW PRODUCTS

Ring Dynamometer Transducers 750

Made in both resistance and capacitance types, these ring dynamometer transducers are designed for extreme sensitivity and micro-deflection values. The resistance type changes resistance of the firm's load cell 20,000 ohms with a 0.001-in. deflection. It operates from a 1.5 v dc supply at a current drain of 0.001 amp. Clark Electronic Laboratories, Dept. ED, Box 165, Palm Springs, Calif.

DC Power Supply 744

This dc power supply is designed to power thermoelectric cooling modules. Currents are up to 20 amp. Maximum power output is 50 w. Input power is standard 115 v, 60 cps. The unit measures 8 x 12 x 8 in. and weighs 11 lb. It is intended for low-power laboratory experimentation. Mar-Cone Corp., Dept. ED, 44 Winn St., Woburn, Mass.

Power Line Filters 458

The manufacturer claims reduction in voltage drop, reactive current, and weight of these power line filters. Type A-25 is rated at 20 amp at 250 v ac. Attenuation is 100 db down from 70 to 45,000 mc. Other types have 100-db attenuation to 0.014 mc. McMillan Industrial Corp., Dept. ED, Brownville Ave., Ipswich, Mass.

VHF Receiver 459

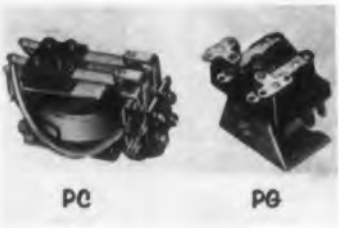
Designed for airport control or point-to-point applications, the fixed tuned Type RV-9 vhf receiver is capable of reliable unattended performance. Both local oscillators of the double superheterodyne design use crystal control. Range is 108 to 152 mc. ITI Electronics, Inc., Dept. ED, 369 Lexington Ave., Clifton, N. J.

Illuminated Switch 460

This push-push switch, the J8000 Series, is a dpdt unit with independent light circuit rated at 28 v dc or 115 v ac. It has a nickel-plated brass plunger and anodized aluminum case, a choice of 6 lens colors, and an over-all length of 2-33/64 in. Controls Co. of America, Control Switch Division, Dept. ED, Foleroft, Pa.

Vane-Axial Fan 461

A type originally designed for aircraft, this turboslot vane-axial fan, designated model 8057AX48, delivers 250 cfm at a total pressure rise of 1.15 in. H_2O. The induction-type unit operates on 115 v, cps, at 3,450 rpm. General Dynamics Corp., Electric Boat Div., Dept. ED, Groton, Conn.



Power Control Relays 463

A wide range of coil voltages and mounting and terminal arrangements is available in the PC and PG Series power control relays. The ac or dc units are rated at 15 amp resistive, 5 amp inductive; the PG series may be hermetically sealed, with contacts rated at 20 amp resistive. Elgin Advance Relays, Elgin National Watch Co., Dept. ED, 2435 N. Naomi St., Burbank, Calif.

DC Amplifiers 464

This line of amplifiers has 4 compatible models: medium high gain amplifiers, power amplifier, and chopper stabilizer. Open loop gain is to about 30,000, with chopper drift rate stabilized to less than 1 mv per day. The units are interchangeable with others now on the market. Deltex Laboratories, Dept. ED, Box 2666, Jackson, Miss.

Erase Heads 465

The HQ Series of stereo and monophonic erase heads use double-gap construction; quiet, efficient erasure is claimed. Suitable for two-track or four-track tape, the heads come in three-mounting styles to enable any mode of installation. High and low impedance models are available. Nortronics Co., Inc., Dept. ED, 1015 S. 6th St., Minneapolis 4, Minn.

Availability: From stock.

Adjustable Switch 466

Differential travel can be adjusted frm 0.0025 in. to 0.007 in. on the 10BS210 switch, affecting contract distance, pre-travel distance and operating and differential force. It is rated at 20 amp, 120 to 460 v ac; 3/4 hp at 115 v ac or 1-1/2 hp at 230 v ac. Minneapolis-Honeywell Regulator Co., Micro Switch Div., Dept. ED, Freeport, Ill.

MIL-SPEC Blowers 467

This line of MIL-SPEC rack-mounted centrifugal blowers has units ranging in panel height from 3-1/2 in. to 10-1/2 in., and airflow ranges from 150 cfm to 800 cfm. All parts in the line meet military specifications. Motors are 50 to 400 cps single and 3-phase, 115 v to 440 v. McLean Engineering Laboratories, Dept. ED, Princeton, N. J.

Accuracy Is Our Policy . . .

In the New Product description of miniature connectors on p 80 of the Nov. 23 issue, Atlas Connectors Corp. was incorrectly identified as Atlan Connectors Corp. The firm is located at 27 E. 21st St., New York, 10, N.Y.

from
-60°F to +185°F

VC-42 subcarrier oscillator

UED's brand-new achievement in subcarrier oscillator performance. Ultra-stability ELIMINATES the need for EXTERNAL ADJUSTMENTS. Center frequency, sensitivity and linearity are *unaffected* by:

- **TEMPERATURE — from —60°F to +185°F**
- **TIME — tested for stability over a period of 6 months**
- **SUPPLY VOLTAGE VARIATION — from 24 volts to 32 volts**

The VC-42 has been designed to give the telemetry systems engineer a feeling of pride in his system design accomplishments. The unit combines the following advantages that are most essential to system integration:

- **SMALLER than any high-performance oscillator previously available**
- **HIGH LEVEL OUTPUT eliminates the need for mixed signal amplifier**
- **NO EXTERNAL ADJUSTMENT required because of new ultra-stable circuit design**

UNITED ELECTRODYNAMICS, INC.

MU 2-1134 SY 9-7161

210 Allendale Road Pasadena, California

CIRCLE 71 ON READER-SERVICE CARD

Wheatstone Bridge 588

Accuracy is 0.05%

Model MV-276A electronic Wheatstone bridge has a measuring range of 1 ohm to 1,000 meg with an accuracy of 0.05%. The calibrated unbalance makes it possible to read many similar resistances directly without balancing each time. The unit is portable, contains an electronic null detector and power source, and measures 12 x 8 x 9 in.

Millivac Instruments, Div. of Cohu Electronics, Inc., Dept. ED, Schenectady, N.Y.

Power Breaker Control 456

In module form

The model 30A-D15 power breaker control module is a 115 v ac, 30-amp equipment overload protection unit. The input line circuit, 110 to 120 v at 30 amp, is protected by a push-to-reset circuit breaker. The output line, either one 30-amp or two 15-amp circuits, is protected by automatic breakers. The 1.5-lb module is 5-1/4-in. high, 3-in. wide, and 9-1/4-in. deep.

TelePrompTer Corp., Dept. ED, 311 W. 43rd St., New York 36, N. Y.
Price: *$50.*
Availability: *30-day delivery from stock.*

Water-Cooled Triode 601

For use as a Class C amplifier

Type ML-7560 water-cooled triode is designed to have a 400-kw continuous output as a Class C amplifier or as an oscillator at frequencies to 30 mc. It delivers 2.5 megawatts in a pulsed rf amplifier and switches 14 megawatts in a pulse modulator at long-pulse duration with high duty factors. Maximum ratings are: 20 kv dc, plate voltage; 600 kw, plate input at frequencies to 30 mc.

Raytheon Co., Machlett Laboratories, Inc., Dept. ED, 1063 Hope St., Springdale, Conn.
Price: *$4,700.*
Availability: *From stock.*

Universal Test Set 591

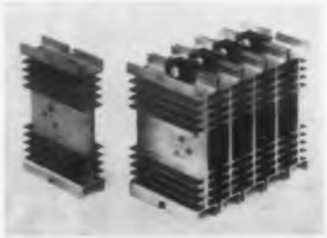
Provides standardized signals

Model 1300B universal module test set provides standardized test signals for verifying operation of the firm's transistorized digital system modules. It generates waveforms necessary for checking the modules and provides supply voltages, variable loads and controls for sensitivity, margin and frequency checking. A single-pulse generator and output monitor meter eliminate the need for an oscilloscope during most tests.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.
Price: *$995.*
Availability: *45 days.*

Heat Sinks 558

For power transistors and diodes



These heat sinks are especially designed for easy mounting and stacking. They can be used singly or in multiple heat-sink arrays and offer 25-sq-in. of surface area for each inch of length. They have holes for mounting or stacking.

Invar Electronics Corp., Dept. ED, 323 W. Washington Blvd., Pasadena, Calif.

Variable Transformer 633

Has output-limiting switch

The VT8G is a portable, variable transformer which has an overvoltage-no-overvoltage selection switch. With it the user can limit the output of the transformer to the line voltage of 120 v or to the overvoltage rating of 140 v. The VT8G is rated at 7.5 amp and incorporates a circuit breaker for protection.

Ohmite Manufacturing Co., Dept. ED, 3627 Howard St., Skokie, Ill.
Price: *$28.50 for one to five units.*

Tantalum Capacitors 457

Are 0.438 in. long, 0.172 in. in diameter

Type TSP tantalum capacitor measures 0.438 in. long and 0.172 in. in diameter. The capacitance range extends to 5.6 μf, voltage rating is 50 v, and leakage current rating is 0.01 μa per μf per v.

U. S. Semiconductor Products, Dept. ED, 3540 W. Osborn Road, Phoenix, Ariz.
Price & Availability: *$1.65 ea; 10-day delivery time.*

Frequency-Deviation Meter 618

Input sensitivity is 10 mv rms

Called the series PI-111 Pulse Rate Integrator, this unit is for monitoring power-line frequencies, tachometers, repetition rate pick-ups, radiation detectors and other devices. Input sensitivity is as low as 10 mv rms. Standard models indicate 57 to 63 cps and 380 to 400 cps. Variations with center frequencies from 50 cps to 50 kc are also offered. All models have a resolution of 0.1%.

Anadex Instruments, Inc., Dept. ED, 14734 Arminta St., Van Nuys, Calif.
Availability: *30 days.*

IMMEDIATE DELIVERY OF ELMENCO

capacitors

IN QUANTITIES UP TO

500 Per Item

CONTACT THESE AUTHORIZED ELMENCO INDUSTRIAL DISTRIBUTORS

ARIZONA: Radio Specialties & Appl. Corp., 917 N. 7th St., Phoenix.

CALIFORNIA: Brill Elect., 610 E. 10th St., Oakland; **Elect. Supply Corp.**, 2085 E. Foothill Blvd., Pasadena; **Federated Purchaser Inc.**, 11275 W. Olympic Blvd., L. A. 64; **Hollywood Radio Supply Inc.**, 5606 Hollywood Blvd., Hollywood 28; **Newark Electronics Corp.**, 4747 W. Century Blvd., Inglewood; **Pacific Wholesale Co.**, 1850 Mission St., San Francisco 3; **Peninsula Elect.**, 656 S. 1st St., San Jose; **Shanks & Wright Inc.**, 2045 Kettner Blvd., San Diego; **Shelley Radio Co. Inc.**, 2008 Westwood Blvd., L. A. 25; **R. V. Weatherford Co.**, 6921 San Fernando Rd., Glendale 1; **Zack Electronics**, 654 High St., Palo Alto.

COLORADO: Denver Electronics Supply Co., 1254 Arapahoe St., Denver 4.

DISTRICT OF COLUMBIA: Capitol Radio Wholesalers Inc., 2120 14 St., N.W., Wash., D. C.

FLORIDA: Elect. Supply, 1301 Hibiscus Blvd., Melbourne; **Elect. Supply**, 61 N. E. 9th St., Miami.

ILLINOIS: Newark Electronics Corp., 223 W. Madison St., Chicago 6.

MARYLAND: D & H Distributing Company, Inc., 2025 Worcester St., Baltimore 30; **Kann-Ellert Electronics, Inc.**, 2050 Rock Rose Avenue, Baltimore; **Wholesale Radio Parts Co. Inc.**, 308 W. Redwood St., Baltimore 1

MASSACHUSETTS: Cramer Electronics Inc., 811 Boylston St., Boston 16; **Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17.

NEW JERSEY: Federated Purchaser Inc., 1021 U.S. Rte. 22, Mountainside; **General Radio Supply Co.**, 600 Penn St., Camden 2; **Radio Elec. Service Co., Inc.**, 513 Cooper St., Camden 2.

NEW MEXICO: Electronics Parts Co., Inc., 222 Truman St., N. E., Albuquerque; **Midland Specialty Co.**, 1712 Lomas Bl. N.E., Albuquerque; **Radio Specialties Co., Inc.**, 209 Penn Ave., Alamagordo.

NEW YORK: Arrow Elect. Inc., 525 Jericho Turnpike, Mineola, L. I.; **Elect. Center Inc.**, 211 W. 19th St., N. Y. 11; **Harvey Radio Co., Inc.**, 103 W. 43rd St., N.Y. 36; **Lafayette Radio**, 100 Sixth Ave., N.Y. 13; **Stack Industrial Electronics, Inc.**, 45 Washington Street, Binghamton; **Terminal Elect. Inc.**, 236 W. 17 St., N. Y. 17

NORTH CAROLINA: Dalton-Hege Radio Supply Co., Inc., 938 Burke St., Winston-Salem.

PENNSYLVANIA: Almo Radio Co., 913 Arch St., Philadelphia; **George D. Barbey Co. Inc.**, 622 Columbia Ave., Lancaster; **George D. Barbey Co. Inc.**, 2nd & Penn Sts., Reading; **D. & H. Distributing Co., Inc.**, 2535 N. 7th St., Harrisburg; **Phila. Elect. Inc.**, 1225 Vine St., Phila. 7; **Radio Elec. Service Co., Inc.**, 701 Arch St., Phila. 6; **A. Steinberg & Co.**, 2520 N. Broad St., Phila.; **Wholesale Radio Parts Co., Inc.**, 1650 Whiteford Rd., York.

TENNESSEE: Electra Distributing Co., 1914 West End Ave., Nashville 4.

TEXAS: All-State Dist. Co., 2411 Ross Ave., Dallas 1; **Busacker Elect. Equip. Co. Inc.**, 1216 W. Clay, Houston 19; **Engineering Supply Co.**, 6000 Denton Dr., Dallas 35; **Midland Specialty Co.**, 500 W. Paisano Dr., El Paso; **The Perry Shankle Co.**, 1801 S. Flores St., San Antonio.

UTAH: Carter Supply Co., 3214 Washington Blvd., Ogden.

WASHINGTON: C & G Radio Supply Co., 2221 Third Ave., Seattle.

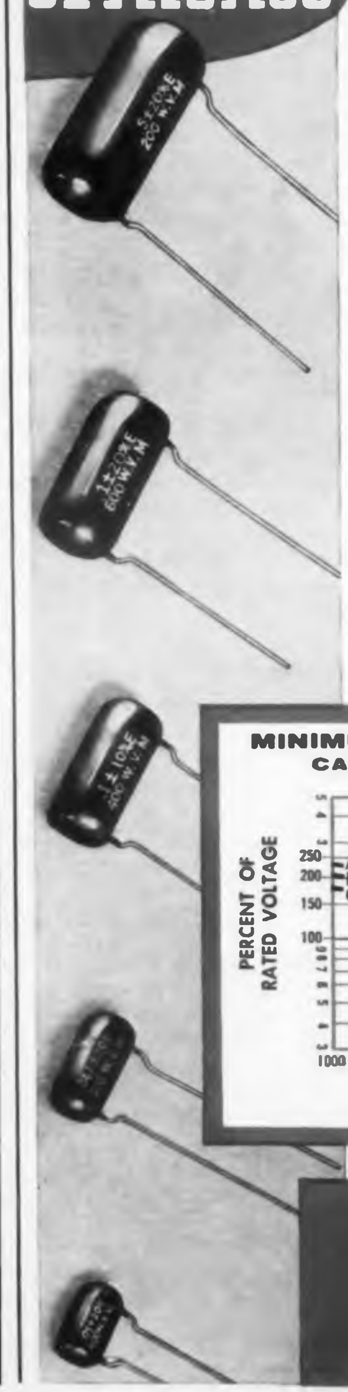
CANADA: Electro Sonic Supply Co., Ltd., 543 Yonge Street, Toronto 5, Ont.

ARCO ELECTRONICS, INC.
NEW YORK • DALLAS • LOS ANGELES
Exclusive Supplier of ELMENCO Capacitors to Distributors and Jobbers in U.S.A. and Canada

CIRCLE 72 ON READER-SERVICE CARD

Another New High Order of Reliability!

El-Menco



*MYLAR-PAPER DIPPED CAPACITORS

TYPE MPD

ASSURE A LOW FAILURE RATE OF

Only 1 Failure in ~~7,168,000~~ 14,336,000 Unit-Hours for 0.1 MFD Capacitors★

Setting A New High Standard Of Performance!

★ Life tests have proved that El-Menco Mylar-Paper Dipped Capacitors — tested at 105°C with rated voltage applied — have yielded a failure rate of only 1 per 1,433,600 unit-hours for 1.0 MFD. Since the number of unit-hours of these capacitors is inversely proportional to the capacitance, 0.1 MFD El-Menco Mylar-Paper Dipped Capacitors will yield ONLY 1 FAILURE IN 14,336,000 UNIT-HOURS.

CAPACITANCE AND VOLTAGE CHART

● *Five case sizes in working voltages and ranges:*

200 WVDC —	.018 to .5 MFD
400 WVDC —	.0082 to .33 MFD
600 WVDC —	.0018 to .25 MFD
1000 WVDC —	.001 to .1 MFD
1600 WVDC —	.001 to .05 MFD

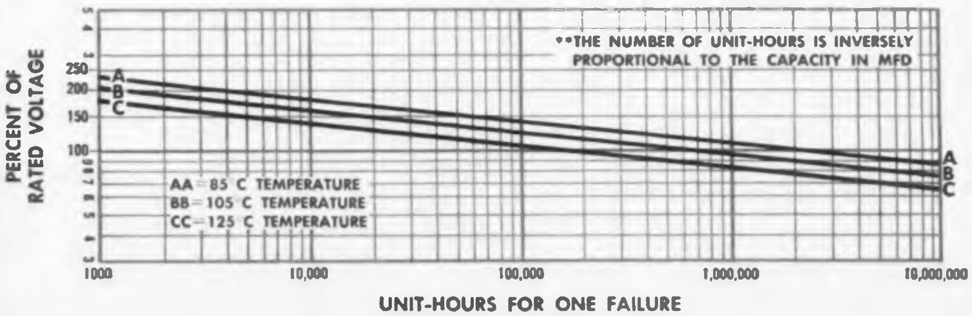
SPECIFICATIONS

- TOLERANCES: 10% and 20%. Closer tolerances available on request.
- INSULATION: Durez phenolic, epoxy vacuum impregnated.
- LEADS: No. 20 B & S (.032") annealed copper clad steel wire crimped leads for printed circuit application.
- DIELECTRIC STRENGTH: 2 or 2½ times rated voltage, depending upon working voltage.
- INSULATION RESISTANCE AT 25°C: For .05MFD or less, 100,000 megohms minimum. Greater than .05MFD, 5000 megohm-microfarads.
- INSULATION RESISTANCE AT 105°C: For .05MFD or less, 1400 megohms minimum. Greater than .05MFD, 70 megohm-microfarads.
- POWER FACTOR AT 25°C: 1.0% maximum at 1 KC

These capacitors will exceed all the electrical requirements of E. I. A. specification RS-164 and Military specifications MIL-C-91B and MIL-C-25C.

Write for Technical Brochure

MINIMUM LIFE EXPECTANCY FOR **1.0 MFD *MYLAR-PAPER DIPPED CAPACITORS AS A FUNCTION OF VOLTAGE & TEMPERATURE



* Registered Trade Mark of DuPont Co.

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC CONNECTICUT

• molded mica • mica trimmer • dipped mica • silvered mica films
• tubular paper • mylar-paper dipped • ceramic feed-thrus • ceramic discs

CIRCLE 73 ON READER-SERVICE CARD

Ambient Temperature Changes Can't Affect This New **AO TRACE-MASTER**

This AO TRACE-MASTER is the world's finest 8-channel direct writing recorder. The cooling equipment is also the world's finest . . . because it's made by McLEAN.

thanks to **McLEAN**
Cooling Equipment!

When American Optical Co. designed the new TRACE-MASTER, it had to detect the tiniest variables with the greatest fidelity. To do this it was necessary to eliminate excessive temperature gradients by using highly reliable cooling equipment. McLEAN and only McLEAN was selected for this critical task. McLEAN's cooling units contribute importantly to the high-quality trace and superior performance of the AO TRACE-MASTER.

McLEAN blowers are smart, compact, and easy to install. Over 100 models in various panel heights and CFM's are available.

Also a complete line of fractional horsepower motors

MODEL 2E408,
Over 15,000 in use
all over the world.

WRITE TODAY
44 Page Packaged Cooling Catalog

McLEAN ENGINEERING LABORATORIES
World Leader in Packaged Cooling
Princeton, N. J. • WAlnut 4-4440
TWX Princeton, New Jersey 636

CIRCLE 74 ON READER-SERVICE CARD

NEW PRODUCTS

DC Power Supply 471

Regulated to 0.01%

Model CR-36-20 dc power supply is regulated to 0.01% and rated at 0 to 36 v and 0 to 20 amp. Specifications include: peak-to-peak ripple, 0.003 v; recovery time from full load step, 40 μsec; stability, 5 parts per 10,000 per 24-hr day. The unit weighs approximately 70 lb and measures 7 x 19 x 16-5/8 in.

NJE Corporation, Dept. ED, 20 Boright Ave., Kenilworth, N.J.

Price: $845 ea.

Phenolic Varnish 382

Resinox 495 is a flame-retardant, high-electrical grade laminate with good cold-punching properties. Especially recommended for printed circuits in commercial radio and TV applications and as copper-clad laminates for computers and military applications. The varnish meets NEMA specs.

Monsanto Chemical Co., Plastics Div., Dept. ED, Springfield, Mass.

Wire-Stripping Tool 383

The SW-1 Stripwright has a squeeze-grip slide action with all parts machined to a close tolerance. It is equipped with a cam-action calibrated dial that can be adjusted to strip wire sizes 12 to 26 AWG with a full range of up to 0.08 in.

Kelsey-Hayes Co., Utica Drop Forge and Tool Div., Dept. ED, Utica 4, N.Y.

Control Relay 384

The Compact 300 is rated at 6 amp, 300 v max. It is a fixed-circuit device with provisions for eight independent poles and is also available with 2, 3, 4 or 6 poles in any combination of normally open or normally closed contacts. It requires only 5.5 in. of panel space.

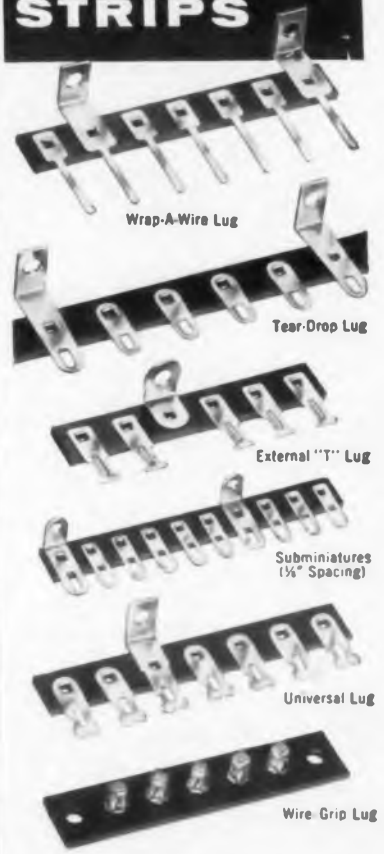
Cutler-Hammer, Dept. ED, 538 N. 12th St., Milwaukee, Wis.

Plastic Tape 402

Tesamoll 763 polyurethane foam tape stands temperatures to 248 F. It is fungus-proof, chemically inert, and resistant to most oils. Offered in 30-ft rolls, it is 1/4 in. thick.

United Mineral & Chemical Corp., Dept. ED, 16 Hudson St., New York 13, N.Y.

MANDEX
OFFERS YOU THE MOST COMPLETE LINE OF TERMINAL STRIPS



High Speed Automated Assemblies Bring You:

- **Consistent Quality**
- **Quick Delivery**
- **Low Cost**

Send prints-specs for prompt quotation... For complete information request

NEW MANDEX GUIDE BOOK TO TERMINAL STRIPS

MANDEX MANUFACTURING COMPANY, INC.
MANDEX Specialists in Electronic Parts
2624 West 48th St., Chicago 32, Illinois

CIRCLE 75 ON READER-SERVICE CARD

Generator-Detector 462

Provides six output ranges

Model 800-R generator-detector provides six output ranges to match loads from 1 ohm to 100 K. The output is continuously variable from 0 to 1 w into a matched load. The unit is a combination of a variable power supply and a sensitive microvoltmeter. The modulator-type, calibrated, dc microvoltmeter has ranges from 0.2 mv per dial division to 1,000 v full scale. The unit is particularly suited to high-accuracy bridge measurements.

Electro Scientific Industries Inc., Dept. ED, 7524 S.W. Macadam, Portland, Ore.

Price: *$1,300 ea.*

Availability: *30 days.*

Soldering Machine 378

This machine uses a wave method for production soldering of printed-circuit panels. Standard performance to 0.015 in. spacing of circuitry is possible. Operation is automatic. Conveyor speeds are up to 72 in. per min.

Hollis Engineering, Inc., Dept ED., 669 South Ave., Weston 93, Mass.

Plastic Front Meter 379

Model 68H is available in all common milliameter, ammeter and voltmeter ranges with an accuracy of 1% full scale. The acrylic plastic is rugged and does not fade.

The Hickok Electrical Instrument Co., Dept. ED, 10526 Dupont Ave., Cleveland 8, Ohio.

Coaxial Load 663

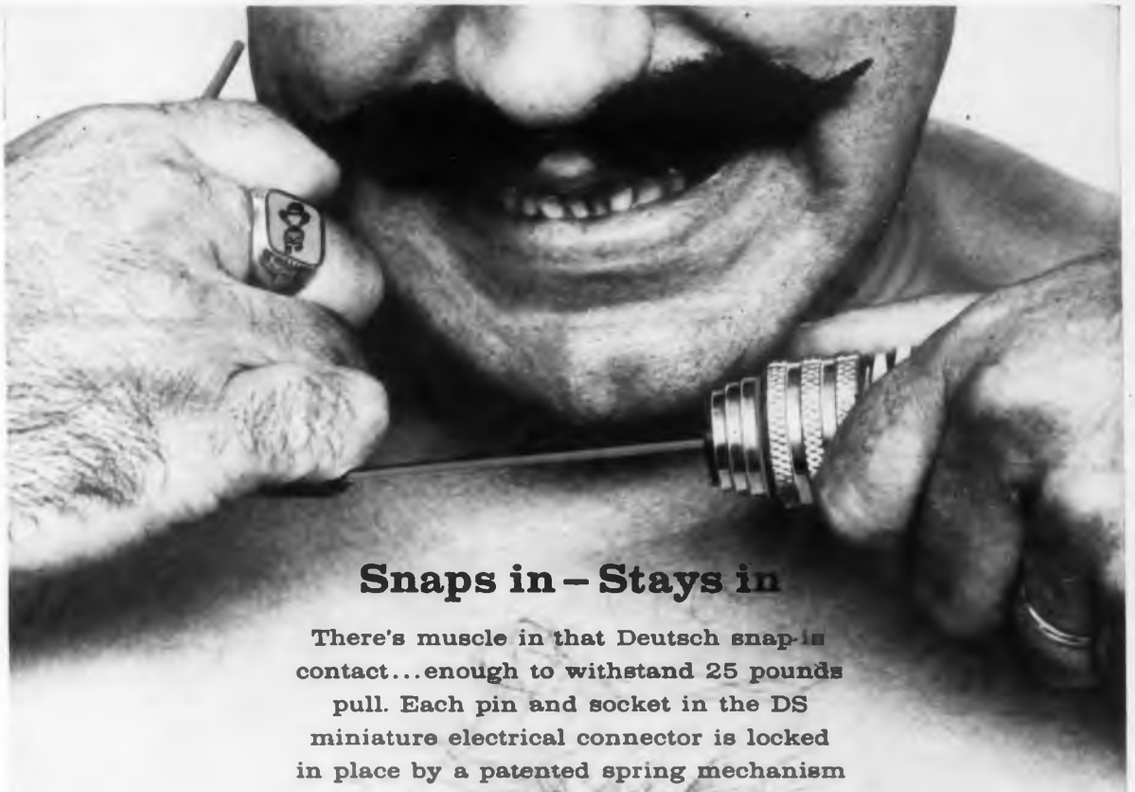
Model 1117 coaxial load has vswr of 1.1 max at 5,000 to 6,000 mc. It stands extreme vibration.

Radar Design Corp., Dept. ED, Pickard Drive, NE, Syracuse 11, N.Y.

Console Cabinet 385

Model 14 is designed for industrial use and is made of 14-gage steel. It is oil and dust tight; seams are welded and doors and panel have neoprene gaskets. Dimensions are 50 x 24 x 23 in.

Hoffman Engineering Corp., Dept. ED, Anoka, Minn.



Snaps in – Stays in

There's muscle in that Deutsch snap-in contact...enough to withstand 25 pounds pull. Each pin and socket in the DS miniature electrical connector is locked in place by a patented spring mechanism that can only be released by specially designed tools. Add to this a crimp that is strong as AN #18 wire itself, and you have the completely reliable DS snap-in type connector. What's more... crimping, inserting, and removing contacts is a quick and easy operation with Deutsch designed tools...even in the hands of unskilled operators. The DS series also features the Deutsch ball-lock coupling mechanism which operates in the direction of plug travel...just push to connect and pull to disconnect. With environmental performance that meets or exceeds MIL-C-26482, plus a wide range of shell sizes and contact arrangements, this connector will satisfy your toughest design requirements with ease.*

DEUTSCH

Electronic Components Division • Municipal Airport • Banning, California

ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS

***For complete information contact your Deutschman or write for Data File C-1.**

CIRCLE 76 ON READER-SERVICE CARD

The Industry's Widest Variety

When weight and space are critical and it becomes essential to use the smallest and lightest production servos available, Sperry Rand's Wright Division offers you the industry's widest variety of advance components.

Typical of this variety are Wright Size 8 Servos, a few of which are shown above. Normal Torque or High Torque. High Acceleration or Exceptional Acceleration. Normal Torque to Power or High Torque to Power. You name it, Wright has it. And 200°C operation is standard!

Telephone Durham (919) 682-8161 or write for get-acquainted literature and name of our nearest representative.

Servo Motors, Motor Tachometers, Geared Servos, Synchros, Servo Packages, and Spin Motors in frame sizes from Size 8 through 30.

WRIGHT / **DIVISION OF SPERRY RAND**
Durham, North Carolina

CIRCLE 77 ON READER-SERVICE CARD

NEW PRODUCTS

Plug-In Unit For Vertical Expansion 475

Fits all firm's oscilloscopes

Type Z plug-in unit fits all the firm's oscilloscopes that accept letter-series plug-in units. It enables measurement of small segments of large waveforms at maximum vertical sensitivity and permits vertical expansion of a waveform for detailed analysis and measurement. Dynamic range is ±100 v; common-mode rejection ratio is 40,000:1 which allows measurement of differential signals less than 50 mv; comparison voltage accuracy is within 0.25% on the ±1-v scale, within 0.20% on the ±10-v scale, and within 0.15% on the ±100-v scale.

Tektronix, Inc., Dept. ED, P.O. Box 500, Beaverton, Ore.

Price: $525 ea.

Availability: From stock.

Missile Test System 717

This portable electronic laboratory is for testing missiles, aircraft equipment, communications equipment, and other systems. It is portable for transportation to missile launching sites.

Goodyear Aircraft Corp., Dept. ED, Akron, Ohio.

Plated Wire 718

These silver-plated, nickel-plated copper conductors can be used at temperatures up to 250 C. They are available in full AWG ranges of single end and stranded conductors.

Hudson Wire Co., Ossining Div., Dept. ED, Ossining, N. Y.

Instrument Counters 709

Three series of high-speed units offer several choices as to number of figures, rotation, side of drive and type of wheel imprint. They are suitable for applications such as missile tracking devices, radar controls, computers and gaging instruments.

Durant Manufacturing Co., Dept. ED, 1953 N. Buffum St., Milwaukee 1, Wis.

ANALYZE NOISE

WITH AN

ALLISON FILTER

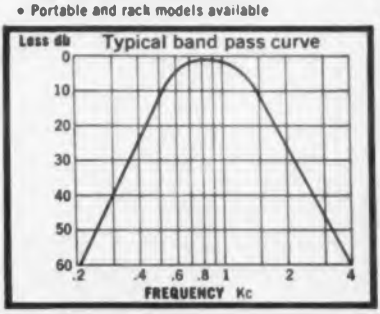
Allison 2B Filter

You can evaluate the amount of a noise and its frequency characteristics with an Allison Filter. You can make this evaluation regardless of whether the noise is continuous or intermittent, or whether it has sharp peaks. *Allison Filters do not ring on transient noises.* This analysis can be very important in testing equipment, preventing hearing loss, and controlling harmful or irritating industrial noises.

Allison Filters have been in constant use for a wide range of laboratory and industrial applications for nearly a decade.

ALLISON SERIES 2 FILTER SPECIFICATIONS

- Continuously variable passive network – no power supply
- Frequency range: 2A, 15 to 10,080 cycles; 2B, 60 to 20,160 cycles; 2C, 9 KC to 670 KC
- Designed for use in 600 OHM circuit and with transformers for other impedances
- Low loss – approximately 2db in pass band
- Attenuation rate – 30 db per octave
- Size: 14" high, 7" deep, 5¼" wide
- Portable and rack models available



Write today for complete literature and prices

Allison Laboratories, Inc.

11301-B Ocean Avenue, La Habra, California

CIRCLE 78 ON READER-SERVICE CARD

Thermal Timing Relay 430

Provides instant-reset operation

Type DM thermal timing relay provides instant-reset operation. Operating voltages up to 230 v can be used. The unit provides time delays down to 0.75 sec. Setting tolerance is ±10%. Load rating is 3 amp to 250 v ac, 1 amp resistive to 32 v dc. Timing elements must be specified for normally open or normally closed single-point output.

G-V Controls Inc., Dept. ED, Okner Parkway, Livingston, N.J.

Voltage Reference Standards 431

For high-temperature applications

Series 260 voltage reference standards are for high-temperature military applications. Temperature coefficient is ±0.001% per deg C from −55 to +150 C. These units operate directly from an unregulated 26.5-v dc source. Regulation is ±0.005% for ±10% line voltage change. Approximately 1-ma current is delivered to an external load. Outputs are 5.8 or 8.5 v dc.

Viking Industries, Inc., Dept. ED, 21343 Roscoe Blvd., Canoga Park, Calif.

CIRCLE 79 ON READER-SERVICE CARD ➤

Model 737A shown with Model 732A Converter Plug-In

→ Measure frequency dc to 220 mc
→ Measure period to 0.1 microsecond
→ Measure time interval 0.1 microsecond to 10^7 seconds
→ Count dc to 10 mc

CMC, first with solid state reliability, announces the transistorized Model 737A frequency-period meter.

Here, combined in one compact package weighing a scant 53 pounds, are the functions of a high speed counter, frequency meter, and period meter. Sensibly priced at $2400, the Model 737A mates an all solid state counter with a plug-in vacuum tube heterodyne converter.

Only 14" high, 17" wide, and 13" deep, CMC's new Model 737A requires a mere 125 watts of power which in itself reduces operating temperatures and contributes to long trouble-free life. And except for the vacuum tubes, the new unit is unconditionally guaranteed for two years.

THREE PLUG-INS AVAILABLE

1. 10 mc to 100 mc frequency converter; 2. 100 mc to 220 mc frequency converter; 3. Solid state 0.1 microsecond to 10^7 second time interval section.

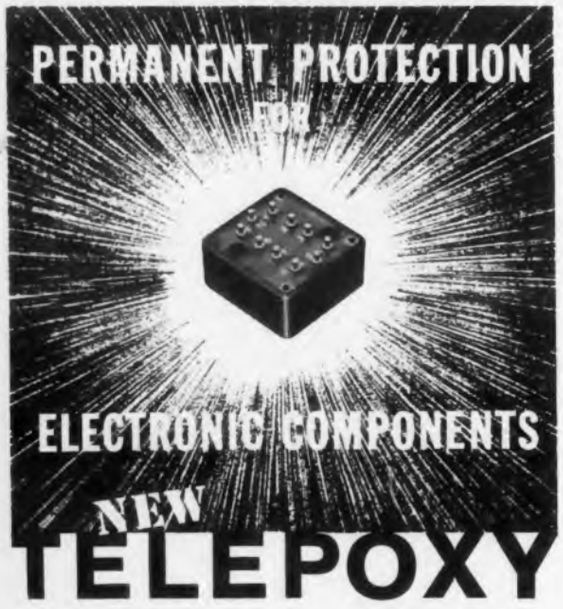
Converter plug-ins $250 each. Time interval plug-in $300.

FEATURES AND ADVANTAGES ✱ *Decade count down time base, frequency divider circuits never need adjustment.* ✱ *Automatic decimal point.* ✱ *Nixie readout available as standard option.* ✱ *Stability, 2 parts in 10^7 standard, 5 parts in 10^8 special.* ✱ *Accuracy, ±1 count ± oscillator stability.* ✱ *Sensitivity, 0.25 v rms.* ✱ *Standardize against WWV.* ✱ *Remote programming without special regard to cable length, type of cable, or impedance matching.* ✱ *Printer output to drive digital recording equipment, punches, inline readout and other data handling gear, $80 extra.*

NEW TECHNICAL BULLETIN TELLS ALL

Your nearby CMC engineering representative will be happy to provide you with full technical, sales, and delivery information and arrange a demonstration at your convenience. For a free copy of our new technical bulletin, please address Dept. 86.

Computer Measurements Co.
A Division of Pacific Industries
12970 Bradley Avenue, Sylmar, California
Phone: EMpire 7-2161



a formulation breakthrough in resin systems for POTTING AND ENCAPSULATING ELECTRONIC COMPONENTS

TELEPOXY SYSTEMS are highly superior Insulating Compounds, made possible through Narmco's recondite research and advanced materials chemistry.

TELEPOXY ASSURES reliable performance from potted, encapsulated or coated components and sub-assemblies – even when they are subjected to extreme operating conditions.

A VARIETY OF TELEPOXY COMPOUNDS ARE AVAILABLE. EACH OFFERS:

- **UNEXCELLED** physical and electrical properties
- **DIMENSIONAL STABILITY** – negligible shrinkage during cure
- **EXTREMELY LOW** moisture absorption
- **PROPER COEFFICIENTS OF THERMAL EXPANSION** – for maximum protection of delicate components
- **SIMPLICITY** of application

TYPICAL APPLICATIONS: Encapsulating toroidal transformers . . . discriminators . . . antenna-matching transformers . . . capacitors . . . ferrite pot cores . . . r-f chokes . . . inductors . . . semi-conductors . . . magnetic and vacuum tube amplifiers. Write for literature describing a variety of TELEPOXY formulations.

NARMCO . . . for high-performance materials.

Formulators of Structural and Industrial Adhesives . . . Reinforced Plastic Laminating Materials . . . Ablative and Molding Compounds . . . Insulating Compounds.

NARMCO MATERIALS
Subsidiary | **TELECOMPUTING CORPORATION**

600 Victoria Street, Costa Mesa, Calif. • Liberty 8-1144 • MAdison 6-7923

SERVES THE NATION AND INDUSTRY WITH SYSTEMS AND SUB-SYSTEMS FOR CONTROLS, GUIDANCE, ELECTRONICS, TELEMETRY, DATA ANALYSIS, AND THEIR INTEGRAL COMPONENTS

CIRCLE 80 ON READER-SERVICE CARD

NEW PRODUCTS

Tone Generator 642

For use in telephone systems

The TGS-720 tone generator transforms dialed pulses from a telephone dial to interrupted tone signals for transmission over any voice channel. The unit consists of a stable-tone oscillator and a regulated power supply that works from 117 v at 50 or 60 cps. The oscillator circuit is of the symmetrical type. The unit may be used single-ended for radio applications. The power supply provides heater and regulated plate voltage for the oscillator and has sufficient capacity to operate the firm's digital decoders. Designed primarily for signaling over wire lines, the unit works well over carrier, microwave and radio in any combination.

Secode Corp., Dept. ED, 555 Minnesota St., San Francsico 7, Calif.

Stator Wedges 712

These U-shaped wedges have widths of 5/16, 11/32 and 3/8 in. One-piece molded construction of polyester reinforced with woven fiberglass provides high strength and easy driving. Dielectric strength is 3,000 v min. The wedges are designed for use as electrical insulation in Class B and Class F motors.

The Glastic Corp., Dept. ED, 4321 Glenridge Road, Cleveland 21, Ohio.
***Price:** $0.10 to $0.24 per ft.*

Mylar Film Capacitor 713

Series 9FM tubular capacitors have Mylar-film dielectrics and plastic cases with epoxy resin end seals. Units are compact and are able to withstand humidity.

John E. Fast & Co., Victoreen Instrument Corp., Dept. ED, 3598 N. Elston Ave., Chicago 18, Ill.

Display Light 714

The TEC-Lite RDL lights have easily replaceable lamps. They can be furnished for computers, data processing, control systems, and instrument and airborne equipment. Legends with up to three characters can be stamped on the lens.

Transistor Electronics Corp., Dept. ED, 3357 Republic Ave., Minneapolis 26, Minn.

Magnetic-Tape Recorder 619

Has 22 channels

Model 104-1 magnetic-tape recorder with 22 channels is for use in airport-traffic-control centers. Up to eight units may be used simultaneously in some areas. The unit will operate unattended for 32 hr. The 22 amplifiers are modular, plug-in type. Each reel holds 4,800 ft of tape. Rewind time for one reel is 3.5 min. Normal recording and playback tape-speeds are 15/16 in. per sec. Forward and reverse speeds are 250 in. per sec.

Webcor, Inc., Dept. ED, 816 N. Kedzie Ave., Chicago 51, Ill.

Electrical Enclosures 678

These cabinets have a sliding-tilting drawer which permits instrumentation in each drawer to be easily repaired or replaced. Construction can be of steel, aluminum, stainless steel or other commercial metals.

The Formweld Products Co., Dept. ED, 1530 Coit Ave., East Cleveland 12, Ohio.

Switch Plates 679

These on-off switch plates are designed especially for subminiature toggle switches with 1/4-in. diam bushings. They are made of a pre-gummed aluminum foil 0.002-in. thick.

Alco Electronic Products, Inc., Dept. ED, 3 Wolcott Ave., Lawrence 2, Mass.
***Availability:** From stock.*

Instrument Wire 680

Developed for satellite use, Super-Jet instrument wire is offered in two styles, both radiation resistant. Style one is for use in sealed capsules and style two stands a dielectric test of 1,500 v after 90 days immersion in tap water. Sizes are 24 through 16 awg.

Boston Insulated Wire & Cable Co., Dept. ED, 25 Bay St., Boston 25, Mass.
***Price:** $0.35 to $1.10 per ft in 1,000-ft lots.*
***Availability:** From stock to 30 days.*

Semiconductor Test Set 639

Test frequency is 1,000 cps

Model 310 portable-semiconductor tester measures operational parameters and leakages of small and medium transistors, rectifiers and Zener diodes. Test frequency is 1,000 cps. The standard h parameters of transistors may be measured at constant emitter currents to 100 ma and constant collector voltages to 30 v. Rectifier diodes may be measured with up to 100-ma forward current. For Zener diodes, 65 ma is available at 10 v, 50 ma at 15 v and 30 ma at 20 v. Leakage and reverse current test potentials range to 600 v.

