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1981 Microwave Symposium and Exhibition -Los Angeles, CA

MTT-S, AP-S, URSI Programs & Exhibition Guide and Microwave Landing System EMI/RFI Shielding Marchand Balun Graphs

Super Component Improves Airborne IFF Interrogator Performance

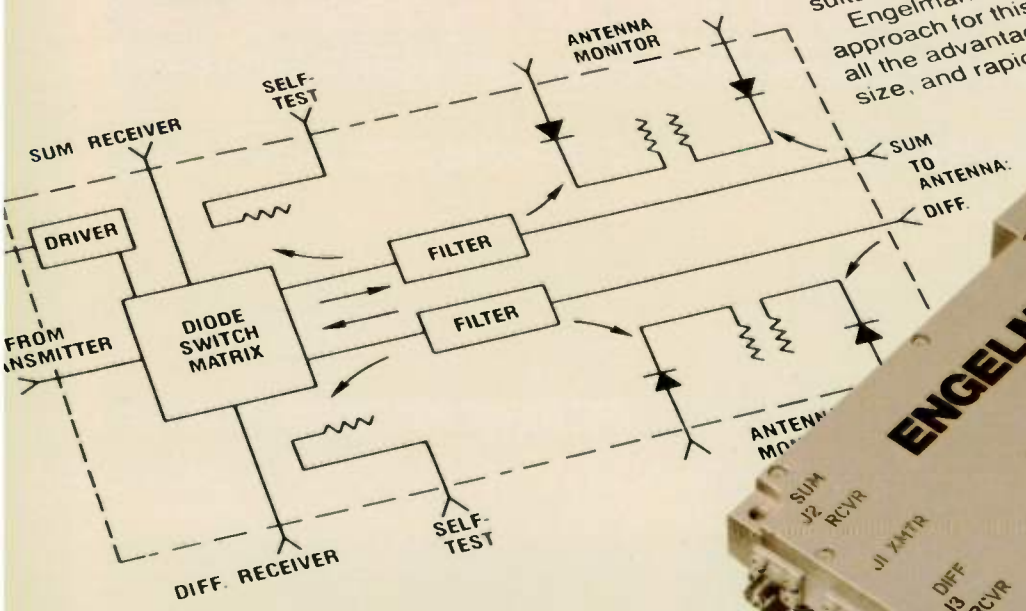
Complete transmit and receiver functions are provided in a single microwave integrated circuit with significant reduction in total insertion loss, size, and weight, compared to discreet components.

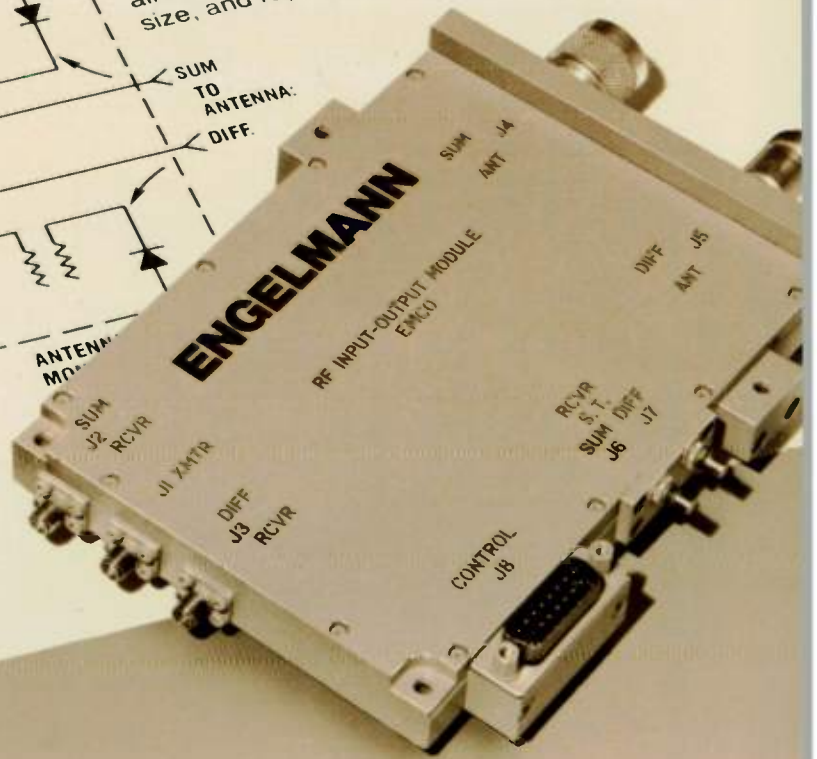
ISLS Switch and dual channel duplexing, filtering, antenna monitor detectors, and self-test coupler functions are all combined in this stripline RF module, with a total insertion loss of only 1.0db from antenna to either receiver.