Owen Laboratories, Inc., Dept. ED, 55 Beacon Place, Pasadena, Calif.
Price: $685.
Availability: *From stock.*

Hook-Up Lead Wire 377

Type BB-1000 can be supplied for a variety of applications. It provides continuous service at 1,000 F, intermittent service to 1,800 F. It has braid and fibrous insulation able to stand 2,000 F without decomposing or melting.

Birnbach Radio Co., Inc., Dept. ED, 145 Hudson St., New York 13, N. Y.
Availability: *Three weeks.*

Plug-In Reset Timer 380

Type-125 interval timer, designed for installation in a 3-1/8 in. diameter opening, may be removed and replaced in a few seconds. It contains four separate, independent load contacts; two may be used as relays and two are time-delay relay contacts which operate at the end of the time set on the dial.

Eagle Signal Co., Dept. ED, 202 20th St., Moline, Ill.

Proximity Transducers 381

These proximity-transducer systems, for sensing moving or stationary-ferrous and -nonferrous metal work pieces, use a probe-type pickup or sensing element. Sensing is accomplished without contact. A typical application is control of vibratory-bowl part feeders.

Electro Products Laboratories, Inc., Dept. ED, 4501 N. Ravenswood Ave., Chicago, Ill.

You get solid state reliability with **SF**'s *new*

1 uv to 1 kv Standard Potentiometric Voltmeter

Only Smith-Florence's Model 951 provides the design and standards engineer with all these features:

* .01% accuracy, absolute accuracy curves available on request
* Extreme stability, drift less than ½ uvolt per day
* Secondary laboratory standard
* Recorder and oscilloscope outputs
* Automatic decimal and range lights

Compare these key specifications

RANGE	10 micro-volts full scale to 1000 v dc full scale
POTENTIOMETER ACCURACY	.005%, certification furnished
INSTRUMENT ACCURACY	.01% to 10 v, .02% 10 v-1 kv
INPUT IMPEDANCE	Infinite at null, below 10 v
DRIFT	Less than .5 micro-volt
REFERENCE	Special temperature compensated Zener plus calibrated standard cell
POTENTIOMETER RANGES	(4) 0-10 v dc to 0-10 mv dc and 0-100 v dc and 0-1 kv dc*
NULL RANGES	(7) 0-10 v dc to 0-10 micro-volts dc
POLARITY	Floating—may be operated with either positive, negative, or external ground
PRICE	$2,495 f.o.b. factory

*Precision .01% probe 10/1 + 100/1 available for operation above 10 v, $139.50 if purchased with the instrument; $179.50 separate

For a demonstration of this precise new instrument, contact your nearby Smith-Florence engineering-representative whose name and phone are listed below. Write for complete technical information including a helpful bulletin titled "How To Make Precision Low Level Measurements."

SF SMITH-FLORENCE, INC.
4228 - 23rd WEST • SEATTLE 99, WASHINGTON
Dept. 38 ATwater 4-0170

Smith-Florence Engineering Representatives: ALBUQUERQUE, New Mexico, F. Y. Gates Company, CH 3-8010 • **ATLANTA 19, Georgia,** Col-Ins-Co., Inc., CEdar 7-1494 **BOSTON (WALTHAM 54), Massachusetts,** Burlingame Associates, TWinbrook 4-1955 • **CINCINNATI 45, Ohio,** The Satullo Company, JEfferson 1-3094 • **CLEVELAND 12, Ohio,** The Satullo Company, IVanhoe 6-2800 • **DENVER (ENGLEWOOD), Colorado,** F. Y. Gates Company, SUnset 1-8566 • **DETROIT (ROYAL OAK), Michigan,** The Satullo Company, Liberty 9-3910 • **HUNTSVILLE, Alabama,** Col-Ins-Co., Inc., JEfferson 9-1771 • **LOS ANGELES (WOODLAND HILLS), California,** Van Groos Company, Diamond 0-3131 **NEW YORK CITY (MT. VERNON), New York,** Burlingame Associates, OLiver 4-6400 • **ORLANDO, Florida,** Col-Ins-Co., Inc., CHerry 1-1501 • **PHILADELPHIA (UPPER DARBY), Pennsylvania,** Burlingame Associates, SHerwood 7-9080 • **PITTSBURGH 37, Pennsylvania,** The Satullo Company, WEllington 1-5200 • **SALT LAKE CITY 1, Utah,** F. Y. Gates Company, EL 9-1101 • **SAN FRANCISCO (PALO ALTO), California,** C. W. Mauldin Company, DAvenport 6-5291 • **SEATTLE 4, Washington,** Comptronics, MAin 4-5135 **SYRACUSE, New York,** Burlingame Associates, GRanite 4-7409 • **TORONTO 13, Ontario,** B. H. (Bruce) McGregor, OXford 9-5521 • **WASHINGTON, D. C.,** Burlingame Associates, OLiver 4-6400 • **EXPORT (San Francisco, California):** Frazar & Hansen, Ltd.

CIRCLE 81 ON READER-SERVICE CARD

NEW PRODUCTS

Digital Voltmeter 638

Stability is ±0.02%

Model 231 digital voltmeter has a stability of ±0.02%, a sampling rate of 0 to 30 v per sec, a range of 0.001 to 1,100 v and a resolution to 0.1 mv. Input impedance is 1 meg. A complete line, the 200 series, includes ac, dc, ratio and ohms measuring modules.

Systron-Donner Corp., Dept. ED, 950 Galindo St., Concord, Calif.

Price: $2,650 for model 231.

Interlock Switches 671

Types WC1627 and WC1630 interlock switches with resistance to high shock and vibration conditions, are for use in aircraft. Design of the switch provides for always having one button in the multi-station system down.

Controls Co. of America, Control Switch Div., Dept. ED, Folcroft, Pa.

Bread Boards 672

Proto-boards are designed to provide specific transistor locating holes. They eliminate a large part of point-to-point wiring, terminal boards and connecting hardware usually required in prototype circuit lay-outs.

Spectronics, Dept. ED, 13901 Saticoy St., Van Nuys, Calif.

Tape Unwinder 673

This portable unit eliminates manual rewinding. It holds a 12-in. reel of up to 1,300 ft of chadless tape or up to 2,000 ft of fully-perforated tape. It weighs 1.5 lb.

Western Apparatus Co., Div. of Comptometer Corp., Dept. ED, 5600 Jarvis Ave., Chicago 48, Ill.

Standoff Terminals 674

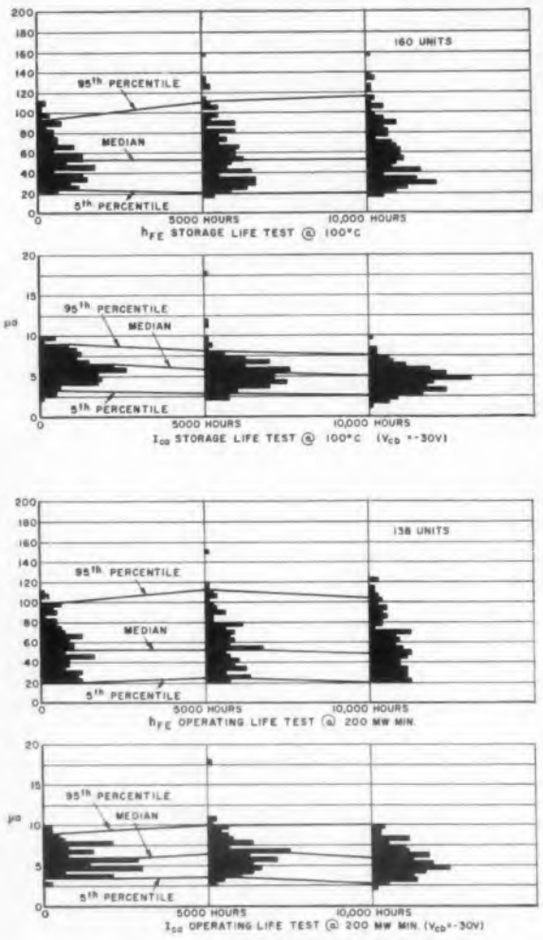
Type RST-SM-31 TUR-L2, for miniature assemblies, has a turret stud with Teflon body. Over-all length of the unit is 0.296 in., soldering lug is 0.156-in. long. The Teflon body is 0.148 in. in diam with a 0.172-in. diam shoulder for chassis support.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N. Y.

The industry's most stable low-frequency PNP transistors!

The man in the picture, Hugh Lowry, General Electric authority on semiconductor applications

TO-5 Type	Max. V_{CBO}	Max. V_{CER}	Max. I_C	Max. P_t	Max. Cutoff I_{CO} @ V_{CB}	20 ma h_{FE} Min.	20 ma h_{FE} Max.	h_{FE} Min.	h_{FE} Max.	V_{CE} (SAT)	V_{BE}	Max. C_{OB}
2N524	45v	30v	500 ma	225 mw	10μa 30	19	42	16	41	.070v	.255	40
2N525	"	"	"	"	" "	34	65	30	64	.075v	.243	"
2N526	"	"	"	"	" "	53	90	44	88	.080v	.230	"
2N527	"	"	"	"	" "	72	121	60	120	.090v	.216	"
2N1413	35v	25v	200 ma	200 mw	12μa 30v	25	42	20	41	.070v	.255	40
2N1414	"	"	"	"	" "	34	65	30	64	.075v	.243	"
2N1415	"	"	"	"	" "	53	90	44	88	.080v	.230	"



General Electric 2N1414 and 2N525 Series carry complete parameters backed up by 10,000-hour life tests

You don't buy a "pig in a poke" when you standardize on General Electric low-frequency PNP germanium alloy transistors, Series 2N1414 and 2N525. Parameters are completely spelled out, including "Minimum," "Typical" and "Maximum" values, and are backed up by 10,000-hour life tests on 138 units to date (see curves above). In fact, 300 new units start life-test each week.

The new lower-priced 2N1413, 2N1414 and 2N1415 types are designed for industrial audio amplifiers and low-frequency switching applications where cost is a prime consideration.

To assure top reliability under adverse environments, all units are hermetically sealed and subjected to 100 hours of high-temperature bake and a detergent pressure leak test. The transistor base is welded to the case for greater thermal efficiency.

For proved reliability in low-frequency PNP's, at a very pleasant price, see your G-E Semiconductor District Sales Manager or Authorized Distributor. General Electric Company, Semiconductor Products Department, Electronics Park, Syracuse, N. Y. *In Canada:* 189 Dufferin St., Toronto, Ont. *Export:* International General Electric Co., 150 E. 42nd St., N. Y. C.

GENERAL ELECTRIC

CIRCLE 82 ON READER-SERVICE CARD

Timer Motor 439

Stands 7,000-g axial shock

Measuring 7/8 in. in diameter, type 9001-00 size 9 permanent-magnet timer motor stands 8,000-g axial shock and 500-g transverse shock. The unit also stands the shock of dropping from a height of 1 mile. There is virtually no speed variation from −67 to +167 F. Gear-train ratios are 6:1 to 46,656:1. Peak loads of up to 500 oz-in. can be handled. At 100 oz-in., rpm is 0.25 to 10. The unit measures 1.406-in. long without gear train.

John Oster Manufacturing Co., Avionic Division, Dept. ED, Racine, Wis.

Phosphor for Picture Tubes 667

Type CR407 phosphor offers rewet adherent characteristics that simplify application to the face of a picture tube. It also resists contamination from impure elements during production processes and resists ion burn that sometimes causes a spot on the face of the tube.

Sylvania Electric Products, Inc., Dept. ED, 730 Third Ave., New York 17, N. Y.

Subminiature Feed-Throughs 668

Having an extra-long pin, type FT-SM-16L6 subminiature feed-through is for use with a chassis of 0.06-in. maximum thickness. Over-all length is 0.987; the Teflon body is 0.93 in. in diameter through-chassis and 0.125 in. in diameter through the mounting shoulder.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N. Y.

Test Receptacle 669

This test receptacle receives the 0.08-in. test probe used with ammeters, voltmeters, ohmmeters and other test equipment, to test printed-board circuits without interrupting operating currents. It is available with two- or three-leg mount.

Amp, Inc., Dept. ED, Harrisburg, Pa.

Electro-Luminescent Panels 670

Offered in sizes to 12 x 12 in., these panels can be used as instrument panels in both military and commercial aircraft. They are constructed of plastic for easy machining and provide glare-free lighting.

Controls Co. of America, Control Switch Div., Dept. ED, Folcroft, Pa.

YOUR MOST
ECONOMICAL
ASSURANCE
OF RELIABILITY

. . . only one **ROTOCON** *required to monitor the performance of components or assemblies for final acceptance tests*

LOW COST. PORTABLE ROTOCON SPOTS ASSEMBLY DEFECTS IN ELECTRICAL AND ELECTRONIC COMPONENTS OR SUB ASSEMBLIES. MOST PRACTICAL QUALITY CONTROL COMPLEX WAVE VIBRATION MACHINE AVAILABLE TODAY. EASY TO OPERATE.

DESIGNED BY CONVAIR— *manufactured and sold under exclusive license by Rototest.* **AUTOMATIC**—*easily operated by any production personnel. Low maintenance cost.* **DUAL PURPOSE**—*prevents cumulative error at each assembly stage, plus final check on any item up to 120 lbs.* **RELIABLE**—*built-in capability to 20,000 cps. Damped to 50–2000 cps. No special power or cooling requirements.* **QUIET**—*only 75 db six feet from machine.* **WRITE** *J. K. Davidson for complete data.*

ROTOTEST
LABORATORIES, INC.
. . . as near as your telephone
2803 Los Flores Blvd., Lynwood, California

AVAILABLE
NOW
price $3850

CIRCLE 83 ON READER-SERVICE CARD

NEW PRODUCTS

Microvoltmeter 597

Frequency range is 10 kc to 30 mc

Type USVH microvoltmeter has a frequency range of 10 kc to 30 mc. It uses a sensitive superheterodyne receiver; the output of this is read by a diode voltmeter. Applications include: selective attenuation and frequency-response measurements on four-terminal networks; selective frequency-response measurements on amplifiers or filters within their passbands; measurements of rf distortion on transmitters; modulation-depth measurements with carrier frequencies from 10 kc to 30 mc and modulation frequencies over 1 kc.

Rhode & Schwartz, Dept. ED, 111 Lexington Ave., Passaic, N.J.

Pushbutton Switches 371

These switches have from 2 to 16 buttons per row, with momentary, locking or accumulative lock-button actions. Behind-the-panel depth is 3-11/16 in. for model 20 and 2-5/8 in. for model 10.

Switching Controls Corp., Dept. ED, 8222 Lankershim Blvd., North Hollywood, Calif.
Availability: *From stock.*

Prefabricated Circuit Cards 404

This circuit card can be prefabricated and adapted to different circuit requirements. It contains a universal etched pattern which can be modified by interconnections to form any desired circuit function. The etched circuitry is carried through from the base plug of each card to the top where a duplicate connector is provided. This permits operational checks.

General Precision Inc., Librascope Div., Dept. ED, Glendale, Calif.

Switch and Balance Units 405

Model C-10 switch and balance units are for use with strain gages and resistance bridge transducers. They have a modular construction that enables ready assembly of systems ranging in size from 10 to 100 channels. Special cables and terminal boxes are provided to extend the input connections to the gage location.

Automation Industries, Inc., Dept. ED, 3613 Aviation Blvd., Manhattan Beach, Calif.

Crossbar Switch 599

Capacity is up to 600 circuits

This crossbar switch provides a capacity of up to 600 circuits for many varied switching combinations within a space of 14-5/16 x 8-3/4 x 5-3/8. It has 5 x 12 coordinates with 10 contacts per cross-point, double-wound hold coils and ball-bearing pivot pins. Bifurcated springs with silver-alloy contacts provide for a contact life of over 50,000,000 operations. The switch can be used in analog and digital computers and automatic test programing.

North Electric Co., Dept. ED, Galion, Ohio.
Price: *$250.*
Availability: *30 days.*

Ceramic Capacitors 389

Offered in 19 sizes, these capacitors fit 0.1-in. modular spacing. Body sizes are 1/4 in. max for units rated at 5 to 750 pf and 5/16 in. max for 1,000 to 10,000 pf.

Mucon Corp., Dept. ED, 9 St. Francis St., Newark 5, N.J.
Availability: *Immediate*

Transistor Analyzer 390

Model 850 P portable transistor analyzer is suitable for use as a breadboard to determine the operating characteristics of a transistor under different conditions. It measures parameters in any of three configurations: common base, common emitter and common collector.

The Hickok Electrical Instrument Co., Dept. ED, 10520 Dupont Ave., Cleveland 8, Ohio.
Price: *$169.50.*
Availability: *From stock.*

Temperature Chamber 391

Model A-120-2-HC has a range of −150 to +300 ±2 F. It measures 24 x 12 x 13-1/2 in. and has a fin coil and blower. The lid has a multipane frost-free window.

Cincinnati Sub Zero Products, Dept. ED, 3932 Reading Road, Cincinnati 29, Ohio.
Price: *$2,100.*
Availability: *From stock.*

Oscilloscope Recording Camera 485

Has two-min processing attachment

Model KA-30 oscilloscope recording camera has a two-min rapid processing attachment. It records radar and crt impulses and develops the film in the camera in one min without tanks of processing solutions. This continuous-strip unit allows the checking of a limitless number of electronic functions at selected intervals on a strip of film up to 100-ft long. Designed for any standard 5-in. oscilloscope, it has a speed range of from 0.25 to 12.5 ips. The unit weighs 15 lb and measures 19 x 13 x 7 in.

Chicago Aerial Industries, Inc., Dept. ED, 550 W. Northwest Highway, Barrington, Ill.
Availability: January 1961.

Solid-State Materials 375

These active solid-state materials are up to 99.999%+ pure. Gallium arsenide, indium arsenide, gallium antimonide and indium antimonide are available in large grain, poly-crystalline-ingot form. Cadmium telluride, bismuth telluride, lead telluride and mercury telluride are available in microcrystalline-powder or polycrystalline-ingot form.

Alloys Unlimited Chemicals, Inc., Dept. ED. 42-73 Hunter St., Long Island City 1, N.Y.

Cathode Supports 376

The cathode support consists of a stamped mica insulator combined with two beryllium copper end pieces. The insulator measures 1/8 x 5/16 in. and is punched from 0.015-in. thick clear ruby mica. The unit possesses the dielectric and mechanical strength for use in reflex klystrons.

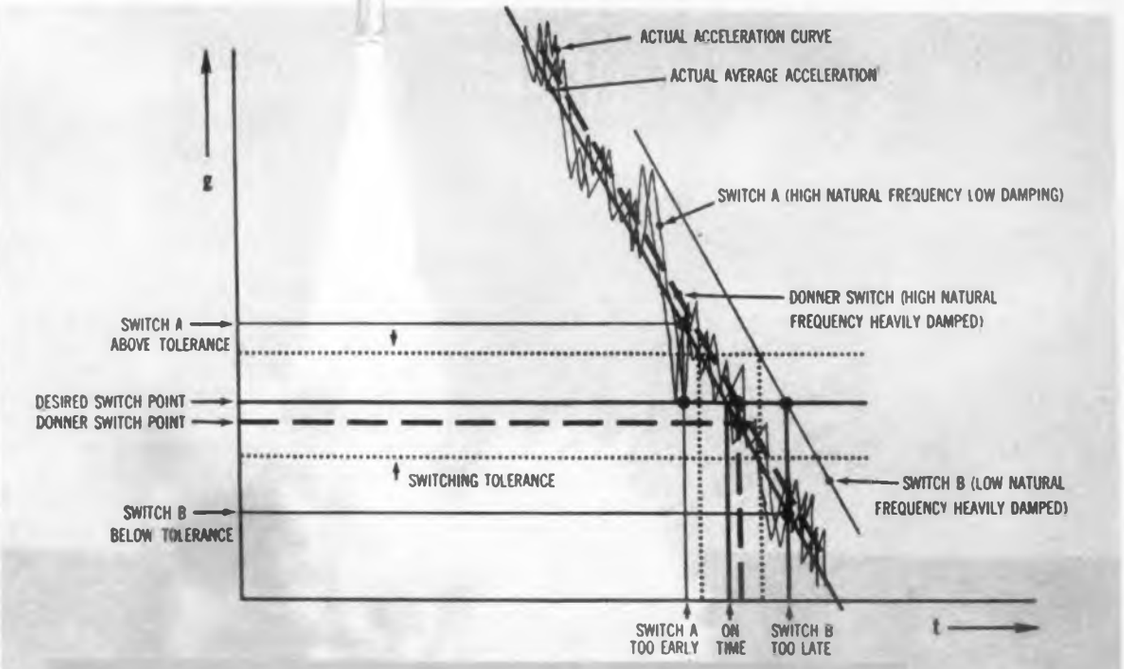
Ford Radio and Mica Corp., Dept. ED, 536-540 63rd St., Brooklyn 20, N.Y.

Subminiature Capacitors 710

These subminiature capacitors are for missile, computer and communications applications. A typical 2-pf capacitor is contained in a 1-in. cube. Other units average 1-1/16 x 1 x 15/16 in. The hermetically sealed units have tolerances held to within 0.1%.

Southern Electronics Corp., Dept. ED, 150 W. Cypress Ave., Burbank, Calif.

There's only one reason to specify Donner acceleration switches



..BECAUSE THEY UNDERSTAND THE MEANING OF ACCURACY

It's dynamic accuracy that counts. In truth, several firms make precision acceleration switches. But accuracy, like reliability, is a term with shades of definition. Some switches are accurate in the lab or on the test bench. That is, they provide *static* accuracy. Donner acceleration switches give you accuracy where it counts, on the operational missile. They are *dynamically* accurate.

Look at the graph above. Under static conditions, switch "A" with a better switching response, might be desirable. But suppose the missile were experiencing a 10 g vibration of a high frequency nature and proper thrust cutoff depended on detecting a 2 g switch point. Switch "B" would eliminate the problems of early switching, but introduce intolerable phase shift which in turn would make the switch "see" the event after it actually occurred. In other words, under the dynamic conditions of missile and aircraft flight, it is absolutely necessary to know when an event occurred rather than precisely where it occurred. Frequency response becomes a more important consideration than switch accuracy.

Heavily damped, with a high natural frequency, Donner acceleration switches have low phase shift providing the transient response necessary to follow rocket engine operation and perform their task with meaningful accuracy.

Donner Acceleration Switches are Flexible

Because of the inherent flexibility of Donner's basic accelerometer servo system and associated electronics, Donner acceleration switches will satisfy virtually any requirement.

Features include multiple switch points, any specified damping ratio, built-in time delays to overcome initial transients or delayed output, memory damping, and total programming capacity.

Six Page Brochure on Request—For complete technical information, write for our new brochure: Acceleration Switches for Accurate Determination of Thrust Termination in Missile and Satellite Vehicles. Please address Dept. 36

DONNER SCIENTIFIC COMPANY
A Subsidiary of Systron-Donner Corporation
30 CONCORD, CALIFORNIA • MUlberry 2-6161

• Challenging career opportunities available for engineers and scientists.

CIRCLE 84 ON READER-SERVICE CARD

wherever DEPENDABILITY is a prime requisite

PRESS-FIT® TEFLON® TERMINALS

Sealectro Press-Fit Teflon Insulated Terminals, Feed-Throughs, and Test Jacks assure **maximum dependability** under all operational conditions. Designs resulting from unparalleled experience, careful fabrication from the finest materials, and precise inspection combine to make Sealectro Press-Fit units first choice for quality and value . . .

WRITE FOR CATALOG

*Reg. Trademark of E. I. Du Pont de Nemours & Co., Inc.

Sealectro CORPORATION

139 HOYT STREET • MAMARONECK, N. Y.

PRESS-FIT® TEFLON TERMINALS

CONHEX® RF CONNECTORS

British Branch: Sealectro Corporation, Hersham Factory Estate, Lyon Road, Walton-on-Thames, Surrey, England

CIRCLE 85 ON READER-SERVICE CARD

NEW PRODUCTS

Coaxial Switches 446

Use 28-v dc solenoids

This line of type W miniature coaxial switches includes spdt and transfer types with either type N or TNC connectors. The spdt is a latching type requiring no holding power. The transfer type, having one solenoid, switches from one set of contacts to the other when energized. Typical rf characteristics at 2 Gc are 1.15 vswr, 0.2-db insertion loss, and 50-db crosstalk.

Transco Products, Inc., Dept. ED, 12210 Nebraska Ave., Los Angeles 25, Calif.

Cold-Weather Electrical Tape 369

This vinyl electrical tape strips easily, remains flexible, never freezes, and sticks down to −20 F. Total working range is −20 to +120 F. Designated Slipknot CW, the tape is 8-1/2-mil thick, and is available in 66-ft rolls.

Plymouth Rubber Co., Dept. ED, Canton, Mass.

Miniature Eyelets 370

These precision miniature eyelets have outside diameters from 0.046 to 0.1 in. They are made of nickel, stainless steel, copper, nickel-plated steel, and brass.

Ramco Manufacturing Co., Dept. ED, 540 Westfield Ave., Roselle Park, N. J.

Strain Relief 372

This plastic strain relief is held in place by a metal C-ring. Designated type SR-1082, the device satisfies U. L. strain relief pull-test requirements. The unit can be used for both round and D-shaped panel openings.

Phalo Plastics Corp., Dept. ED, Shrewsbury, Mass.

Strain Gage Module 373

Model SRB-75A strain gage module and hand servo gun is used to obtain automatic null of a strain gage bridge. It contains a stable, regulated, strain-gage power supply, automatic calibration circuits and space for bridge completion resistors. Plug-in resistor boards permit rapid conversion of circuitry for various applications.

Video Instruments Co., Inc., Dept. ED, 3002 Pennsylvania Ave., Santa Monica, Calif.

new, low-cost
micro-microammeter

Model 414 offers high performance over 17 ranges for just $280.00!

● The Keithley 414 Micro-micro-ammeter is today's lowest-cost instrument for low current measurements in production tests, monitoring installations and experiments in the range of 10^{-2} to 10^{-11} ampere. The 414 can be used as the amplifier element in systems, such as reactor controls, thickness gauges, ionization gauge control in high-vacuum equipment. Contact meter models are available for go, no-go production tests, alarm and control systems.

SPECIFICATIONS

Ranges: 17 ranges in 1x and 3x steps, from 10 ma to 0.1 mμa f.s.

Accuracy: Within ±3% of f.s. to 10 mμa: ±4% on lower ranges.

Input Voltage Drop: Below 5 mv all ranges with full-scale signals.

Response Time: Below 0.5 sec. all ranges, for any input capacitance to 5000 μμf.

Zero Drift: Below 2% of f.s. per day.

Recorder Output: 5 volts with a 1 ma capability.

Price: Model 414 . . . . . $295.00

For full details, write:

KEITHLEY
INSTRUMENTS

12415 EUCLID AVENUE
CLEVELAND 6, OHIO

CIRCLE 86 ON READER-SERVICE CARD

Thermocouple Junction 409

For airborne equipment

This thermocouple reference junction is a miniature, heated, multi-channel unit for airborne equipment and test cells. It is designed to replace the conventional ice bath as reference temperature for thermocouples. The unit is available in 115 or 28 v ac or dc and having adjustable (3 F stability) or non-adjustable (1.5 F stability) regulators. Accuracy is ±1 F and temperature range is −65 to +220 F.

Aero Research Instrument Co., Inc., Dept. ED, 315 N. Aberdeen St., Chicago 7, Ill.

Price: *On request.*

Availability: *Made to order, 8 weeks.*

Self-Locking Synchro Clamp 419

For sizes 5 through 11

This self-locking synchro clamp, called Mini-Synclamps, permits the fastening of size 5 through size 11 miniature components to any base. It meets Mil specs and is functional up to 350 F. Diameter is 0.265-in. max. The unit is available in four different grip thicknesses: 0.031, 0.047, 0.062 and 0.093.

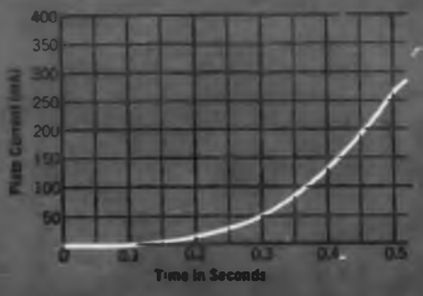
Timber-Top, Inc., Dept. ED, 38 Brooklyn Ave., Freeport 2, L.I., N.Y.

Price: *40¢ ea, 1 to 99.*

Availability: *From stock.*

CIRCLE 87 ON READER-SERVICE CARD ➤

The tube that transistors made necessary!



RF Power Amplifier — Class C Telegraphy

	ICAS 25-50	ICAS 148-174 mc.	
Frequency (mobile)			
DC plate voltage	600	600	volts
DC screen grid voltage	200	200	volts
DC plate current	2x40	2x40	mA
DC screen grid current	[illegible]	4.5	mA
DC control grid current	2x1.2	2x1.3	mA
Plate input	2x24	2x24	watts
Plate dissipation	2x6.5	2x7.2	watts
Power output	[illegible]	33.6	watts

Amperex® 5895 twin tetrode reaches **85%** of full emission in **½ second** — minimizes transistor drift.

The Amperex 5895 allows "push-to-talk" operation in compact, transistorized mobile equipment — reaches a practical operating level of 85% of full emission in ½ second (see curve). Minimizes transistor drift and reduces battery drain

The 5895 RF power amplifier facilitates the design and manufacture of compact, mobile FM VHF/UHF transistorized transmitters.

ask Amperex
for your copy of the latest condensed tube catalog containing data on tubes for mobile operation.

AMPEREX ELECTRONIC CORP. 230 Duffy Avenue, Hicksville, L. I., N. Y.
In Canada: Rogers Electronic Tubes & Components, 116 Vanderhoof Ave., Toronto 17, Ont.

Can a silicon rectifier solve your problem?

It might, if you have a problem in DC power sources. For example, some time ago C & D needed a high efficiency, constant potential, current limiting DC power supply. Output had to be held within ± 1% over an AC input variation of ± 15%. In addition, maintenance would have to be virtually nil.

The answer was found by using a silicon rectifier in combination with simplified components that became the heart of C & D's *AutoReg*® charger. *AutoReg* chargers provide continuous, automatic, unattended charging of industrial storage batteries. With the exception of a timing circuit there are no moving parts. There are no relays to adjust and practically no maintenance is required.

Now, C & D has expanded facilities of the *AutoReg* plant to provide industry with similar DC sources, which incorporate silicon rectifiers and automatic regulation. Final form of these units can supply power in a range from milliwatts to megawatts, depending upon your requirements.

Companies with a problem in DC power sources should write, giving a general outline of their requirements, to: *Vice President in Charge of Engineering*

AutoReg® Power Sources

C&D BATTERIES
of Conshohocken, Pa. ... Attica, Ind.
DIV THE ELECTRIC AUTOLITE CO

Manufacturers of Styvex-Clad® Industrial Batteries • PlastiCell® and PlastiCal® Batteries for Communications, Control, and Auxiliary Power • Producers of AutoReg® Silicon Chargers and AutoCal® Charger-Battery Combinations

CIRCLE 88 ON READER-SERVICE CARD

NEW PRODUCTS

Curve-Follower 641

Interprets function curves

Model FGE 5048 Data-Track curve follower interprets function curves drawn as a double line with an ordinary pencil on graph paper. The pencilled chart guides a servo-driven capacitive prove that follows the centerline between the plotted lines. A potentiometer, geared to the probe-drive mechanism, divides any impressed voltage in precisely the same proportion as the drawn curve divides the graph scale. Data-drum rotation time is 300 to 10 sec per revolution on standard models. Operation may be continuous or limited to an arbitrary number of cycles. Units can have two or three channels.

Research, Inc., Dept. ED, Box 6164, Minneapolis 24, Minn.

Seamless Tubing 362

Made of 80% nickel and 20% chromium alloy, this tubing comes in OD sizes of 0.01 to 0.375 in. Standard wall thicknesses extend to 0.001 in. It stands temperatures to 2,100 F and has good electrical resistance. It is used in resistance-heating elements, thermocouple protection tubes and instrument components.

Uniform Tubes, Inc., Dept. ED, Collegeville, Pa.
Availability: *Delivery in four to five weeks.*

Pushbutton Switch 356

This pushbutton switch is available in single pole to six poles, double throw or single throw, models. It combines in a single unit a control switch and an indicator light. It will mount either horizontally or vertically. It is for dry circuit to 3 amp operation.

The Sloan Co., Dept. ED, 7704 San Fernando Road, Sun Valley, Calif.

Electrostrictive Ceramics 358

These thin-sheet electrostrictive ceramics are available in a wide variety of shapes and sizes. Motor elements constructed from this material are offered in beam, disc and stack forms. They have application in relays, computers, sonic systems and as actuators in specialized valves, pumps and meters.

Electric Machinery Mfg. Co., Dept. ED, Mullenbach Div., 2100 E. 27th St., Los Angeles 58, Calif.
Price: *Minimum order, $10*
Availability: *30 days.*

ANNOUNCING

ANOTHER CTI FIRST!

The Model 230
TAPE-PROGRAMMED CABLE HARNESS ANALYZER

- Automatic Testing by Tape Control
- Search and Fault Print-Out
- Capacity up to 9600 wires

Introducing the most flexible testing unit devised for the analysis of wiring harnesses . . . the CTI Tape-Programmed Cable Harness Analyzer, Model 230. Any number of complex test procedures are programmed with ease. Operation is entirely automatic and unattended. The unique "Search-Out" feature provides a printed record of test failures and the actual location of all circuits associated with each failure. Simultaneously programmable go/no-go continuity and leakage tests. Any combination of branch or standard circuits can be selected. Test capacity of up to 9600 wires in 600 wire increments. Engineering changes in the cable harness tests are quickly handled by paper tape programming. The CTI Tape-Programmed Cable Harness Analyzer is another outstanding breakthrough by CTI.

NEW

Write for full information

CTI®
CALIFORNIA TECHNICAL INDUSTRIES
DIVISION OF TEXTRON INC.
BELMONT 6, CALIFORNIA

Foremost in Automatic Testing
CIRCLE 89 ON READER-SERVICE CARD

Silicon Mesa Diodes 634

Reverse recovery is 2 nsec

These silicon-mesa diodes have a reverse recovery of as fast as 2 nsec and a capacitance of 2 pf. A typical unit, type PD307 exhibits these characteristics: forward current at 1 v dc, 10 ma; breakdown voltage at 100 amp, 50 v; capacitance, 2 pf; inverse current, 0.1 μa at −20 v and 25 C and 10 μa at −20 v and 150 C; reverse recovery time, 4 nsec. Called Micro Diodes, the units are offered in 11 types with designations PD301 through PD311.

Pacific Semiconductors, Inc., Dept. ED, 10451 W. Jefferson Blvd., Culver City, Calif.
Price: *$2.50 to $6.02 in large quantities.*

Dual-Element Fuse 724

These dual-element cartridge fuses, designated Fuseking, are for the range of 250 to 600 v. The thermal cut-out element provides reliable control of over-load currents. The snap-open jaws of the heat sinks are activated when heat from any source approaches 300 F.

El-Tronics, Inc., Monarch Electric Div., Dept. ED, Jamestown, N. Y.
Price: *$24.54 to $1,246.87 per 100.*
Availability: *From stock.*

Stripper For Printed-Circuit Boards 725

Type 99 stripper "K" was developed for photo resist on printed-circuit boards. It may be used by immersion techniques or may be sprayed or brushed. Stripping action is almost immediate and requires only a water rinse.

Arnold Laboratories, Dept. ED, 7103 Laurel Canyon Blvd., North Hollywood, Calif.
Price: *$4.75 per 5 gal.*
Availability: *From stock.*

Coaxial Load 664

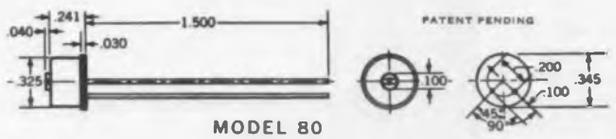
Model RDL-3LT coaxial load is rated for 1.05 vswr max and 0 to 1,500 mc. Typical operation is to 3,500 mc.

Radar Design Corp., Dept. ED, Pickard Drive, NE, Syracuse 11, N.Y.
Price: *$82 ea.*
Availability: *Stock to 4 weeks, depending on quantity.*

...it's the new Spectrol ultraminiature trimmer... **the smallest trimming potentiometer on the market! Measuring 1/3" in diameter, weighing only 1 gram, and designed specifically for transistor circuits, the Spectrol Model 80 is a remarkable breakthrough in component technology.**

Design engineers can now shrink printed circuit packages in all three dimensions. The single turn adjustment is from the top, rather than the side. It is ideal for printed circuit applications. Sealed construction allows complete package encapsulation.

THE MODEL 80 is approximately one-quarter the size of ordinary trimmers, yet it offers greater resolution and resettability because the resistance element is nearly twice as long. These trimmers meet all applicable military and commercial specifications including the most severe humidity cycling and immersion tests.



MODEL 80

SPECIFICATIONS

DIAMETER 0.345"
STANDARD RESISTANCES (ohms) 50, 100, 200, 500, 1K, 2K, 5K, 10K
RESISTANCE TOLERANCE ±5%
NO. TURNS ONE
POWER RATING 1 watt at 70°C
LINEARITY ±1.0%
NOISE 100ΩENR per NAS-710
SHOCK 50 G
VIBRATION 30 G to 2,000 CPS
HUMIDITY MIL-E-5272C, Proced. I (10 days, cycling) and MIL-STD-202A, Method 104, Condition A (immersion in hot water)
SALT SPRAY MIL-STD-202A, Method 101A, Condition A (96 hours)
LOAD LIFE 1000 hours
WEIGHT 1 Gram
PRICE (1-9 units) $6.00 each

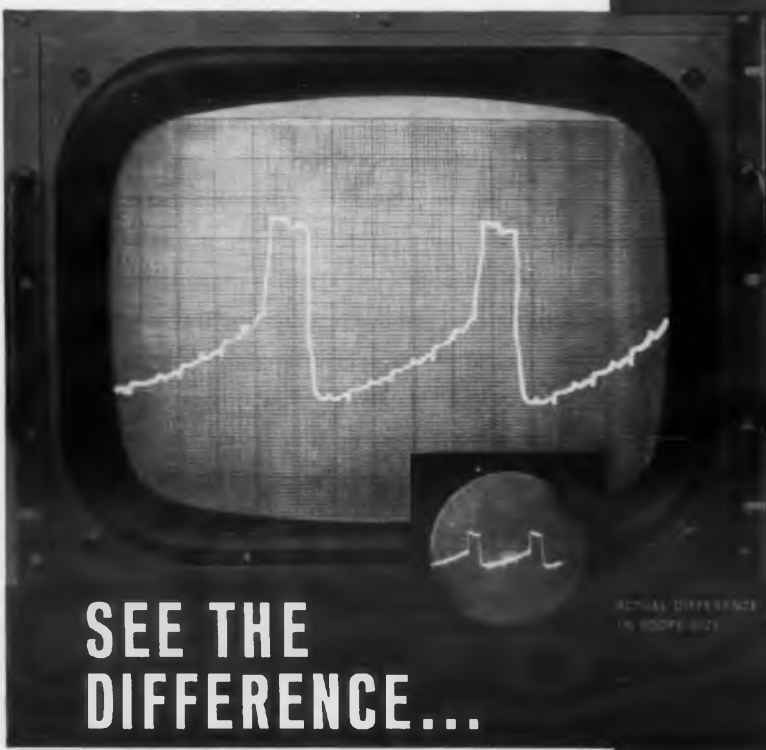
Available now for immediate delivery. Standard models of Spectrol trimmers and miniature potentiometers, as well as other standard precision potentiometers, are available from your nearby Spectrol distributor. For complete technical information, contact your Spectrol engineering representative or write directly to the factory. Please address Dept. 36.

The Spectrol name, your assurance of quality.
Spectrol trimmers are produced to the same exacting standards of quality and reliability engineered into the entire Spectrol potentiometer line . . . the largest selection in the industry.

SPECTROL ELECTRONICS CORPORATION
30
1704 South Del Mar Avenue • San Gabriel, California
Phone: ATlantic 7-9761
1250 Shames Drive • Westbury, L. I., New York
Phone: EDgewood 3-5850

CIRCLE 90 ON READER-SERVICE CARD

WITH AN ITT LARGE SCREEN OSCILLOSCOPE



SEE THE DIFFERENCE...

• in *picture size* that presents so much more information • in *accuracy* that allows you to observe even minute details • in *reading ease* that eliminates operator errors and fatigue.

These are some of the differences you see with ITT large scope viewing—advantages you don't get with conventional scopes.

In both 17" rack-mounted and 21" cabinet-mounted units, ITT's precise magnetic deflection system provides excellent resolution and linearity for a wide variety of applications...for teaching, demonstration or exhibition...for telemetering, production testing, waveform analysis, computer readout, X-Y plotting, data plotting and medical observation...easily adapted for bar graph presentation and monitoring.

Complete application and specification data is available at your ITT Instruments representative or by writing us direct for Data File ED-1045-2.

ITT **Industrial Products Division**
International Telephone and Telegraph Corporation
15191 Bledsoe Street • San Fernando Calif. • EMpire 7-6161

static power conversion • instruments • closed circuit television

CIRCLE 91 ON READER-SERVICE CARD

NEW PRODUCTS

Amplitude- and Phase-Sensitive Relay 640

Operates from ac or dc signals

This sensitive relay operates from either ac or dc input signals and provides closure of two dpdt 10-amp relay contacts. When used with ac signal, one relay closes when the input is in phase with the reference signal. When the input is 180 deg out of phase with the reference signal, another relay closes. The relay closes on a 5-mv input and opens at 4.9 mv. Hysteresis is ±2% under conditions specified by MIL-E-5272 with a power-supply variation of 25 to 31 v dc. Units are packaged in modules measuring 2-5/16 x 2-1/16 x 2-1/12 in.

Natel Engineering Co., Dept. ED, 15922 Strathern St., Van Nuys, Calif.

Price: *Relay amplifier, $90 to $225; ac feedback amplifier $80 to $225.*

Availability: *Three weeks.*

Magnetic-Tape Recorder 366

The MFR-1 is a portable drum-type recorder with a 54-db signal-to-noise ratio. The auxiliary power pack contains the time standard, phase comparator and motor-drive oscillator.

Mandrel Industries, Electro-Tech Labs, Dept. ED, P. O. Box 13243, Houston 19, Tex.

High-Voltage Fuses 367

Designed for current-limiting applications, these fuses are available in ratings from 1 to 150 kv dc and 0.5 to 35 amp, continuous current. Clearing time is claimed to be extremely fast.

Franklin Engineering Design Co., Dept. ED, 977 Commercial St., Palo Alto, Calif.

Dust-Light Relays 368

Series DOS relays come with a plastic dust cover. They are 2 pdt general purpose units rated at 15 amp and can be furnished for ac or dc operation. They have octal plug-terminated bases.