The pin diode switch matrix connects 3.2 KW peak, 20 Watts average at 1030MHz transmitted power to two antennas in the aircraft system. The I.L. in this mode is 1.25db, and the switching speed is 200 nanosecs max. Low and band pass filters are provided for unwanted signal rejection out to 12GHz.

Forward and reflected directional detectors are provided to constantly detect and monitor transmitter and antenna efficiency in the system. In the receive mode, 1090MHz is duplexed to the sum and difference ports of the receiver. Directional couplers are included in the receiver circuit to make a built-in test (BIT) circuit which allows the system operator to perform an operational check in any mode.

The design features a rugged modularized one-piece housing construction which is highly suitable for MIL-E-5400 Class 2 operation. Engelmann Microwave selected a stripline approach for this custom MIC because it offered all the advantages of low insertion loss, small size, and rapid and cost effective development.





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E81-1

CIRCLE 1 ON READER SERVICE CARD

YOUR BEST BET -

Model Number	Freq. Range (MHz)	Min. Gain (dB)	Gain Flat. (±dB)	Noise Figure Typ.	Noise Figure Max.	VSWR Max. In	VSWR Max. Out	Dynamic Range 1 dB Gain Comp. (dBm Min.)	Dynamic Range 3rd Order Inter. (Typ.)	DC Power Volt	DC Power mA
					To 500 MHz						
AU-2A-0110	1-100	30	.5	1.0	1.3	2:1	2:1	0	+10	15	30
AU-3A-0110	1-100	45	.5	1.0	1.3	2:1	2:1	+5	+15	15	50
AU-4A-0110	1-100	60	.5	1.0	1.3	2:1	2:1	+10	+20	15	75
AU-2A-0120	1-200	30	.5	1.2	1.4	2:1	2:1	+5	+15	15	55
AU-3A-0120	1-200	45	.5	1.2	1.4	2:1	2:1	+5	+15	15	50
AU-4A-0120	1-200	60	.5	1.2	1.4	2:1	2:1	+10	+20	15	75
AU-2A-1045	100-450	30	.5	1.3	1.6	1.5:1	1.5:1	+7	+17	15	50
AU-3A-1045	100-450	45	.5	1.3	1.6	1.5:1	1.5:1	+10	+20	15	50
AU-4A-1045	100-450	60	.5	1.3	1.6	1.5:1	1.5:1	+10	+20	15	80
AU-1A-0150	1-500	15	.5	3.5	4.0	2:1	2:1	+10	+20	15	40
AU-2A-0150	1-500	30	.5	1.5	1.8	2:1	2:1	+10	+20	15	55
AU-3A-0150	1-500	45	.5	1.5	1.8	2:1	2:1	+10	+20	15	70
AU-4A-0150	1-500	60	.5	1.5	1.8	2:1	2:1	+10	+20	15	100
					To 1000 MHz						
AM-1A-0510	500-1000	8	.5	2.0	2.5	2:1	2:1	-5	+5	15	20
AM-2A-0510	500-1000	20	.5	1.5	1.8	2:1	2:1	0	+5	15	45
AM-3A-0510	500-1000	30	.5	1.5	1.8	2:1	2:1	+5	+15	15	75
AM-4A-0510	500-1000	40	.5	1.5	1.8	2:1	2:1	+10	+20	15	105
AM-1A-000110	1-1000	10	.5	2.0	2.5	2:1	2:1	-10	0	15	20
AM-2A-000110	1-1000	25	.5	1.8	2.2	2:1	2:1	+5	+15	15	70
AM-3A-000110	1-1000	35	.5	1.8	2.2	2:1	2:1	+10	+20	15	60
AM-4A-000110	1-1000	50	.5	1.8	2.2	2:1	2:1	+10	+20	15	105

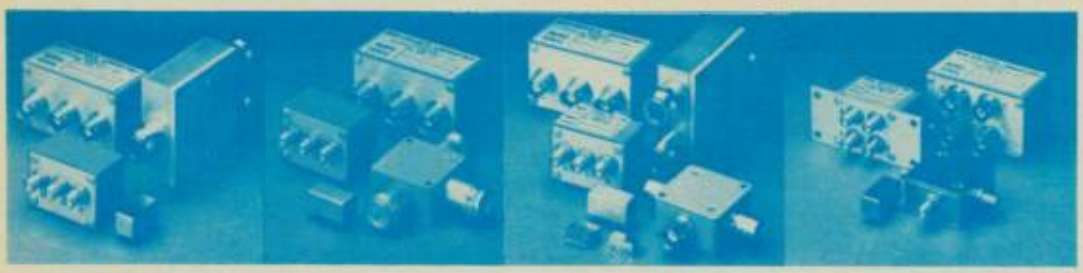
MITEQ AMPLIFIERS

					To 1500 MHz						
AM-1A-0515	500-1500	10	.5	2.0	2.5	2:1	2:1	-5	+5	15	25
AM-2A-0515	500-1500	18	.5	2.0	2.5	2:1	2:1	-5	+5	15	50
AM-3A-0515	500-1500	30	.5	2.0	2.3	2:1	2:1	+7	+17	15	75
AM-4A-0515	500-1500	40	.5	2.0	2.3	2:1	2:1	+7	+17	15	100
AM-1A-000515	5-1500	10	.5	3.0	3.2	2:1	2:1	-10	0	15	20
AM-2A-000515	5-1500	25	.5	3.0	3.2	2:1	2:1	+10	+20	15	60
AM-3A-000515	5-1500	30	.5	3.0	3.2	2:1	2:1	+10	+20	15	100
AM-4A-000515	5-1500	40	.5	3.0	3.3	2:1	2:1	+10	+20	15	100
					To 2000 MHz						
AM-1A-1020	1000-2000	10	.5	2.0	2.5	2:1	2:1	-10	0	15	10
AM-2A-1020	1000-2000	18	.5	2.0	2.5	2:1	2:1	0	+10	15	50
AM-3A-1020	1000-2000	30	.5	2.0	2.5	2:1	2:1	+10	+20	15	75
AM-4A-1020	1000-2000	35	.75	2.0	2.5	2:1	2:1	+10	+20	15	105
AM-5A-1020	1000-2000	50	.75	2.0	2.5	2:1	2:1	+10	+20	15	120
AM-3A-0322	300-2200	30	.75	2.2	2.75	2:1	2:1	0	+10	15	75
AM-1A-0420	400-2000	7	.5	2.4	2.8	2:1	2:1	-10	0	15	20
AM-2A-0420	400-2000	18	.5	2.0	2.5	2:1	2:1	0	+10	15	50
AM-3A-0420	400-2000	30	.5	2.0	2.5	2:1	2:1	+5	+15	15	75
AM-4A-0420	400-2000	40	.5	2.0	2.5	2:1	2:1	+5	+15	15	100
AM-5A-0420	400-2000	50	.75	2.0	2.5	2:1	2:1	+10	+20	15	125
AM-1A-000520	5-2000	7	.5	3.0	3.5	2:1	2:1	-10	0	15	20
AM-2A-000520	5-2000	15	.5	3.5	4.0	2:1	2:1	-10	0	15	50
AM-3A-000520	5-2000	23	.5	3.5	4.0	2:1	2:1	+5	+15	15	75
AM-4A-000520	5-2000	30	.75	3.5	4.2	2:1	2:1	+5	+15	15	100

Contact factory for custom options - often at no extra charge.