Ohmite Manufacturing Co., Dept. ED, 3634 Howard St., Skokie, Ill.

From the NEW convenience-styled L&N line...

9844 A-C NULL DETECTOR with interchangeable filters for 50, 60, 400 or 1000 cps

To facilitate rapid, accurate measurements using a-c bridges, current and potential transformer test sets, electrolytic conductivity bridges, etc., the new 9844 A-C Null Detector has many applications in research and testing laboratories and quality control departments.

This rugged, portable, line-operated detector has separate, tuned, plug-in "Twin T" filters of unique design, making the instrument selectively sensitive to input signal frequencies of 50, 60, 400 or 1000 cycles/second.

List No.—*9844-☐ A-C Null Detector, normally available for delivery from stock.*

Input Signal Frequency—*Specify for 50, 60, 400 or 1000 cycles/sec. Add suffix -50, -60, -400 or -1000 to list number.*

Sensitivity—*Five choices, over a range of 10,000 to 1. Max. sensitivities are as follows:*

Source Impedance (Ohms)	Sensitivity (Position 1) (μv/ scale div.)
Up to 20,000	0.3
20,000 to 50,000	0.6
50,000 to 100,000	1.1

Period—*Less than 1 sec. for 50% full scale unbalance.*

Noise—*Less than 1 μv peak-to-peak.*

Input Impedance—*10,000 ohms.*

Meter Response—*Non-linear. Essentially linear from 0 to approx. 60% of full scale. Amplifier saturates completely at about 85% of full scale.*

Power Supply—*120 volts, 60 or 50 cycles.*

Case—*Vinyl covered metal with handle, 9¼" (h) x 6½" (w) x 14" (l). Wt., 16 lb.*

Price—$295.00 *f.o.b. Phila. or North Wales, Pa. (subject to change without notice). Order No. 9844-☐ from L&N, 4908 Stenton Ave., Philadelphia 44, Pa.*

LEEDS NORTHRUP
Instruments — Automatic Controls • Furnaces

Pioneers in Precision

CIRCLE 92 ON READER-SERVICE CARD

Radio Interference Filters 410

For military equipment

These 400-cycle, electronic, interference filters are for use on critical military equipment. They are available in seven basic case sizes having voltage ranges of 150 and 250 v ac and current ratings of 0.4 to 100 amp.

All-Tronics, Inc., 400 Cycle Filter Dept., Dept. ED, 45 Bond St., Westbury, L.I., N.Y.

Price: *From $4 to $25 ea.*
Availability: *1 week.*

Sweeping Power Supply 425

For voltage-tuned magnetrons

Model 610C sweeping power supply is designed for operation of voltage-tuned magnetrons. It provides electronically swept operation either linear with time, with repetition rates from 10 to 0.01 cps, or nonlinearly at 60 cps. Swept and unswept signals may be internally modulated with an 800 to 1,200 cps square wave. Specifications include: anode, −250 to −2,500 v, sweep increases linearly with time; ripple and noise, 0.2% max peak-to-peak; control electrode, 0 to 900 v, 0 to 5 ma, 0.02% peak-to-peak ripple above 50 v; dc operation, internal, 800 to 1,200 cps square wave; filament supply, 0 to 6 v dc at 0 to 4 amp.

Alfred Electronics, Dept. ED, 897 Commercial St., Palo Alto, Calif.

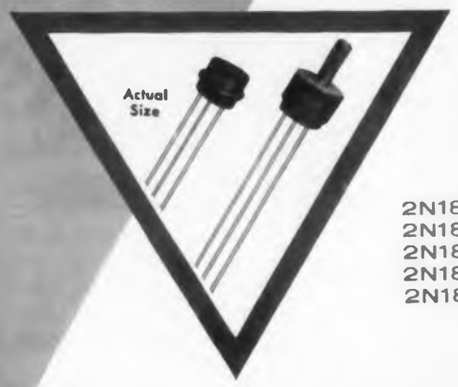
Price: *$16.90 ea, fob Palo Alto.*
Availability: *45 days.*

CIRCLE 93 ON READER-SERVICE CARD ▶

NEW ...FROM SSPI

ONE AMP SILICON CONTROLLED RECTIFIERS

offering closer specification control
—to provide realistic design margins
for today's high performance systems



2N1881
2N1882
2N1883
2N1884
2N1885

PROVEN LEADERSHIP
IN *PNPN* TECHNOLOGY
.....from SSPI

- **HIGH CURRENT**
  At 100°C . . . 1 amp (continuous)
- **HIGH SENSITIVITY**
  2mA . . . to control 1 amp (continuous)
- **LOW LEAKAGE**
  10 μA cutoff current
  at full voltage
- **ALL LEADS ISOLATED**
  No mica washers or
  insulating standoffs

Type	Maximum Anode Voltage (DC or Peak AC) ± Volts	Maximum Average Forward Current 100°C Case Amps	Maximum Gate Current to "Fire" mA	Gate Voltage to Fire + Volts	
				Min.	Max.
2N1881	30	1.0	2	.40	2.5
2N1882	60	1.0	2	.40	2.5
2N1883	100	1.0	2	.40	2.5
2N1884	150	1.0	2	.40	2.5
2N1885	200	1.0	2	.40	2.5

This series provides significant improvement in gate firing sensitivity, cutoff currents, and high temperature capability — as compared to the companion 2N1595 series. As such, they are particularly suited for high performance systems — where design margins assume major importance. These devices are replacing the 2N1595 series in many such applications.

These types combine a current rating of 1 ampere *at a case temperature of 100°C* with extremely small size. Compared to the 2N1595 series, cutoff currents and gate firing sensitivity are improved by a factor of 5. With higher temperature capability at specific current levels, these characteristics permit greatly improved system performance over wider design limits.

The internally insulated junction eliminates the need for mica washers, which provides design flexibility, simplified assembly, and improved reliability.

The miniature SCR is useful in applications such as AC and DC static switching, proportioning control, DC to AC converters, servo motor driving, squib firing, protective circuits, and related applications. SSPI Bulletin D420-02 covers many SCR applications in detail.

Encapsulated in the unique SSPI cold welded TO-9 case, these units offer a high degree of mechanical ruggedness and long-term reliability. All units are subjected to extensive temperature storage and cycling and 100% acceptance testing, as a regular part of the manufacturing operation. This series is designed to meet the requirements of MIL-S-19500.

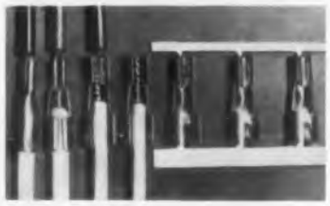
WRITE FOR BULLETIN C415-04

SOLID STATE Products, Inc.
ONE PINGREE STREET • SALEM, MASSACHUSETTS
PIONEER 5-2800

NEW PRODUCTS

Splice Connector 614

Joins heater wire to stranded wire



This splice connector for joining heater wire to stranded wire handles heater wire in sizes of 0.085 to 1.25 in. in OD and stranded wire in sizes of 14 to 18. The device is constructed so that open circuits will not occur. Pull-out strength is 12 lb max.

Berg Manufacturing Corp., Dept. ED, New Cumberland, Pa.

Price: *$3.63 to $4.97 per 1,000, including the use of high-speed machines.*

Availability: *Four to six weeks.*

Automatic Tape Degausser 493

Erases 90 db below saturation level

Type TD-2903 automatic tape degausser is capable of erasing reeled tape to a nominal 90 db below saturation level. The instrument handles TV tapes in widths of 1/4 to 2 in. on 7- to 14-in. reels. Both CEC and NARTB reel-hubs may be used. The unit measures 22 x 16 x 15 in. and requires 117 v of single-phase power at 60 cps, 20 amp.

DataTape Div., Consolidated Electrodynamics Corp., Dept. ED, 360 Sierra Madre Villa, Pasadena, Calif.

Panel Lights 626

Have snap-on lenses

These panel lights have snap-on lenses which permit replacing the bulb from the front of the panel. Lens dimensions are 0.51-in. long and 0.57 in. in diameter. Lens base is 0.6 in. in diameter and 0.125-in. thick. Terminals are beryllium copper, cadmium plated or gold flashed.

Elotec Inc., Dept. ED, 1425 N. Lidcombe, El Monte, Calif.

Price: *$0.40 in lots to 10.*

Availability: *Immediate on small quantities.*

Ultrasonic Cleaners 595

Have 50-kc power generator

These cleaning systems consist of a 50-kc power generator and a stainless-steel transducerized tank where sound is introduced into a fluid. A normal duty system combines Model UG-70, a 70-w generator and model UT-15, a transducerized tank which has a 1.5-gal capacity. Model UG-70 measures 12 x 13 x 9 in. and model UH-15 measures 6 x 11-3/4 x 6 in.

Ultrasonics Corp., Dept. ED, 10909 Venice Blvd., Los Angeles 34, Calif.

Hermetic-Seal Bushings 488

For solder-in installation

Type M-1003 bushings are constructed of solid cast-epoxy resin. Having no internal voids to be filled with oil, they can be mounted in any position. They are capable of corona-free operation at 40 kv and have a peak-pulse operating level of greater than 70 kv for air-to-oil or 140 kv for oil-to-oil operation. Flashover is 65 kv, positive dc.

Components for Research Inc., Dept. ED, 979 Commercial St., Palo Alto, Calif.

Price: *$18.*

Cathode-Ray Tube 625

For transistorized oscilloscopes

This flat-face cathode-ray tube, designated type 31SBP, is designed to meet the space and power requirements of transistorized oscilloscopes. Rectangular in design, the tube measures 3.25 x 2.75 in. Useful scan is 2.5-in. horizontal and 2.25-in. vertical. Requirements of MIL-E-1D are met.

Electron Tube Corp., Dept. ED, 1200 E. Mermaid Lane, Philadelphia 18, Pa.

Price: *$150.*

Availability: *Four to six weeks.*

Radiation Tracking Transducers 589

Two types offered

Models XY-20 and XY-20A radiation-tracking transducers are for applications in instrumentation, tracking, guidance, computer and control-automation fields. Having no moving parts, the devices detect the position of a source of radiation in two axes in microseconds. Model XY-20A is for use where the radiation image will be placed on the cell surface by a system's light source. Model XY-20 is equipped with a 25-deg, f:0.95, F-1 lens to detect the angular position of a radiation source in space.

Micro Systems, Inc., Dept. ED, 319 Agostino Road, San Gabriel, Calif.

AC Voltage-Current Source 492

Voltage range is to 1,000 v rms

Model PVCA-504 primary standard ac voltage-current source provides a voltage range to 1,000 v rms. Resolution is 0.01 v, repeatability is ±0.002% or ±0.01 v, and absolute accuracy is ±0.01% or 2 mv. In the current mode, there are full-scale ranges of 10, 1 and 0.1 amp. Resolution is ±0.001%, repeatability is ±0.002%, and absolute accuracy is ±0.015% or ±50 μa. The frequency range is 30 cps to 10 kc except for voltages over 300 v where it is 30 cps to 2 kc.

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

Electro-Optical Relays 636

Ranges are 0 to 1.5 and 0 to 24 v

Types CK1102 and CK1104 electro-optical relays are for continuous operation, primarily as potentiometers, with control-voltage ranges of 0 to 1.5 and 0 to 24 v, respectively. In both models, the photoconductor has a power capability of 75 mw and a resistance change of about 10^5 over the control-voltage range. The coupling between signal and control terminals is about 0.01 pf.

Raytheon Co., Industrial Components Div., Dept. ED, 55 Chapel St., Newton 58, Mass.

Price: *$9 for up to 24 units; $7 for 25 or more.*

Availability: *In production quantities.*

For Immediate Delivery Of

MOTOROLA

- **TRANSISTORS**
- **ZENERS**
- **RECTIFIERS**

Contact These DISTRIBUTORS

BIRMINGHAM
Ace Semiconductors, Inc.
3101 Fourth Ave., So.
FAirfax 2-0585

BOSTON
Cramer Electronics, Inc.
811 Boylston St.
COpley 7-4700

Lafayette Radio
110 Federal St.
HUbbard 2-7850

CAMDEN
General Radio Supply Co.
600 Penn St.
WOodlawn 4-8560

CEDAR RAPIDS
Deeco Inc.
618 First St., N. W.
EMerson 5-7551

CHICAGO
Allied Radio Corp.
111 N. Campbell Ave.
HAymarket 1-6800

Newark Electronics Corp.
223 W. Madison St.
STate 2-2944

Semiconductor Specialists, Inc.
5706 W. North Ave.
NAtional 2-8860

CLEVELAND
Pioneer Electronic Supply Co.
2115 Prospect Ave.
SUperior 1-9411

DALLAS
Tekko, Inc.
4308 Maple Ave.
LAkeside 6-8763

DENVER
Inter State Radio & Supply
1200 Stout Street
TAbor 5-8257

DETROIT
Radio Specialties Co.
12775 Lyndon
BRoadway 2-4700

HOUSTON
Lenert Co.
1420 Hutchins
CApitol 4-2663

JAMAICA, N. Y.
Lafayette Radio
165-08 Liberty Ave.
AXtel 1-7000

LOS ANGELES
Hamilton Electro Sales
11965 Santa Monica Blvd.
EXbrook 3-6441
BRadshaw 2-8453

Kierulff Electronics
820 W. Olympic Blvd.
RIchmond 8-2444

MELBOURNE, FLA.
Electronic Wholesalers
1301 Hibiscus Blvd.
PArkway 3-1441

NEWARK, N. J.
Lafayette Radio
24 Central Ave.
MArket 2-1661

NEW YORK
Lafayette Radio
100 6th Ave.
WOrth 6-5300

Milgray Electronics
136 Liberty St.
REctor 2-4400

OAKLAND
Elmar Electronics
140 11th St.
TEmplebar 4-3311

PHOENIX
Electronic Specialties Co.
917 N. 7th St.
ALpine 8-6121

SAN DIEGO
San Delco
3845 Park Blvd.
CYpress 8-6181

SEATTLE
Elmar Electronics
1466 E. Marginal Way
MAin 3-6456

WASHINGTON, D. C.
Electronic Wholesalers, Inc.
2345 Sherman Ave., N. W.
HUdson 3-5200

CANADA
Canadian Motorola Electronics Ltd.
105 Bartley Drive, Toronto 16, Ontario
PL 9-3222

MSD=SSS

Motorola Semiconductor Distributors offer you

Service — factory OEM prices for quantities up to 999 on transistors, rectifiers and the more popular zener diodes.
Stock — complete stock, in depth . . . for immediate local product availability.
Specialists — industrial specialists . . . staffed to serve your electronic components, parts, and equipment requirements.

6.2 volt temperature compensated reference diodes

15 14 13 12 11

10 OHMS MAXIMUM

8 OHMS TYPICAL

ELECTRICAL CHARACTERISTICS (At 25°C Ambient unless otherwise specified)					
TYPE	V_z Zener Voltage at I_{zt} = 7.5 mA Volts	Z_{zt} Max Dynamic Impedance at I_z = 7.5 mA Ohms	Voltage Temperature Coefficient (−55°C — +100°C) at I_z = 7.5 mA % /°C	Max Millivolt Change at I_z = 7.5 mA −55°C to +25°C	+25°C to +100°C
1N821A	5.9 — 6.5	10	0.01	50	46
1N823A	5.9 — 6.5	10	0.005	25	23
1N825A	5.9 — 6.5	10	0.002	10	9.2
1N827A	5.9 — 6.5	10	0.001	5	4.6

NEW LOW IMPEDANCE ZENERS from MOTOROLA

minimize voltage fluctuations due to current changes

Motorola brings you dramatically increased stability with this new series of 6.2 volt temperature-compensated zener diodes. Their typical dynamic impedance of 8 ohms is nearly half that of presently available units . . . greatly minimizing voltage fluctuation due to current changes.

The Motorola 2N821A series makes ultra-stable reference sources possible for many precision applications which now require complex constant-current circuits. They are ideal for digital voltmeters, high-stability oscillators, analog to digital converters and similar applications.

The new units are housed in DO-7 axial-lead glass packages and cost no more than conventional 1N821-7 types.

SUBMINIATURE 8.4 VOLT ZENERS NOW AVAILABLE — Motorola is now supplying 8.4 volt temperature-compensated zeners in DO-7 axial-lead glass packages. The new 1N3154A series is less than 1/5 the size of equivalent diodes now in use.

IMMEDIATELY AVAILABLE — All of these new Motorola temperature-compensated zeners are available at factory OEM prices in quantities from 1 to 99 . . . from your Motorola Semiconductor Distributor.

FOR COMPLETE TECHNICAL INFORMATION on the 1N821A series and the 1N3154A series, as well as the 1N821 and 1N3154 series, write for #DS8001 and #DS8002. Please address inquiries to MOTOROLA SEMICONDUCTOR PRODUCTS INC., Technical Information Department, 5005 East McDowell, Phoenix, Arizona. A complete line of subminiature temperature-compensated reference diodes is available from Motorola.

DISTRICT OFFICES
Boston/Chicago/Dallas/Dayton/Detroit/Los Angeles/Minneapolis
New York/Orlando/Philadelphia/San Francisco/Syracuse/Washington

MOTOROLA
Semiconductor Products Inc.
A SUBSIDIARY OF MOTOROLA INC.

5005 EAST McDOWELL ROAD • PHOENIX, ARIZONA

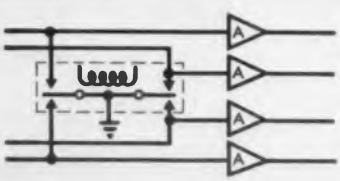
CIRCLE 94 ON READER-SERVICE CARD

NEW

twin contact miniature DC-AC choppers

Eleven types, both single and double pole.
Long life.
Low noise level.
Extreme reliability.

DPDT
LOW COST
FULL ISOLATION



A

Write for Catalog 515-B

STEVENS
INCORPORATED
ARNOLD

QUALITY SINCE 1943

7 ELKINS ST., SOUTH BOSTON 27, MASS.

S/A 16¾

CIRCLE 95 ON READER-SERVICE CARD

NEW PRODUCTS

DC Motor 560

Output torque is 40 oz-in.

Type B dc instrument motor has output torques of 40 oz-in. continuous and 80 oz-in. intermittent at 2 rpm. Standard output speeds are from 2 to 200 rpm. Inputs are 80 mw avg at no load and 180 mw avg at 40 oz-in., at 2 rpm. Inputs of 3, 6, 12 and 24 v dc are available. The motor measures 2-19/64 x 2-1/8 x 1-9/16 in. and weighs 3 oz.

Brailsford & Co., Inc., Dept. ED, 670 Milton Road, Rye, N.Y.

Price: *$19 to $20.*

Availability: *1-week delivery.*

Plastic Grommet 719

Wire and tubing can be insulated and supported from a mounting panel, chassis, wall, housing or other surface with this grommet. Two identical halves snap together and lock in place.

Budwig Manufacturing Co., Dept. ED, P. O. 4212, Glendale 2, Calif.

Ball Bushings 720

Designated INST-258 and INST-396, these ball bushings are for use on shaft diameters of 0.1246 and 0.1871 in. Outside diameters are 0.3125 in. and lengths are 0.5, 0.375, and 0.562 in., respectively. Each bearing contains three complete ball circuits.

The Kotula Co., Inc., Dept. ED, 400 Madison Ave., New York 17, N. Y.

Pliers 721

These pliers are for applying and removing internal and external retaining rings. They are made of black-finished carbon spring steel and have induction-hardened tips.

Industrial Retaining Ring Co., Dept. ED, 57 Cordier St., Irvington 11, N. J.

Liquid Epoxy 723

This two-component insulating system was developed to meet the requirements of MIL-I-16923C, types B, C and D. Electrical, thermal and physical properties are claimed to be outstanding.

Hysol Corp., Dept. ED, Olean, N. Y.

LATEST DATA ON ULTRASONIC DELAY LINES!

THIS NEW CATALOG

gives you up-to-date specs on the industry's most complete line of ultrasonic delay lines for missiles, MTI, radar countermeasures and computer applications. Send for it today.

LFE

LABORATORY FOR ELECTRONICS, INC.
Computer Products Division
1079 Commonwealth Avenue
Boston 15, Mass., Dept. E-14

CIRCLE 96 ON READER-SERVICE CARD

Programable Counter-Timer 416

Meets rugged environmental conditions

This 10-meg, solid-state, programable counter-timer is designed to meet rugged environmental conditions. Guaranteed to MIL specs, it is for use as the basic measuring unit in automatic check-out consoles. Measurements include frequencies from 0 to 10 mc and time intervals to 10 sec with an accuracy of 0.1 μsec.

Systron-Donner Corp., Dept. ED, 950 Galindo St., Concord, Calif.
Price: *$2,800 ea.*
Availability: *90 days.*

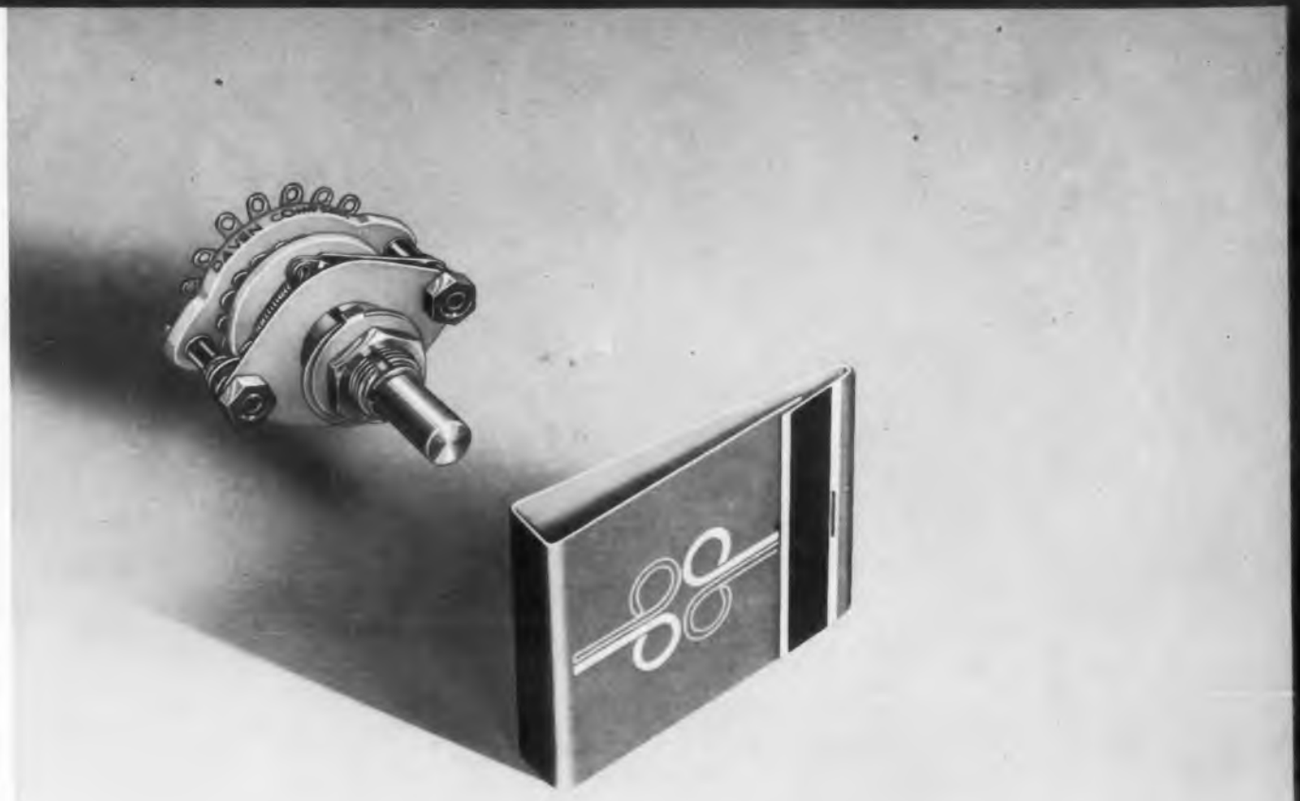
S-Band Ferrite Circulators 414

Designed for telemetry operation

These S-band ferrite circulators are designed for telemetry operation. Model HS-1 covers the 2,200 to 2,300-mc frequency band and model HS-2 covers the 2,700 to 2,900-mc frequency band. Both units weigh 4 or 7 oz, depending on choice of connectors which are type N or TNC. They measure 2.5 in. in diameter and 1 in. in height. Both circulators have an isolation of 20 db min and a maximum insertion loss of 0.3 db. Power handling capability is 1 w avg.

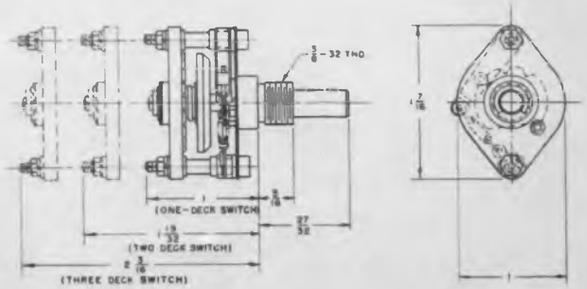
Melabs, Dept. ED, 3300 Hill View, Stanford Industrial Park, Palo Alto, Calif.
Price: *$300 ea, fob Palo Alto.*
Availability: *30 to 45 days.*

CIRCLE 97 ON READER-SERVICE CARD ➤



DID YOU SAY | small? |

Occupying less than 1½ square inches of panel space, this Miniature Ceramic Switch nevertheless contains as many as **18 positions on a single wafer.** And it's rugged! Solid silver alloy contacts, rotors, and slip rings provide low and uniform contact resistance. Ceramic parts are silicone impregnated to function under extreme humidity. Sturdy solder terminals are supplied for wiring. This miniature switch meets and exceeds the electrical and environmental requirements of Mil-Spec S-3786. Flashover voltage at 60 cycles is 1000 volts peak . . . current carrying capacity is 2 amperes. For guided missiles, airborne radar equipment, portable and mobile ground equipment . . . for any application that requires an extremely small and rugged switch, specify Daven's Series M Miniature Ceramic Switches. These units can be "ganged" with up to 8 decks with slight mechanical modifications. 2 or 3 poles per deck may also be obtained as standard. Prototypes can be delivered within 2 weeks.



Write for complete information.

THE DAVEN CO.
526 West Mt. Pleasant Ave.
Route 10, Livingston, N. J.

TODAY, MORE THAN EVER, THE DAVEN Ⓓ STANDS FOR DEPENDABILITY!

LUNAR PROBE

The moon—lacking an erosive atmosphere—may hold the key to the history of the solar system. Because of this lack of atmosphere, oceans and wind, lunar explorations may help solve fundamental, universal questions.

Logically, the moon will be the first objective in the exploration of space. Initially the moon itself will be photographed and instrumented; then manned observation stations will be established for astronomical and meteorological purposes. In time, the moon will serve as an intermediate station enroute to other planets—stepping stones into infinite space.

The National Aeronautics and Space Administration's Lunar Program will utilize Lockheed's AGENA B satellite to play a significant part in forthcoming lunar explorations—as well as a host of other scientific space missions. The NASA lunar launch in 1961-62 will utilize the highly reliable Lockheed AGENA as second stage to carry the RANGER spacecraft. The AGENA will provide the extremely critical guidance and control necessary to place the RANGER on the required lunar impact trajectory.

The lunar probe application demonstrates the versatility, reliability and success of the AGENA vehicle in Lockheed's satellite and spacecraft programs. Developed for the Air Force for use in the DISCOVERER program, the AGENA is utilized in the MIDAS missile defense alarm system and the SAMOS surveillance satellite system. Noted for a record of outstanding accomplishments, the AGENA is credited with being the first to be placed on a polar orbit; first to achieve a precise, predicted and nearly circular orbit; first to attain attitude control on orbit; first to eject a reentry capsule which was successfully recovered. The AGENA can be modified for a variety of space missions such as navigation, geophysical investigations, long-range communications and deep space probes.

Lockheed's capability in satellites and spacecraft, manifested by such an achievement as the AGENA, encompasses the entire field. It includes current and long-range programs such as interplanetary probes, global and space communication systems, and manned space travel.

Engineers and Scientists: The accomplishment of such programs offers challenging opportunities to engineers and scientists in the research, design, development, test and operation phases of these programs. If you are experienced in work related to any of the above areas, you are invited to write: Research and Development Staff, Dept. M-29C, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

Lockheed / **MISSILES AND SPACE DIVISION**

Systems Manager for the Navy POLARIS FBM; the Air Force AGENA Satellite in the DISCOVERER, MIDAS and SAMOS Programs

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA • HAWAII

REPLACE STANDARDS WITH MINIATURES! Now, because of GREMAR CONNECTRONICS (T), it is possible to miniaturize your RF cable assemblies and still maintain rigid electrical specs.

Red Line Miniatures, identified by their red Teflon insulation, are half the size and weight of the reliability-proved GREMAR TNC Connectors.

DESIGNED FOR USE WITH MIL-TYPE SUBMINIATURE COAXIAL CABLES, Red Line Miniature Connectors and adapters feature:

- A new patented metal-to-metal cable clamping method which saves up to 80% of your cable assembly time while assuring a lower, more constant VSWR.
- Nominal 50 ohm characteristic impedance, 500 volts rms peak and 10,000 megacycles practical frequency limit.
- Operating temperature range: −65F to +350F.
- Meets or exceeds all applicable requirements of MIL-STD-202A and MIL-E-5272B.
- Configurations for all typical applications including adapters to BNC and TNC connectors.
- Metal parts are heavily silver plated for maximum corrosion-resistance . . . protected with Iridite to retard tarnishing. All contacts are gold-plated.
- Standard *Red Line* adapters and connectors are stocked for *immediate* delivery.

WRITE FOR BULLETIN 9 containing complete data on Gremar *Red Line* T Miniatures. Literature on all other RF connectors is available for the asking.

GREMAR

MANUFACTURING COMPANY, INC.

RELIABILITY THROUGH QUALITY CONTROL

Dept. B Wakefield, Mass., CRystal 9-4580

CIRCLE 98 ON READER-SERVICE CARD

NEW PRODUCTS

Multiplexer 559

Single quadrant accuracy is 0.01%

Model 3735 multiplexer has an accuracy of 0.01% for single-quadrant multiplication and squaring. Four-quadrant multiplication accuracy is 0.05% of full scale. The unit is compatible with all analog computers and needs no external power supplies or amplifiers. It can also be used on analog data and process-control systems.

Donner Scientific Co., Dept. ED, Concord, Calif.

Price: $633 per channel.
Availability: 90 days.

High-Temperature Adhesive 715

Raiseal 100 elastomeric adhesive withstands 300 lb per sq in. in shear at 700 F for 1 hr. Based on silicon elastomers, it has excellent environmental resistance.

Radiation Applications, Inc., Development Div., Dept. ED, 36-40 37th St., Long Island City, L. I., N. Y.

Price: $14.50 to $190 for 1/2 pint to 1 gal.
Availability: From stock.

Adhesive 716

Raiseal 200, a one-component system is for sealing and encapsulation. It has good resistance to acids, alkalis and oxidizers. It may be used at 50 lb per sq in. at 800 F for 90 min.

Radiation Applications, Inc., Development Div., Dept. ED, 36-40 37th St., Long Island City, L. I., N. Y.

Price: $16 to $110 for 1 pint to 1 gal.
Availability: From stock.

Packaging for Resistors 722

The Reel-Packs provide a means of storing, holding and positioning resistors for automatic feeding in automated assembly lines. Principle use is in conjunction with printed-circuit boards for computers, guidance systems and similar equipment. Maximum capacity is 1,000 3-w Axiohm resistors per reel.

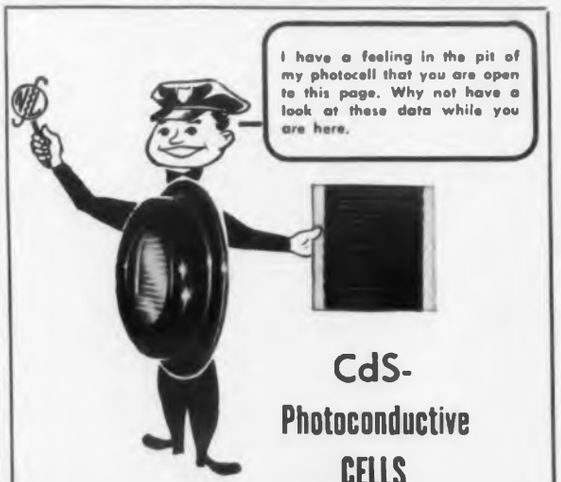
Ward Leonard Electric Co., Dept. ED, Mount Vernon, N. Y.

NEW CUSTOMED SOLDER PREFORMS IMPROVE AUTOMATIC SOLDERING

New customed preforms consist of an accurately predetermined amount of a specific alloy. The proper melting temperature and correct volume of solder are assured. Labor costs are lowered. Production increases. Scrap is eliminated. Get the facts today! Write for 8 page Guide to Preform Soldering.

21-01 43rd Ave., Long Island City 1, N. Y.

CIRCLE 99 ON READER-SERVICE CARD



CdS-
Photoconductive
CELLS

Capable of dissipating especially high power up to one watt.

• RUGGED • ECONOMICAL

Various standard types with different electrical and physical characteristics available to meet your specifications.

WRITE:

NATIONAL SEMICONDUCTORS LTD.
230 AUTHIER ST. Montreal 9, P. Q.
Phone: RI: 4-2946

CIRCLE 100 ON READER-SERVICE CARD

Modular Power Supplies 426

For use as integral modules

This line of 45 transistorized dc power-supply modules are for use as integral modules or for mounting directly on 5-1/4-in. panels. The units come in nine voltage ranges, from 1 to 37 v and in five power ranges, from 0.7 to 15 amp. All models have 15-mv max line and load regulation and 2-mv max ripple. The units are rated for operation to 500 C.

Invar Electronics Corp., Dept. ED, 323 W. Washington Blvd., Pasadena, Calif.

Availability: From stock.

Electric Counter 437

Speed is 600 counts per min

Having four or five digits, type DC-41 counter can be operated at speeds up to 600 counts per min. Actuation is by any device providing a minimum closed period of 0.04 sec and a minimum open period of 0.06 sec for each required count. The unit is hermetically sealed and has over-all dimensions of 1.69 x 2.52 x 3.32 in.

General Controls Co., PIC Automation Controls Div., Dept. ED, 8078D McCormick Blvd., Skokie, Ill.

A SUMMIT
in storage tube development

EXCLUSIVE COAXIAL GUN DESIGN A NEW HIGH POINT IN ITT IATRON PROGRAM

Latest additions to the ever-increasing line of ITT Iatron storage tubes are several new models in which both the writing and the flooding guns are symmetrically disposed about the axis of the cathode-ray display tube. This imaginative solution to a difficult packaging problem in radar indicator design eliminates at the same time all possibility of trapezoidal distortion.

Added to the full line of ITT Iatrons with the more conventional off-axis writing gun arrangement, the new coaxial gun models make it possible to specify an ITT Iatron for virtually any storage tube application—in any diameter from 2½ to 7 inches, to satisfy any requirement with regard to weight, size and desired brilliance under high ambient light conditions.

New and further improved ITT Iatrons, in an even wider range of types, are scheduled for release in the near future. ITT's unlimited access to world-wide research, development and production facilities turns a new design concept into a production model at record pace—in Iatrons as well as other electron tube types.

Write for information on the complete line of ITT Iatrons. Application assistance is available for your specific requirements.

ITT IATRON STORAGE TUBES

TYPE	DIAMETER (in.)	SPECIAL FEATURES	FOCUS*	DEFLECTION*	TYPE	DIAMETER (in.)	SPECIAL FEATURES	FOCUS*	DEFLECTION*
7172	2½	Coaxial gun	ES	ES	FW-204	5	Coaxial gun	EM	EM
FW-211	2½	Coaxial gun	ES	ES	D-3001	5	—	ES	ES
7173	4	—	EM	EM	FW-212	5	Coaxial gun	EM	ES
7174	4	—	EM	EM	FW-217	5	Coaxial gun	ES	EM
FW-227	4	2 writing guns	ES	ES	FW-208	7	—	EM	EM
7423	5	—	ES	ES					

*EM = Electromagnetic ES = Electrostatic

ITT

ELECTRON TUBE DEPARTMENT ■ COMPONENTS DIVISION
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, CLIFTON, NEW JERSEY

ITT COMPONENTS DIVISION PRODUCTS: POWER TUBES • IATRON STORAGE TUBES • HYDROGEN THYRATRONS
TRAVELING WAVE TUBES • SELENIUM RECTIFIERS • SILICON DIODES AND RECTIFIERS • TANTALUM CAPACITORS

CIRCLE 101 ON READER-SERVICE CARD ➤

IERC TRANSISTOR HEAT DISSIPATOR

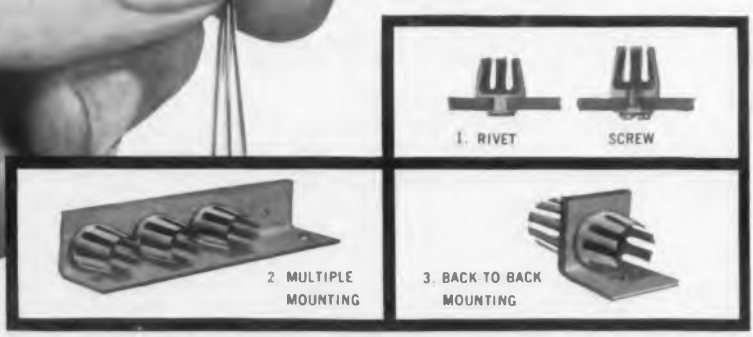
actual size

accepts .305 to .335 variations in TO-5 cases!

IERC Transistor Heat-dissipating Retainers readily accommodate diameter variations up to .030" found in TO-5, TO-9, TO-11, TO-39 transistor cases. This single IERC part saves you time and costs in specifying, stocking and application.

IERC's exclusive design features maximum thermal contact with transistor case for efficient transfer of heat to the dissipator and heat sink. Attaching methods suitable for printed circuit boards, chassis and heat sinks provide thermal benefits and retention in extreme shock and vibration environments.

Installation is a smooth, tension fit—eliminating the possibility of "snap-fit" impact injuries to the transistor!



Simplified installation for effective heat dissipation with IERC Transistor Heat Dissipators are illustrated: 1. Parts available in rivet or screw attaching types. 2. Single or multiple mounting on heat sink angle. 3. Back-to-back mounting.

Detailed information, performance graphs, etc. are available in latest IERC Technical Bulletin. Write for a copy today!

IERC DIVISION

INTERNATIONAL ELECTRONIC RESEARCH CORPORATION
135 West Magnolia Boulevard, Burbank, California

Foreign Manufacturers: Europelec, Paris, France. Garrard Mfg. & Eng. Co., Ltd., Swindon, England

CIRCLE 102 ON READER-SERVICE CARD

NEW PRODUCTS

Power Transformers 561

In ratings of 2 to 150 va

These 400-cps, isolation transformers are available in ratings of 2 to 150 va. They are furnished in hermetically-sealed cans with Teflon terminals and are designed to meet MIL-T-27-A. Military designation is TF4 RX 01. On special order, units can be obtained with epoxy-molded construction with pins or lugs. Military designation for these units is TF5 RX 01.

Microtran Co., Inc., Dept. ED, 145 E. Mineola Ave., Valley Stream, N.Y.
Price: $5.70 to $11.80.
Availability: From stock.

Microwave Absorber 683

Type T absorber has been improved to operate over the temperature range of −70 to +270 F. It is light in weight and is furnished in standard sheets measuring 18 x 36 in. The high electrical characteristics of the previous type unit are retained.

McMillan Industrial Corp., Dept. ED, Brownsville, Ave., Ipswitch, Mass.
Availability: From stock.

Work Positioner 684

The Rototilt handles chassis and bench assemblies. Tilt angle is 135 deg and rotation is through 360 deg. Tilt and rotation functions are independently controlled. The tilt adjustment locks under loads of up to 300 lb-in. Dimensions are 3-3/4 x 3-3/4 x 4 in.

Technical Devices Co., Dept. ED, 11242 Playa Court, Culver City, Calif.

Silicon Diodes 685

Two types are offered. The audio detector diode has a low noise-to-signal ratio and detects up to 3 mc. The noise-generator diode can be used in instruments requiring a balanced noise circuit, frequency oscillator and as a noise balancer.

Solitron Devices, Inc., Dept. ED, 67 Lexington Ave., White Plains, N. Y.
Price: $0.17 to $0.95.

NEW STROMBERG-CARLSON TELEPHONE HANDSET CRADLE

. . . for positive retention in all mobile applications

There's no jump, no sway—when a telephone handset is in the firm grip of this new handset cradle by Stromberg-Carlson.

Retaining clip spring assembly assures positive retention in any mobile application on land or sea, or in the air. Even extremely severe jars, jolts and vibrations fail to dislodge the handset.

The cradle is strong and resilient, fits any Stromberg-Carlson handset. Different models provide varying switch combinations with 2 or 4 Form C contacts. All models available with or without the clip assembly.

Specifications on request. In Atlanta call TRinity 5-7467; Chicago: STate 2-4235; Kansas City: HArrison 1-6618; Rochester: HUbbard 2-2200; San Francisco: OXford 7-3630. Or write to Telecommunication Industrial Sales, 116 Carlson Road, Rochester 3, New York.

STROMBERG-CARLSON
A DIVISION OF
GENERAL DYNAMICS

CIRCLE 103 ON READER-SERVICE CARD

Chemical Film Transducer 423

Resistance is from 0 to 5,000 lb

This chemical film transducer has an electrical resistance of from 0 to 5,000 lb over 100,000 ohms, with a 0.0005-in. deflection at full load. The unit stands from —150 to +450 F continuously. Units are available with up to 3 million lb thrust for missile pads, hydrofoil boats, machine tools and presses.

Clark Electronic Laboratories, Research Products Div., Dept. ED, Box 165, Palm Springs, Calif.
Price: *$38 ea.*
Availability: *From stock.*

Absolute Pressure Transducer 427

For missile and aircraft applications

Model 735 absolute pressure transducer is for missile and aircraft applications. It can be used with any media compatible with the Ni-Span-C Bourdon tube, including conductive gasses and liquids and explosive atmospheres. LOX compatibility can be provided. Specifications include: static error band, ±1%; vibration, to 35 g; response time, 15 msec or less; range, 0-to-400 to 0-to-5,000 psia; resistance, 1 K to 10 K; resolution, 0.2% to 0.4%; temperature range, —100 to +200 F. The unit weighs approximately 7 oz.

Bourns, Inc., Instrument Div., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.
Price: *$350 to $450 ea, 1 to 10 units.*
Availability: *45 to 75 days.*

CIRCLE 104 ON READER-SERVICE CARD ▶

IMPACT!

This is a "warhead". It's the front end of a carrier which darts through a pneumatic tube system at speeds up to 20 mph, and is subject to frequent shocks and impact. There's a story behind the choice of LEXAN® polycarbonate resin for this new design . . .

Formerly, destinations were set by contacts along the entire body of the carrier. Engineers of Airmatic Systems Corporation, Saddle Brook, New Jersey, reasoned that if all the control elements could be fitted into a small impact- and wear-resistant head, the rest of the carrier could be designed for easy maintenance and quick replacement. Many plastics had the required dielectric strength, but none could measure up to LEXAN resin's combination of good electrical properties, excellent dimensional stability and extremely high impact strength. LEXAN resin actually withstands over 12 foot-pounds per inch of notch — an impact strength attained by no other plastic!