MITEQ INC./100 RICEFIELD LANE/HAUPPAUGE NY 11787/516)543-8873

power splitters



TWO WAY 90°
(1.4-4200 MHz)

TWO WAY 180°
(10 KHz-500 MHz)

TWO WAY 0°
(2 KHz-4200 MHz)

THREE WAY 0°
(0.01-750 MHz)

the world's largest selection... **covering 2 KHz to 4.2 GHz** from Mini-Circuits, from $9.95

Over 105 standard models 2-way to 24-way, 0°, 90°, 180°, pin or connector models... Mini-Circuits offers a wide variety of Power Splitters/Combiners to choose from, with immediate delivery. But there are always "special" needs for "special applications"... higher isolation, SMA and Type N connectors Intermixed, male connectors or wide bandwidths. Contact us. We can supply them at your request... with rapid turnaround time. Naturally, our one year guarantee applies to these units.

For complete specifications and performance curves refer to the Microwaves Product Data Directory, EEM, or the Gold Book.

Model	Freq. range (MHz)	Min. isol-dB (Mid-band)	Max. insert. loss-dB (Mid-band)	See notes below	Price (Qty.)
2-WAY 90°					
PSCQ2-1.5	1.4-1.7	25	0.7†	2	$12.95 (5-49)
PSCQ2-3.4	3.0-3.8	25	0.7†	2	$16.95 (5-49)
PSCQ2-6.4	5.8-7.0	25	0.7†	2	$12.95 (5-49)
PSCQ2-7.5	7.0-8.0	25	0.7†	2	$12.95 (5-49)
PSCQ2-10.5	9.0-11.0	20	0.7†	2	$12.95 (5-49)
PSCQ2-13	12-14	25	0.7†	2	$12.95 (5-49)
PSCQ2-14	12-16	25	0.7†	2	$16.95 (5-49)
PSCQ2-21.4	20-23	25	0.7†	2	$12.95 (5-49)
PSCQ2-50	25-50	20	0.7†	2	$19.95 (5-49)
PSCQ-2-70	40-70	20	0.7†	2	$19.95 (5-49)
PSCQ-2-90	55-90	20	0.7†	2	$19.95 (5-49)
PSCQ-2-120	80-120	18	0.7†	2	$19.95 (5-49)
PSCQ-2-180	120-180	15	0.7†	2	$19.95 (5-49)
PSCQ-2-250	150-250	18	0.8†	2	$19.95 (5-49)
PSCQ-2-400	250-400	16	0.9†	2	$19.95 (5-49)
PSCQ-2-450	350-450	16	0.9†	2	$19.95 (5-49)
ZSCQ-2-50	25-50	20	0.7†	2,3	$39.95 (4-24)
ZSCQ-2-90	55-90	20	0.7†	2,3	$39.95 (4-24)
ZSCQ-2-180	120-180	15	0.7†	2,3	$39.95 (4-24)
ZMSCQ-2-50	25-50	20	0.7†	2,4	$49.95 (4-24)
ZMSCQ-2-90	55-90	20	0.7†	2,4	$49.95 (4-24)
ZMSCQ-2-180	120-180	15	0.7†	2,4	$49.95 (4-24)
ZAPDQ-1	500-1000	20	0.9	2,13	$59.95 (1-9)
ZAPDQ-2	1000-2000	18	0.9	2,13	$59.95 (1-9)
ZAPDQ-4	2000-4200	20	0.9	2,13	$59.95 (1-9)
2-WAY 180°					
PSCJ-2-1	1-200	25	0.8		$19.95 (5-49)
PSCJ-2-2	0.01-20	25	0.5		$29.95 (5-49)
ZSCJ-2-1	1-200	25	0.8	3	$37.95 (4-24)
ZSCJ-2-2	0.01-20	25	0.5	3	$47.95 (4-24)
ZMSCJ-2-1	1-200	25	0.8	4	$47.95 (4-24)
ZMSCJ-2-2	0.01-20	25	0.5	4	$57.95 (4-24)
ZFSCJ-2-1	1-500	25	1.5	5	$49.95 (4-24)
ZFSCJ-2-3	5-300	25	1.5	5	$39.95 (4-24)

1. 75 ohms impedance
†2. Average of coupled outputs less 3 dB
3. BNC connectors standard TNC available
4. SMA connectors only
5. BNC connectors standard, TNC available, SMA & Type N available at $5 additional cost
6. BNC and TNC connectors (SMA and Type "N" at $5 additional cost.) (BNC not available on ZAPD-4) Please specify connectors