The new warhead is injection-molded of black LEXAN resin by Berkeley Engineering & Manufacturing Co., Berkeley Heights, N. J. Now when wear and tear take their toll, the transparent carrier body is easily replaced, since it has no control elements. Also, body length can be varied to suit customer needs, and carrier weight is reduced. Printed circuits and compactly arranged brushes and control plates are used. The new design is more attractive, more practical, less costly. And—LEXAN resin warheads have proved in field tests to last longer than the old control units.

G.E. LEXAN polycarbonate resin has raised the quality of many designs to new levels. It has been reduced in price approximately 40% over the past year! Can this tough, new thermoplastic help you? Send for design literature.

LEXAN®
Polycarbonate Resin

GENERAL ELECTRIC

Chemical Materials Dept., Section ED-11, Pittsfield, Mass.

Westinghouse

SILICON POWER RECTIFIERS AND TRANSISTORS

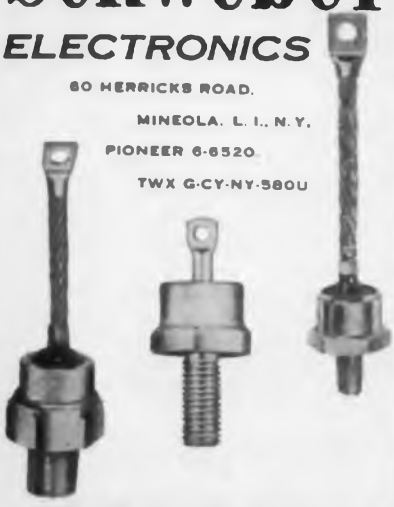
NOW IN STOCK

YOU CAN OBTAIN UP TO 1000 PIECES OF MOST TYPES AT FACTORY PRICES FROM

Schweber

ELECTRONICS

60 HERRICKS ROAD.
MINEOLA. L. I., N. Y.
PIONEER 6-6520
TWX G-CY-NY-580U



CIRCLE 105 ON READER-SERVICE CARD

Westinghouse 30-amp silicon "rock-top" power transistors

New 30-amp ratings, the industry's highest! These latest Westinghouse Silicon Power Transistors are especially designed for those applications where you need more transistor power, extra long-life and extra stability under all operating conditions. Your choice of nine devices in this new family—each rated at 30 amps.—for greater flexibility of circuit design in high-power applications. Other Westinghouse high-performance features include: • Exclusive "rocktop" ceramic construction for greater reliability • Voltage ratings to 200 volts • Double-ended case design • Low saturation resistance • 250 watts power dissipation.

Production quantities of the type 115 family are now available. Westinghouse also offers the 2N1015 and 2N1016 series of Silicon Transistors, ideal as companion drivers. Military and industrial applications include: power supplies/regulators/amplifiers/high-power switching/inverters.

For more information call your nearest Westinghouse representative or semiconductor distributor. Or write: Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Pa. SC-1012

You can be sure . . . if it's

Westinghouse

For immediate "off-the-shelf" delivery, order from these Westinghouse Distributors:

EASTERN

ACK SEMICONDUCTOR, INC.
Birmingham, S. Ala./FA 2-0588
CAMERADIO
Pittsburgh, Pa./EX 1-4000
CRAMER ELECTRONICS, INC.
Boston, Mass./CO 7-4700
ELECTRONIC WHOLESALERS, INC.
Melbourne, Florida/PA 3-1441
GENERAL RADIO SUPPLY CO.
Camden, N.J./WO 4-8560
GENESEE RADIO PARTS CO.
Buffalo, N.Y./DE 9661
KANN-ELLERT ELECTRONICS, INC.
Baltimore, Md./TU 9-4242
MILGRAY ELECTRONICS
New York, N.Y./RE 2-4400
RADIO & ELECTRONIC PARTS CORP.
Cleveland, Ohio/UT 1-6060
SCHWEBER ELECTRONICS
Long Island, N.Y./PI 6-6520

MIDWESTERN

ELECTRONIC COMPONENTS FOR INDUSTRY CO.
St. Louis, Mo./WO 2-9917
INTER-STATE RADIO & SUPPLY CO.
Denver 4, Colo./TA 5-8257
LENERT CO.
Houston, Texas/CA 4-2663
RADIO DISTRIBUTING CO.
Indianapolis, Ind./ME 7-5571
SEMICONDUCTOR SPECIALISTS, INC.
Chicago, Ill./NA 2-8860
S. STERLING CO.
Detroit, Mich./BR 3-2900
UNITED RADIO, INC.
Cincinnati, Ohio/MA 1-6530
WHOLESALE ELECTRONICS SUPPLY
Dallas, Texas/TA 4-3001

WESTERN

ELMAR ELECTRONICS
Oakland, Calif./TE 4-3311
HAMILTON ELECTRO SALES
Los Angeles, Calif./BR 2-9154
NEWARK ELECTRONICS CO.
Inglewood, Calif./OR 4-8440

Westinghouse

SILICON POWER RECTIFIERS AND TRANSISTORS

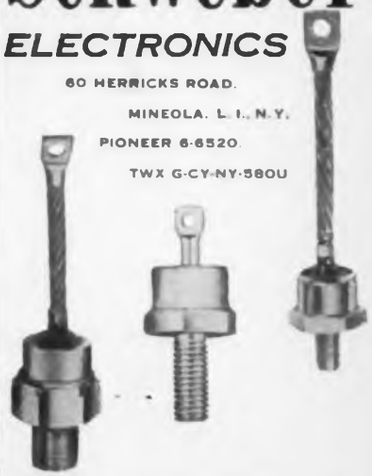
NOW IN STOCK

YOU CAN OBTAIN UP TO 1000 PIECES OF MOST TYPES AT FACTORY PRICES FROM

Schweber

ELECTRONICS

60 HERRICKS ROAD,
MINEOLA, L. I., N.Y.
PIONEER 6-6520
TWX G-CY-NY-580U



CIRCLE 106 ON READER-SERVICE CARD

◄ CIRCLE 107 ON READER-SERVICE CARD

NEW PRODUCTS

Insulation Tester 553

Provides 0-3,500 v dc

Model T high-potential and insulation tester offers 0 to 200 v dc for tests on small capacitor transistors and other components and 0 to 3,500 v dc for hi-pot testing. Leakage-current ranges of 1, 10 and 100 μa are also provided. The test voltage is automatically cut off when the predetermined leakage-current level is exceeded. The unit measures 7 x 19 x 7 in. and weighs 22 lb.

Arizona Instrument Corp., Dept. ED, 3839 N. 39th Ave., Phoenix, Ariz.

Price: *$680.*

Availability: *Two weeks.*

Plastic Laminate 498

For high-temperature use

Grade AA-HT plastic laminate is recommended for continuous use at 500 F. It retains 40% of its mechanical strength after exposure to 500 F for 1,000 hrs. It has an asbestos woven fabric reinforcement and a modified phenolic resin binder. Applications include: use in missiles, for inhibitor tubes and for the handling of propellant fuels in space vehicles.

Synthane Corp., Dept. ED, Oaks, Pa.

Signal Simulator 576

For checkout of ground stations

Model ESS-204 signal simulator produces PAM, PDM or PAM/NRZ pulse trains for calibration and checkout of telemetry ground stations. The continuously variable pulse rate is 20 to 7,000 pps. Linearity is within 0.15% of full scale and stability of output and pulse width is within 0.15% of full scale for 12 hr after 45-min warmup.

Telemetrics, Inc., Dept. ED, 12927 S. Budlong Ave., Gardena, Calif.

Solid-State PCM Multicoders 551

Accept analog and digital inputs

The MCH series multicoders accept time-multiplexed analogs and digital data, both serial and parallel. Analog inputs are from 31 channels at 1,400 samples per sec to 127 channels at 355 samples per sec. Each analog channel may be replaced by 10 bits of two-state data. Over-all coding accuracy is ±0.1% of full scale. Coding characteristics include clock frequency of 500 kc.

Applied Electronics Corp. of New Jersey, Dept. ED, 22 Center St., Metuchen, N.J.

Carbon-Film Resistors 518

Are rated at 1/10 w

These specially coated carbon-film resistors are rated at 1/10 w at 125 C. Resistance range is 10 ohms to 300 K. Length is 1/4 in. and diameter is 3/32 in. Lead length is 1-1/2 in. Designated type DC1/10, the units are built to stand environmental extremes.

Electra Manufacturing Co., Dept. ED, 4051 Broadway, Kansas City, Mo.

Availability: *From stock; 16-day delivery.*

Indicator Light 594

Life is 100,000 hr at 5 v

Model 106S indicator light has a life of 100,000 hr at 5 v and 60,000 hr at 6.3 v. It can be furnished with military or commercial bulbs and lenses of red, white, blue, green or amber. All materials and processes used meet or exceed Mil specs. Lights may be installed either from the front or rear of the panel in a 5/16-in. diam hole.

The Sloan Co., Dept. ED, 7704 San Fernando Road, Sun Valley, Calif.

Selector Switch 556

Hermetically sealed

Series 150,000 hermetically-sealed switches are furnished in eight voltage ratings from 6 to 240 v dc. Configurations of 4 pdt through 14 pdt on the two-position units and sp 12 t through 4 p 12 t on the 12-position units, are offered. The units are primarily for remote-switching functions and can be furnished as both stepping and selective controls.

Ledex Inc., Dept. ED, 123 Webster St., Dayton 2, Ohio.

Availability: *Seven weeks.*

Materials for RF Shielding 406

For integrity of equipment

These materials for rf shielding insure the integrity of equipment, components, housings and shielded enclosures. They have been tested from 10 kc to 10,000 mc for magnetic and electric field effectiveness. Materials include conductive adhesives, conductive surface coatings, conductive caulking compounds, finger stock and honeycomb vent.

Emerson & Cuming, Inc., Dept. ED, Canton, Mass.

Inertia Switch 566

For accelerations up to 250 G

Model 6U0-200 is pre-set to respond to acceleration forces of up to 250 g within a tolerance of ±15% of setting. It has only one moving part, a precision-ground steel ball held against a solid base by a uniform magnetic field. The unit meets all environmental specs of MIL-E-5272.

Inertia Switch, Inc., Dept. ED, 311 W. 43rd St., New York 36, N.Y.

Price: *$100.*

Availability: *10 days.*

Flame-Retardant Laminate 686

Insurok T-777 is a paper-base, phenolic laminate. Manufacturer claims it has good electrical properties, fine dimensional stability and superior punching characteristics. All standard sheet sizes, thicknesses and tolerances are offered.

The Richardson Co., Dept. ED, 2735 Lake St., Melrose Park, Ill.

Alnico With High-Cobalt Content 687

This isothermally treated alnico has a coercive strength in excess of 1,300 oersteds and energy levels above 4,000,000 gauss-oersteds. This material will make possible smaller magnetron tubes and backward-wave-oscillator tubes, the manufacturer claims.

Thomas & Skinner, Inc., Dept. ED, 1 N. LaSalle St., Chicago 2, Ill.

Gold-Plated Conductors 688

These conductors can be furnished in single-end and stranded types. Gold plating is used to eliminate surface oxide or tarnish which develops during shelf life and makes the material less solderable.

Hudson Wire Co., Dept. ED, Ossining, N. Y.

Chassis Latch 689

A small version of the Gripwell, this latch is for a 5.25-in. electronic-chassis drawer. Over-all size is 4.7 in. Installation requires two drilled or punched holes.

The Hartwell Corp., Dept. ED, 9035 Venice Blvd., Los Angeles 34, Calif.

Teflon Components 690

A wide variety of molded and extruded electronic components made of Teflon FEP are offered. Minimum thinness can be 0.02 in. Temperature range is −395 to +400 F.

Garlock Electronic Products, Dept. ED, Camden 1, N. J.

Transistor Lead Insulators 691

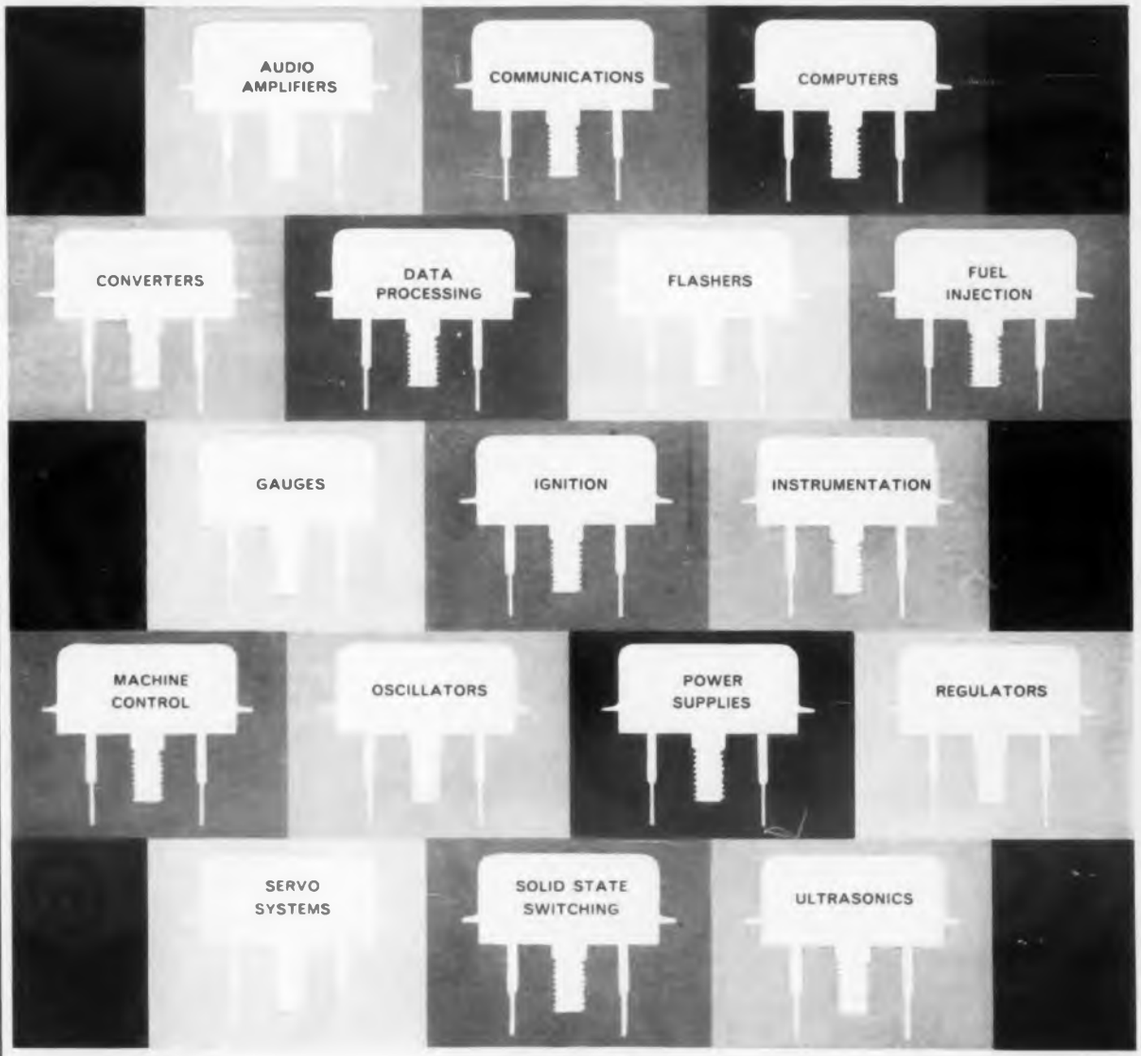
Made of Teflon TFE, these insulators stand temperatures from −100 to +500 F. Loss factor is less than 0.0005. They stand shock and vibration.

Garlock Electric Products, Garlock Inc., Dept. ED, Camden 1, N. J.

Plastic Laminate 692

NEMA Grade G-10 is available in both standard and printed-circuit copper-clad varieties, types 11546A and 1158A. It stands temperature and humidity extremes. Bonding strength is superior.

General Electric Co., Laminated Products Dept., Dept. ED, Coshocton, Ohio.



DELCO RADIO—THE LEADER IN POWER TRANSISTORS

For top performance in a wide, wide range of applications, specify Delco Radio's 2N174. ■ This multi-purpose PNP germanium transistor is designed for general use with 28-volt power supplies, and for use with 12-volt power supplies where high reliability is desired despite the presence of voltage transients. ■ It has a high maximum emitter current of 15 amperes, a maximum collector diode rating of 80 volts and a thermal resistance below .8°C per watt. The maximum power dissipation at 71°C mounting base temperature is 30 watts. Low saturation resistance gives high efficiency in switching operations. ■ The 2N174 is versatile, rugged, reliable, stable and low priced. For more details or applications assistance on the 2N174 or other highly reliable Delco transistors, contact your nearest Delco Radio sales office.

DELCO RADIO

Newark, New Jersey
1180 Raymond Blvd.
Mitchell 2-8165

Santa Monica, California
726 Santa Monica Blvd.
UPton 0-8807

Chicago, Illinois
5750 West 51st Street
POrtsmouth 7-3500

Detroit, Michigan
57 Harper Avenue
TRinity 3-6560

Division of General Motors · Kokomo, Indiana

CIRCLE 108 ON READER-SERVICE CARD

looking for a special potentiometer?

. . . reach for **EDC**

Your copy of EDC lists 157 different types of potentiometers in its PRODUCT LOCATOR. 27 categories from "AC" to "Wirewound" are included. Each sub-listing such as "Clutch," "Linear Motion," "Microminiature," "Precision," or "Self-trimming" gives manufacturers' name and thumbnail specs to aid in rapid selection. 52 items are further described by special literature bound in sections 2 or 3 of EDC.

This is only one example of the more than 7,000 products from 2,212 companies which are displayed.

Handy Inquiry Cards or Application Data Forms are bound in to make it easier for you to obtain additional data — and manufacturers' reps are also listed if you wish to phone for quick price and delivery information.

Electronic Designers' Catalog is one more service provided by the publishers of *Electronic Design*.

NEW PRODUCTS

Packaged Capacitors 627

With capacitance ratings to 1,130 pf

These packaged capacitors are for automatic insertion or automatic cutting and forming. Style 309 is available in 5 to 663 pf and style 310, in 14 to 1,130 pf. They are lacquer-enamel coated, axial lead, tubular ceramic-dielectric units. Both temperature-compensating and general-purpose types are offered.

Erie Electronics Div., Erie Resistor Corp., Dept. ED, 645 W. 12th St., Erie, Pa.
Availability: *In production quantities.*

Wire Stripper 693

Model H is for quick stripping of Teflon and low-melting insulations. Stripping heat is controlled by a foot switch. Wire sizes 12 to 24 AWG in low-melting types and with Teflon sizes 20 to 24 AWG can be handled.

Western Electronic Products Co., Dept. ED, 2420 N. Lake Ave., Altadena, Calif.
Price: $47.50.
Availability: *Immediate.*

Gallium Arsenide 694

Four of the five grades offered are dense. The crystallites are about 1-sq cm in cross-sectional area and 1-cm long. The fifth grade is a fine-grained material with a cross-sectional area of about 1-sq mm and is suitable for laboratory devices or as starting material for doping and crystal growth.

Ohio Semiconductors, Inc., Dept. ED, 1205 Chesapeake Ave., Columbus 12, Ohio.
Price: *From $8 to $37.50 per gram.*
Availability: *Immediate.*

Epoxy Resin 698

Araldite DP-437 is recommended as a modifier for conventional liquid epoxies to produce flexible systems. It is suitable for use in adhesives, caulking and sealing compounds, electrical potting, high-solids coatings, impregnating and other applications.

CIBA Products Corp., Dept. ED, Fair Dawn, N. J.
Availibility: *Experimental samples can be furnished.*

Sampling Switch 584

Low-torque type

This low-torque sampling switch can be used for scanning many circuits, as pulse generators for precision measurements, for high-level and low-level telemetry signals, strain gaging and other applications in aircraft, missiles, satellites and computers. Standard units can be furnished with up to 12 positions, single pole, in a size 10 synchro housing. The unit shown consists of eight slip rings interconnected to an eight-segment commutator.

Electro-Tec Corp., Dept. ED, 10 Romanelli Ave., S. Hackensack, N.J.

Clad Metal Materials 681

These raw materials and stampings are for semiconductor applications. They consist of an overlay of a low-melting point solder such as tin or tin-antimony over one or both sides of a base material. Tolerance on over-all thickness can be ±0.0002 in.

Accurate Specialties Co., Inc., Dept. ED, 340 Hudson St., Hackensack, N. J.

Availability: One week.

Digital Converter 682

This unit converts the indication of pointer-type instruments (pressure gages, temperature indicators, voltmeters and others) for operation of standard digital-readout equipment. It is particularly suitable with instruments having circular scales. The pick-off unit is photoelectric.

MacLeod Instrument Corp., Dept. ED, 4250 N.W. 10th Ave., Fort Lauderdale, Fla.

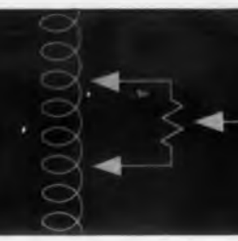
Availability: About 30 days.

Metal Cans 734

Offered in aluminum, brass, copper, steel, mumetal, stainless steel and nickel silver, these cans come in MIL-T-27A sizes AF to OA. All sizes can be supplied with holes, slots, cover stops, knockouts, screws, inserts and other special features.

Hudson Tool & Die Co., Inc., Dept. ED, 18-38 Malvern St., Newark 5, N. J.

Availability: From stock.



vernistat®
design report

Information on Vernistat a.c. potentiometers for design engineers

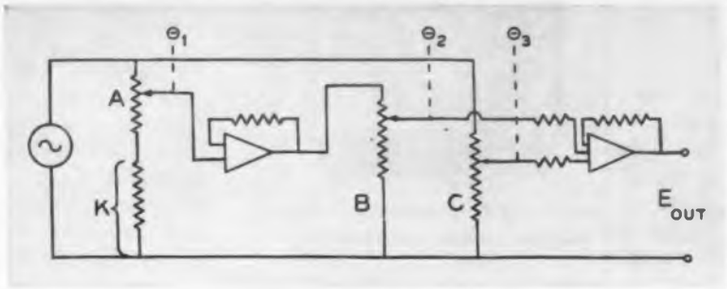


Fig. 1 Using Resistance Potentiometers.

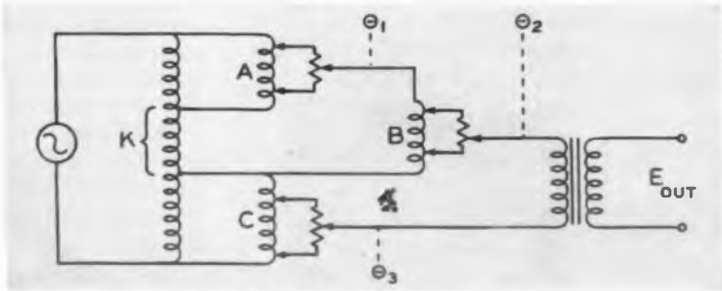


Fig. 2 Using Vernistat Potentiometers.

HOW VERNISTATS SAVE AMPS AND AMPLIFIERS IN A COMPUTER STAGE

Here's a whopping good example of an equation solved by two different circuits. It multiplies three variables (shaft angles) by three constants and throws in a couple of additions and multiplications for good measure:

$$E_o = (K + A\theta_i) \cdot (B\theta_i) + C\theta_i$$

At a glance you can see how the use of Vernistat precision a.c. potentiometers simplifies the circuit.

Due to the high output impedance of resistive pots, an isolation amplifier is required in the multiplication section of the circuit in Figure 1. For addition, summing resistors are used in conjunction with a feedback amplifier. The system is accurate enough, but it suffers on two counts: 1. the amplifiers chew up power and throw off heat; 2. use of the amplifiers reduces the circuit's reliability, since reliability is a function of the number of elements in a system.

No isolation amplifiers are needed, thanks to Vernistat's high ratio of input to output impedance. Addition is accomplished simply by using phase reversal in an input transformer. By eliminating amplifiers, the Vernistat gives you reductions in size, weight, power supply requirements and heat rise.

Don't overlook other advantages of the Vernistat. This remarkable, new circuit element provides high linearity, low phase shift and precise voltage division. It takes ten turns of the shaft to cycle through its voltage range, and the shaft may be turned **forward**, instead of backward, to its starting point.

If you're looking for high resolution with practically no background of phase-shift "noise" (quadrature), Vernistat a.c. potentiometers are for you! Make sure you get a full rundown on their construction, specifications and applications by writing to us.

If your business involves design of analog computers, servos, and other controls—then resolve to look into the Vernistat picture immediately! Our literature may help you soar to new levels of design thinking. Write now!

SIZE II VERNISTAT AC POTENTIOMETERS

These miniature components are approximately 1⅔ inches long, a little over an inch in diameter and weigh 2 ounces. The Series 4 operates on 400 cycle power at 17-40 volts maximum input. Minimum input impedance is 2,500 ohms; maximum output impedance — 40 to 200 ohms. Terminal linearity is ±0.05%. Rotates continuously through a ten-turn electrical cycle.

Four Series 4 Vernistats are available in numerous sizes and ratings. Vernistats are useful not only as a.c. potentiometers, but in data transmission, mathematical operations, as computer elements, as driving elements for resolvers, as servo follow-up elements, for voltage step-up and phase reversal.

vernistat division
PERKIN-ELMER CORPORATION
765 Main Avenue, Norwalk, Connecticut

CIRCLE 110 ON READER-SERVICE CARD

NEW PRODUCTS

Sequencing Switch 582

Exceeds 50,000 cycles in operation

Designed to exceed a minimum of 50,000 cycles, this hermetically-sealed, sequencing switch is compact, light, accurate and sensitive. Requirements of MIL-E-5272, MIL-I-6181, MIL-W-5026 and MIL-S-901 are met. It can be used wherever rotary motion must be transmitted to circuit control. Mounting can be with bolts or studs.

Acme Machine Works, Divac Div., Dept. ED, 13025 Cerise Ave., Hawthorne, Calif.

Holding Clip 387

This holder is suitable for many types of square and rectangular components. It is made of beryllium copper. It holds components up to 1 in. square or 1 x 2 in. rectangular.

Atlee Corp., Dept. ED, 47 Prospect St., Woburn, Mass.

Tape for Protecting Cables 403

No-Ox-Id wrap and No-Ox-Idized asbestos tape No. 100 protect cable from corrosion and arc-proofing, respectively. The No-Ox-Id wrap, for application to lead-sheathed cable, can be applied through narrow openings. The tapes can be used separately or together.

Dearborn Chemical Co., Dept. ED, Merchandise Mart Plaza, Chicago 54, Ill.

Mechanical Filters 364

Ferrite transducers in these mechanical filters are said to limit transmission loss to 4 to 5 db and passband ripple to 1.5 db.

Collins Radio Co., Western Div., Dept. ED, 2700 W. Olive, Burbank, Calif.

Capacitance Standards 365

These capacitance standards are offered in fixed and variable types. Also offered are teraohmmeters for measuring insulation resistance to 5,000 x 10^{12} ohms and voltages to 1,000 v. Both products are manufactured by Richard Jahre Co. of West Berlin.

Rohde & Schwarz Sales Co., Inc., Dept. ED, 111 Lexington Ave., Passaic, N. J.

SERVING AS THE SERVO STANDARD FOR THE PAST 10 YEARS

SERVOSCOPE® is accepted in many weapons systems programs:

Polaris	*Nike-Zeus*
Atlas	*Hustler*
Vanguard	*Sparrow*
Jupiter	*Hercules*
Hawk	*Titan*
F-104	*...and many others*

Typical applications include:

aerophysics

flight test instruments

airborne radar seeker servo systems

network response

computers and servomechanisms

autopilot and damper testing simulating rate gyro

frequency response characteristics of components and systems

loops of autopilot and aircraft flight controls

antenna servo drive tests

aircraft electronic servo system testing

servo system analyses in servo test program (flight training)

frequency response on electrohydraulic servo system

testing of radar systems

SERVOSCOPE®
servo system analyzer . . .

standard: *that which is established by authority, custom, or general consent, as a model or example; criterion; test.*

From missiles to manufacturing, wherever servo systems must be tested and evaluated quickly, accurately, and dependably, there is only one standard: SERVOSCOPE®.

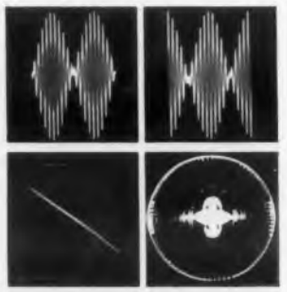
When Servo engineers introduced the remarkable "servo system analyzer" ten years ago, industry was quick to recognize the fundamental contribution made by this highly useful test instrument. And industry was quick to adopt it. Why?

From the simplest to the most complex electronic, electrohydraulic, electromechanical, and electropneumatic servo system, engineers found. SERVOSCOPE could provide them with reliable answers in a hurry. Here, at last, was an accurate, useful standard—a well thought-out, well designed test instrument made *for* servo engineers *by* servo engineers.

Today, thousands of instruments later, wherever you look you see SERVOSCOPE. To the engineer working with missiles, weapons systems, airborne gear, ground support equipment, instrumentation, navigation equipment, communications, computers, controls...SERVOSCOPE is an accepted fact, an accepted part of the program. SERVOSCOPE is the standard.

Measures phase, gain, transient response

SERVOSCOPE's significant contribution is fundamental. It enables the investigator to determine the ability of his servo system to meet specifications



Typical scope patterns, measuring phase of A.C. servo system.

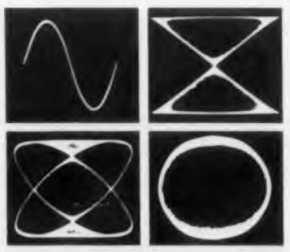
by measuring the changes in phase, gain, and transient response which occur when signals of various frequencies are fed to the design.

Using SERVOSCOPE, the engineer can safely evaluate the behavior pattern of the system for ultimate operating conditions.

A combination of instruments

Essentially, SERVOSCOPE combines a sweep generator and a multiple signal generator with a calibrated phase shifter. The instrument generates sine waves, modulated carrier wave, and square wave phaseable signals with respect to either electronic linear sweep or sinusoidally modulated reference signals. It can be used to evaluate A.C. carrier and D.C. servo systems, accepting any carrier frequency from 50 to 5,000 cps.

SERVOSCOPE electromechanical frequency generation offers the advantages of excellent low frequency, good sine wave, low distortion, and wide range in carrier frequency.



Typical scope patterns, measuring phase of D.C. servo system.

Shift of scope pattern is measured to calculate gain. Formula:

$$\text{gain} = \frac{\text{system output}}{\text{system input}} = \frac{\text{SERVOSCOPE "input"}}{\text{SERVOSCOPE "output"}} = \frac{\text{information grid reading}}{1}$$

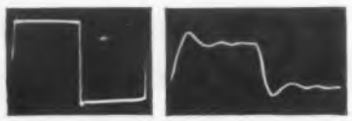
Probing analyses

Because the investigator can easily plot his system's phase and amplitude response to various frequencies, SERVOSCOPE is being used for penetrating servo analyses.

The instrument analyzes transfer functions of open and closed loops and of damping and filter networks. Transient response and frequency response of systems and sub-systems components containing multi- and single-loop circuits can be observed.

Similarly, frequency response of portions of systems can be determined. SERVOSCOPE is also used for locating sources of non-linear distortion and establishing servomotor time constants.

With SERVOSCOPE, *even a new man can plot Nyquist, Bode, and Nichols diagrams after only a few minutes demonstration.*



Typical scope patterns, measuring transient response. Overshoot, response time, rise time, setting time may be determined from patterns.

Fast direct setting and readout together with high-accuracy measurement give precise and rapid results. No calibration is required, making the analyzer immediately applicable to new problems.

Vital defense role

In test stands, ground support equipment, and other critical applications, virtually every major missile and weapons system program finds SERVOSCOPE in the shadow of its success. The instrument has military acceptance in the leading missile programs and other vital defense projects.

With SERVOSCOPE, investigators can easily perform:

Complete 5-minute analyses of any servo system, whether electronic, electrohydraulic, electromechanical, or electropneumatic.

Go—No Go production testing of control systems and components.

Ready analyses of radar and other tracking servo systems—in the field, as easily as at the breadboard stage.

6 models cover all ranges, provide the utmost reliability, from .001-100 cps.

Model A—frequency range: 0.1-20 cps.

Model B—frequency range: 0.15-30 cps.

Model C—frequency range: 0.3-60 cps.

Model D—frequency range: 0.001-20 cps.

Model F—frequency range: .005-100 cps.

Model H—small, lightweight, production line servo tester. Frequency range: 0.1-20 cps.

Send for free SERVOSCOPE worksheets

Servo has designed a set of SERVOSCOPE worksheets which provide an easy and permanent method of dynamic analyses through recording and plotting phase and amplitude of any servo component system. Each of these worksheets is a reproducible master, so that you can make as many working copies as you need. Send for a set. You should find them useful. Just fill in the coupon below.

* * * * * * * * * *

Ask for a free demonstration by filling in coupon below.

SERVO CORPORATION OF AMERICA

Sales and service offices coast to coast • 111 New South Road • Hicksville, Long Island, New York • WEIls 8-9700

Servo Corporation of America
111 New South Road
Hicksville, Long Island, N.Y.

Gentlemen:

- ☐ Please get in touch with me right away to demonstrate the SERVOSCOPE at my plant without obligation.
- ☐ Please send me a *free* set of SERVOSCOPE worksheets.
- ☐ Please send me detailed information on SERVOSCOPE.

NAME_____
TITLE_____
ORGANIZATION_____
ADDRESS_____
CITY_____ ZONE____ STATE_____
DEPT._____ PHONE_____ EXTENSION_____

CIRCLE 111 ON READER-SERVICE CARD

Circuit Connectors 581

For use in extreme environments

Called AMPin-cert, this line of connectors has crimp-type pin and socket contacts which are housed in a diallyl-phthalate insert encased in a cadmium-plated cast-aluminum shell. They operate at a current ration of 5 amp at temperatures from —40 to +400 F. Maximum operating voltage between contacts, at 100,000 ft is 150 v ac, rms, or 210 v dc. They resist shock in every direction in each of three mutually perpendicular planes for 11 msec with a maximum deceleration of 15 g. Vibration frequencies of 55 cps can be withstood. Units can be furnished to meet MIL-C-5015D or MIL-C-8384A or both.

AMP, Inc., Dept. ED, Harrisburg, Pa.

Sensitive Relays 386

The 800N series of sensitive, microminiature, crystal-can relays have a contact life of 100,000 operations in high-level switching. They are rated at 2 amp, resistive, at 28 v dc or 115 v ac. Sensitivity is 25 mw. The units meet MIL-R-5757C.

Iron Fireman Manufacturing Co., Electronics Div., Dept. ED, 2838 S. E. Ninth Ave., Portland 2, Ore.

Knobs 360

Series 91525 knobs are used on AN/GRC, AN/PRC, AN/TRC and AN/VRC equipment.

Vemaline Products Co., Dept. ED, Franklin Lakes, N.J.

Price: *On request.*

Availability: *From stock.*

Spring Tension Gage 354

Model STG-2-Z spring tension gage checks tensions of relay or other springs and determines settings. Range is 0 to 1,200 g in 100-g steps. The range is also shown in ounces and pounds avoirdupois from 0 to 2-3/4 lb.

P. K. Neuses, Inc., Dept. ED, 511 N. Dwyer St., Arlington Heights, Ill.

Price: *$8.40 ea.*

Vibration Exciter 355

Rotocon, a complex-wave vibration exciter, is for rapid checkout of production line items. It supplies wideband complex vibration to payloads up to 120 lb.

Rototest Laboratories, Inc., Dept. ED, 2803 Los Flores Blvd., Lynwood, Calif.

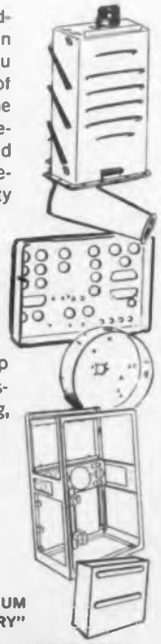
Price: *$3,850.*

INSTEAD OF THIS...

YOU'LL DO THIS...

with American Aluminum
Quality ... Dependability ... Service!

And when it comes to quality and dependable service . . . everyone at American Aluminum gets in the act. The minute you call American Aluminum, all members of our family concentrate on giving you the aluminum products that serve your specific needs. From the design to the finished product, all under one roof, you can depend on American Aluminum for quality and service . . . when you need it!



SPECIALISTS IN CONTRACT MANUFACTURING OF ALUMINUM FOR THE ELECTRONICS INDUSTRY

Complete fabricating facilities for Deep Drawing, Heat Treating, Spinnings, Assembly, Brake Work, Stampings, Anodizing, Welding, Finishing.

Complete die making facilities
Stock dies on hand for many shapes
Complete inspection facilities

Send for brochure "ALUMINUM FABRICATING FOR INDUSTRY"

AMERICAN ALUMINUM COMPANY

Manufacturers of Aluminum Products for industry since 1910

Sheffield Street, Mountainside, New Jersey

CIRCLE 112 ON READER-SERVICE CARD

NEW PRODUCTS

Frequency-Shift Converter 583

Speeds are to 100 words per min

Model 700B-1 frequency-shift converter provides a single channel of half-duplex teletype communications at speeds to 100 words per min via any single sideband or am radio circuit. It can also be used in airborne data systems for transmitting digital information at up to 75 bits per sec. In airborne use, it accommodates a doppler shift for speeds to 600 knots. In fixed station use, the tele-typewriter may be 1 mile from the converter. Dimensions are 19-1/2 x 2-1/4 x 7-5/8 in.

Collins Radio Co., Western Div., Dept. ED, Burbank, Calif.

Epoxy Glass Tubing 357

Phenolite grade G-11-3681 epoxy-resin bonded glass-fabric base material is for insulation applications. It is much lighter than phenolic rods but has equal or better mechanical and electrical properties.

National Vulcanized Fibre Co., Dept. ED, 1060 Beech St., Wilmington 99, Del.

Price: $1.70 per ft for tubing with 1-in. ID and 1-1/8-in. OD.

Telephone Switch 359

Type TF comes in locking type, series 970L, and non-locking type, series 970. It is designed for applications where space and reliability are prime considerations. The switch has integral contacts, recommended for low-level circuits.

Switchcraft, Inc., Dept. ED, 5555 N. Elston Ave., Chicago 30, Ill.

Cordless-Program Board 363

This cordless-program board has gold-plated contact strips for low contact resistance over long periods of time. It is offered in all configurations with virtually unlimited X- and Y-axis functions. Component interposition is possible with the use of this unit.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 113 ON READER-SERVICE CARD

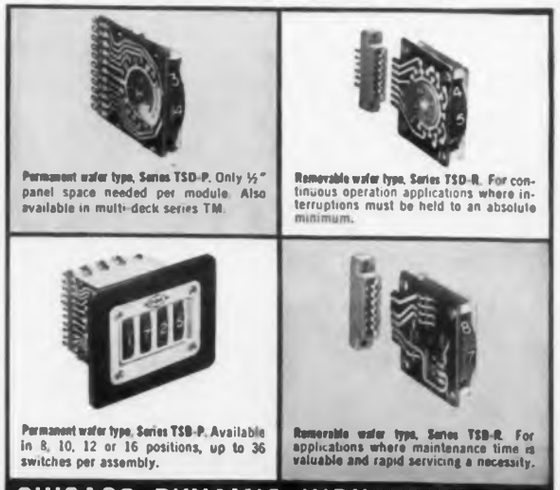
THUMBWHEEL SWITCHES

TABET U.S. Patent 2,841,660

Binary & Digital

C·D·I

- **For Critical Reliability Applications.**
- **Available with Internal lighting MIL-L-25467A.**



Permanent wafer type, Series TSD-P. Only ½" panel space needed per module. Also available in multi-deck series TM.

Removable wafer type, Series TSD-R. For continuous operation applications where interruptions must be held to an absolute minimum.

Permanent wafer type, Series TSB-P. Available in 8, 10, 12 or 16 positions, up to 36 switches per assembly.

Removable wafer type, Series TSB-R. For applications where maintenance time is valuable and rapid servicing a necessity.

CHICAGO DYNAMIC INDUSTRIES, Inc.

C·D·I PRECISION PRODUCTS DIVISION
1725 Diversey Blvd., Chicago 14, Illinois
Phone: WEllington 5-4600

CIRCLE 114 ON READER-SERVICE CARD

Dry-Reed Relay Lines 429

Available in five types

These encapsulated dry-reed relays are available in 1, 2, 4, 12 and 20-pole types. Any combination of normally open or normally closed contacts can be furnished. Break-make action can be furnished to insure non-overlapping of contact closures. The relays are for low-level and light-load switching for many operations and computer and data-handling applications. Overall length, including leads, is 3-1/4 in. Widths and depths vary from 0.585-in. in diameter for the 1-pole unit to 1-in. x 2-1/2-in. for the 20-pole type. Terminals conform to 0.2-in. grid spacing.

Struthers-Dunn, Inc., Dept. ED, Pitman, N.J.

Strip-Chart Recorder 428

Integrating type

This integrating strip-chart recorder uses a full-chart scale for faster, easier reading. Accurate quantitative analysis of any variable that depends on the precise measurement and integration of the curves may be obtained. Five count rates can be selected through an adjustable gear system: maximum is 40,000 area counts per min. Counting-rate linearity is ±0.5% of full scale.

Texas Instruments, Inc., Dept. ED, 3609 Buffalo Speedway, Houston 6, Tex.

Price: *$1,590.*

Availability: *45 days; after January, from stock.*

CIRCLE 115 ON READER-SERVICE CARD ➤

how ROBINSON *Vibration and Shock Control* PROTECTS PERFORMANCE and assures RELIABILITY in Mobile Installations ...

Robinson was the first to design and produce ***all-metal MET-L-FLEX® mounts and mounting systems*** for the Army's latest vehicular communications and electronic equipment.

These mounts are designed for virtually every type of military vehicle—including tanks, trucks, jeeps and helicopters, and will be installed wherever greater reliability of vital equipment must be ***attained and maintained.***

Robinson Models W504-5 and W504-7 were designed specifically for the U. S. Army Signal Corps' new AN/VRC-12 radio receiver and transmitter units produced by Avco Electronics and Ordnance Division.

These are the first all-metal mounts to pass the Signal Corps' Ballistic Shock Test (simulating gunfire impact) and the Package Test (simulating repeated road shock). **Send for FREE brochure.**

Photos Courtesy of Avco Electronics and Ordnance Division

ROBINSON VIBRASHOCK DIVISION *Vibration and Shock Control*

ROBINSON *Technical Products Inc* **TETERBORO, NEW JERSEY**

West Coast Engineering Office: Santa Monica, Calif.

DESIGNERS AND MANUFACTURERS OF VIBRATION CONTROL SYSTEMS

Latest high-temperature capacitor from AIRBORNE permits continuous duty at 700°F

STANDARD SIZES

STYLE A STYLE B STYLE C

PART No.	MFD	L	E	D	STYLE
E-8196-1M	.01	1.50	.625	625	A, B
-2M	.1	1.50	.875	.875	A, B, C
-3M	.25	.750	1.687	1.687	A, B, C
-4M	.5	1.625	1.437	2.00	A, B, C
-5M	1.0	1.625	2.125	2.125	A, B, C
-6M	2.0	1.625	2.750	2.750	A, B, C

Designed for integration with high-temperature aircraft/missile components, this newest addition to Airborne's line of miniaturized capacitors offers a working temperature range of -65 to +700°F—without voltage derating and with low capacitance variation.

As a dielectric for this new Airborne capacitor, we use a ribbon of thin, pure mica—because mica maintains its characteristics at temperatures well above 700°F. The conductor is aluminum foil, and the completed winding is encased in a stainless steel can for maximum corrosion resistance. A new copper spray technique has also been developed to provide high-temperature end connections. For terminals a special ceramic is used. These and other refinements provide the characteristics listed in the column opposite.

If you have requirements in high-temperature miniaturized capacitors, consult Airborne. Besides mica construction, we offer metallized Mylar* and Teflon† types—noted, as are all Airborne capacitors, for their electrical and mechanical reliability. Mylar is recommended to 300°F; Teflon to 400°F. Contact any of our offices or write for Product Bulletin PS-6A.

STANDARD CHARACTERISTICS—AIRBORNE HIGH-TEMPERATURE MICA CAPACITORS

Temperature: -65 to +700°F
Rated voltage: 300 VDC
Life: 250 hr. min. @ 340 VDC and 700°F
‡Capacitance tolerance: 10% Std.
Dissipation factor @ room temp.: 10,000 megohm/mfd @ 25°C

*Du Pont's TM for its polyester film
†Du Pont's TM for its tetrafluoroethylene resins
‡Closer tolerances on special order

AIRBORNE®

Engineered Equipment for Aircraft and Industry

AIRBORNE ACCESSORIES CORPORATION

HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas

CIRCLE 116 ON READER-SERVICE CARD

NEW PRODUCTS

Scanner System 579

Combines scanner relay and timer

Combining a sensitive photoelectric scanner relay and an adjustable electronic timer, type PE7 scanner system is a versatile control unit for applications such as monitoring the flow of parts on a conveyor or providing timed energizing of a reject gate for photoelectric inspection of parts. Sensitivity ranges are from 2 in to 18 ft with adjustable time-delay ranges from 1.5 to 30 sec. Scanning can be by direct or reflected light. The unit operates from a 100 to 130 v, 60-cps line.

Farmer Electric Products Co., Inc., Dept. ED. 2300 Washington St., Newton Lower Falls, Mass.

Wire and Harness Taper 675

This semi-automatic machine for taping bundles of wires to form a taped harness applies pressure-sensitive tape to either single wires or bundles of wires. It makes spot-tape applications of single or multiple wraps, revolving the tape around the bundle or wire. A production rate of 20 applications per min is possible.

Possis Machine Corp., Dept. ED, 825 Rhode Island Ave. South., Minneapolis 26, Minn.

Solder Mask 676

This solder mask fits over the etched, printed-circuit boards which are inserted into a connector. During dip-soldering, the solder is prevented from adhering to the etched contacts.

Western Electronic Products Co., Dept., ED, 2420 N. Lake Ave., Altadena, Calif.

Price: *$8 to $12.*

Transistor Amplifier 697

Models C118 and C119 transistor amplifiers have current gains of 15 and 25 at 10-μa collector currents. Maximum guaranteed I_{CO} is 1 mμa.

Crystalonics, Inc., Dept. ED, 249 Fifth St., Cambridge, Mass.

Availability: *From stock.*

VERSATILE

HIGH RESISTANCE MEGOHMMETER

- Up to 50,000,000 Megohms
- 100-600 vdc Variable Test Voltage
- Easy-to-read 4½" Meter Scale
- Provision for Capacitor Discharge
- Completely Safe Test Terminals

Designed for use in laboratory and high speed production testing of motor and transformer winding insulation, cable insulation, high value resistors, capacitor insulation, and for the measurement of surface and volume resistivity of insulating materials. Complete line of Type L Megohmmeters for testing in accordance with ASTM-D-257, and Federal Spec. LP-406b, Method 4041. Incorporates many features not found on other instruments selling at twice the price. Choose the model that best fills your needs from this condensed table of specifications

Model	TEST Voltage	RANGE Low	RANGE High	POWER Consumption
L-2A	200 fixed	1 meg	100,000 meg	40 Watts
L-4A	200 and 500 fixed	1 meg 2.5 meg	100,000 meg 250,000 meg	52 Watts
L-6B	100 to 600*	1 meg	100,000 meg	82 Watts
L-7	100 to 600*	1 meg	5×10^{13} ohms	75 Watts

*Continuously variable, built-in voltmeter for accurate setting

Industrial Instruments

Industrial Instruments Inc.

89 Commerce Road, Cedar Grove, Essex County, N. J.

CIRCLE 117 ON READER-SERVICE CARD

Single-Point Recorder 441

Pen carriage speed is 1/2 sec

Model 6701 recorder has been improved to operate at a faster pen speed. Its uses are in high-speed testing or recording applications, including missile checkout. A null-balance unit, the recorder uses a line-driven synchronous converter and amplifier to control a two-phase motor and rebalance the measuring circuit. It is constructed to resist shock and vibration.

Daystrom Inc., Weston Instruments Div., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N.J.

Paper-Tape Perforator 422

For ground support application

This motorized, military paper-tape perforator provides smooth eccentric drive suited for ground support applications. The unitized package consists of a type 118A-5 tape perforator, drive motor, control switches, input relays and indicators. The enclosure and components have been ruggedized for GSE applications. The unit measures 19-1/8 x 14 x 18-1/4 in. and operates in speeds from 0 to 30 columns per sec on standard code channels 5, 6, 7 or 8. Punches are available for metalized Mylar tape.

Telecomputing Corp., Data Instruments Div., Dept. ED, 12838 Saticoy St., North Hollywood, Calif.
Price: *$595 to $2,000 ea. 1 to 9 units.*
Availability: *90 days.*

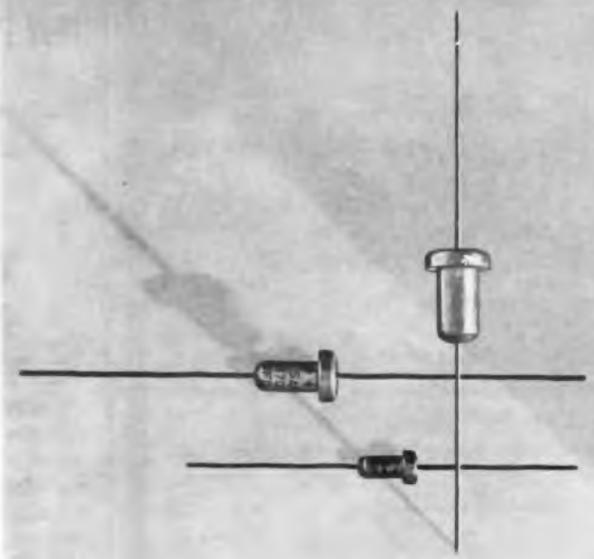
Matched Filters 440

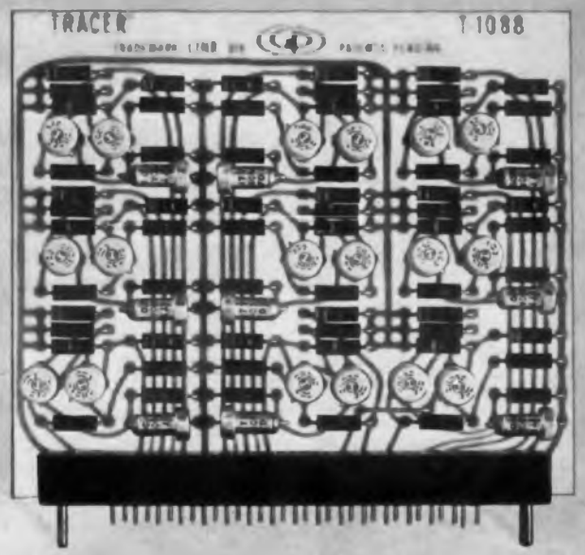
Provide 80-db attenuation

Type 34900 band-reject filter and type 34800 narrow bandpass filter together provide 80-db attenuation from 6 to 252 kc. Specifications include: maximum tolerance on 152-kc center frequency, ±200 cps for type 34900 and ±50 cps for type 34800; insertion loss at 0-db reference or at center frequency, 12 db max; ripple, 0.5 db max.

Hill Electronics, Inc., Dept. ED, Mechanicsburg, Pa.

CIRCLE 118 ON READER-SERVICE CARD ▶





Link Division of General Precision, Inc. specified ITT capacitors for this vital portion of its Tracer Identification and Control System, which demands utmost reliability and long life expectancy from every component.

TOTAL PROCESS CONTROL AND DISCIPLINED PRODUCTION DELIVER

HIGH-RELIABILITY WET-ANODE TANTALUM CAPACITORS FROM ITT

ITT wet-anode tantalum capacitors meet MIL-C-3965B—a fact proved by independent laboratory qualifications tests on ITT capacitors. The reliability and long life expectancy of these competitively-priced capacitors are direct results of ITT's total process control and disciplined production procedures, above and beyond testing standards more stringent than normal industry practice—and backed by ITT's world-wide facilities and experience.

ITT
COMPONENTS DIVISION
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
915 SAN ANTONIO RD., PALO ALTO, CALIF.

Phone these ITT-CD Capacitor Sales Offices:

Albuquerque	AX 9-8013	Los Angeles	HI 6-6325
Boston	CA 7-2000	Miami	MI 4-3311
Chicago	SP 7-2250	Minneapolis	WE 8-0457
Cleveland	GR 8-3080	New York	LO 5-1820
Dallas	EM 1-1765	Philadelphia	TR 8-3737
Dayton	BA 6-5493	Phoenix	WN 5-2471
Denver	KE 4-5091	Rochester	FI 2-1413
Detroit	TO 8-3322	San Francisco	LY 1-7321
Fort Wayne	HA 0641	Seattle	MA 2-5433
Kansas City	JE 1-9236	St. Louis	EV 2-3500

IN STOCK AT ITT DISTRIBUTORS:

- TWO TYPES—M-Type and P-Type, for applications from −55 to 85 and 125 C. respectively
- 29 VALUES—from 1.75 to 330 mfds over a working voltage range to 125 VDC and maximum surge voltages to 140 VDC
- COMPACT AND RUGGED—sintered tantalum slug in fine-silver cases for 2000-hour life at maximum temperature and working voltage
- GUARANTEED—to 80,000 ft. and accelerations of 20 G's with a 0.1 in. excursion in 50-2000 cps range
- LONG STORAGE LIFE—tantalum-oxide dielectric is completely stable; assures trouble-free operation

COMPLETE SPECIFICATIONS ON ITT wet- and solid-anode tantalum capacitors are available on request. Write on your letterhead, please, to the address below.

ENGINEERS: Your ITT representative has a complete set of qualifications and quality control tests for your inspection.

BENDIX-PACIFIC

in Southern California

needs ENGINEERS *with*

DOCTORS'- MASTERS'- BACHELORS'

DEGREES

for electrical and systems work in fields of Missile Guidance Instrumentation—Telemetry—Anti-Submarine Detection Systems/Operations Research—Military Navigation

Advanced positions are open in our "Eagle" Missile Program in Electrical Engineering for the design of transistor circuits, servomechanisms, microwave electronics and data links.

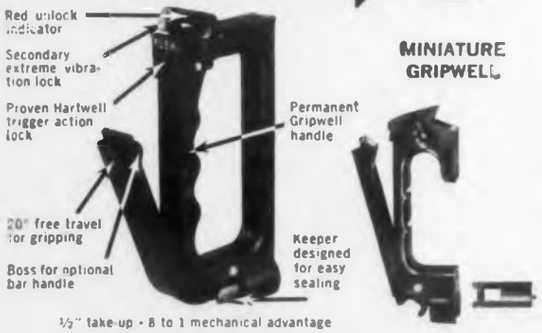
Please send resume to W. C. WALKER
ENGINEERING EMPLOYMENT MANAGER

Bendix-Pacific Division
11604 SHERMAN WAY
NORTH HOLLYWOOD, CALIF.

Other High-Level Electronic Engineering Positions Available

CIRCLE 912 ON CAREER INQUIRY FORM, PAGE 151

WHEN QUALITY IS YOUR TARGET...
THE GRIPWELL ELECTRONIC CHASSIS LATCH HELPS YOU HIT THE BULLSEYE



⅓" take-up • 8 to 1 mechanical advantage

GRIPWELL® ELECTRONIC CHASSIS LATCH

A handsome, strong and durable handle latch to fasten "plug-in" type electronic chassis, providing for positive ejection and injection of the chassis and allowing an eight to one mechanical advantage, with a total one-half inch take up.

Write today for complete information

THE HARTWELL CORPORATION
9035 VENICE BOULEVARD, LOS ANGELES 34, CALIFORNIA
Offices: Chicago • Ft. Worth • Hackensack • Seattle • Wichita

CIRCLE 119 ON READER-SERVICE CARD

New retainer brings new benefits!

In MPB's new R Series instrument bearings, the advanced ribbon type retainer provides acceleration without hang-up . . . reduces starting torque and assures smooth, uniform running torque . . . lengthens service life. R Series bearings are manufactured to ABEC Class 7 tolerances, the precision standard of all MPB miniature bearings. For details on any MPB bearings call your MPB Sales Engineer or write Miniature Precision Bearings, Inc., 11 Precision Park, Keene, N. H.

MPB

Helps you perform miracles in instrumentation

CIRCLE 120 ON READER-SERVICE CARD

NEW PRODUCTS

Bending-Separator Gage 577

Eliminates back-to-back mounting

This bending-separator gage, called Flexagage, separates and identifies tensile strains and strains produced by bending moments on the surface of a structure. It can be mounted on one side of a structure, eliminating the need for mounting strain gages back-to-back on both inside and outside surfaces. Maximum error without correction factors for gages is 2%. Units come in three models and can be used with materials ranging from 0.04 to 0.32-in. thick.

The Budd Co., Instruments Div., Dept. ED, P. O. Box 245, Phoenixville, Pa.

Diode and Transistor Holder 695

Known as the Universal Spring Hat Holder, this device accommodates over 800 types of transistors and diodes. The radiator is constructed of aluminum alloy, springs are stainless steel and the base insulator is of glass-epoxy laminate.

Augat Brothers, Inc., Dept. ED, 33 Perry Ave., Attleboro, Mass.

Price: *$0.20 to $0.36 without base insulator; $0.25 to $0.43 with base insulator.*

Availability: From stock.

Servo-Equipment Kits 696

The size A kit consists of a permanently packaged group of standardized servomechanism components from which a vertually unlimited number of mechanisms and gear trains can be assembled. Anti-backlash gears, slip clutches and adjustable limit stops are included. The requirements of MIL-E-5400C are met.

Precision Mechanisms Corp., Dept. ED, 577 Newbridge Ave., East Meadow, N. Y.

Price: *$690.*

Multi-Ratio Gear Box 677

This gear box provides five reductions and five increases. It can be mounted with hangers, breadboard plates and development components. Backlash is less than 30 min through the entire gear train. Shaft sizes are 1/8, 3/16 and 1/4 in.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., East Rockaway, L. I., N. Y.

Availability: *From stock.*

Pulse-Control Relay 585

Weighs 10.5 oz.

Weighing 10.5 oz and measuring 4-1/4 x 2-1/4 x 1-3/16 in., the Genalex relay provides for counting, absorbing and controlling pulses from a continuous train of accurately-timed and closely-spaced pulses. It is for applications in automatic-telephone systems, control of machine tools, recording of aircraft instruments and control of components in data-processing systems. Operating coil consumption ranges from 150 to 200 ma at 50 v. The unit contains two separate springsets, each accommodating up to six contact springs.

IMTRA Corp., Dept. ED, 11 University Road, Cambridge 38, Mass.

Coaxial Tuner 665

Model 1142 coaxial tuner operates from 1,500 to 6,000 mc. It has LLT fittings that replace type N tuner and two LT/N adapters.

Radar Design Corp., Dept. ED, Pickard Drive, NE, Syracuse 11, N.Y.

Price: $186 ea. single orders.
Availability: 4 weeks.

Circular Connectors 666

Designed to meet MIL-C-26500, the Hi-Reli-Acon series ME-20000 and FE-2000 connectors are offered in 55 contacts with strain-relief clamp hardware. The Contacts are crimp style. Resilient silicone-rubber inserts provide sealing.

Methode Manufacturing Corp., Dept. ED, 7447 W. Wilson Ave., Chicago 31, Ill.

Epoxy Adhesive 726

Maraset resin 533A two-component, contact-pressure epoxy adhesive can be cured at room temperature. Tensile strength is 8,300 psi. It meets MIL-A-8623, type II specs for aircraft applications.

Marblette, Dept. ED, 37-31 Thirtieth St., Long Island City, L. I., N. Y.

Metal Enclosures 727

Polyform enclosures can be furnished in almost any shape, including reverse angles. Inside dimensions can be held to ±0.005 in. or better. The enclosures are light in weight and are claimed to have superior magnetic strength.

Barber-Colman Co., Dept. ED, Rockford, Ill.

The Leaders Specify **ALPHLEX® ZIPPER TUBING**

ALPHA electronic WIRE

- constant flexibility
- cuts time and labor
- outer jacket is replaceable
- wire changing is simplified
- eliminates costly jacket extrusion
- immediate delivery from your local Alpha distributor

For all these benefits, Alphlex Zipper Tubing is used by such OEM leaders as IBM, IT&T, Librascope, Lockheed, Martin, Sperry Rand and Government agencies. Write for free Alphlex Catalog Z-2.

The new Alphlex Closing Tool (above) designed to save you time, labor and money in your cable production requirements is free with each order of 1,000 feet of Zipper Tubing.

TYPES OF ZIPPER TUBING	
ZIP-31	fabricated from .020" polyvinyl sheet made from MIL-I-631C materials. All purpose type for general applications to 105°C. Standard colors: Clear, Black, Yellow.
ZIP-31M	heavy duty construction. Similar to ZIP-31 type except nominal wall thickness of .040". Standard colors: Clear, Black.
ZIP-44	polyvinyl sheet made from MIL-I-7444B materials. Extremely flexible; for aircraft and low-temperature uses to −67°C. Standard colors: Clear (amber), Black.
ZIP-44M	heavy duty construction. Similar to ZIP-44 type except nominal wall thickness of .040". Standard colors: Clear (amber), Black.
ZIP-50	"sandwich" of aluminum foil laminated between two sheets of polyvinyl. For 100% RF shielding applications to 105°C. Standard color: Silver Grey.
ZIP-90	polyvinyl bonded to woven fibreglass sheet per MIL-I-3190A. For rough usage, abrasion resistance, and high temperature uses to 130°C. Standard color: Black.
	All types available in inside diameters from ¼" to 2" in increments of ⅛"; and from 2" to 4" in increments of ¼".

Alphlex Zipper Tubing covered by Patents #RE24,613 and #2,558,367 and other patents.

ZIPPER SPECIFICATIONS FOR ALL TYPES OF ALPHLEX ZIPPER TUBING	
Material	Polyvinyl Chloride
Track Thickness (when closed)	.095"
Dielectric Strength, V/mil	750
Tensile Strength P.S.I.	3810
Ultimate Elongation	255%
Operating Temperature, Upper Limit	105°C
Cold Brittleness	−65°C
Fungus-proof	will not support fungus
Flammability	self-extinguishing
Lateral Pull Strength (unsealed)	42.7 pounds/inch
Lateral Pull Strength (permanently sealed)	50.8 pounds/inch
Standard Colors	Black, Clear, Yellow

ALPHA WIRE CORPORATION Subsidiary of LORAL Electronics Corporation
200 Varick Street, New York 14, N. Y.
Pacific Division: 1871 So. Orange Dr., Los Angeles 19, Calif.

ALPHA electronic WIRE

CIRCLE 121 ON READER-SERVICE CARD

when it comes to
JOB-TAILORED SEALS
Go Goshen

TETRASEALS RECTANGULAR SECTION RINGS

High performance, economical static seals, TETRA-SEALS are equal in quality to, and interchangeable with, standard O-rings. Available in natural, synthetic and silicone compounds to meet MIL, AMS, SAE, ASTM and industrial specifications.

O-RINGS of SILICONE RUBBERS HAVING SAME SHRINKAGE AS ORGANIC RUBBERS

Now, dimensions and tolerances of AN, MS, SAE, JIC and NAS met consistently with standard tooling from compounds useful over a temperature range of −80°F to +500°F. Non-toxic, too. Lower unit costs, fewer rejects, faster delivery, are other advantages.

For more details, ask for free literature on TETRASEALS and O-RINGS.

Goshen Rubber Co., INC.
911 S. TENTH ST. GOSHEN, INDIANA

CIRCLE 122 ON READER-SERVICE CARD

Cut Your Coil Form Costs
WITH
PRECISION PAPER TUBES

Lowest cost in any quantity.
Finest dielectric materials:

Kraft . . . Fish Paper . . . Acetate . . . Resinite (phenolic impregnated) . . . DuPont Mylar . . . Johns-Manville Quinterra . . . Specials . . . Combinations.

★

Any Shape . . . Any O. D. or I. D. . . . Any Length . . . Di-Formed or Bowed Sidewall Construction.

★

. . . Send for bulletin on Precision's Complete Coil Form Service. Request Arbor List of over 2000 sizes.

PRECISION PAPER TUBE CO.
2055 WEST CHARLESTON STREET • CHICAGO 47, ILL.
Plant No. 2: 1 Flower Street, Hartford, Conn.

CIRCLE 123 ON READER-SERVICE CARD

A SIGNAL ACHIEVEMENT IN TELEMETRY... ELECTRO-TEC'S NEW 450-CIRCUIT COMMUTATING SWITCH

Electro Tec's new compact 8-oz motor driven telemetering switch enables circuit combinations up to a maximum of 5 poles, 90 channels per pole ... truly the answer to precision performance with optimum size and weight.

Specifically developed for satellite and missile use, the ETC switch incorporates unique engineering ideas extending its utility to a variety of other military and industrial applications. Exclusive microminiature design minimizes brush velocity. Precious metal contact surfaces assure lowest levels of noise and resistance. Hermetically-sealed connectors add to environmental protection. These and other features provide a life expectancy of well beyond 1000 hours.

Write for new ETC switch brochure

ELECTRO-TEC CORP. South Hackensack, N. J. Blacksburg, Va. — Ormond Beach, Fla.

WEST COAST LICENSEE: PACIFIC SCIENTIFIC CO., P. O. BOX 22019 LOS ANGELES 22, CALIF.

CIRCLE 124 ON READER-SERVICE CARD

NEW PRODUCTS

Solid-State Digital Counter 557

Counting rate is up to 150,000 cps

This solid-state digital counter has a counting rate up to 150,000 cps. Temperature range is −55 to +125 C. Power requirement is 18 to 31 v dc at 18 ma nominal. Input requirement is positive pulse, 20 v min. Power drain is 18 ma at 28 v dc. Applications include: uni-directional counters, shift registers, staircase generators, series-to-parallel converters and parallel-to-series converters.

Tempo Instrument Inc., Dept. ED, P.O. Box 338, Hicksville, L.I., N.Y.

Recorder-Reproducer System 565

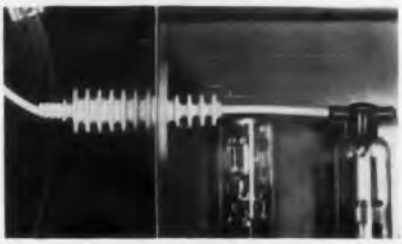
For use in anti-submarine weapon

This recorder-reproducer system is designed for use in the ASROC anti-submarine weapon. It serves as the core of a complex signal-analysis system that identifies targets at great distances in the pretense of making background noise. Primary function of the recorder-reproducer is to provide a precise and stable frequency multiplication of 100 times for all input-signal components. Its use permits time-division multiplexing of the remainder of the analysis equipment and provides a permanent record of raw data for a 13-hr period.

Cook Electric Co., Dept. ED, 2700 N. Southport Ave., Chicago 14, Ill.

Availability: *90 days.*

high voltage connector problems?



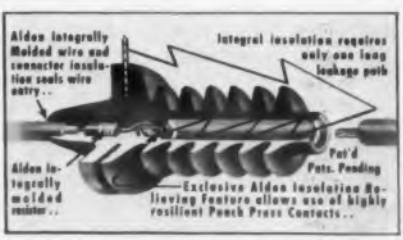
ALDEN

solves them by return mail

Alden makes high voltage connectors that are more reliable . . . simpler . . . and less expensive. Connectors you can trust absolutely to tame arc-over and corona problems at voltages as high as 30 KDVC.

A few of the many Alden IMI High Voltage Connectors and tube caps available for solving your problems.

It's done through Alden's exclusive IMI (Integral Molded Insulation) technique. With this unique method, we can mold Kel-F, Polyethylene, or Nylon insulation in a single hot shot directly around leads, contacts, and any special circuit components like chokes, resistors, or corona shells.



This one shot technique saves production costs. These savings are passed on to you. And it actually adds reliability.

Let us prove it. Let us send you complete information by return mail. Better still, send us a sketch. Tell us what you want to connect. Lay out lead lengths, give voltage and current, environmental conditions. We'll send you a sample connector assembly or a proposal specifically tailored to your needs. Just write:

ALDEN

PRODUCTS COMPANY

1139 N. Main Street, Brockton, Mass.

CIRCLE 125 ON READER-SERVICE CARD

Variable-Phase Standard 628

Accuracy is ±0.05% or better

Model VPS-1 variable-phase standard permits phase between two self-generated voltages to be shifted to any desired angle with an accuracy of ±0.05 deg or better. The instrument generates two signals of equal amplitude, differing in phase by any angle as determined by the front-panel control. The reference signal has a fixed amplitude of 50 v rms. Vector output has a maximum amplitude of 50 v rms and can be attenuated in steps of 50 mv. Frequencies are selected from the range of 150 to 3,000 cps.

Gertsch Products, Inc., Dept. ED, 3211 S. La Cienega Blvd., Los Angeles 16, Calif.

Price: *$3,200.*

Availability: *90 days.*

Mechanical Recorders 575

Two control types available

Model 7813 comes in two types: one employing an on-off electric control and the other, an electrical proportional control with manual reset. The On-Off Temperature-Pressure Recorder Controller can be combined with single or dual thermosetters or pressure recorders and indicators. It accommodates one or two filled system-temperature actuations of any class, one or two pressure spirals or one pressure bellows. The proportional-electric-temperature-recorder controller, for liquid and mercury filled thermal systems, can have ranges as low as —100 F or as high as 1,000 F.

Daystrom, Inc., Weston Instruments Div., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N.J.

Some Ideas

K+E

for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.

Six years ago, K&E introduced the very first polyester-base drafting film—a special-purpose medium featuring extreme dimensional stability. Experience with that film indicated that a definite need also existed for a *general-purpose* drafting film, if one could be perfected. About two and a half years ago we succeeded, introducing HERCULENE® Drafting Film—the first polyester-base medium for general drafting to meet professional standards. Many recognized its value immediately, stocked up on HERCULENE, and have used it happily ever since. Others—a bit more "canny" about adopting a relatively untried medium—deferred decision, saying "see us in a year or so." Still others—having tried one or more of the other films marketed immediately after HERCULENE—seemed permanently disenchanted with *all* film based media. What with the passage of time and much favorable ado about drafting films in general, we rather think that those once stung may now have adopted a more congenial attitude—so we address ourselves solely:

To fence-sitters everywhere . . .

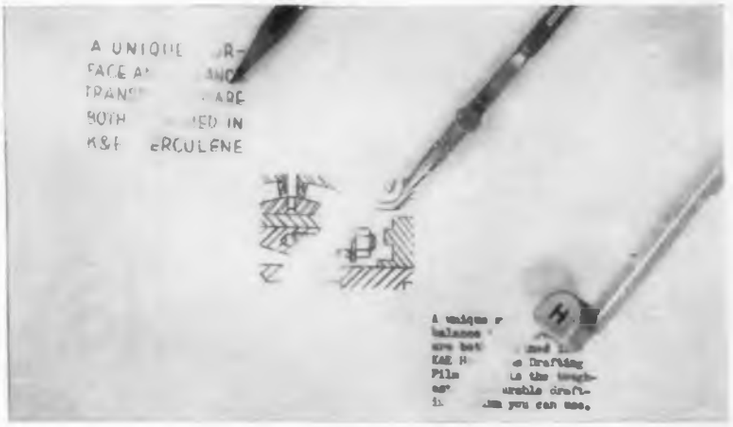
Just as we felt in '58, we feel today, that film has an important place in the drafting room. The only difference now is that experience has *proved* it so. Since 1958, the number of HERCULENE users has grown by leaps and bounds. All, we're happy to say, have found HERCULENE a welcome, efficient, and *much needed* addition to their stock of drafting media. It is these HERCULENE users who have written the record. Their many and rigorous tests, their months of experience, their numerous successes and continuing satisfaction are convincing evidence that HERCULENE is all we said it would be.

Why all the fuss about HERCULENE? . . .

HERCULENE combines practically all the qualities of a perfect drafting medium. An excellent product when introduced, it's even closer to perfection today. Working with major film users, K&E specialists have refined HERCULENE in many subtle ways since its introduction.

Unlike cloth or paper, HERCULENE is virtually indestructible. No matter how roughly or frequently a HERCULENE tracing is handled, it will never crack, wrinkle or fade. Absolutely waterproof, a HERCULENE drawing can never be permeated and ruined by moisture. Filed away, HERCULENE will last indefinitely. And HERCULENE has body, too, making it far easier to handle and file, and to keep flat on the drawing board.

Most of the refinements made in HERCULENE since 1958 have concerned its engineered drafting surface. HERCULENE's surface "take" for pencil, ink and typing is now better than ever. Erasability, of course, is excellent for all three. Contrast has been built up for sharper definition of line, too, yet all the transparency necessary for fast, clear reproductions has been maintained.



Two big bonuses, too . . .

A significant chapter in the HERCULENE story has been the development of a waterproof writing mate—the Duralar plastic pencil. Drawings made on HERCULENE with this waterproof pencil can actually be

washed in soap and water. Even gray, grimy "unreproducible" drawings can be washed spotless with this new technique. Many firms now use the HERCULENE/Duralar team exclusively . . . and are realizing undreamt-of savings in costly re-draws.

Some firms, of course, by virtue of smaller work volumes and "cleaner" or less frequent handling, will have little need for this new wash technique. Of particular interest here is another K&E exclusive recently introduced—the amazing Ruwe pencil. The Ruwe pencil will not withstand washing, but in every other respect, this new pencil is graphite-*plus*. Although of plastic composition, the Ruwe pencil has all the "fine" feel of graphite, erases well, and deposits a sharp, dense black line. The big bonus: Ruwe pencil lines are *virtually smudge-proof*. Rendered on HERCULENE's engineered drafting surface, they actually resist smudging better than graphite on regular paper!

We leave it to you . . .

The best test remains the one you make for yourself. We've just completed a new brochure, titled "A Report on the Growing Acceptance of Polyester Film." In it is detailed most of what we have learned about HERCULENE and its use since 1958—including tests you can make to assess its every property. We'd like you to have a copy of this new brochure—plus a sample sheet of HERCULENE, a Duralar pencil, and a Ruwe pencil—for your own private testing. To get these free samples, simply fill out and mail the coupon below:

KEUFFEL & ESSER CO., Dept. ED-1, Hoboken, N. J.

Gentlemen:

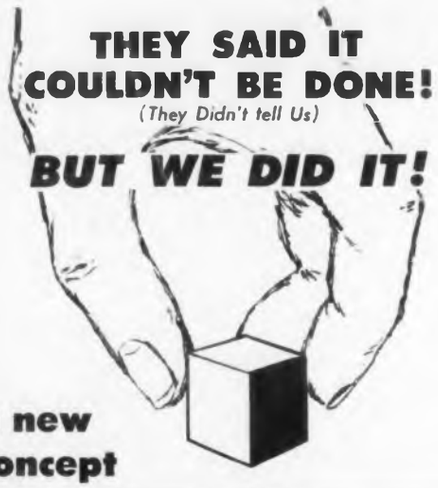
Please send me your new brochure, titled "A Report on the Growing Acceptance of Polyester Film," a sample sheet of HERCULENE Drafting Film, and samples of the Ruwe and Duralar Pencils.

Name & Title _____

Company & Address _____

4031

CIRCLE 126 ON READER-SERVICE CARD



THEY SAID IT COULDN'T BE DONE!

(They Didn't tell Us)

BUT WE DID IT!

a new concept in non-linear potentiometers

Differentialyzer Control to .00001

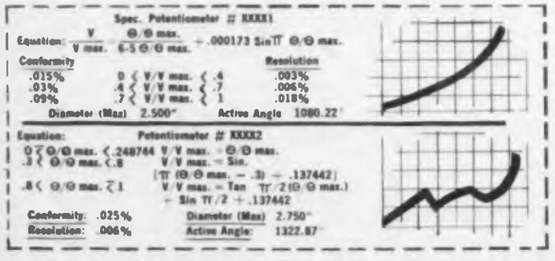
A new concept in non-linear winding—the Calbest Computing Differentialyzer, control center of automatic winding equipment, constructs and accurately duplicates linear, step, or non-linear functions.

In the past, two major deficiencies of cam-type servo-controlled winding equipment have limited the accurate reproduction of close-tolerance potentiometer windings. Inaccuracy in the cam and its associated plotter-head, and "hunting" or hysteresis in the servo system combine to restrict the tolerances to which a function can be reproduced and create excessive variations between supposedly identical windings.

The computer Differentialyzer uses no cams and no servo system. Mathematical information representing the function is fed *directly* into the computing section. The Differentialyzer automatically controls the winding pitch to within ±.001%. Once programming is established, the computer accuracy insures absolute duplication of windings. Months or years later, the same computer settings will insure a supply of identical coils.

This revolutionary application of digital (rather than analog) methods to winding control extends the possible conformity of a non-linear function by almost a full order of accuracy.

If you have a difficult non-linear function problem, or a potentiometer presently in production on which you would like to "tighten" specifications, inquiries are invited.



Inquiries from factory representatives invited

CALBEST ELECTRONICS

"Byword for Better Products"

4801 EXPOSITION BLVD. • LOS ANGELES 16, CALIF.

CIRCLE 127 ON READER-SERVICE CARD

NEW PRODUCTS

Magnetic Amplifier 535

For low level signals

Model 2628 magnetic amplifier measures and amplifies low-level signals so that they are suitable for metering, recording, telemetry and other applications. Excitation is 26 v, center-tapped, 400 cps, with a regulation of ±10%. Amplifier power requirement is less than 1 w. Signal-source impedance is 16 ohms ±10%, signal-source voltage is 0 to ±15 mv min, load impedance is 50 ohms to infinity and load voltage is ±120 mv with a minimum signal input of ±15 mv. Linearity is ±1-1/4%. Operating temperature range is 0 to 75 C.

Lumen, Inc., Dept. ED, P. O. Box 905, Joliet, Ill.

Price: *$380.*

Availability: *Three weeks for small quantities.*

Servo Amplifier 562

For both ac and dc inputs

Model 122 20-w, 60-cps servo amplifier is designed for use with both dc and ac input signals. A 100-mv input will cause 115 v at 60 cps output to rated load. Input impedance is over 300 K for signal input and 25 K for tachometer input. Output impedance is less than 100 ohms. Noise output is negligible and waveform shows less than 10% harmonic distortion. Gain, zeroing, output, level and tach controls are provided. Applications include use in commercial and laboratory servomechanisms, self-balancing instruments, industrial process controllers and data-repeater systems.

K-F Products, Inc., Dept. ED, 3100 E. 43rd Ave., Denver 16, Colo.

Price: *$325.*

Series PI-100

Frequency indicators and frequency deviation indicators

Series PI-300

Precision frequency-to-dc converters for telemetry and other aircraft and missile uses.

Series PI-400

Precision plug-in module frequency-to-dc converter and indicator. Six may be mounted in 19" rack.

For Frequency Measurement

PULSE RATE INTEGRATORS

by Anadex

Designed For Use With

- **Turbine Flow Sensors**
- **Tachometers**
- **Rotating Machinery**
- **Repetition Rate Pick-ups**
- **Radiation Detectors and other frequency generating devices**

Here is a complete, all new line of versatile, reliable Pulse Rate Integrators especially designed for accurately converting a frequency or pulse rate to an analog output of dc voltage or current, or to a visual meter indication. Featuring many different models for the widest range of applications, these Anadex instruments represent the ultimate in dependability and operating performance.

Write today for complete detailed specifications.

Anadex INSTRUMENTS INC.

14734 Arminta St., Van Nuys, Calif.

CIRCLE 128 ON READER-SERVICE CARD

250 LBS. TENSILE STRENGTH*

IMPROVED RG8/U Cable Assembly with K-GRIP® CONNECTORS

Plus all these other advantages

- Time required to attach connectors to the cable greatly reduced;
- No highly skilled assembly personnel required;
- Ease of inspection or replacement in the field;
- Uniformity of performance from unit to unit;
- Present inventories of connectors do not become obsolete.

* TEST DATA AVAILABLE!

WRITE FOR DESCRIPTIVE LITERATURE

K-GRIPS® are available for most RF Connectors

KINGS Electronics CO., INC.

41 MARBLEDALE ROAD — TUCKAHOE, N. Y. — SWIFTWATER 2-5000

CIRCLE 129 ON READER-SERVICE CARD

Moisture Analyzers 590

For semiconductor manufacture

These moisture analyzers are for use in measuring and controlling the dryness of gases in dry boxes, gas lines, dryers and furnaces. Types NEP-PL and NEP-PL-V are for measuring moisture where the gas pressure is greater than 5 psig or where a vacuum source is available. Type VAC has a built-in vacuum system for handling systems where the gas pressure is less than 5 psig. Type R, for use where pressure is over 5 psig, is portable and has a strip-chart recorder. Type R-VAC is portable, has a strip-chart recorder, vacuum system, and is for use where pressure is less than 5 psig.

Manufacturers Engineering & Equipment Corp., Dept. ED, York and Sunset Lane, Hatboro, Pa.

B-H Meter 602

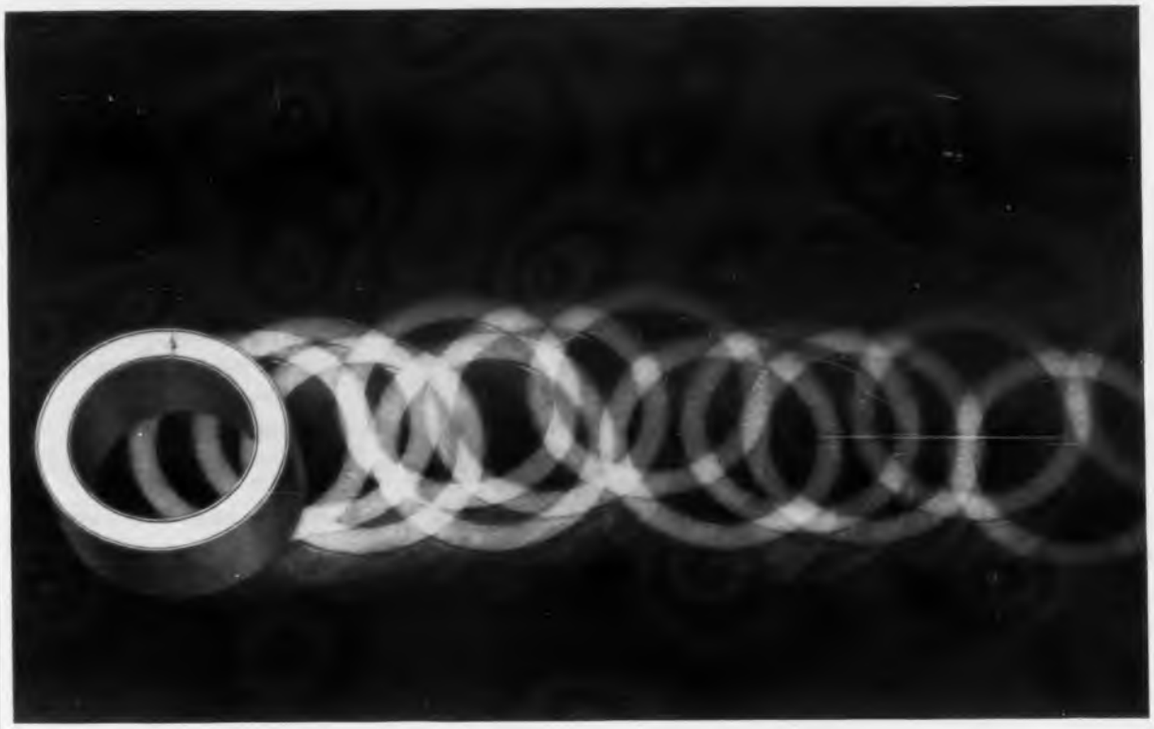
Displays the hysteresis loop of magnetic stage

This B-H meter, designated model 651B, displays the hysteresis loop of magnetic tape or pigment on an oscilloscope. Measurements on samples as small as four strands of 1/4-in tape are possible. A display adequate for qualitative inspection can be obtained from a single strand. Direct-reading calibrated range of sample flux is from 3 to 1,000 maxwells with a maximum sample-chamber diameter of 3/8 in. The instrument can measure coercive force and flux at an arbitrary point.

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

Price: *$6,000.*

Availability: *45-day delivery.*



the strong case for Centricores®

When you're considering magnetic cores it pays to get down to cases. The sturdy aluminum case for Centricores assumes special importance where impact, vibration, heat or mechanical pressure could cause trouble in a control loop you're designing, or where you want to miniaturize an inductive component.

The case is ruggedly rigid, so that you can apply your circuit windings without danger of distorting the core's magnetic properties. And the case is absolutely leakproof. You can vacuum-impregnate Centricores without danger of their damping oil leaking out or foreign matter leaking in. The tightly sealed case also guards against leakage in applications where high ambient temperatures are present, or where Centricores are used in rotating equipment.

Here's a tip on miniaturization. The rugged design of the Centricore case permits use of a thinner gage aluminum that shaves fractions of an inch off their size—fractions that can add up to precious inches where you want to scale down component dimensions. *Centricores are the slimmest magnetic cores on the market.*

Centricores are the most uniform. They give the exact performance you want, from core to core and lot to lot. Their remarkable consistency in insulation, dimensions, squareness, thermal stability and gain is the product of unique quality controls that begin with the very selection of raw materials and extend through final testing.

Write for complete data. Centricores are available from stock from our East and West Coast plants in all standard sizes and magnetic qualities, and in both aluminum and phenolic cases. We will match them within 5 per cent over the entire voltage-current loop, in sets, units or in multiples up to twelve. Write for detailed specifications today.