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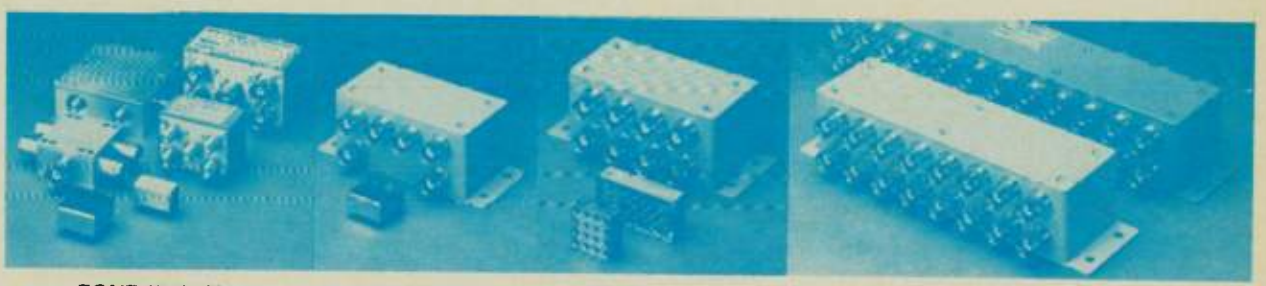
CIRCLE 5 ON READER SERVICE CARD

65-1 REV. ORIG.

and combiners



FOUR WAY 0°
(2 KHz-4200 MHz)

SIX WAY 0°
(1-175 MHz)

EIGHT WAY 0°
(0.01-750 MHz)

SIXTEEN WAY 0°
(0.5-125 MHz)

TWENTY FOUR WAY 0°
(0.2-100 MHz)

Model	Freq. range (MHz)	Min. isol-dB (Mid-band)	Max. insert. loss-dB (Mid-band)	See notes below	Price (Qty.)
2-WAY 0°					
PSC-2-1	0.1-400	20	0.75		$9.95 (6-49)
PSC-2-1W	1-650	20	0.9		$14.95 (6-49)
PSC-2-2	0.002-60	20	0.6		$19.95 (6-49)
PSC-2-1.75	0.25-300	20	0.75	1	$11.95 (6-49)
PSC-2375	55-85	25	0.5	1	$19.95 (6-24)
PSC-2-4	10-1000	20	1.2		$19.95 (6-49)
MSC-2-1	0.1-450	20	0.75		$16.95 (5-24)
MSC-2-1W	2-650	25	0.8		$17.95 (5-24)
ZSC-2-1	0.1-400	20	0.75	3	$27.95 (4-24)
ZSC-2-1.75	0.25-300	20	0.75	1.3	$29.95 (4-24)
ZSC-2-1W	1-650	20	0.8	3	$32.95 (4-24)
ZSC-2-2	0.002-60	20	0.6	3	$37.95 (4-24)
ZSC-2375	55-85	25	0.5	1.3	$37.95 (4-24)
ZMSC-2-1	0.1-400	20	0.75	4	$37.95 (4-24)
ZMSC-2-1W	1-650	20	0.8	4	$42.95 (4-24)
ZMSC-2-2	0.002-60	20	0.6	4	$47.95 (4-24)
ZFSC-2-1	5-500	20	0.6	5	$31.95 (4-24)
ZFSC-2-1.75	0.25-300	20	0.75	5	$32.95 (4-24)
ZFSC-2-1W	1-750	20	0.8	5	$35.95 (4-24)
ZFSC-2-2	10-1000	20	1.0	5	$39.95 (4-24)
ZFSC-2-4	0.2-1000	20	1.0	5	$44.95 (4-24)
ZFSC-2-5	10-1500	20	1.0	5	$49.95 (4-24)
ZFSC-2-6	0.002-60	20	0.6	5	$36.95 (4-24)
ZFSC-2-6-75	0.004-60	20	0.8	1.5	$38.95 (4-24)
ZAPD-1	500-1000	19	0.6	6	$39.95 (1-9)
ZAPD-2	1000-2000	19	0.6	6	$39.95 (1-9)
ZAPD-21	500-2000	18	0.7	6	$49.95 (1-9)
ZAPD-4	2000-4200	19	0.8	6	$39.95 (1-9)
3-WAY 0°					
PSC-3-1	1-200	25	0.7		$19.95 (5-49)
PSC-3-1W	5-500	15	1.4		$29.95 (5-49)
PSC-3-1-75	1-200	25	0.7	1	$20.95 (5-49)
PSC-3-2	0.01-30	25	0.45		$29.95 (5-49)
PSC-3-13	1-200	35	0.6		$24.95 (5-49)
ZSC-3-1	1-200	25	0.7	3	$37.95 (4-24)
ZSC-3-1-75	1-200	25	0.7	1.3	$38.95 (4-24)
ZSC-3-2	0.01-30	25	0.45	3	$47.95 (4-24)
ZSC-3-2-75	0.02-20	25	0.6	1.3	$48.95 (4-24)
ZMSC-3-1	1-200	25	0.7	4	$47.95 (4-24)
ZMSC-3-2	0.01-30	25	0.45	4	$57.95 (4-24)
ZFSC-3-1	1-500	20	0.9	5	$39.95 (4-24)
ZFSC-3-1W	2-750	20	1.0	5	$41.95 (4-24)
ZFSC-3-13	1-200	35	0.6	5	$39.95 (4-24)