MAGNETIC METALS

Magnetic Metals Company

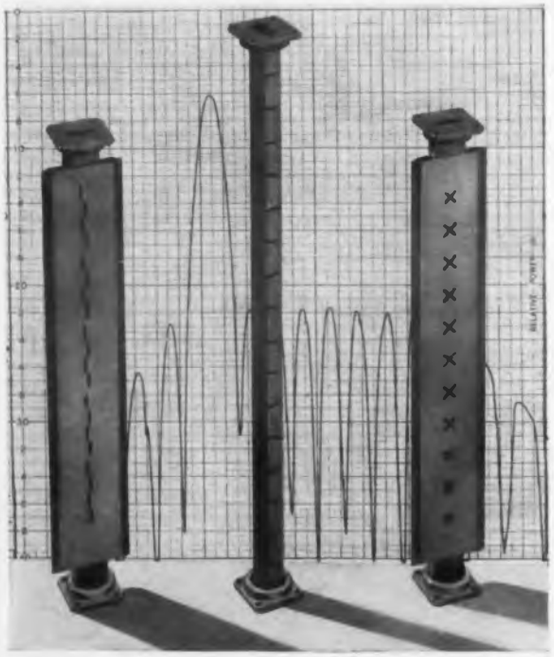
Hayes Avenue at 21st Street, Camden 1, N.J.

853 Production Place, Newport Beach, California

transformer laminations • motor laminations • tape-wound cores

powdered molybdenum permalloy cores • electromagnetic shields

CIRCLE 130 ON READER-SERVICE CARD



MICROWAVE ANTENNAS

Turbo pioneered the first full production of slotted antennas ten years ago. After a million slots and fifty thousand antennas, Turbo possesses unparalleled experience in the design, development and production of slotted line sources, flush-mounted systems and scanning arrays.

Competent engineers, advanced design techniques and modern development facilities at Turbo mean quick, economical solutions to your antenna problems.

Turbo's extensive manufacturing plant is available for quantity production. Close tolerances are maintained and Turbo offers production antenna pattern testing.

For the answers to *your* antenna problems, call or write to Turbo today.

TURBO

TURBO MACHINE COMPANY, LANSDALE, PENNA., U. S. A.

CIRCLE 131 ON READER-SERVICE CARD

revolutionizes soldering!

No other solder provides the performance advantages of ALPHA Cen-Tri-Core Energized® Rosin-filled Solder because no other solder is *made* this way.

ALPHA Cen-Tri-Core's center wire is rosin coated then inspected *visually* before an extruded outer sleeve is added. Result? Every inch of its "core within a core" construction is filled with fast-acting, non-conductive flux. Meets federal specifications QQS-571C. *Write for details.*

When dependability counts!

alpha metals INC.

In Los Angeles, Calif.: 2343 Saybrook Ave.
In Chicago, Ill.: ALPHALOY Corp., 2250 S. Lumber St.
58C Water St., Jersey City 4, N. J.

Other ALPHA products: Fluxes • Solder Preforms • High Purity Metals

CIRCLE 132 ON READER-SERVICE CARD

now! get this NEW

problem-solving money-saving

Setko Catalog 23 FREE

- INCLUDES NEW SELF-LOCKING SET SCREW SELECTOR CHART
- LATEST STYLES OF SOCKET SCREWS INCLUDING: BUTTON HEADS, FLAT HEADS, SHOULDER SCREWS, DOWEL PINS.
- COMPLETE INFORMATION ON THE COST-CUTTING SETKO HOPPER FEED METHOD OF INSERTING SET SCREWS.

Lists all standard set screws and socket screw products . . . plus many special types designed for unusual conditions of vibration; close precision setting, resistance to tampering, etc. Describes many specific ways in which Setko Set and Socket Screw products cut costs and improve product quality.

Partial Contents of New Setko Catalog 23:

- Hopper-Fed Headless Set Screws, with New Automated Feed System
- Self-Tapping Set Screw
- Standard Hexagon Socket
- Zip-Grip Self-Locking®
- Nu-Cup Set Screws®
- Self-Locking Offset

"Indicates Setko Set Screw "Firsts"!

- Point-Lok, Flush-Lok, Spred-Lok®
- Isothermal Heat-Treated Set Screws

Stainless Steel Set Screws, Cap Screws, Button Heads, Flat Heads, Shoulder Screws, Dowel Pins and Pipe Plugs

Set Screw & Mfg. Co.

send for FREE catalog 23 today!

Use letterhead—or write name and address in margin of this page, tear out ad and mail.

265 Main St., Bartlett, Ill. (Chicago Suburb)

We Specialize in Solving Puzzling Set Screw Problems

CIRCLE 133 ON READER-SERVICE CARD

NEW PRODUCTS

Coaxial Switches 578

Have BNC connectors

These multi-position coaxial switches have BNC connectors. Model 560 is a single-pole five-position switch that handles to 350 v rms and can be used in transmitter and antenna applications. Model 561 is a double-pole, two-position unit for rapidly cutting equipment in and out of series connection in coaxial lines. Both are for 52 or 75-ohm lines.

Barker & Williamson, Inc., Dept. ED, Bristol, Pa.

Metal-Film Resistors 515

Have special coating

Type MFS metal-film resistors are specially coated for high-reliability applications. They exceed the requirements of MIL-R-10509C. Type MFS1/10 has a wattage rating of 1/10 w, a resistance range of 30 ohms to 300 K and a maximum voltage rating of 250 v; type MFS1 has a wattage rating of 1 w, a resistance range of 50 ohms to 4 meg and a rated voltage of 500 v max. Units rated at 1/8, 1/4 and 1/2 are also available.

Electra Manufacturing Co., Dept. ED, 4051 Broadway, Kansas City 11, Mo.

Availability: *From stock; 16-day delivery.*

Voltage-Comparison Amplifier 598

Sensitivity is better than 500 μv

Model 51 voltage-comparison amplifier, for a broad range of critical go/no-go applications, provides a rapid means of determining if an input voltage or a series of input voltages are within preset limits. The instrument has a sensitivity of better than 500 μv. Voltage range is to ±50 v and up to 100 v, if the limit-to-input differential does not exceed 25 v.

Non-Linear Systems, Inc., Dept. ED, Del Mar, Calif.

Price: *$950.*

Strain-Gage Indicator 623

Accuracy of indication is ±1% of scale

Model 800 strain-gage indicator is for indication or recording of static and dynamic strain-gage measurements. Designed for use as a research tool, the instrument accommodates all commonly used gage factors, gage resistances and transducer-bridged configurations. Maximum resolution is better than 1 micro-inch per in. There are eight calibrated sensitivity ranges.

Daytronic Corp., Dept. ED, 225 S. Jefferson St., Dayton 2, Ohio.
Price: *$565.*

Lumped Delay Line 495

Activates clock generator in computers

Having a 1% delay time tolerance, this lumped delay line is used to activate the clock generator of a computer system. Temperature stability is 12.7 ppm per deg C. Other specs include: total delay, 1.37 ±0.01 μsec; 93 ohms ±10%; attenuation, 5 to 6 db; resistance, 43.5 ohms; voltage, 35 to 50 v. Requirements of MIL-E-5400 are met. The unit is housed in a brass case measuring 6-1/2 x 1 x 1 in.

Nytronics, Essex Electronics Div., Dept. ED, 550 Springfield Ave., Berkeley Heights, N.J.

Module Extractor 631

For use with printed-circuit modules

Model 84 module extractor is designed to facilitate the removal of series 300 card modules from the firm's 80-320 mounting racks. Cards can be removed with very little effort and with no danger of damaging or marring.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.
Price: *$14.50.*
Availability: *From stock.*

360° of versatility

The precious metal ring shown above is the heart of a Gamewell style SG-270 Precision Rotary Switch. Cut into as many angular segments as required, it provides the precise basis for a highly versatile switching component.

Custom-designed, the SG-270 Switch is ideal for circuit sampling, sequencing, programming, digital generators, etc. Connections to the segments are made through terminals adjacent to the segments on the periphery of the housing. Precious metal rings and brushes provide smooth, trouble-free action with either Make-Before-Break (MBB) or Break-Before-Make (BBM) contacts. Multiple gangs can be assembled to provide multi-pole switches. Cased in special plastic, the SG-270 Switch is inherently fungus resistant . . . stable at high temperatures . . . sizes ⅝" — 1¼" — 1⅝" — 2" — 3" — 5" diameter in various mounting styles. It can be used with confidence over a wide range of environmental requirements.

Investigate their outstanding operating characteristics for use in *your* products. Write, stating requirements, to The Gamewell Company, 1397 Chestnut Street, Newton Upper Falls 64, Mass. *A Subsidiary of E. W. Bliss Co.*

GAMEWELL SG-270
Precision Rotary Switch

BLISS Gamewell®

PRECISION POTENTIOMETERS

"INTEGRALS OF HIGH PERFORMANCE"

CIRCLE 134 ON READER-SERVICE CARD

Wide-Range

Self-Contained, Precision

INDUCTANCE BRIDGE

MODEL 63A PRICE $1500

- **Inductance Range:** .002 Microhenry to 1.1 Henries.
- **Series Resistance Range:** .002 Ohm to 110K Ohms.
- **Built-in 1 to 100 KC Oscillator – Detector.**
- **No False or Sliding Nulls.**

ALSO MANUFACTURERS OF THESE FINE INSTRUMENTS

DC Millivoltmeter

Capacitance Bridge

RF Distortion Meter

UHF Grid Dip Meter

Boonton *ELECTRONICS* Corp.

Morris Plains, New Jersey • Phone: JEfferson 9-4210

CIRCLE 135 ON READER-SERVICE CARD

NEW PRODUCTS

Magnetic Heads 547

For multichannel recording

Series 4000 multichannel heads provide for simultaneous recording of up to 20 channels per in. on tape or drum. They are available in six compatible track formats with track widths of 0.02 to 0.05 in. and track spacings of 0.05 to 0.14 in. A choice of track formats and electrical characteristics is offered.

Brush Instruments, Div. of Clevite Corp., Dept. ED, 37th and Perkins, Cleveland 14, Ohio.
Availability: *45 to 60 days.*

Indexing Machine 728

This indexing machine provides for semi-automatic soldering at an increased production rate. Solder and flux are rapidly applied. A production rate of 2 soldered joints every 10 seconds is claimed for a job that previously took 3 min.

Fusion Engineering, Dept. ED, 17921 Roseland Ave., Cleveland 12, Ohio.
Price: *Cost price is under $1,000.*

Adjustable Hub Clamps 705

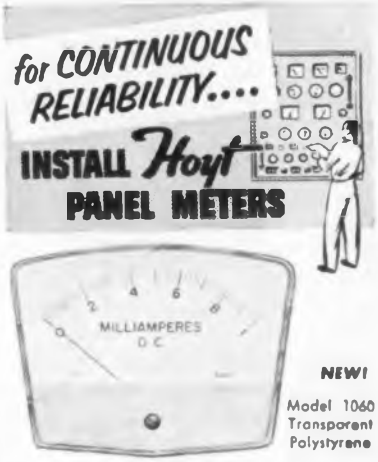
Designed for applications in high-speed precision motors, synchros, resolvers and increment shafts, these clamps come in shaft sizes of 1/8, 3/16 and 1/4 in. Dynamically balanced they are made from heat-treated stainless steel and meet Mil specs.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., East Rockaway, N. Y.
Availability: *From stock.*

High-Strength Alumina 711

Alumina Ninety-Five, for high-temperature metalizing applications, has a compressive strength of 400,000 psi, a flexural strength of 45,000 psi, a maximum working temperature of above 1,700 C and excellent dielectric values. It meets the requirements of electronic and missile applications.

Gladding, McBean & Co., Dept. ED, 2901 Los Feliz Blvd., Los Angeles 39, Calif.
Availability: *30 to 60 days for delivery.*



Quality meters on the panel indicate quality throughout—and HOYT Panel Meters are quality in appearance and function . . . the complete Line of matching AC and DC Meters for original equipment and replacement applications. Get accuracy, readability, and reliability; plus economy. Specify HOYT Electrical Instruments—compatible components for production, research, and test requirements.

Model 647
Black Bakelite

Moving coil, rectifier, and repulsion types available promptly in a wide assortment of sizes, ranges, cases, shapes, and colors; some with parallax-free mirror scales —all with standard mounting dimensions. Or custom designed to the most exacting specifications.

Model 17/3
Black Bakelite

Send for latest fully illustrated brochure with descriptions, engineering data, and moderate prices.

Hoyt SINCE 1904 **ELECTRICAL INSTRUMENTS**

BURTON-ROGERS COMPANY
Sales Division—Dept. ED
42 Carleton Street, Cambridge 42, Mass.

CIRCLE 136 ON READER-SERVICE CARD

FROM PHILBRICK:
10 stabilized amplifiers in one supremely versatile manifold!

STABILIZED OPERATIONAL MANIFOLD

MODEL K7-A10

Contains 10 USA-3 Universal Stabilized Amplifiers. A precision instrument of unusual versatility. Permits fast, economical set-up of many instrument or computing configurations. Ideal as a low cost computor, with unusual flexibility as a "simulator" of large scale systems. Also well suited for industrial or production line test equipment applications. Price, **$1200**

POWER SUPPLY — MODEL R-300

As a power source for the K7-A10, we recommend this 300 ma regulated power supply, because its exceptional regulation and sub-millivolt noise allow it to serve also as a high accuracy reference voltage. Due to its ultra-conservative ratings, the R-300 will allow the K7-A10 to operate indefinitely, even under full load conditions (350 ma). Price, **$390**

- Available from stock
- Military equivalents available
- Technical data available on request

GEORGE A.
PHILBRICK
RESEARCHES, INC.
285 Columbus Avenue, Boston 16, Mass.
COmmonwealth 6-5375, TWX: BS1032, FAX: BSN
Representatives in principal cities
Export Office 240 West 17th St., New York 11, N.Y.
Tel CHelsea 3-5200, CABLE TERMRADIO

CIRCLE 137 ON READER-SERVICE CARD

Surge Suppressor 605

Protects silicon diodes

The Surge Stop, a selenium surge suppressor, protects the firm's silicon diodes against burnout from voltage transients. It delays good reverse characteristics for dissipating energy found in transient voltages. It makes possible a reduction in size of silicon diodes.

Syntron Co., Semiconductor Div., Dept. ED, Homer City, Pa.

Price: *$0.70 to $1 in quantities of 1,000.*

Availability: *One week.*

Coaxial and Combination Connectors 701

These micro-miniature, multi-contact, power, coaxial and combination connectors can be supplied for applications such as in missile, satellite and industrial automation fields. Size is compact.

Microdot Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

Micromanipulators 702

These devices, called models 100 and 200, are useful in semiconductor and related work for positioning and probing of wafers and microelectronic assemblies. Accessories include tungsten probes and phenolic insulating jaws.

The Kemble Co., Dept. ED, 109 De la Guerra St., Santa Barbara, Calif.

Silicon for Semiconductors 703

These polycrystalline rods are suitable for zone refining to the single-crystal silicon used in power rectifiers, transistors, diodes and other semiconductor devices. They can be converted into single-crystal silicon having a resistivity of 1,000 ohms per cm and a minority carrier lifetime of more than 400 μsec.

Dow Corning Corp., Dept. ED, Midland, Mich.

Price: *$300 per lb.*

Engineering Kit 704

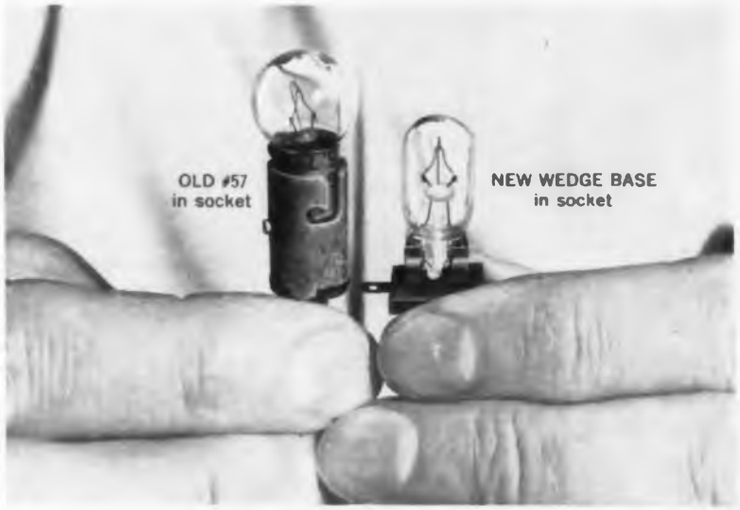
Type UEP-1 kit contains small ferrite E and U cores, bars and pot cores for pulse transformer and other similar applications. The pot cores, for example, measure 0.368 in. in diameter.

Ferroxcube Corp. of America, Dept. ED, Saugerties, N. Y.

Price: *$10.*

Availability: *Immediate.*

NEW G-E "WEDGE BASE" LAMP SAVES SPACE, SAVES MONEY, SAVES TIME, SAVES MANPOWER



The new "Wedge Base", all-glass, incandescent indicator lamp is an exclusive G-E development designed to replace the old #57 and other similar bayonet-based lamps. It's available in 6.3 and 12 volts. See below.

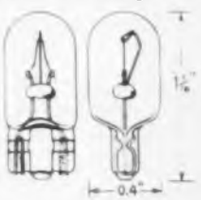
The Wedge Base saves space because, with its holder, it is considerably smaller than the old #57. It saves money because the holder and total installation costs are less. It saves time because the holder is easier to install and the lamp can be seated with just a push. And it saves manpower because installation can be automated and holders can be molded into plastic circuits. The G-E Wedge Base lamp can withstand ambient temperatures up to 600°F because it has no basing cement.

A major automobile manufacturer is already using G-E Wedge Base lamps; they're available in mass quantities. For more information write: General Electric Co., Miniature Lamp Department M-12, Nela Park, Cleveland 12, Ohio.

The Wedge Base is available in two ratings

G.E. Lamp No.	158	159
Circuit Volts	12	6.3
Amperes	0.24	0.15
Design Volts	14	6.3
Rated Av. Life at design volts	500 Hrs	*
Filament	C-2V.	C-2R
L.C.L.	½"	½"
Bulb	T-3¼	T-3¼
Base Type	Wedge	Wedge
Candlepower	2	.35

*In excess of 5000 hrs. at 6.6 volts



Progress Is Our Most Important Product

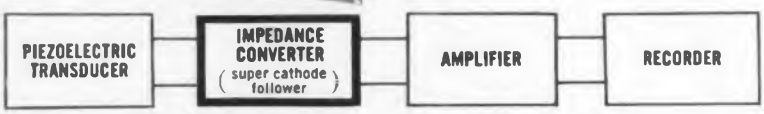
GENERAL ELECTRIC

CIRCLE 138 ON READER-SERVICE CARD

impedance converter:

A CATHODE FOLLOWER FOR GROUNDED PIEZOELECTRIC PICKUPS

NOW...you can buffer piezoelectric transducers, other high impedance signal sources from such instruments as: recorders; preamps; instrument amplifiers and other low Z devices.



Input impedance: 1,000 MΩ.
Bandwidth: 1 cps to 100 kc.
Double isolation: 10,000 MΩ, 4 μμf.
CMR: 130 db to 100 cps.
Driven inner shield of triaxial input allows long input cables.

"The Source for Noise-free Instrumentation"

Write today for our Bulletin **SCE-1**

COMPUTER ENGINEERING ASSOCIATES, INCORPORATED
350 NORTH HALSTEAD
PASADENA, CALIFORNIA
ELGIN 3-7121

CIRCLE 139 ON READER-SERVICE CARD

PROVEN PROCESSES

At Buckbee Mears, photomechanical techniques have been refined and applied to products in the electronic field.

Results are:

- Shadow masks for Color T.V. tubes
- Electroformed mesh for storage display tubes
- Micro Mesh Sieves for particle sizing
- Etched reticles in glass or metal
- Etched metal parts to rigid specifications
- Etched circuits, rigid board or flexible

All of these and many more products are possible through the application of proven processes at Buckbee Mears.

For assistance with your problem, call or write

BUCKBEE MEARS CO.
ST. PAUL 1, MINNESOTA

CIRCLE 140 ON READER-SERVICE CARD

NEW PRODUCTS

Frequency Comparators 552

Standard units have 0.5% accuracy

The FC series frequency comparators produce dc voltage or current output. Standard outputs are 0 to 1 v dc filtered, 0 to 5 v dc filtered, 0 to 50 μamp filtered and 0 to 1 ma unfiltered. Seven models cover the audio frequency range to 14,000 cps. Linearity and accuracy are better than 0.5% of full scale with temperature sensitivities of less than 100 ppm per deg C from −60 to +71 C. These self-contained units meet military and missile requirements.

Pioneer Magnetics Inc., Dept. ED, 850 Pico Blvd., Santa Monica, Calif.

Price: *$125 to $750 ea, 1 to 10 units.*

Availability: *14 days, made on order.*

Instrument Cart 706

This mobile cart consists of a blank rack which holds any standard 19-in. rack-mounted instrument. It may be positioned anywhere in the laboratory. Carts are available in models with panel heights of 12-1/4, 12-3/4 and 21 in.

Perkin Electronics Corp., Dept. ED, El Segundo, Calif.

Casting Resin 707

Type E-200 is for general-purpose potting, encapsulating and casting applications. Viscosity at 77 F is 1,500 to 1,800 centipoises; density is 9.9-lb per gal. Dielectric strength is 430 v per mil.

Melpar, Inc., Dept. ED, 3000 Arlington Blvd., Falls Church, Va.

Price: *$1.70 per lb in lots of 14 lb.*

Availability: *From stock.*

Curing Agent 700

Araldite DP-121 is claimed to offer a longer pot life than other low-viscosity curing agents that are used in solventless systems. It can be cured two to three days after mixing with conventional liquid epoxy resins.

CIBA Products Corp., Dept. ED, Fair Lawn, N. J.

Availability: *Experimental samples can be furnished.*

An important

NEW GUIDE to ELECTRONIC CHEMICALS

of high, defined purity

...may we send you your complimentary copy? Mail coupon below.

More than 40 electronic chemicals of exceptional purity appear in this handy new reference guide. You will find, for example, high purity 'Baker Analyzed' Reagents for semi-conductors...vacuum tubes...ferrites...thermistors.

Do you know that every 'Baker Analyzed' Reagent electronic chemical is labeled with an *Actual Lot Analysis* that defines the degree of purity to the decimal? And that many are labeled with an *Actual Lot Assay* as still a further proof of purity? Do you know that in many of these chemicals copper, nickel and other critical impurities are defined at levels of .1 and .2 parts per million? And that several important solvents are now controlled to meet *stringent resistivity specifications?*

SEND FOR YOUR FREE GUIDE TODAY.

It lists J. T. Baker electronic chemicals controlled to extremely low limits of critical impurities, and includes specification sheets that prove the superiority of 'Baker Analyzed' Reagents for electronic specifications. Fill in coupon now.

J.T.Baker

J. T. Baker Chemical Co.

Phillipsburg, New Jersey Dept. B1

Gentlemen: Please send me my copy of "J. T. Baker Electronic Chemicals."

Name_____

Title_____

Company_____

Street Address_____

City_____ Zone____ State_____

CIRCLE 141 ON READER-SERVICE CARD

CLEAN

Electronic, Electrical, Mechanical Components and Contacts with NO Film or Residue

Cobehn

HIGH-VELOCITY SPRAY-CLEAN TECHNIQUE

APPLICATIONS

Electronic Components & Assemblies: Diodes, Transistors, Slip-Ring Commutators, Crystals, Vacuum Tube Components, Sub-Miniature Assemblies.

Meter & Instrument Components: Instrument Bearings, Jewel Bearings & Pivots, Gear Trains, Lapped Surfaces.

Electrical Contacts: Relays, Vibrators, Voltage Regulators, Sensitive Switches.

FEATURES

No film, residue, or corrosive effect to damage surface, fire and explosion hazard nil, non-polar, non-ionic, an all around safe operation.

For specific information about your critical cleaning problems, send product information and production requirements.

Cobehn Inc.
226 Passaic Avenue
Caldwell, N. J. CApital 6-6675

CIRCLE 142 ON READER-SERVICE CARD

Octal Socket Saver 487

Can be used in relay work

Model SS-11 octal socket saver is designed for installation on tube testers and other electronic equipment to prevent wear and tear of sockets on original equipment. It can be used in relay work and all 11-pin socket applications. Contacts are silver-plated beryllium copper; socket and plug are of mica-filled phenolic type MFE. Maximum height above equipment is 1 in.

Pomona Electronics Co., Inc., Dept. ED, 1500 E. Ninth St., Pomona, Calif.
Price: *$1.56 to $1.95 ea.*
Availability: *From stock.*

SPDT Switch 564

Is Permanently Sealed

These switches have the case-halves sealed together; a flexible silicone boot seals the clearance between the case and the operating button. Designated the A60 series, the units can be furnished with plain button, hinged-lever actuator or hinged roller-lever actuator. They are listed by UL and CSA for spdt operation at 15 amp, 125 or 250 v ac; 3/4 hp at 125 v ac; 1-1/2 hp at 250 v ac.

Unimax Switch Div., W. L. Maxson Corp., Dept. ED, Wallingford, Conn.
Price: *$1.10 to $1.95.*
Availability: *Four to five weeks.*

Reference Amplifer 506

In modular design

Type BBMRA-3 modular reference amplifier has temperature coefficients of 0.005% to 0.002% per deg C. It consists of a diffused silicon mesa amplifying transistor and Zener diodes in one package. Total dissipation at 25 C is 600 mw. Other characteristics are: maximum dc beta of 20 at I_c of 1 ma; V_{ce}, 3 v; maximum I_{cbo} of 2 μa at a V_{cbo} of 15. Emitter to Zener voltage range is 8 to 9 v and base to Zener range is 9.5 to 10.5 at an I_z of 5 ma. Typical dynamic impedance is 120 ohms.

Industro Transistor Corp., Dept. ED, 35-10 36th Ave., Long Island City 6, N.Y.
Price: *$31.40 in lots to 100.*
Availability: *From stock.*

DEVIATION MEASURED

10cps to 125kc

New FM Deviation Meter has carrier frequency range 4—1024Mc, crystal controlled LO enables measurement down to 10cps deviation. Used with a 'scope, it measures peak deviation of complex wave forms. Very easy to operate. Model 791D ***speeds*** deviation measurements.

Carrier Freq. Range:	4—1024Mc, xtal locked
Mod. Freq. Range:	25cps to 35kc
Deviation Ranges:	0-5, 25, 75, 125kc.
Accuracy:	3%. Xtal standardized
Distortion:	Less than 0.2%
21 tubes:	6AK5, 6C4, 0B2, 5651, 6CD6G, 5Z4G, 5647, 6AS6

MARCONI INSTRUMENTS

111 CEDAR LANE • ENGLEWOOD, NEW JERSEY

CIRCLE 143 ON READER-SERVICE CARD

COOLING UNITS

50 WATTS to 50,000 WATTS

SELF-CONTAINED IN STANDARD RACK MOUNTING

These packaged cooling units are completely self-contained and consist of a liquid circulator, the liquid to air heat exchanger, the reservoir, flow and temperature interlocks as required. They transfer the heat from congested locations, where high temperature is detrimental to the operation of other components, to remotely located locations where the heat can be dumped conveniently and where it will not affect the operation of other equipment.

CU-5000 (illustrated) dissipated 5000 watts, is designed to mount in standard 19" rack and the panel is 17" high. Standard Models from 50 watts to 50,000 watts are available.

PRICE

$395.00

EACH

Delivery: 30 days.

For complete information on this and other cooling units write to Dept. C.

Electro IMPULSE LABORATORY INC. | 208 RIVER ST. • RED BANK, N.J. Phone: SHadyside 1-0404

CIRCLE 144 ON READER-SERVICE CARD

FREE 416-PAGE PIC MASTER CATALOG #21
Lists over 12,000 PRECISION INSTRUMENT PARTS and ASSOCIATED COMPONENTS
Available From STOCK!
Completely illustrated with detailed drawings specifications and prices
GEARS • SHAFTS • COLLARS • CLUTCHES • BEARINGS • COUPLINGS • DIFFERENTIALS • SPEED REDUCERS and many other Precision Engineered Parts & Components.
Send for your FREE copy today.
PIC DESIGN CORP.
Subsidiary of BENRUS WATCH COMPANY, Inc.
477 Atlantic Ave., East Rockaway, L.I., N.Y.
CIRCLE 145 ON READER-SERVICE CARD

LepeL
HIGH FREQUENCY INDUCTION
HEATING EQUIPMENT
for Hardening • Annealing • Soldering
Brazing • Zone Refining • Crystal Growing
ELECTRONIC TUBE GENERATORS:
1 kw; 2½ kw; 5 kw; 10 kw; 20 kw; 30 kw; 50 kw; 75 kw; 100 kw.
SPARK GAP CONVERTERS:
2 kw; 4 kw; 7½ kw; 15 kw; 30 kw.
WRITE FOR THE NEW LEPEL CATALOG 36 illustrated pages of valuable information.
LepeL HIGH FREQUENCY LABORATORIES, INC.
55th ST. & 37th AVE., WOODSIDE 77, N. Y.
CIRCLE 146 ON READER-SERVICE CARD

NEW PRODUCTS

DC Power Supply 635

Provides 0 to 50 v dc

This dc power supply provides a continuously adjustable output of 0 to 50 v. Rated output current is 7.5 amp; maximum is 8 amp. When the load current exceeds 8 amp, the output voltage and current are automatically triggered off to less than 25% of set value. Ripple is less than 1 mv rms. Voltage regulation is better than ±0.02% or ±10 m for full load change or rated line change. Input is 105 to 125 v at 50 to 60 cps.

Power Instruments Corp., Dept. ED, 235 Oregon St., El Segundo, Calif.

Price: $895.

Availability: Three weeks.

Carbon-Film Resistors 600

Values are from 30 ohms to 1,000 meg

These miniature, carbon-film resistors are available in values from 30 ohms to 1,000 meg. Maximum working voltage is 15,000 v, standard tolerance is 5% and maximum operating temperature is 125 C. They are housed in glass packages and measure 3/16 in. in diameter and 2-in. long.

Pyrofilm Resistor Co., Dept. ED, Parsippany, N.J.

Block Reader 537

Reads eight characters at once

Type 290 modular reader reads simultaneously eight characters in perforated tape to reduce or eliminate data storage and switching circuits. Applications include check-out and inspection

NOW... A NEW SOURCE FOR SOLID STATE MATERIALS
Pb Te Ga As Bi2 Te3 In Sb Ga Sb Hg Te Cd Te
get the complete facts in this new informative brochure.
ALLOYD UNLIMITED CHEMICALS INC.
CIRCLE 147 ON READER-SERVICE CARD

202
212
253
290
= SUM TOTAL
an EPOCAST EPOXY RESIN FORMULA for any ELECTRICAL INSULATION PROBLEM!
More than 30 different formulas are now in stock to solve your electrical insulation problems. Whether it be an extreme environmental condition or a normal impregnation, encapsulation or coating project, there's a Furane epoxy resin to fit your requirements.
WRITE NOW FOR FREE ELECTRICAL PROPERTIES CHART!
furane plastics INCORPORATED
EPOCAST
WEST COAST/4516 Brazil Street, Los Angeles, California CHapman 5-1151
EAST COAST/42 Chasner Street, Hempstead, Long Island, N.Y.
CIRCLE 148 ON READER-SERVICE CARD

BRAND NEW
COIL BOBBIN
WORK SHEETS

High Quality SMALL BOBBINS in NYLON-DELRIN-KEL F and other engineering thermoplastics

FROM STOCK: scores of bobbins for immediate delivery.
VARIATIONS: simplified design data for modifications of stock items at little or no tooling cost.
TO SPECIFICATIONS: wide design possibilities including miniatures.

Handy reference to help you choose or design the right bobbin. GRC's unique single-cavity techniques assure uniformity and precision. Smooth, flash-free surfaces simplify winding, reduce assembly costs.

NO SIZE TOO SMALL! Maximum sizes—1¼" long .0.3 oz

Send **TODAY** for **SAMPLES** & your **GRC COIL BOBBIN WORK SHEET**

World's Foremost Producer of Small Die Castings

GRIES

GRIES REPRODUCER CORP.
40 Second St. • New Rochelle, N. Y. • New Rochelle 3-8600

CIRCLE 149 ON READER-SERVICE CARD

Tight for Space?
USE ALCO MINIATURES

Available Soon
1/2" Dia. Miniature Rotary Switch Adjustable from 2 to 12 positions*

ALCO MINIATURE TOGGLE SWITCHES

RATING: 5 Amps @ 115 VAC
OVERLOAD: Over 200%
INSULATION: Over 1000 Megs
BREAKDOWN: Over 1000 Volts
LIFE CYCLE: Over 80,000 On/Off Cycles
CASE: Phenol Resin 1/2 x 1/2 x 1/2

SOLID SILVER contacts, terminals and wiping parts. Simultaneous action on D.P.D.T. model. Production Quantities available for immediate delivery.

Shown actual size S.P.D.T. or D.P.D.T.

ALCO MINIATURE PANEL METERS

- SHIELDED MOVING COIL MOVEMENT!
- Single 1/2" hole mounting — for ultra small space!
- Feather-weight — Clear plastic front!
- Available in over 20 standard AC/DC ranges!
- Special scales or ranges to your specifications!

Send for FREE Literature

ALCO ELECTRONIC PRODUCTS, INC.
3 Walcott Ave., Lawrence 21, Mass.

CIRCLE 150 ON READER-SERVICE CARD

systems, machine-tool numerical control systems and storage-system program loading and checkout.

Ferranti Electric Inc., Electronics Div., Dept. ED, 95 Madison Ave., Hempstead, L.I., N.Y.
Price: *$8,100 to $11,000.*
Availability: *90 to 120 days.*

Calibrating System 615

For thermocouple inputs

This conditioner and calibrator is for use in accurate recording of dynamic temperature variations. Automatic four-step calibration can be simultaneous or sequential. Calibration sets the scale for direct reading of temperature into a low-impedance galvanometer regardless of input lead length or resistance.

B & F Instruments, Inc., Dept. ED, 3644 N. Lawrence St., Philadelphia 40, Pa.
Availability: *45 to 60 days.*

Double-Duty Connector 541

Provides multiple connections

Model No. 3000H21AB double-duty connector provides multiple connections to the same terminal. It is basically a female connector for attachment to the male terminals on switches, timers, motors, sockets, relays, solenoids, transformers and junction boards. It incorporates an integral male terminal to which another female connector or double-duty connector can be attached. The connector accommodates wires No. 18 to No. 12 and is available individually or in continuous strips for automatic attachment.

Ark-Les Switch Corp., Terminal Div., Dept. ED, 51 Water St., Watertown 72, Mass.

THIS SPACE RESERVED FOR THE SOLUTION TO YOUR DIODE PROBLEM!

As you create new duties for diodes, Computer Diode Corporation creates new diodes to serve you.

To see how we can develop solutions to your design problems, submit your engineering requirements; we welcome inquiries on special types or special testing.

Standard E.I.A. types? Of course!* But we begin where others leave off, by developing specials to meet the challenging requirements of these high-temperature, low-leakage, fast-switching times.

COMPUTER DIODE
CORPORATION

250 GARIBALDI AVENUE, LODI, N. J.
PRESCOTT 3-2511 • CABLE: CODI LODI

*Send for brochures D-100, D-101, and D-102 for specifications of 95 available E.I.A. types.

CIRCLE 151 ON READER-SERVICE CARD

CML

Three Phase Fixed Frequency or Narrow Band

ELECTRONIC GENERATOR

Model 1451-B

WRITE FOR COMPLETE CATALOG WITH ALL DETAILS AND SPECIFICATIONS

Two outstanding models: For constant loads—the 1451-B featuring automatic amplitude control. For transient loads—the 1451-B-1 featuring adjustable positive feedback to control output regulation.

WHERE DEPENDABILITY IS OF PRIME CONCERN

OUTPUT:
170 VA/PHASE
500 VA TOTAL

SIZE:
28" h X 22" w X 18" d

SHIP. WT.:
310 lbs.

RACK MOUNTED MODELS:
Standard 19" panel with WE notching

CML

COMMUNICATION MEASUREMENTS LABORATORY, INC.

346 LELAND AVENUE, PLAINFIELD, NEW JERSEY

Tel. PL 4-5502

CIRCLE 153 ON READER-SERVICE CARD

FIGHT HEART DISEASE

HELP YOUR HEART FUND—HELP YOUR HEART

NEW PRODUCTS

Linear Transducer 616

Measures position accuracy

This linear transducer is simpler in operation than the familiar differential transformer. It converts a linear position to a signal that can be read out on a meter, but the signal need not be amplified. The device is best suited to measuring deviations of a few thousandths of an inch from mechanical null. The transducer can be furnished separately or in combination with a panel meter or meter relay.

Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

Price: *$95 to $215.*

Time-Delay Relay 586

Repeat accuracy is ±1%

The Dunco 235 frame time-delay relay uses a solid-state static switching-timing element. Stand "on" timing ranges are 1/5 to 18 sec and 2 to 180 sec. Timing is adjustable with a screw driver. Repeat accuracy is ±1% with constant voltage. The dpdt load contacts are rated at 10 amp at 115 v ac, resistive, and have an expected life of 20,000,000 mechanical operations.

The Harry P. Bridge Co., Dept. ED, 1201 Chestnut St., Philadelphia 7, Pa.

Variable-Frequency Generator 609

Frequency range is 1 to 100 kc

This 2-kw variable-frequency ultrasonic generator has a frequency range of 1 to 100 kc with an output of 2 mc available on special order. Power output is continuously variable from 0 to 2,000 w at 1 to 50 kc and to 1,200 w at up to

AiResearch integrated environmental conditioning of aircraft fire control systems achieves high effectiveness while reducing space and weight requirements.

Representative of AiResearch progress is this air-to-air environmental conditioning package which uses the integral heat exchanger and cold plate cooling unit as the base and mounting frame of the pressurized enclosure for the fire control system transmitter. Net weight of this unit is 9.5 lb. with a heat rejection of 425 watts.

This example illustrates the important economies which can be achieved when AiResearch is contacted early in the design stage of electronic systems.

Environmental conditioning equipment has been produced for the following electronic systems:

Detection · Communication · Control · Ground Support · Guidance

Write for literature today.

THE GARRETT CORPORATION

AiResearch Manufacturing Division

Los Angeles 45, California

CIRCLE 154 ON READER-SERVICE CARD

TIME-SAVING GUIDE FOR...

SPECIFYING DEFLECTION YOKES

Helps speed your project. Eliminates confusion in choosing the right yoke.

Engineers have saved countless hours, many dollars and numerous headaches by using this simple Guide Sheet For Specifying Deflection Yokes.

Offered as a public service to engineers by SYNTRONIC INSTRUMENTS, INC., YOKE SPECIALISTS, the only firm devoted primarily to deflection yoke manufacture; therefore preeminently qualified to help you specify the correct yoke for your application. Complete line for every military and special purpose—in production quantities or custom designed to your specific requirement.

Phone our nearest rep. today for your Time-Saving Guide Sheet.

New York Area: Jules J. Bressler Co.
Phone: N.Y. OXford 5-0255;
N.J. UNion 4-9577

Philadelphia Area: Massey Associates
Phone: MOhawk 4-4200

Washington-Baltimore Area: Massey Associates
Phone: GRanite 4-2071

Indianapolis: Joe Murphy
Phone: Victor 6-0359

Los Angeles: Ash M. Wood Co.
Phone: CUmberland 3-1201

No obligation. We are glad to help you.

syntronic

INSTRUMENTS, INC.

100 Industrial Road, Addison, Illinois
Kingswood 3-6444

CIRCLE 155 ON READER-SERVICE CARD

100 kc. The standard unit has a choice of ten impedances from 3 to 200 ohms; output transformers can be furnished for higher values. Input power requirement is 5 kw at 230 v, 60 cps, single phase. The unit is designed primarily for research and development work.

International Ultrasonics, Inc., Dept. ED, 1697 Elizabeth Ave., Rahway, N. J.

Rotary Commutators 613

Expected life is 2 x 10^7 cycles

These rotary commutators have a life expectancy in excess of 2 x 10^7 cycles at speeds in excess of 2,000 rpm. They are designed for analog-digital conversion, telemetry, sampling, scanning, programing and pulsing. Commutating surfaces are engaged by special broom-type multiple-strand brushes for minimum noise. Gold or rhodium-plated contacts imbedded in epoxy resin are used.

Airflyte Electronics, Dept. ED, 535 Avenue A, Bayonne, N.J.

Availability: *Three to four weeks in prototype quantities.*

Rate Gyro 548

Is spring-driven

This rate gyro is for applications where immediate, short-term data monitoring is required; it is recommended for expendable drones, missiles and special test applications. Power-time requirement is about 0.2 w-sec. Firing is accomplished by a solenoid-actuated release. The unit operates at temperatures of 0 to 55 C, at an altitude of 25,000 ft and under vibration conditions specified by MIL-E-5272. Weight is about 15 oz.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego 6, Calif.

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 156 ON READER-SERVICE CARD

SWITCHES

FOR AIRBORNE & MISSILE GROUND SUPPORT EQUIPMENT

FAST, POSITIVE ACTION
LONG SERVICE LIFE • MOISTURE-PROOF

ELECTRICAL DOT ASSEMBLIES

A broad line of sinusoidal toggle spring switches designed for compactness, light weight and high reliability in airborne and ground support missile control systems. Extremely fast, audible, double break action reduces arcing and contact wear to negligible minimum. Positive snap action mechanism cannot be teased on or off contact. All contacts made of heavy coin silver for long life and low contact resistance. Available with color coded buttons. These switches exceed military requirements for vibration, shock, humidity and corrosion resistance.

Western Distributor: Western-Electromotive, Inc., Los Angeles.

The UCINITE COMPANY
Division of United-Carr Fastener Corporation, Newtonville 60, Mass.

CIRCLE 157 ON READER-SERVICE CARD

NEW TANSITOR 125C TANTALUM CAPACITORS

CUT CASE SIZE 15%

High reliability at 125C is a key feature of TANSITOR'S new TH-type foil capacitors. But they also provide average savings of 15% in case size over similar high temperature tantalum capacitors.

In short, they give you the most capacitance in the least space of any 125C tantalum foil capacitors. Their specifications also coincide with the new military specification MIL-C-3965-15 through 18.

	Plain Uninsulated	*Plain Insulated*	*Etched Uninsulated*	*Etched Insulated*
Polar	CL 30	CL 31	CL 20	CL 21
Non-Polar	CL 32	CL 33	CL 22	CL 23

COMPLETE LINE AVAILABLE

TANSITOR ELECTRONICS specializes in tantalum capacitors. Wire, foil, or solid types with operating ranges from −80 to +125C, voltages from 1 to 300 and capacitances from 0.0047 to 600 microfarads are available. For full details on the new TH or other TANSITOR tantalums, write TANSITOR ELECTRONICS, INC., Dept. 11, West Road, Bennington, Vermont.

TH CAPACITOR CHARACTERISTICS

• Non-acid electrolyte • Single case, double sealed
• Low leakage current • Long shelf life
• Long life at 125C

TANSITOR
ELECTRONICS INCORPORATED
Where Reliability Comes First
Tantalum Capacitors

CIRCLE 159 ON READER-SERVICE CARD

STAR STAINLESS HANDLES & HINGES

Pull and Drop-type Rod Handles. Hospital-type, Welded Fixed Pin and Loose Pin Butt Hinges; blanks and with hole piercings.

RIGHT OFF THE SHELF®

Special Hinges in Steel, Brass and Aluminum made to order.

These are just two lines in Star's stock of stainless steel fastenings and hardware listed in our 1960 Catalog.

STAINLESS STEEL 300 & 400 Series.
• BOLTS & NUTS • WASHERS • PINS • AN & MS FASTENERS.

Send for YOUR Catalog today, letterhead please.