Model	Freq. range (MHz)	Min. isol-dB (Mid-band)	Max. insert. loss-dB (Mid-band)	See notes below	Price (Qty.)
4-WAY 0°					
PSC-4-1	0.1-200	20	0.75		$28.95 (6-49)
PSC-4-1-75	1-200	20	0.9	1	$24.95 (6-49)
PSC-4-3	0.25-250	20	0.75		$23.95 (6-49)
PSC-4A-4	10-1000	15	1.1		$49.95 (6-49)
PSC-4-6	0.01-40	25	0.5		$29.95 (6-49)
ZSC-4-1	0.1-200	20	0.75	3	$46.95 (4-24)
ZSC-4-1-75	1-200	20	0.8	1.3	$46.95 (4-24)
ZSC-4-2	0.002-20	25	0.5	3	$69.95 (4-24)
ZSC-4-3	0.25-250	20	0.75	3	$43.95 (4-24)
ZMSC-4-1	0.1-200	20	0.75	4	$56.95 (4-24)
ZMSC-4-2	0.002-20	25	0.5	4	$79.95 (4-24)
ZMSC-4-3	0.25-250	20	0.75	4	$53.95 (4-24)
ZFSC-4-1	1-1000	18	1.5	8	$89.95 (1-4)
ZFSC-4-1W	10-500	20	1.5	8	$74.95 (1-4)
ZFSC-4375	50-90	30	1.2	1.8	$89.95 (1-4)
ZA4PD-2	1000-2000	18	1.0	14	$79.95 (1-9)
ZA4PD-4	2000-4200	18	1.0	14	$79.95 (1-9)
6-WAY 0°					
PSC-6-1	1-175	18	1.0		$68.95 (1-5)
ZFSC-6-1	1-175	20	1.2	9	$89.95 (1-4)
8-WAY 0°					
PSC-8-1	0.5-175	20	1.1		$68.95 (1-5)
PSC-8-1-75	0.5-175	20	0.8	1	$69.95 (1-5)
PSC-8A-4	5-500	18	1.8		$89.95 (1-5)
PSC-8-6	0.01-10	23	1.1		$79.95 (1-5)
ZFSC-8-1	0.5-175	20	1.1	10	$89.95 (1-4)
ZFSC-8-1-75	0.5-175	20	1.0	1.10	$90.95 (1-4)
ZFSC-8375	50-90	25	1.3	1.10	$119.95 (1-4)
ZFSC-8-4	0.5-700	20	1.5	10	$129.95 (1-4)
ZFSC-8-6	0.01-10	23	1.1	10	$109.95 (1-4)
16-WAY 0°					
ZFSC-16-1	0.5-125	18	1.6	11	$174.95 (1-4)
24-WAY 0°					
ZFSC-24-1	0.2-100	20	2.0	12	$264.95 (1-4)

7 TNC, SMA & Type N at $5 additional cost. Please specify connectors.
8 SMA connectors standard. BNC on request.
9 BNC connectors standard. TNC available. SMA available at $15 additional cost.
10 BNC connectors standard. TNC available at $10 additional cost. SMA at $25 additional cost.
11 BNC connectors standard. TNC available at $20 additional cost. SMA available at $45 additional cost.
12 BNC connectors standard. TNC available at $35 additional cost. SMA available at $65 additional cost.
13 BNC connectors (not available for ZAPDQ-4). TNC available. (SMA [3MM] and Type "N" on request. Add $5 per unit.) Please specify connectors.
14 TNC, SMA, Type N please specify connectors.