New Catalog Now Ready.

CORROSION RESISTANT

STAR STAINLESS SCREW CO.
663 Union Blvd., Paterson 2, N. J.
Phone: CLifford 6-2300•TWX = LTFSNJ-1382
Direct New York phone: WIsconsin 7-6310
Direct Philadelphia phone: WAlnut 5-3660

CIRCLE 160 ON READER-SERVICE CARD

DOUBLE DISC GRINDING SERVICE

Don't waste your time & don't spend a fortune to get, at best, inferior results by using obsolete methods such as: Fly cutting, face turning & surface or face grinding.

LET US QUOTE on all your parts requiring
TWO FLAT & PARALLEL SURFACES

Your tolerances, materials and shapes won't scare us, but they may affect our prices! Talking about prices, we're sure that by our doing the job the **right way** we won't have any competition from anyone doing it the **hard way**.

NORMAL SIZE LIMITATIONS
Round Discs & Rings from ⅛" dia. to 30" dia.
Rectangular Plates up to 14" x 24".
Square Plates up to 16" x 16"
Thickness from .010" to 3".

WRITE FOR BROCHURE BEFORE NEXT TUESDAY
or contact P. D. Allen

PRECISION DISC GRINDING CORP.
255 E. 2nd St., Mineola, N. Y. • Pioneer 7-5450
West Coast Plant:
1044 W. Hillcrest Blvd., Inglewood, Cal. • ORchard 3-1317

CIRCLE 161 ON READER-SERVICE CARD

NEW LITERATURE

Switches 261

This 16-page brochure gives characteristics of the firm's line of switches. Included are miniature-enclosed and miniature-open switches, stack-type switches, spdt switches, a general-purpose switch, a light-force switch and an open subminiature-type switch. Variations on each of the basic types of switches are illustrated. Dimensional diagrams are included. Cherry Electrical Products Corp., 1650 Deerfield Rd., Highland Park, Ill.

Strain-Gage Accelerometer 262

Bulletin 4202, two pages, describes type 4-202 temperature-compensated strain-gage accelerometer. Mechanical, electrical and physical specifications and a dimensional diagram are given. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Test Instrument Compendia 263

This four-page brochure is a list of booklets that contain physical dimensions, weight and price for all power supplies, signal sources, measuring instruments, and af, rf and microwave devices manufactured in America. Prices of these booklets range from $1 for swr meters to $14.25 for laboratory supplies. Booklets on power supplies include: high current supplies, laboratory supplies, ac supplies and special purpose supplies. Signal sources include signal generators, oscillators, pulse generators, sweep generators, noise generators, and square wave and function generators. Frequency, time and phase measurement devices include frequency meters, frequency counters, phase meters, phase shifters and time delay units. Current, voltage and power measurement devices include multimeters, vtvm's lab type meters, digital voltmeters, wattmeters and field strength meters. Waveform measurement devices include oscilloscopes, oscillographs, wave analyzers and distortion meters, spectrum analyzers, receivers and amplifiers. Af, rf and microwave devices include terminations, directional couplers, attenuators, isolators, variable filters and swr meters. Technical Information Corp., 41 Union Square, New York 3, N.Y.

Variable Resistors 264

Bulletin 42-944, two pages, describes the six basic types and 60 models of the model 7 linear-motion variable resistors. Physical dimensions and electrical and environmental characteristics are given. Centralab, Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Basic Switches 265

Data sheet No. 181, two pages, describes type E basic switches. It gives mounting dimensions, operating and electrical characteristics and pricing information. Variations in terminal designs, actuators, and operating characteristics are shown. Micro Switch, Freeport, Ill.

Kmc Oscilloscope 266

Bulletin A-2023, eight pages, describes type 519 calibrated, high-speed, laboratory kmc oscilloscope. Specifications, block diagrams and performance data are given. Schematic diagrams and waveform patterns for various measurement applications are included. The unit is designed for observation, measurement and photographic recording of wideband phenomena. Tektronix, Inc., P.O. Box 500, Beaverton, Ore.

Gyros 267

The theory of gyroscopes is discussed in this 44-page publication. Performance, application, construction, and testing information on rate, rate integrating, free, vertical, and directional gyros and on accelerometers are provided. Descriptions, illustrations, and tabulated specifications of the firm's models appear. A chapter of this book on stable platforms appeared in *ED*, Sept. 14, 1960 in an article entitled "System Applications of Ferrite Devices." Also included is a section of reference data containing commonly encountered constants and a table of LaPlace transformations. Kearfott Div., General Precision, Inc., 1150 McBride Ave., Little Falls, N.J.

Logic Trainer 268

This four-page brochure describes how application of a large selection of logic diagrams can be visually traced and demonstrated on the firm's self-contained logic trainer. The trainer can be used in classroom or lab for studying basic and complex operations of various circuits. Epsco, Inc., 275 Massachusetts Ave., Cambridge 39, Mass.

Quality Control Manual 269

This 35-page booklet desribes the firm's quality control program based on MIL-Q-9858 procedures. The 14 chapters are: introduction, inspection procedures, government source inspection, receiving of purchased items, inspection instructions, inspection records, drawing change control, material review, indication of inspection status, rejected devices, shipping, packing and packaging, definitions, forms and list of inspection equipment. National Connector Corp., 311 Fifth Ave., N., Minneapolis, Minn.

Amazing NEW Pencil-Type Epoxy offers almost unlimited applications to industry

For the first time . . . a single component epoxy in stable stick form. The New Cetron Epoxy Pencil offers a simple solution for most problems involving bonding, cementing, sealing and insulating. In pencil-stick form, the new epoxy is handy to use. In many instances it offers the only practical means of applying epoxy to minute objects and hard-to-get-at places.

The New Cetron Epoxy Pencil is always ready for use . . . requires no refrigeration or special storage . . . nothing to mix. The New Cetron Epoxy Pencil is simple to apply . . . cures fast to a tough, permanent waterproof bond . . . unaffected by most oils and solvents.

WRITE FOR FURTHER INFORMATION

CETRON ELECTRONIC CORPORATION
Plastics Division
2265 E. Foothill Blvd., Pasadena, California

CIRCLE 162 ON READER-SERVICE CARD

MODEL 4005 with AMBITROL V-1

CONSTANT VOLTAGE
CONSTANT CURRENT
from the **SAME TERMINALS!**

$143.50 F.O.B. FACTORY

Other Models Available Write For Catalog

MODEL 4005 is a 40 volt, 500 ma, regulated DC power supply incorporating AMBITROL,* a transistorized regulator permitting continuous control of voltage or current to .05% with *adjustable automatic electronic crossover* to either voltage or current regulation.

*TM

Power Designs inc.
1700 SHAMES DRIVE
WESTBURY, NEW YORK
EDgewood 3-6200 (LD Area Code 516)

CIRCLE 163 ON READER-SERVICE CARD

NOW! NEW LOWER PRICED COIL FORMS

Interchangeable with industry standards

Thermosetting epoxy cement permanently positions collars and lugs to withstand severe shock under high temperature (250°C). Available in any lug configuration. Completely rustproof and moisture resistant. Ceramic conforms to Grade L5 JAN-I-10 silicone impregnated. Lightweight aluminum bushing. Silicone fibre glass washers. Unique built-in dependable tension device guarantees vibration-proof, smooth tuning. Nickel-plated parts conform to MIL-P-5879 QQ-N-190. Diameters: .205, .260, .375, .500. Frequencies: .1-1.5 mc, .5-10 mc, 10-30 mc, 30-50 mc, 30-150 mc, 50-200 mc, and brass slugs. Write for quotes and bulletin CF-860.

Waters MANUFACTURING, INC. WAYLAND, MASS.

ALSO AVAILABLE IN EXCLUSIVE RIBBED DESIGN

CIRCLE 164 ON READER-SERVICE CARD

A Variety OF WAVEFORMS...

now available to your requirements!

THE
tensor
5846 ARBITRARY
FUNCTION GENERATOR

$495.00 F.O.B.
Brooklyn, N.Y.

In addition to producing standard sine, triangular and square waveforms, the Model 5846 can generate arbitrary functions as desired by changing cam shapes.

Specific waveshapes are quickly formed by inserting appropriate cams into the instrument. Cams for desired functions are available from the factory, or can be easily constructed from enclosed instructions.

Tensor's Arbitrary Function Generator comes equipped with two cams... one for sine wave... one for triangle wave. The square wave, at the function frequency, is of adjustable phase and symmetry. It is always available regardless of the function being generated.

APPLICATIONS:

The Tensor Arbitrary Function Generator is extremely flexible because of (1) the infinite variety of waveforms that can be produced, (2) the wide frequency range and (3) provision for suppressed carrier modulations. Listed below are typical applications:

AC or DC servo testing
Vibration machine programming
Medical electronics
Input to analogue devices
Process control testing
Any application where electrical simulation of mechanical, physiological, biological or hydraulic functions is desired.

SPECIFICATIONS:

Frequency Range: .001 to 10 cps in four ranges

Output Voltage: 10 volts peak to peak, adjustable

Load Requirements: 10K or greater

Output Function: Cams supplied for sine and triangle waveforms

Sine Wave Distortion: 3% harmonic

Triangle Wave Distortion: ±3% deviation from a straight line

Power Requirements: 50 watts at 115 VAC 60 cps

tensor ELECTRIC DEVELOPMENT COMPANY, INC.

Engineers Bldg. 1295 Northern Blvd., Manhasset, N.Y. • MA 7-7220

CIRCLE 165 ON READER-SERVICE CARD

NEW LITERATURE

Frequency Measurement 270

In five pages, this application note, No. 2, presents methods of frequency measurement by using high-speed electronic counters and various accessories. Principal accessories include transfer oscillators and harmonic mixers, which, when combined with the counters, extend the measurable frequency range up to 18 kmc and above. Useful charts and diagrams summarize equipment applicable to the various frequency ranges and show typical instrument arrangements in each range. Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto, Calif.

Electronic Switches 271

Data sheet 177, two pages, describes electronic switches that eliminate spurious voltage pulses caused by contact bounce. They are for use with high-speed electronic components that operate in less than a microsecond. Characteristics and mounting dimensions are given. Micro Switch Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Vibration Equipment 272

Bulletin 420G, 16 pages, describes the firm's line of products that produce, measure and control vibration. It gives the principles of vibration testing and specifications for electrodynamic vibration exciters, electrohydraulic shaker systems, electronic power supplies and sine and random motion electronic control consoles. The booklet includes sections on vibration pickups and vibration meters used in testing engines, missiles, rockets and equipment subject to vibration. The final section contains information on vibration isolating Isomode pad and engine, machinery- and shipping-container mounts. MB Electronics, 781 Whalley Ave., New Haven 8, Conn.

Sealed Components 273

Bulletin 760, six pages, describes hermetically sealed crystals, ovens and associated components. Diagrams and application information are given. Northern Engineering Laboratories, 372 Wilmot Ave., Burlington, Wis.

ALL Digits Can Be Read from Any Angle

IN-LINE DIGITAL READOUT

featuring

ONE-PLANE PRESENTATION

Over 1000 firms throughout the world in just a few years prove unprecedented acceptance of IEE digital readouts.

Series 10000

PRICE COMPLETE $18.00

QUANTITY PRICES ON REQUEST

The IEE digital readout puts the digit right up front, visible from any angle. Vision is unimpaired by stacked characters and sharp, clear-white digits provide high-contrast, error-proof reading. Use of words, color, and multiple projections offer utmost versatility

WRITE TODAY FOR COMPLETE SPECIFICATIONS.

Binary-To-Decimal Decoders Available.

Representatives in Principal Cities

INDUSTRIAL ELECTRONIC ENGINEERS, INC.

Engineers and Manufacturers of Fully Automatic Systems and Digital Readouts

5528 Vineland Avenue, North Hollywood, California

CIRCLE 166 ON READER-SERVICE CARD

Trimmer Potentiometers 274

This four-page folder gives details of function, specifications, capacity and other specification information on Daystrom trimmer potentiometers. Information is given in tabular form. Schweber Electronics, 60 Herricks Road, Mineola, L.I., N.Y.

Metals For Base Tabs 275

This data sheet No. 107-A describes and illustrates the physical properties of partially coated metals used as base tabs in the manufacture of transistors, or as a solder-coated part acting as its own preform. Dimensional ranges of base materials and full or partial coatings are listed. Alpha Metals, Inc., 56 Water St., Jersey City 4, N.J.

Printed-Circuit Board 276

Data Sheet No. 9-60, two pages, describes Econo-Grid, a paper-base, epoxy, printed-circuit board. Applications, available stock sizes and prices are given. Erie Resistor Corp., Elgin Laboratories, Inc. Div., Waterford, Pa.

Sweep Generators 277

Data Sheet No. T-203B, four pages, describes sweep generators used for television receiver alignment and production. Specifications for uhf and vhf application are given. A table of marker frequencies in megacycles is included. Telonic Industries, Inc., Beech Groove, Ind.

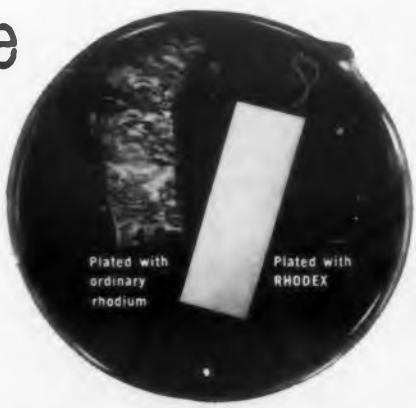
Computing Resolvers 278

This 16-page, illustrated monograph describes the characteristics of computing resolvers. Properties and techniques of measurement are explained. Applications include system calculation and competitive evaluation. Theta Instrument Corp., 520 Victor St., Saddle Brook, N.J.

Wirewound Potentiometers 279

This six-page brochure describes precision wirewound potentiometers and turns counting dials. Specifications and dimensional mounting diagrams are given. Spectrol Electronics Corp., 1704 S. Del Mar Ave., San Gabriel, Calif.

Rhodium Plate Won't Curl, Crack or Peel!



Sel-Rex®

RHODEX

produces compressively stressed deposits

assuring crack-free, peel-free service. Here's proof! The photograph demonstrates the high tensile stress of conventional rhodium electroplate and the CS of RHODEX. Dissolving the basic metal caused the conventional rhodium electroplate to disintegrate into small crystalline flakes. The Sel-Rex RHODEX electroplate remained unimpaired, and in a continuous film. RHODEX does not peel or crack regardless of thickness! Write for details.

SEL-REX CORPORATION

NUTLEY 10, NEW JERSEY

Sel-Rex®

The world's largest selling precious metal electroplating processes

CIRCLE 167 ON READER-SERVICE CARD

HST*

Type TT

Built and tested to meet MIL T-27A, Class R, Grade 5 Specifications, the type TT miniaturized transformers are ideally suited for transistor circuits. In addition, frequency response ratings are based on military specifications.
The exceptional reliability, low distortion and high efficiency of these units combine for excellent performance.

TRANSFORMERS

24 Hour Delivery

* Dresser Electronics
HST Division

ARCO electronics inc.
Transformer Division,
Community Drive, Great Neck, New York • HUnter 7-0500

BRANCHES:

LOS ANGELES
ARCO CAPACITORS INC.
1548 So. Robertson Blvd., Los Angeles 35, Calif.
CRestview 1-1151

DALLAS
ARCO ELECTRONICS INC.
1339 Crampton St., Dallas 7, Texas
RIverside 8-0648

CIRCLE 168 ON READER-SERVICE CARD

THE POLYSKOP, Type SWOB

A SWEPT FREQUENCY MEASURING SYSTEM THAT:

- Displays two separate quantities (gain, attenuation, impedance, mismatch) as a function of frequency.
- Makes possible study of four terminal networks.
- Represents a complete measuring system with calibration standards (precision attenuator in steps of 1 and 10 db, crystal frequency marker of 1, 10 and 50 mc), electronic switch and large screen scope.
- Eliminates uncontrollable error sources.
- Is ideal for measurements of single tuned circuits, band pass filters, multi-section filters, RF, video and wide band amplifiers, discriminators, TV receivers, etc.
- Determines insertion loss and frequency characteristics of attenuators.
- Mismatch of cable connectors, terminating resistors, antennas.
- Mismatch and discontinuities in coaxial cables.
- Combined with the SELECTOMAT, type USWV, the POLYSKOP has a dynamic range of 80 db.
- Range 500 kc to 400 mc.
- Sweep width continuously variable from ±0.2 to ±50 mc.
- Flatness of output level 0.1% per mc.

Write for detailed description of our select line of unique instruments. 8-page brochure POLYSKOP — 4-page data sheet SELECTOMAT

ROHDE & SCHWARZ
111 Lexington Ave., Passaic, New Jersey
Telephone: PRescott 3-8010
Cable Address: ROHDESCHWARZUSA

CIRCLE 169 ON READER-SERVICE CARD

AUTOMATIC DECISION DEVICES

precision **GO**..NO-GO
voltage comparators

various models to choose from **vacuum tube or transistorized**

model 3T

APPLICATIONS:
Automatic Go... No-Go Testing
Automatic Decision Making
Automatic Checkout Circuits
Automatic Control
Automatic Voltage Calibration

MORE SENSITIVE & PRECISE THAN METER RELAYS

Comparative sensitivity—**better than 1 millivolt**
Repeatability of trip point—**better than 50 microvolts**
Output—**relay contacts for external connections**

write for free Engineering Guide to Dept. ED

Additional Products:
MODULAR AUTOMATIC TESTING EQUIPMENT and COMPLETE AUTOMATIC TESTING SYSTEMS.
write for literature.

OPTIMIZED DEVICES, INC.
ROgers 9-6110
864 FRANKLIN AVE.
THORNWOOD, N. Y.

CIRCLE 170 ON READER-SERVICE CARD

NEW LITERATURE

Digital Circuitry 280

This eight-page brochure explains how to increase the work capacity of personnel through application of packaged logic circuits. It emphasizes that digital circuitry can be readily utilized to satisfy the needs of small as well as large systems. Epsco, Inc., 275 Massachusetts Ave., Cambridge 39, Mass.

Data-Processing Systems 281

This illustrated 28-page booklet describes more than 12 major data-processing systems controlled automatically by the firm's business machines. Tape-operated machines described include the firm's Flexowriter for document writing, Computyper for invoicing, Teledata for code transmission, Collectadata for collecting work data and Selectadata auxiliary unit for data selection-readout. Friden, Inc., 1 Leighton Ave., Rochester 2, N.Y.

Pilot Light Handbook 282

This 256-page handbook of pilot lights contains a Lamps Section which describes 15 types of incandescent lamps and six types of neon glow lamps. Following sections are in categories by particular lamp type. The text covers specific assemblies designed to receive the lamps. Illustrations, dimensions, lens styles, finishes, optional features and mounting clearance holes are given. An eight-page catalog number index is provided as a numerical cross reference for use with the handbook. Write for handbook application form to Dialight Corp., 60 Stewart Ave., Brooklyn 3, N.Y.

Induction Potentiometer Transducers 283

Bulletin S-606, two pages, describes models UH-16 and UH-18 induction potentiometer transducers. The illustrated bulletin gives electrical, mechanical and dimensional specifications for both units. Servonic Instruments, Inc., 640 Terminal Way, Costa Mesa, Calif.

High-Voltage Pentode 284

Illustrated bulletin 2158-9, four pages, describes type 7683 high voltage pentode. Dimensional and schematic diagrams illustrate typical circuits in which the pentode can be used as a series regulator or as a shunt regulator. Curves give transfer, screen and plate characteristics. Electrical and mechanical data are listed in tabular form. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

THIS CARD IS AN ADDED SECRETARY

Like a good secretary, *Electronic Design's* reader service card works quickly and efficiently to obtain the information you request. Cards now bear AIR MAIL prepaid postage for western areas, but even more important, your requests are forwarded to advertisers within ONE DAY OF RECEIPT. Special pre-typed labels also help to cut down the time required to get the data you want in the mail and on its way back to you.

Another Improved Reader Service . . . Only Available in

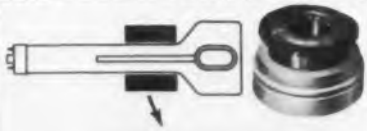
ELECTRONIC DESIGN
a HAYDEN publication
New York • Chicago • Los Angeles
London

a **spot** is a **spot**
is a high
resolution **spot**
with
CELCO YOKES

● **Celco YOKES**
keep spots **smallest**

● **Celco YOKES**
keep spots **roundest**

● **Celco YOKES**
keep spots **sharpest**



Use a **CELCO DEFLECTION YOKE** for
your high resolution applications.

In a **DISPLAY SPOT?** call **Celco!**

Celco
Constantine Engineering Laboratories Co.

Main Plant: MAHWAH, N. J. DAvis 7-1123
• Pacific Division - Cucamonga, Calif. - YUkon 2-2688

CIRCLE 172 ON READER-SERVICE CARD

Transistorized Mixer 285

Type RA-1627 transistorized mixer for audio recording is described in this illustrated, four-page brochure. Electrical and mechanical characteristics of the modularized unit, photographs, graphs and schematics are included. Litton Industries, Westrex Recording Equipment Dept., 6601 Romaine St., Hollywood 38, Calif.

Continuous Facsimile Recorder 286

This illustrated eight-page brochure describes model RJ continuous facsimile recorder for weather maps, charts and other pictorial data sent by radio. Specifications for this self-contained unit are given. Litton Industries, Westrex Communications Equipment Dept., 540 W. 58th St., New York 19, N.Y.

Short Form Semiconductor Catalog

This short form catalog, 24 pages, describes and illustrates over 800 semiconductor devices. Ratings and characteristics are given for silicon glass diodes; silicon small power, medium power and high-power rectifier cells; high-voltage cartridge rectifiers; Zener diodes and reference elements; silicon-controlled rectifiers; silicon and selenium rectifier stacks; silicon solar cells; and selenium contact protectors. A listing of JEDEC rectifier types with cross reference to device classification, rating and page number is included. *Write on company letterhead to International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.*

Guidance System Components 287

This folder illustrates guidance system components and describes the firm's facilities and equipment. The firm specializes in mechanical prototypes, mechanical development, electromechanical instruments, assemblies and component part production. General Machine and Instrument Co., 125 Clinton Road, Caldwell, N.J.

Automatic Lathes 288

This folder contains three brochures describing model 30 automatic lathes. Bulletins LO-6017, LO-6018 and LO-6010, 16, 12 and 12 pages, respectively, give specifications for the three lathes. Model 30-2D is for chuck work, model 30 is for work supported on centers using a tailstock, and model 30-60 is for a combination of a variety of machine components. Photographs and diagrams are included. Jones & Lamson Machine Co., Springfield, Vt.

CIRCLE 173 ON READER-SERVICE CARD

CIRCLE 174 ON READER-SERVICE CARD

Cutting Your Reading Time in Half

Cutting Your Reading Time in Half

MANY designers, technicians and executives in the electronic industry are now using only about 20 per cent of their reading capacities. The general reading rate of the average businessman is less than 250 words per minute. Slowness in reading speed can be directly attributed to reading word-by-word, at a rate not much faster than one can talk—and try talking faster than 250 words a minute. Since your work is of a technical nature, you are probably reading even slower and carrying this same speed over to all your reading.

As different purposes in driving a car require different shifts, so do different types of material in reading require different techniques. For instance, the average person will read a light novel only slightly faster than a highly technical report. The skilled reader, on the other hand, will adapt his speed to the nature of the material. This series of articles will show you many of the techniques necessary to become a skilled reader.

How Fast Do You Read At the Present Time?

To find out how you compare to the average reader, turn to the article "Microwaves: Typical Year Upcoming" on page 32, which contains 2,000 words. Use a clock or watch with a second hand and note starting and finishing time. Divide total number of minutes into 2,000 to discover your word-per-minute reading rate.

Do not be alarmed if your reading rate is well below 250 words per minute, as every person

Busy designers have more reading to do than ever before and less time in which to do it. To help you keep up with this flood of printed matter, a series of articles will present suggestions to double your present speed.

varies, and you are capable of the same increases as the person reading at above average speeds. At the end of this series of articles we will give you another exercise to check your success with the new techniques.

Phrase Reading Is Road To Better Reading

The basis of better reading is phrase reading; reading meaningful units rather than isolated words. When you read a line of print you have

the feeling that your eye sweeps smoothly across the page. Actually, your eyes make a series of stops on the line. The skilled reader makes few of these stops, and he makes them smoothly as shown by the numbers in the following lines:

1 2
Reading word by word is a condition
3 4
that can cause a slow reading rate
5 6 7
even though comprehension ability is good.

The eye pattern of the average reader might look like this:

1 2 3 4 5
Contrary to common belief comprehension
6 7 8
increases with speed.

Your eyes do not pick up words while in motion, as for example, a motion-picture camera does. Rather, they have to get a series of "stills," as they move from left to right, starting and stopping across the line.

To acquire the phrase-reading habit, you must develop an awareness of thought units. The phrase-circling method is the first step toward this awareness. Take a pencil and draw a circle around each phrase in this article. These need not be grammatical clauses, but simply groups of words containing meaning in themselves, answering, for example, the questions "who," "what," "why," "when," "where," etc.

After you have circled a few phrases, mark a small dot or "x" slightly above, and in the center

Advancement Your Goal? Use CONFIDENTIAL Action Form

ELECTRONIC DESIGN's Confidential Career Inquiry Service helps engineers "sell" themselves to employers—*as confidentially and discreetly as they would do in person.* The service is fast. It is the first of its kind in the electronics field and is receiving high praise from personnel managers.

To present your job qualifications immediately to companies, simply fill in the attached resume.

Study the employment opportunity ads in this section. Then circle the numbers at the bottom of the form that correspond to the numbers of the ads that interest you.

ELECTRONIC DESIGN will act as your secretary, type neat duplicates of your application and send them to all companies you select—*the same day the resume is received.*

The standardized form permits personnel managers to inspect your qualifications rapidly. If they are interested, they will get in touch with you.

Painstaking procedures have been set up to ensure that your application receives complete, confidential protection. We take the following precautions:

- All forms are delivered unopened to one reliable specialist at *ELECTRONIC DESIGN*.
- Your form is kept confidential and is processed only by this specialist.
- The "circle number" portion of the form is detached before the application is sent to an employer, so that no company will know how many numbers you have circled.
- All original applications are placed in confidential files at *ELECTRONIC DESIGN*, and after a reasonable lapse of time, they are destroyed.

If you are seeking a new job, act now!

ELECTRONIC DESIGN CAREER INQUIRY SERVICE

USE BEFORE FEB. 15, 1961

After completing, mail career form to *ELECTRONIC DESIGN*, 830 Third Avenue, New York, N. Y. Our Reader Service Department will forward copies to the companies you select below.

(1)

(Please print with a soft pencil or type.)

Name _____ *Telephone* _____

Home Address _____ *City* _____ *Zone* _____ *State* _____

Date of Birth _____ *Place of Birth* _____ *Citizenship* _____

Position Desired _____

Educational History

College	*Dates*	*Degree*	*Major*	*Honors*

Recent Special Training _____

Employment History

Company	*City and State*	*Dates*	*Title*	*Engineering Specialty*

Outstanding Engineering and Administrative Experience _____

Professional Societies _____

Published Articles _____

Minimum Salary Requirements (Optional) _____

Use section below instead of Reader Service Card. Do not write personal data below this line. This section will be detached before processing.

Circle Career Inquiry numbers of companies that interest you

900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924
925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949

SELECTIVE OPPORTUNITIES AT MOTOROLA—PHOENIX—FOR

--TEST EQUIPMENT CIRCUIT DESIGN ENGINEERS

SYSTEMS TEST EQUIPMENT DESIGN, CONVENTIONAL OR TRANSISTORIZED. FAMILIARITY WITH TECHNICAL SUPERVISION, OR T.E. MAINTENANCE AND CALIBRATION, OR T.E. CONSTRUCTION REQUIRED. E.E. DEGREE PREFERRED.

--TRANSDUCER DESIGN ENGINEER

SUPERVISE DEVELOPMENT NEW LINE INDUSTRIAL TRANSDUCERS.

--RADIO FREQUENCY INTERFERENCE ENGINEER

CONSULTANT TO PROJECT AND SUBCONTRACTORS. EXPERIENCE LOW THROUGH MICROWAVE FREQUENCIES AT SYSTEMS LEVEL.

WRITE BOB WORCESTER, DEPT. 102 AT ADDRESS BELOW.

THE E.E. WHO IS FINDING FULFILLMENT

With a B.S. degree (E.E.) from the University of Texas, 1950, he took his first job in industry but found it lacked security. His second job — with the guided missile division of a large corporation — offered security but lacked the growth potential he sought. In 1957 he applied to MOTOROLA. Pains were taken to place him in a job that would utilize his talents to the fullest — give him the challenge needed. Today, he is Project Leader of an Electronic Design Group in MOTOROLA's Military Electronics Division. His case is typical of advancement at MOTOROLA. For it is our policy to exercise extreme care in professional personnel placement. By doing so, we help scientists and engineers find continuing fulfillment — and thus strengthen MOTOROLA's capability to serve the nation.

EQUAL OPPORTUNITY

MOTOROLA

MILITARY ELECTRONICS DIVISION, WESTERN CENTER

8201 E. McDowell Road, Scottsdale, Arizona

Motorola also offers opportunities at Riverside, California and Chicago, Illinois.

CIRCLE 901 ON CAREER INQUIRY FORM

4 Vital, Rewarding Positions

For Creative Engineers with Project BMEWS

RCA offers electronics engineers truly creative assignments on the most complex and challenging radar/data processing system ever undertaken—BMEWS. Engineers capable of meeting the challenge of this prime defense effort will find these opportunities both stimulating and rewarding.

FIELD-STRENGTH MEASUREMENT ENGINEER—Implement a complete monitoring and measuring program for BMEWS forward sites. A minimum of three years' experience in microwave and X-ray measurement techniques, and ability to analyze and write technical reports are required. BSEE, plus some supervisory background preferred. Frequent travel to forward sites.

QUALITY CONTROL ENGINEER Develop quality control program on the component and assembly level, in support of an operating BMEWS system. Minimum of 3 years' quality control engineering; familiarity with quality control inspection techniques, statistical sampling, and evaluation. Ability to provide self direction and leadership to a quality control operation. Location: Rome, N.Y.

DIGITAL ENGINEERS—Liaison and project level responsibility for site engineering activities on missile impact prediction computer, radar data take-off, and switching systems. Experience in digital logic design and transistor techniques on computer and on-line data handling equipment, plus degree is required. Locations: Riverton, N. J. with periodic trips to site; Van Nuys, Calif., with subsequent extended assignment to Thule, Greenland.

DETECTION AND TRACKING RADAR SYSTEMS ENGINEERS Supervise installation, checkout and integration of detection and tracking radar equipment. Intensive formal or on-the-job training on equipment, systems acceptance, and performance evaluation. Three to ten years' experience on long range radar (transmitters, receivers, and data processing systems) is required. Location: Riverton, N. J., with 3 months site rotation; or extended site assignments.

There is special site compensation for positions requiring extended site assignment.

To arrange a confidential interview, send your résumé to:

Mr. J. P. Thatcher, Employment Mgr.
RCA Service Company, Dept. BM-
1908 Bannard Street
Riverton, New Jersey

EQUAL OPPORTUNITY For All Qualified Applicants

RCA®

The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

of, each phrase. You should be able to see the whole phrase when you focus on this point. For example, focus your eye on the "x":

x x
If you read word by word
x
you spend
x
needless time and energy

Ten minutes of practice for a few days will soon have you automatically seeing phrase groups instead of words.

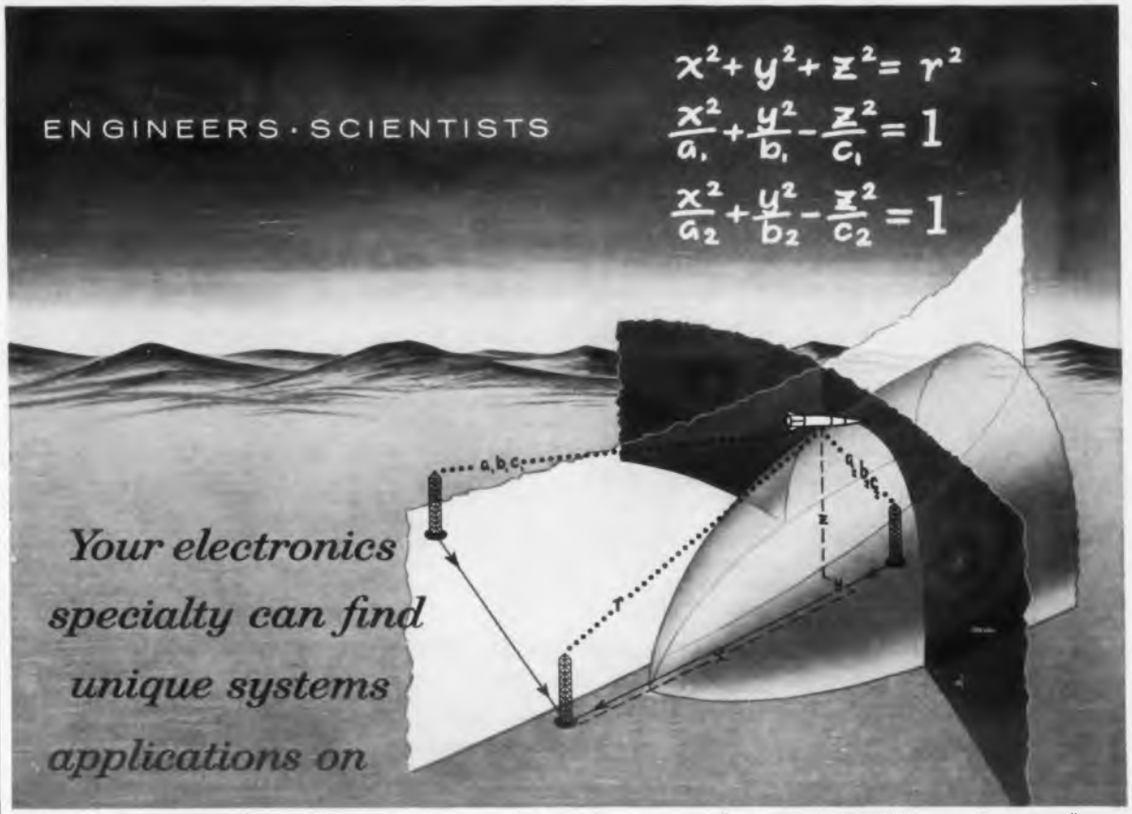
The Fast Reader Concentrates; The Slow Reader Wanders

Comprehension will increase because if you read slowly, your mind is free to wander. By reading faster in phrases or thought units, your mind is absorbed, and you are reading the same way you think—in concepts.

A great help in increasing your eye span is called "columnar reading." At first, draw a pencil line down the center of a column of print, either in a newspaper or magazine. Let your eyes move down the column of type with only one fixation at the center of each line. Try to see the first and last words of each line of type while looking directly at the center. Example:

> To start, you may find it easier to try the second and the next-to-last words of each line of type. Later you may practice this technique on the way to work or during breaks in the work routine. This eye exercise will help you to encompass larger phrase groups at one fixation.

All of the techniques discussed in this and future articles have been adopted in training by thousands of individuals. It can work as easily for you as it does for them, but you must remember that you are changing habits acquired early in life, habits that have been solidified by years of reading. Just a few minutes of practice each day can make you a skilled reader with greater reading speed than you ever thought possible, and a greater capacity for comprehension and understanding. ■ ■



MISTRAM

▲ Basic MISTRAM system features radio receiving stations in "L"-shaped configuration. Signals from missile transponder are measured on CW carrier for computer calculation of phase differences. These yield missile position, velocity and trajectory data through spatial intersection of a sphere (range from central receiving station) and hyperboloids of revolution (range differences from remote receiving stations).

... the next generation system for precise missile trajectory measurement being developed by General Electric's Defense Systems Department

OPPORTUNITIES AVAILABLE NOW

By joining Defense Systems Department now, you can take an increasingly important part in the long-term development of MISTRAM. And, you'll be able to broaden your technical knowledge by applying your specialty in the ever more critical field of large-scale system engineering. Significant experience in any of the following areas can qualify you:

Test Equipment • Consoles
Digital Data Transmission & Recording
Power Generation & Transmission
Digital & Analog Computing • C-W Radars
Feedback Control • Acquisition & Tracking
Airborne Transponders
Microwave Communications

▶ For a more complete technical description of MISTRAM —and full details of current opportunities on a broad scope of systems programs at DSD—write today to Mr. E. A. Smith, Box 1-C.

DSD's important new MISTRAM System embodies these features:

- Greater accuracy and range than any existing missile trajectory measurement system
- Reduction of many previously standard tracking system components by eliminating high precision radar tracking antennas
- Instantaneous correction of electrical baseline length errors through phase stabilization techniques
- Ability to utilize orbiting satellite to virtually eliminate present day survey errors

Defense Systems Department is Prime Contractor for MISTRAM.

DSD is now developing a basic system unit which can be multiplied many times over and integrated into a vastly extended MISTRAM system, using G-E's 'building block' approach. Ultimately this would provide hemispheric coverage for missile trajectory measurement.

DSD DEFENSE SYSTEMS DEPARTMENT
A Department of the Defense Electronics Division
GENERAL ELECTRIC
Northern Lights Office Building, Syracuse, New York

CIRCLE 903 ON CAREER INQUIRY FORM

RESEARCH ENGINEERS & SCIENTISTS

Kollsman's
NEW RESEARCH DIVISION
Creates NEW Opportunities

The recent formation of a Research Division at Kollsman creates positions of unusual challenge for engineers and scientists interested in basic and applied research. Projects currently being initiated apply to advanced tracking, computing, communications, control, instrumentation and display systems. These programs will include theoretical work in the basic sciences and experimental verification in the areas of:

DIGITAL SYSTEMS
SOLID STATE PHYSICS
LOGICAL DESIGN
SYSTEMS ANALYSIS & SYNTHESIS
ELECTRONIC DISPLAYS
DIGITAL SENSORS
PULSE TECHNIQUES
MICROMINIATURIZATION
LIGHT GENERATION, MODULATION & DETECTION

Kollsman's established leadership in automatic navigation and flight instrumentation...plus its association with Standard Kollsman Industries Inc., a company with diversified industrial and consumer products...provide a broad base for future growth.

To arrange a confidential interview, forward a brief resume to Mr. John Whitton.

Kollsman Instrument Corporation

80-08 45th AVE., ELMHURST 73, QUEENS, NEW YORK A Subsidiary of Standard Kollsman Industries Inc.

CIRCLE 905 ON CAREER INQUIRY FORM

TIME FOR A CHANGE?

When it's time to change jobs, how can you amplify your earnings and job satisfaction to the maximum?

First of all take a good inventory of your own assets, liabilities and ambitions, both short and long term. Then get someone with a recognized professional status to represent you—like Davies-Shea, Inc., for example.

Virtually all big earners from movie stars to steel executives find that a representative can negotiate a much better offer for them—on all fronts. And Davies-Shea, Inc. is the foremost negotiator in the electronics business.

Third, don't make any quick judgments about companies based on chance conversations or rumors. Firms are changing fast and you will need up-to-date information about them. Here again, the expert like Davies-Shea, Inc. knows the material intimately and can save you time and costly errors. Keeping up on these firms is the full time, lifetime job of Davies-Shea, Inc.

Job searching is a major operation, a veritable exodus that can result in a happy promised land or bleak exile. Go about it intelligently. Let Davies-Shea help you find a place in the sun of success.

No charge, of course. Confidential, definitely. You can have Davies-Shea looking for you at no risk to your present position and no time off from it. If you know an electronics man saying "It's time for a change," have him circle reader service card No. 884 for free monthly bulletin listing America's best electronics jobs, or circle Career Inquiry Form No. 906.

DAVIES - SHEA, Inc. WEbster 9-3833
332 South Michigan Chicago 4, Illinois

Electronics Personnel Consultants

THIS LABEL SPEEDS THE INFORMATION YOU REQUEST!

Watch for this label—it signals the material you have inquired about, and helps to bring it to you faster.

This pre-typed label is only part of *Electronic Design's* NEW, FASTER, ONE DAY READER SERVICE. All inquiries are now completely processed and air mailed (1st class within one day delivery zone) to advertisers within ONE DAY of receipt. There is no delay for batch mailing or complicated tabulation.

NEW FASTER INQUIRY HANDLING is one more step in *Electronic Design's* continuing program to improve its services to both reader and advertiser.

ELECTRONIC DESIGN
Leading Electronics Magazine

YOUR CAREER
NEWS AND NOTES

Starting salaries for engineers in 1959-1960 averaged $524 per month for B.S. degrees compared to $508 for 1958-1959, according to the University of Michigan placement office, Ann Arbor, Mich. Salaries at the master's level rose to $655 from $598 in the same period. Salaries accepted at the doctoral level ranged between $650 and $800 monthly as against a previous range between $653 and $750. (Liberal-arts salaries were included in doctoral averages.)

Greatest demands were for electrical and mechanical engineers, the University said.

• • •

The fllowing comes from Risa Hirsch, Filtron Co., Inc., Flushing, N.Y.

Purely Environmental

Two young, and bright technicians were testing on the sly,
Were fooling with components when inspectors ambled by.
The testers gazed upon them with expression innocent,
For they knew they knew a thing or two about environment.

They would test for shock resistance; use their meters for db's,
And get a jolt from every volt or proven VDC's.
They soberly considered every AC alternation,
And put the new component through immense, intense vibration.
After causing every package to accelerate 10 g's,
They slowly dropped its temperature (they did it by degrees).

They knew their product wouldn't rust, but still they let it lie
Within a little chamber of enormous THI.
They drowned it in a cycle bath to test for any leaks,
And, fraught with fear, they put an ear to listen for the squeaks.
They heated it to Hades; they cooled to absolute,
And cold, enrolled their project in a quiet missile shoot.

They marched in triumph from the lab, because, though mental wrecks,
They'd foiled sharp inspectors, and met military specs.

• • •

More Ph.D.'s are employed by large industrial firms than all the liberal-arts colleges in the country put together, according to a statement made recently at the University of Michigan by Bernard Berelson, director of the Bureau of Ap-

plied Research, at Columbia University.

DuPont employs more Ph.D.'s than any other organization in this country, G.E. has more than twice as many Ph.D.'s on its staff as Princeton, Shell more than MIT, Union Carbide, or Eastman or IBM has about as many as Northwestern, or Cal Tech, he said.

Mr. Berelson used these statistics to justify his belief that doctoral candidates should be trained in a research specialty. As far as he was concerned, breadth of culture was a thing to be approached indirectly, "like happiness."

• • •

Spread of demand for electronic techniques will put an increasing demand on engineers to broaden their knowledge into other areas. Scientists in other fields continue to complain that they themselves are more interested in electronics than electronic engineers are interested in the fields of these scientists. Biologists, for example, complain that while one can find many physiologists and biologists with books on electronics on their shelves, it is hard to find many electronic engineers with books on psychology or biology on their shelves.

In space flight, this lack may result in long lead-time if ignorance of effects of space environments on organisms proves critical. (What if disease bacteria multiply rapidly in space or mutations of life-support algae produce one of the rare algae forms which actually uses oxygen rather than replenish it?)

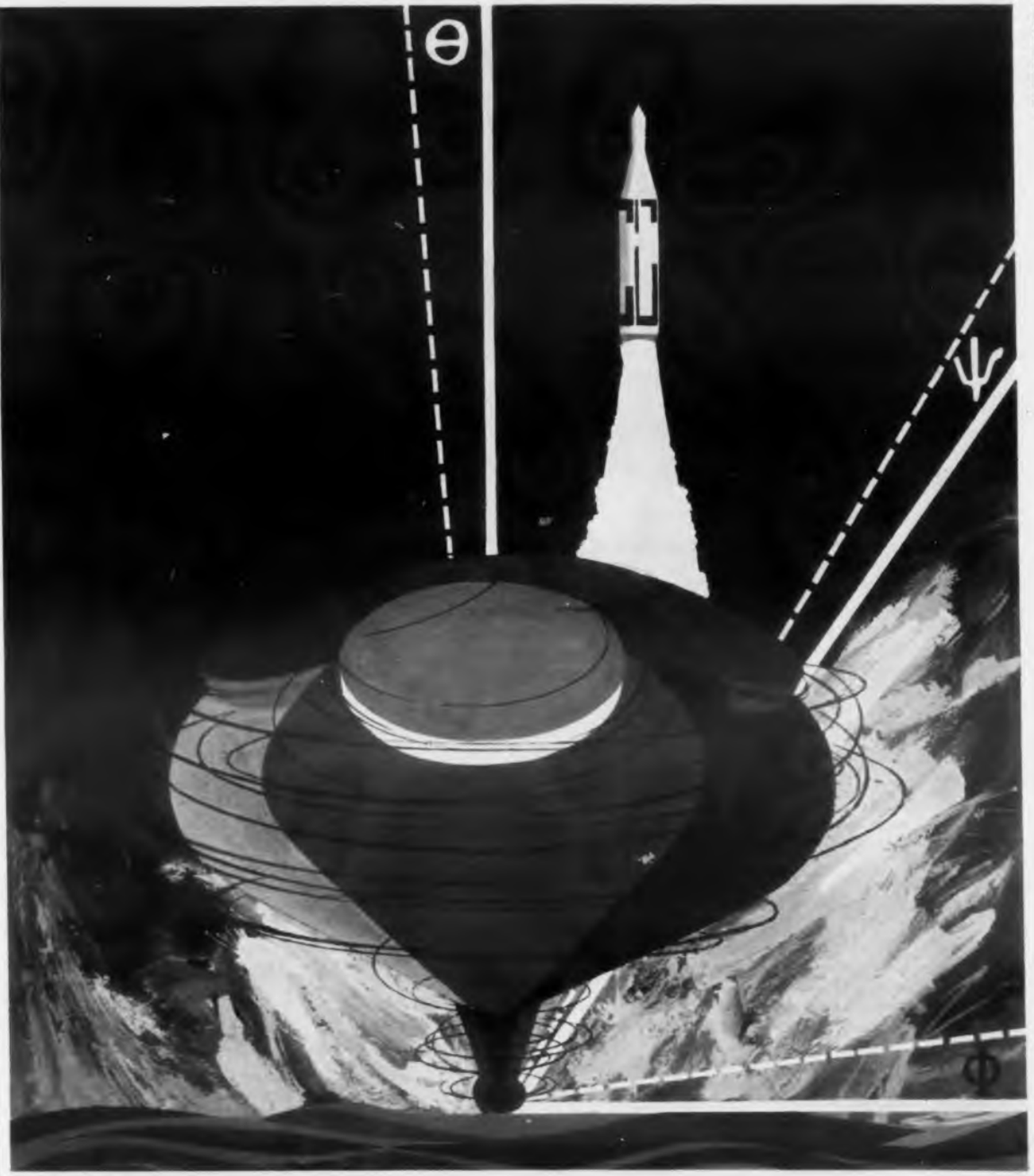
The equipment for the very expensive, in terms of rocket vehicles, and difficult, in terms of measurement, experiments needed in fields like this can only be planned and designed by engineers who can get together with scientists in these fields and talk their language, according to the scientists.

• • •

The "intelligence" aspects of electronics will become the dominant factor in the cold war, according to Dr. Simon Ramo, executive vice president, Thompson Ramo Wooldridge, Inc.

Speaking recently before a group of teachers in Chicago, Dr. Ramo said that with the mastery of nuclear energy, man has available more than enough power for his needs. What he now needs is a similar increase in his intelligence.

Thompson Ramo Wooldridge has coined the term "Intellectronics" to indicate its conviction that human intelligence and electronics have a lot in common. Dr. Ramo believes that electronics will help human intelligence in two ways: in the form of teaching machines, it will help man to improve his intelligence, and in the form of computing machinery, it will help man extend his brainpower.



SORRY, HERR PROFESSOR EULER, BUT WE HAVE OUR OWN ANGLE!

Your angles are necessary when dealing with large rotations, but the mathematics is complicated. However, our single degree of freedom gyros and tight gimbal servo loops result in very small angles of rotation. Thus, we avoid heavy mathematics and also improve guidance system performance. This approach has paid off in our Thor, Mace and Titan guidance systems. If you can understand complex physical laws but know how to work around them, and have a BS, MS or PhD in Physics, ME, EE, or Math, please contact Mr. D. G. Allen, Director of Scientific and Professional Employment, 7929 S. Howell, Milwaukee 1, Wisconsin.

AC SPARK PLUG ✵ THE ELECTRONICS DIVISION OF GENERAL MOTORS

CIRCLE 907 ON CAREER INQUIRY FORM

Electronic Engineers

for assignments on APL's satellite program

Research • Development
Systems Engineering

You will find association with APL particularly rewarding if you appreciate an atmosphere conducive to original thinking, and if you are capable of making contributions to advance the state-of-the-art.

Satellite Development Group

The group is concerned with research and development of satellite-borne equipment, which will be capable of performing highly complex functions. The instruments have to operate in a space environment on exceedingly low power sources, and they have to work for five to ten years without malfunction.

Emphasis is on conceptual design rather than hardware fabrication. Engineers will work without close supervision, will enjoy freedom to create and investigate, and do not have to spend much time writing proposals. BS or more in physics or electronic engineering required. Two or more years of experience in transistor switching circuits and familiarity with utilization of memory and/or logical devices desired.

Satellite Ground Systems Group

This group is responsible for the design of data handling systems for use in shipboard and airborne navigational equipment, and for ground tracking equipment. Assignments involve development of novel and highly sophisticated data processing systems, systems coordination, and technical supervision of contractors.

BS or more in physics or electronic engineering plus four to five years of experience in data processing systems required.

For details about these career opportunities, address your inquiry to:
Professional Staff Appointments

The Applied Physics Laboratory
The Johns Hopkins University

8649 Georgia Avenue, Silver Spring, Md.
(Suburb of Washington, D. C.)

CIRCLE 908 ON CAREER INQUIRY FORM

How Did 1960 Measure Up?

1961's TOP ELECTRONIC JOBS are Available Through Cadillac!

Look at 1960. How did the advancement program you charted measure up? If you find that there was something lacking in the opportunity offered by your present company, then perhaps it's time to consider a change.

For the man who wants challenging work and earnings reflecting his capabilities, we are retained by the nations top 508 electronics firms (both "giants" and "comers"). If the *right* job for you is open, its available at Cadillac where you can weigh and compare the greatest number of opportunities at any given moment.

Our service is *COMPLETELY CONFIDENTIAL* and available to you *ABSOLUTELY* FREE OF CHARGE

FREE—Monthly Opportunities Bulletin

If you wish to receive a monthly bulletin of the finest available electronic opportunities, simply send us your name and *home* address (and if you wish, a review of your qualifications)—Our services are without cost to you through our Chicago office and our Los Angeles subsidiary, Lon Barton Associates.

Cadillac

JACK L. HIGGINS *Vice President*

Cadillac Associates, Inc.

29 East Madison Bldg., Chicago 2, Ill. Financial 6-9400

"Where More Electronic Executives Fnd Their Positions That Anywhere Else in The World"

CIRCLE 880 ON READER-SERVICE CARD

EE, ME, or Physics; BS, MS, Doctoral Degrees

A Unique Career Spot

Investigate New Positions

IN ADVANCED DEVELOPMENT AND PRODUCT ENGINEERING

- Thermoplastic Recording*
- Electronic Visual Amplifiers*

for Large Screen, High Brightness, High Resolution, Information Display Systems

- High Power AM, FM, Short Wave, TV (VHF-UHF) & Scatter Transmitters
- TV Studio Equipment — Monochrome & Color
- TV & AM Station Audio Equipment
- UHF, VHF, & Microwave Antennas

Transmission Line Systems, Studio TV Transmitter Link Equipment

- Educational TV, Industrial TV

GENERAL ELECTRIC'S TECHNICAL PRODUCTS OPERATION

...the "hatching place" of new commercial and military products in fields of

BROADCASTING • CLOSED CIRCUIT TV • SPECIAL VIDEO & DISPLAY

BS or Advanced degrees plus experience in one of the following areas

A. Geometric, Physical & Electron Optics
B. Circuit Design (Semiconductor & Tubed)
C. Mechanical design of products involving complex precision mechanisms, vacuum systems, optics, thermodynamics.

**Descriptive literature sent on request.*

Write in full confidence to: N. C. Murray, Engineering Sect. 76-MA

TECHNICAL PRODUCTS OPERATION

GENERAL ELECTRIC

Electronics Park, Room 215, Bldg. 7, Syracuse, New York

PAPER DEADLINES

Convention Program Chairmen have issued the following deadlines to authors wishing to have their papers considered for presentation.

Jan. 15: Deadline for initial submission of papers for the **Thirteenth Annual National Aerospace Electronics Conference (NAECON)** to be held **May 8, 9, 10, 1961,** at the Biltmore and Miami Hotels, Dayton, Ohio. The following subjects are being considered for session topics: energy-conversion systems; solid-state devices, radio astronomy, ground-support equipment, aerospace-reconnaissance systems; molecular electronics; magnetohydrodynamics; aerospace systems integration; bionics; aerospace communications; antennas and propagation; aerospace environment; vehicle-borne computers; guidance and control systems; telemetry; systems management; microwave tubes and circuits; scientific education; audio techniques; electromagnetic interference, and electric propulsion. Contact: Ronald G. Stimmel, chairman, papers committee, 809 Larriwood Ave., Dayton 29, Ohio.

Feb. 1: Deadline for papers for the **1961 National Aeronautic Meeting of the Society of Automotive Engineers** to be held **April 4 to April 7, 1961,** in New York City. Send papers to: *E. W. Conlon and G. W. Periman, Co-Chairmen, Society of Automotive Engineers, 485 Lexington Ave., New York 17, N.Y.*

Feb. 1: Deadline for abstracts for the **1961 Annual Conference of the Society of Photographic Scientists and Engineers** to be held **May 22 to May 26, 1961,** at the Arlington Hotel in Binghamton, N.Y. Subjects include: scientific and engineering aspects of color and black-and-white photography, photographic image structure, cameras, and printing and processing equipment. Send abstracts to: *F. H. Gerhardt, Papers Chairman, 771 River Road, M. R. 97, Binghamton, N.Y.*

Feb. 1: Deadline for papers for the **7th National Aero-Space Instrumentation Symposium** to be held **May 1 to May 4, 1961,** at Fort Worth, Tex. Subjects include: instrumentation subjects related to aircraft, missiles, satellites, anti-submarine warfare, space bio-medicine and aircraft traffic control. The symposium will be sponsored by the Southern Methodist University. Send papers to: *W. J. Gabriel, Program Chairman, Route 3, Box 36, Fort Worth, Tex.*

The simple gears and stroboscopic disc mounted on a projector would not ordinarily be associated with Avionics design and development. But there is very little of the ordinary in Grumman Avionics activities. These units are part of an ingenious system, simple in concept but complex in accomplishment, used for determining the effective location of antennas on ECM equipped aircraft.

Aiming the system at a small scale model of the aircraft creates "reflections" which are recorded against aircraft attitude. By exposing the models to every degree of view, a measure of the radar cross section of the model is determined. This data permits antenna engineers to design and locate ECM antennas of the aircraft for maximum effectiveness.

Grumman production, design, and study activities include vehicles and systems for projects ranging from submarine searching to space stations. The variety of our programs involving the application of electronics is one of the most extensive in all of industry.

If you can contribute to our ECM program or are qualified in the following or similar areas, you are eligible for a place on one of these projects.

RADOME/ANTENNA DESIGN ENGINEERS BSEE or Physics degree with a minimum of 5 years' experience in the design of antennas and/or radomes. Strong background in electro-magnetic theory and microwave techniques is essential. The finest facilities for laboratory development are available including an anechoic chamber, a 2000-ft. AEW antenna test range, a 300-ft. antenna and model test range, and a precision boresight range.

DIGITAL COMPUTER SYSTEMS ENGINEERS BSEE with a minimum of 4 years' experience in the analysis, design and development of digital computers. Will participate in the integration of a digital computer into a complex weapons system. A significant part of the effort will be devoted to extensive laboratory and flight development programs.

COMMUNICATIONS SYSTEMS ENGINEERS Electronic engineers with thorough knowledge of communications techniques who wish to extend their technical backgrounds to new challenging areas. Should possess a complete understanding of AM, FM, PM and single sideband modulation processes and their application, and be willing to apply this knowledge to the latest data handling techniques. An important phase of this effort will be extensive laboratory development programs in our new Avionics Systems Center using the finest of equipment and facilities. BSEE with a minimum of 3 years' experience required.

AVIONICS SUPPORT EQUIPMENT ENGINEERS Electronic engineers experienced with digital computers, radar and communications who welcome an opportunity to utilize their present skills while they extend their technical background to new areas. These engineers will analyze complex weapons systems to establish test logic and techniques involved in a comprehensive automatic test program utilizing ground support equipment. BSEE with a minimum of 3 years' experience required.

RADAR DEVELOPMENT ENGINEERS. BSEE with a minimum of 4 years' experience in the analysis, design and development of airborne radar systems. Should be capable of analyzing the radar systems with the end view of integrating the equipment into a complex weapons system. Will fully participate in laboratory and flight development programs conducted in the finest facilities available in a professional atmosphere.

To arrange an immediate interview, send your resume to Mr. W. Brown, Manager Engineering Employment, Dept. GR-75. (U.S. citizenship required.)

GRUMMAN AIRCRAFT ENGINEERING CORPORATION

Bethpage, Long Island, New York

CIRCLE 910 ON CAREER INQUIRY FORM

IDEAS FOR DESIGN—*ENTRY BLANK*

To the *Ideas-For-Design* Editor of ELECTRONIC DESIGN —
830 3rd Ave., New York 22, N.Y. • PLaza 1-5530

Here is my design idea for possible publications in your *Ideas For Design* department. I can expect $10 for this idea if accepted for publication.

(Ideas suitable include: *1.* new circuits or circuit modifications, *2.* new design techniques, *3.* designs for new production methods, *4.* clever use of new materials or new components in design, *5.* design or drafting aids, *6.* new methods of packaging, *7.* design short cuts, or *8.* cost saving tips)

STATEMENT OF THE PROBLEM—

MY SOLUTION. AND WHY—(Please be explicit. Include sketches or photos that will help the idea across)

Name_____

Title_____

Company_____

Address_____

(Place illustrations on separate sheet if necessary)

ADVERTISERS' INDEX

January 4, 1961

°*Manufacturers' catalog appears in 1960-1961* ELECTRONIC DESIGN CATALOG

*Manufacturers' catalog appears in 1960-1961 Electronic Design Catalog

SANDERS ASSOCIATES INC.

Announces

the opening of

2 NEW FACILITIES

ADVANCED SYSTEMS LABORATORIES

(on famed "Electronics Row" in suburban Boston)

NEW ENGINEERING OPERATION

(on suburban Long Island near New York City)

To meet the recent increase to $50 million in contract commitments, Sanders Associates of Nashua, New Hampshire is rapidly expanding its engineering staff in 3 locations: Nashua Headquarters; Burlington, Massachusetts and Plainview, L.I., New York.

This new expansion follows a 9-year growth from 11 engineers to over 1600 employees – a growth soundly based on technical excellence – inventing new concepts instead of using traditional approaches.

Pioneering programs are being continued in phased arrays, radar, pulse doppler radar systems, space radar and communication systems. Advanced concepts and techniques in a variety of areas provide stimulating assignments involving space technology, missiles and radar systems.

Positions available at all locations for:

SENIOR SYSTEMS ENGINEERS
To contribute to advanced techniques in the general field of military electronic systems. Applicable experience includes systems analysis, synthesis and integration, with extensive background in circuit design augmented by hardware implementation.

CIRCUIT DESIGN ENGINEERS
EE or Physics graduates with 2 to 8 years experience and familiarity with tubes and transistors and their utilization in all types of circuits, as well as the integration of circuits into sub-systems.

TRANSMITTER DESIGN ENGINEERS
2 to 8 years experience. For work up to and including microwaves.

PRODUCT DESIGN ENGINEERS
ME with heavy experience in feasibility studies coupled with experience in taking developed systems into production, monitoring mechanical design and overall packaging concepts of ECM or other airborne systems.

Positions in Plainview, L. I.

GROUND SUPPORT EQUIPMENT ENGINEERS
To design and develop system, assembly and sub-assembly electronic test equipment for the military. Should have appreciation for test equipment philosophy, with extensive experience in circuit design and hardware follow-through.

To arrange for a convenient interview at any of the three locations, send resumes to Mr. Richard McCarthy, Employment Manager, in Nashua.

SANDERS ASSOCIATES, INC.

NASHUA, NEW HAMPSHIRE

CIRCLE 911 ON CAREER INQUIRY FORM

ENGINEERED COMPONENTS
for the Electronics Industry

Now—Garlock Electronic Components are immediately available wherever and whenever needed!

Through a new, widespread distributor organization, Garlock now offers fast delivery of CHEMELEC Stand-off and Feed-Thru Insulators, Subminiature Tube and Transistor Sockets, and Connectors. Here, too, is an increased opportunity for close-at-hand assistance from Garlock distributors experienced in applying electronic products.

Take advantage of on-the-spot availability—specify these skillfully engineered Garlock electronic components. Reliable under the most severe conditions, they are ideal for high temperature, high voltage, high frequency service on missile guidance, fire control, tracking, and radar systems. Garlock has the technical personnel and modern facilities to produce components of all materials—Teflon† TFE and FEP, Nylon, Delrin†, C.T.F.E.**—and in a range of sizes, designs, and tolerances to fit your exact needs.

At your disposal, too, for development of new electronic products, Garlock maintains complete electrical, chemical and physical laboratories staffed by top-flight engineers. Your Garlock Electronic Products representative will be glad to discuss specific products and service with you. Call him at the nearest of these locations:

ABBETT & HUSTIS
1245 Highland Ave.
Needham 92, Mass.

BOB BRAY
18 North Mentor Ave.
Pasadena, Calif.

CARL HOWER
340 N. Marshall Ave.
Scottsdale, Arizona

DON SMITH SALES CO.
2320 N. 45th St.
Seattle 3, Washington

GRANT SHAFFER COMPANY
14241 Fenkel Ave.
Detroit 27, Michigan

HILL AND GRAY, INC.
41½ Harrison St.
Oak Park, Illinois

J. P. DEARIE AND CO.
P.O. Box 66
Mountain Lake, New Jersey

J. Y. SCHOONMAKER CO., INC.
5328 Redfield Ave.
Dallas 35, Texas

LAKE ENGINEERING CO. LTD.
767 Warden Ave.
Scarborough, Ontario

NAUDAIN-BOHAKER & CO.
Suburban Sta. Bldg.
Rm. 1032
Philadelphia 3, Pa.

RUDAT & EWING
636 Waverley St.
Palo Alto, Calif.

SCOTT & STEFFEN, INC.
1836 Euclid Ave.
Cleveland 15, Ohio

SOUTHERN SALES COMPANY
105 Lakeshore Drive
Angola, Indiana

R. E. CATHEY CO.
1789 Fulton St.
Denver 8, Colorado

STANLEY K. WALLACE ASSOCS., INC.
P. O. Box 67
Lutz, Florida

You may also obtain more information by writing for Catalogs AD-169 and AD-171, Garlock Electronic Products, Garlock Inc., Camden 1, New Jersey.

GARLOCK
ELECTRONIC PRODUCTS

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*Registered Trademark **polychlorotrifluoroethylene
†DuPont Trademark

CIRCLE 175 ON READER-SERVICE CARD

*Manufacturers' catalog appears in 1960-1961 ELECTRONIC DESIGN CATALOG

*Manufacturers' catalog appears in 1960-1961 Electronic Design Catalog

COMPUTERS AND OTHER ELECTRONIC INSTRUMENTS demand resistors which give predictable performance in a small space and high ambient temperatures. This is a good description of Corning tin oxide film resistors, which are now competitive in price with other makes.

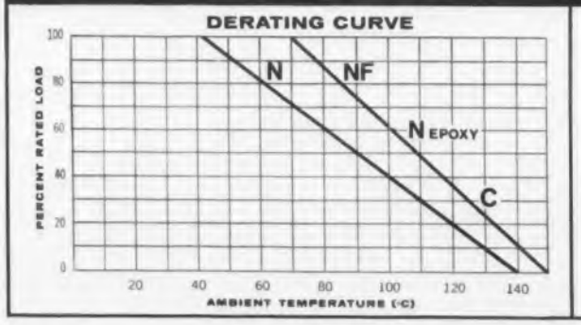
Tin oxide and glass are among the most stable materials. They are also low in cost.

Couple these materials with exacting methods of manufacture, as we have done, and you have low-cost resistors meeting the pinching specifications required for computers and similar devices.

You have resistors with excellent reactive properties. With a shelf life of 0.1 to 0.2% per year. With noise levels lower than 0.1 microvolt per volt. And with typical values like these:

TYPE	DESCRIPTION	CORNING MODEL	WATTAGE	RESISTANCE (ohms)	TC	LOAD LIFE	OVERLOAD	MOISTURE RESISTANCE
NF	Glass ENCAPSULATED MIL-R-10509C, Char. B	NF60 NF65	⅛ ¼	100 100K 100 348K	150ppm/°C. −55 +150°C.	0.3%	0.03%	0.2% (Char. B)
N EPOXY	MIL-R-10509C, Char. B	N60 N65 N70	⅛ ¼ ½	10 133K 10 499K 10 1Meg	150ppm/°C. −55 +105°C.	0.5%	0.03%	0.5% (Char. B.)
N	MIL-R-10509B, Char. X	N12 N20 N25 N30	¼ ½ 1 2	100 133K 10 500K 10 1.5Meg 30 4.12Meg	150ppm/°C. −55 +105°C.	0.35%	0.1%	0.15% (Char. X)
C	Lowest cost film resistor; silicone insulation MIL-R-11C	C20 C32 C42	½ 1 2	51 150K 51 470K 10 1.4Meg	150ppm/°C. −55 +125°C.	1.5%	0.2%	0.3%

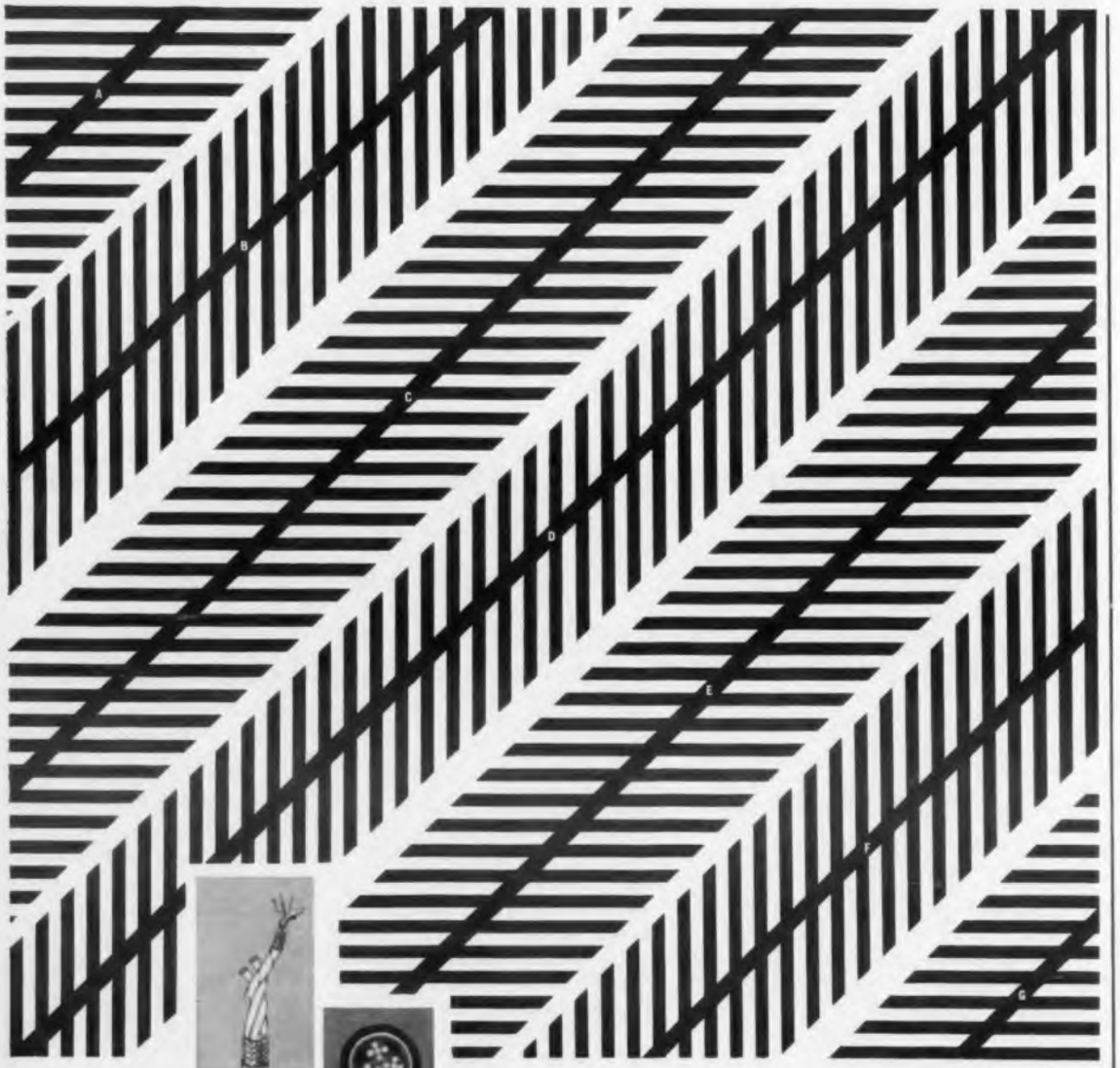
Note: Noise level for all models is less than 0.1 uv/v of applied signal.

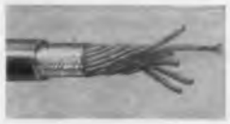


For quantities of less than 1000, contact the nearest distributor serviced by Erie Distributor Division. For data sheets on Corning Type NF, N, N-EPOXY or C resistors, write CORNING GLASS WORKS, 540 High St., Bradford, Pa.

CORNING ELECTRONIC COMPONENTS
CORNING GLASS WORKS, BRADFORD, PA.

CIRCLE 176 ON READER-SERVICE CARD





At Hitemp–Quality is not an illusion

Pick up and examine several different brands of wire and cable. Almost identical, aren't they? Their similarity with regard to quality, however, is just as much an illusion as the art form above.

Although similar materials and equipment may be used in making all brands of wire and cable, one brand—Hitemp—will outlast, outperform the others.

Idle chest thumping? No! Hitemp has the greatest store of experience in the industry—two modern production facilities that are second to none—and more than one-fourth of its entire work force devoted solely to inspection and quality control.

Hitemp products are for you, the wire and cable user who requires quality and reliability that is fact, not illusion. **Hitemp is a Division of Simplex Wire & Cable Co.**

HITEMP WIRES CO.

1200 SHAMES DRIVE, WESTBURY, NEW YORK
1532 S. CALIFORNIA AVE., MONROVIA, CALIF.

CIRCLE 177 ON READER-SERVICE CARD

*Manufacturers' catalog appears in 1960-1961 Electronic Design Catalog

Advertising Representatives

Adv. Sales Manager: Bryce Gray, Jr.

Sales Service Supvr.: Alvin D. Ross

New York: Robert W. Gascoigne, Richard Parker, Blair McClenachan, James P. Quinn, Ralph Richardson, Donald J. Liska, Charles J. Stillman, Jr., Kenneth M. George, John N. Weber, 830 Third Avenue, Plaza 1-5530

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

Los Angeles: John V. Quillman, Wayne Stoops, 3275 Wilshire Blvd., Dunkirk 2-7337

San Francisco: Stanley I. Ehrenclou, 292 Walter Hays Drive, Palo Alto, Davenport 1-7646

Southeastern: Pirnie & Brown, Morgan Pirnie, Harold V. Brown, G. W. Krimsier, 1722 Rhodes-Haverty Bldg., Atlanta, Ga., Jackson 2-8113

London EC4: Brad Nichols, 151 Fleet Street

ELECTRONIC DESIGN · ONE DAY SERVICE

USE BEFORE FEBRUARY 15th, 1961

C

Name ____________________ Title ____________________

Company ____________________

Company Address ____________________ City ________ Zone ____ State ____

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290
1	11	21	31	41	51	61	71	81	91	101	111	121	131	141	151	161	171	181	191	201	211	221	231	241	251	261	271	281	291
2	12	22	32	42	52	62	72	82	92	102	112	122	132	142	152	162	172	182	192	202	212	222	232	242	252	262	272	282	292
3	13	23	33	43	53	63	73	83	93	103	113	123	133	143	153	163	173	183	193	203	213	223	233	243	253	263	273	283	293
4	14	24	34	44	54	64	74	84	94	104	114	124	134	144	154	164	174	184	194	204	214	224	234	244	254	264	274	284	294
5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155	165	175	185	195	205	215	225	235	245	255	265	275	285	295
6	16	26	36	46	56	66	76	86	96	106	116	126	136	146	156	166	176	186	196	206	216	226	236	246	256	266	276	286	296
7	17	27	37	47	57	67	77	87	97	107	117	127	137	147	157	167	177	187	197	207	217	227	237	247	257	267	277	287	297
8	18	28	38	48	58	68	78	88	98	108	118	128	138	148	158	168	178	188	198	208	218	228	238	248	258	268	278	288	298
9	19	29	39	49	59	69	79	89	99	109	119	129	139	149	159	169	179	189	199	209	219	229	239	249	259	269	279	289	299
300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
301	311	321	331	341	351	361	371	381	391	401	411	421	431	441	451	461	471	481	491	501	511	521	531	541	551	561	571	581	591
302	312	322	332	342	352	362	372	382	392	402	412	422	432	442	452	462	472	482	492	502	512	522	532	542	552	562	572	582	592
303	313	323	333	343	353	363	373	383	393	403	413	423	433	443	453	463	473	483	493	503	513	523	533	543	553	563	573	583	593
304	314	324	334	344	354	364	374	384	394	404	414	424	434	444	454	464	474	484	494	504	514	524	534	544	554	564	574	584	594
305	315	325	335	345	355	365	375	385	395	405	415	425	435	445	455	465	475	485	495	505	515	525	535	545	555	565	575	585	595
306	316	326	336	346	356	366	376	386	396	406	416	426	436	446	456	466	476	486	496	506	516	526	536	546	556	566	576	586	596
307	317	327	337	347	357	367	377	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	537	547	557	567	577	587	597
308	318	328	338	348	358	368	378	388	398	408	418	428	438	448	458	468	478	488	498	508	518	528	538	548	558	568	578	588	598
309	319	329	339	349	359	369	379	389	399	409	419	429	439	449	459	469	479	489	499	509	519	529	539	549	559	569	579	589	599
600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890
601	611	621	631	641	651	661	671	681	691	701	711	721	731	741	751	761	771	781	791	801	811	821	831	841	851	861	871	881	891
602	612	622	632	642	652	662	672	682	692	702	712	722	732	742	752	762	772	782	792	802	812	822	832	842	852	862	872	882	892
603	613	623	633	643	653	663	673	683	693	703	713	723	733	743	753	763	773	783	793	803	813	823	833	843	853	863	873	883	893
604	614	624	634	644	654	664	674	684	694	704	714	724	734	744	754	764	774	784	794	804	814	824	834	844	854	864	874	884	894
605	615	625	635	645	655	665	675	685	695	705	715	725	735	745	755	765	775	785	795	805	815	825	835	845	855	865	875	885	895
606	616	626	636	646	656	666	676	686	696	706	716	726	736	746	756	766	776	786	796	806	816	826	836	846	856	866	876	886	896
607	617	627	637	647	657	667	677	687	697	707	717	727	737	747	757	767	777	787	797	807	817	827	837	847	857	867	877	887	897
608	618	628	638	648	658	668	678	688	698	708	718	728	738	748	758	768	778	788	798	808	818	828	838	848	858	868	878	888	898
609	619	629	639	649	659	669	679	689	699	709	719	729	739	749	759	769	779	789	799	809	819	829	839	849	859	869	879	889	899

For employment brochures give home address
Home Address ____________________ City ________ Zone ____ State ____

For Change of Address:
Old Company Name ____________________

Old Company Address ____________________ City ________ Zone ____ State ____

☐ I Do Design Work
☐ I Supervise Design Work
☐ I Do No Design Work

ELECTRONIC DESIGN · ONE DAY SERVICE

USE BEFORE FEBRUARY 15th, 1961

D

Name ____________________ Title ____________________

Company ____________________

Company Address ____________________ City ________ Zone ____ State ____

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290
1	11	21	31	41	51	61	71	81	91	101	111	121	131	141	151	161	171	181	191	201	211	221	231	241	251	261	271	281	291
2	12	22	32	42	52	62	72	82	92	102	112	122	132	142	152	162	172	182	192	202	212	222	232	242	252	262	272	282	292
3	13	23	33	43	53	63	73	83	93	103	113	123	133	143	153	163	173	183	193	203	213	223	233	243	253	263	273	283	293
4	14	24	34	44	54	64	74	84	94	104	114	124	134	144	154	164	174	184	194	204	214	224	234	244	254	264	274	284	294
5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155	165	175	185	195	205	215	225	235	245	255	265	275	285	295
6	16	26	36	46	56	66	76	86	96	106	116	126	136	146	156	166	176	186	196	206	216	226	236	246	256	266	276	286	296
7	17	27	37	47	57	67	77	87	97	107	117	127	137	147	157	167	177	187	197	207	217	227	237	247	257	267	277	287	297
8	18	28	38	48	58	68	78	88	98	108	118	128	138	148	158	168	178	188	198	208	218	228	238	248	258	268	278	288	298
9	19	29	39	49	59	69	79	89	99	109	119	129	139	149	159	169	179	189	199	209	219	229	239	249	259	269	279	289	299
300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
301	311	321	331	341	351	361	371	381	391	401	411	421	431	441	451	461	471	481	491	501	511	521	531	541	551	561	571	581	591
302	312	322	332	342	352	362	372	382	392	402	412	422	432	442	452	462	472	482	492	502	512	522	532	542	552	562	572	582	592
303	313	323	333	343	353	363	373	383	393	403	413	423	433	443	453	463	473	483	493	503	513	523	533	543	553	563	573	583	593
304	314	324	334	344	354	364	374	384	394	404	414	424	434	444	454	464	474	484	494	504	514	524	534	544	554	564	574	584	594
305	315	325	335	345	355	365	375	385	395	405	415	425	435	445	455	465	475	485	495	505	515	525	535	545	555	565	575	585	595
306	316	326	336	346	356	366	376	386	396	406	416	426	436	446	456	466	476	486	496	506	516	526	536	546	556	566	576	586	596
307	317	327	337	347	357	367	377	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	537	547	557	567	577	587	597
308	318	328	338	348	358	368	378	388	398	408	418	428	438	448	458	468	478	488	498	508	518	528	538	548	558	568	578	588	598
309	319	329	339	349	359	369	379	389	399	409	419	429	439	449	459	469	479	489	499	509	519	529	539	549	559	569	579	589	599
600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890
601	611	621	631	641	651	661	671	681	691	701	711	721	731	741	751	761	771	781	791	801	811	821	831	841	851	861	871	881	891
602	612	622	632	642	652	662	672	682	692	702	712	722	732	742	752	762	772	782	792	802	812	822	832	842	852	862	872	882	892
603	613	623	633	643	653	663	673	683	693	703	713	723	733	743	753	763	773	783	793	803	813	823	833	843	853	863	873	883	893
604	614	624	634	644	654	664	674	684	694	704	714	724	734	744	754	764	774	784	794	804	814	824	834	844	854	864	874	884	894
605	615	625	635	645	655	665	675	685	695	705	715	725	735	745	755	765	775	785	795	805	815	825	835	845	855	865	875	885	895
606	616	626	636	646	656	666	676	686	696	706	716	726	736	746	756	766	776	786	796	806	816	826	836	846	856	866	876	886	896
607	617	627	637	647	657	667	677	687	697	707	717	727	737	747	757	767	777	787	797	807	817	827	837	847	857	867	877	887	897
608	618	628	638	648	658	668	678	688	698	708	718	728	738	748	758	768	778	788	798	808	818	828	838	848	858	868	878	888	898
609	619	629	639	649	659	669	679	689	699	709	719	729	739	749	759	769	779	789	799	809	819	829	839	849	859	869	879	889	899

For employment brochures give home address
Home Address ____________________ City ________ Zone ____ State ____

For Change of Address:
Old Company Name ____________________

Old Company Address ____________________ City ________ Zone ____ State ____

☐ I Do Design Work
☐ I Supervise Design Work
☐ I Do No Design Work

VIA
AIR
MAIL

FIRST CLASS
Permit No. 725
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed In U. S.

POSTAGE WILL BE PAID BY

ELECTRONIC DESIGN
ONE DAY READERS INQUIRY SERVICE
830 Third Avenue
New York 22, New York

VIA
AIR
MAIL

FIRST CLASS
Permit No. 725
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed In U. S.

POSTAGE WILL BE PAID BY

ELECTRONIC DESIGN
ONE DAY READERS INQUIRY SERVICE
830 Third Avenue
New York 22, New York

ELECTRONIC DESIGN

Publisher: Robert E. Ahrensdorf
Editor: Edward E. Grazda
Managing Editor: James A. Lippke
Technical Editors: G. H. Rostky, H. Bierman, R. N. DeFloria, L. N. Tolopko, T. E. Mount, A. Rosenblatt, A. W. Solda, R. H. Cushman
News Editors: A. Corneretto, R. Haavind, M. W. Meisels
Copy Editor: D. Murray
Contributing Editors: J. G. Adashko, E. Brenner, S. H. Hubelbank, B. Bernstein, E. Kahn
Editorial Assistants: R. N. Ross, J. Rosenfield, P. A. DeLain, J. Resnick, C. H. Farley
Editorial Production: D. S. Viebig, A. Abramoff, I. A. Yuss
Art Director: R. A. Schulze
Art Assistants: O. Mitch, J. Aruego
Technical Illustrator: P. Rios
Production Manager: T. V. Sedita
Asst. Prod. Mgr.: H. De Polo
Production Assistant: P. Bergang
Circulation Manager: N. M. Elston
Asst. Circ. Mgr.: H. A. Hunter
Reader-Service: A. J. Helfeld

Hayden Publishing Company, Inc.
Chairman of the Board: T. Richard Gascoigne
President: James S. Mulholland, Jr.

Accuracy Policy

Recognizing the power of the printed word to influence, it is ELECTRONIC DESIGN's policy:

To make all reasonable efforts to insure accuracy of editorial matter.

To publish promptly corrections brought to our attention.

To not knowingly publish misleading advertisements.

To reserve the right to refuse any advertisement.

Readers noting errors or misstatements of facts are encouraged to write the editor.

Subscription Policy

ELECTRONIC DESIGN is circulated only to qualified 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 letterhead: 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 NECESSITATE A RESTATEMENT OF THESE QUALIFICATIONS. Subscription rate for non-qualified subscribers —$25.00 per year U. S. A., $35.00 per year all other countries. Single copy $1.50.

CIRCLE 178 ON READER-SERVICE CARD ➤

NOW, pick only the parameters you need, order by model number!

16 NEW! Low cost all-electronic totally-transistorized DIGITAL MULTIMETERS

Now in a single 5¼" or 8¾" x 19" panel Digital Multimeters for measuring any combination of AC/DC volts, AC/DC ratios, and resistance, with new pre-amps for higher sensitivities, optional electrical output and print command capabilities!

FLIP-TOP BOX CONSTRUCTION FOR EASY MAINTENANCE.

- 50 readings per second, average
- Inline "SUPER-NIXIE" readouts
- 0.01% accuracy
- 1000 megohm input impedance
- Automatic, manual and remote ranging
- Automatic polarity
- Twin Zener diode internal reference
- Front panel sensitivity control
- Etched circuits, plug-in card construction
- Will operate directly in multi-point scanning and print-out data logging systems without any additional circuitry or auxiliary equipment.

Many variations of these basic models including AC ratiometers, milliohmmeters, microvoltmeters and specialized measuring instruments tailored to individual systems requirements are available in the same physical configurations. *Ask your EI sales office or representative for complete specifications today!*

Electro Instruments, Inc.

3540 AERO COURT
SAN DIEGO 11 CALIF.

ELECTRONIC DESIGN
HAYDEN PUBLISHING COMPANY, INC.
830 Third Avenue, New York 22, N.Y.

NOW RCA-6952 PACKS TWICE THE PUNCH

RCA announces higher ratings for RCA-6952 Super-Power Tube to permit 2 megawatts useful peak power output. Already proved in sea duty for more than 5000 hours at the lower ratings, these new, higher ratings are based on extensive tests performed under the auspices of the Bureau of Ships, U.S. Navy. Proven life capability at the new ratings *is 1000 hours* minimum.

Variants of the RCA-6952 can be supplied for applications requiring longer pulse lengths to 2000 microseconds ...higher average power to 20 kilowatts...higher-frequency operation to 1000 Mc.

For information on the availability of this remarkable Super-Power Tube—and variants tailored for your radar applications—contact your nearest RCA Field Office, or write Marketing Manager, Industrial Tube Products, RCA Electron Tube Division, Lancaster, Pennsylvania.

Typical Operation—RCA-6952

Useful Peak Power Output (megawatts)	Freq. (Mc)	Pulse Length μ sec.	Duty Factor	Power Gain
2	425	13	0.004	100

ATTENTION DESIGNERS: For a complete technical bulletin on RCA-6952, write RCA, Commercial Engineering, Section A18Q1, Harrison, N. J.

RCA ELECTRON TUBE DIVISION FIELD OFFICES... Industrial Products Sales: Detroit 2, Michigan, 714 New Center Building, TRinity 5-5600 • NEWARK 2, N. J., 744 Broad St., HUmboldt 5-3900 • Chicago 54, Illinois, Suite 1154, Merchandise Mart Plaza, WHitehall 4-2900 • Los Angeles 22, Calif., 6355 E. Washington Blvd., RAymond 3-8361 • Burlingame, Calif., 1838 El Camino Real, OXford 7-1620 • **Government Sales:** Harrison, N. J., 415 S. 5th Street, HUmboldt 5-3900 • Dayton 3, Ohio, 224 N. Wilkinson St., BAldwin 6-2366 • Washington 7, D. C., 1725 "K" St., N.W., FEderal 7-8500.

The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA

← CIRCLE 180 ON READER-SERVICE CARD