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Amplifiers

• Ultra Low Noise • Wide Dynamic Range • Custom Design

Ultra Low Noise Amplifiers

Model Number	Frequency (MHz)	Min. Gain (dB)	Flatness (dB)	Noise Figure (dB) typ.	Noise Figure (dB) max.	Pwr. Out @ 1 dB Compression Pt. (dBm)	Case/ Connectors*
W50ETD	0.01-50	50	± .5	1.3	1.5	0	C/SMA
W50ETC	0.01-50	20	± .5	4.0	4.5	+ 23	C/SMA
W250G	5-250	43	± .5	1.3	1.5	+ 25	B/SMA
W500E	5-500	30	± .5	1.3	1.4	0	C/SMA
L60E-2	50-70	60	± .5	0.9	1.0	+ 10	C/SMA
L450E	400-500	27	± .5	1.2	1.4	+ 5	C/SMA
WIG2H	5-1000	30	± .5	1.3	1.5	+ 5	C/SMA
W2GHH2	1-2 GHz	30	± .5	2.3	2.5	+ 5	AB/SMA

Special Purpose Amplifiers

Model Number	Frequency (GHz)	Gain (dB)	Noise Figure (dB)	Pwr. Out @ 1 dB Compression Pt. (dBm)	Case/ Connectors
L13GE	1.25-1.35	25	2.2	+ 5	C/SMA
W89DGA	0.47-0.89	25	2.0	+ 5	C/SMA
L215GA	2.15-2.165	11	3.2	−3	C/N
L215GC	2.15-2.165	29	2.9	+ 7	C/N
W2GH	0.5-2.0	25	3.0	+ 10	B/SMA
P150P	0.08-150 MHz	60	1.5	+ 30	H/BNC
W15GB1	0.05-1.5	20	1.8	−3	C/SMA
W23GA	0.1-2.3	8	9.0	+ 20	C/SMA

Wide Dynamic Range Amplifiers

Model Number	Frequency (GHz)	Min. Gain (dB)	Pwr. Out @ 1 dB Compression Pt. (dBm) typ.	Pwr. Out @ 1 dB Compression Pt. (dBm) min.	Noise Figure (dB)	Case/ Connectors	Typical Intercept Pt. (dBm)
P60F	30-90 MHz	30	+ 32	+ 31	5.5	H/BNC	+ 43
P150H2	0.1-150 MHz	27	+ 31.5	+ 30	6.5	H/BNC	+ 44
P175M	150-200 MHz	23	+ 34	+ 33	8.0	H/BNC	+ 45
P400C	10-400 MHz	20	+ 31	+ 30	7.0	H/BNC	+ 42
P500N	2-500 MHz	17	+ 31	+ 30	8.0	H/BNC	+ 42
P10GL	0.5-1.0	30	+ 31	+ 30	5.0	H/SMA	+ 42
P2GS-7	0.5-2.0 GHz	30	+ 30	+ 29	10.0	FS/SMA	+ 42
P24GB	1.4-2.4	16	+ 20	+ 19	8.0	A/SMA	+ 32

CASE DIMENSIONS: (Others Available)

	L (in.)	W (in.)	H (in.)
C	1.875	1.875	0.465
A	3.375	1.875	0.465
H	3.75	2.60	1.95
AB	3.00	1.875	0.465
B	2.625	1.875	0.465
FS	4.5	2.8	1.1

*Standard this model; others may be specified.
VSWR all models: 2:1 max, 1.5:1 typ.

The devices above are just a sampling of TRONTECH's product line in state of the art low noise and medium power amplifiers. Our amplifiers are designed so that parameters such as gain, bandwidth, output power, noise figure, form factor, etc., can be tailored to your specifications. Our capabilities include Video and Limiting Amplifiers, Integrated Assemblies, Modular Amplifiers, etc.

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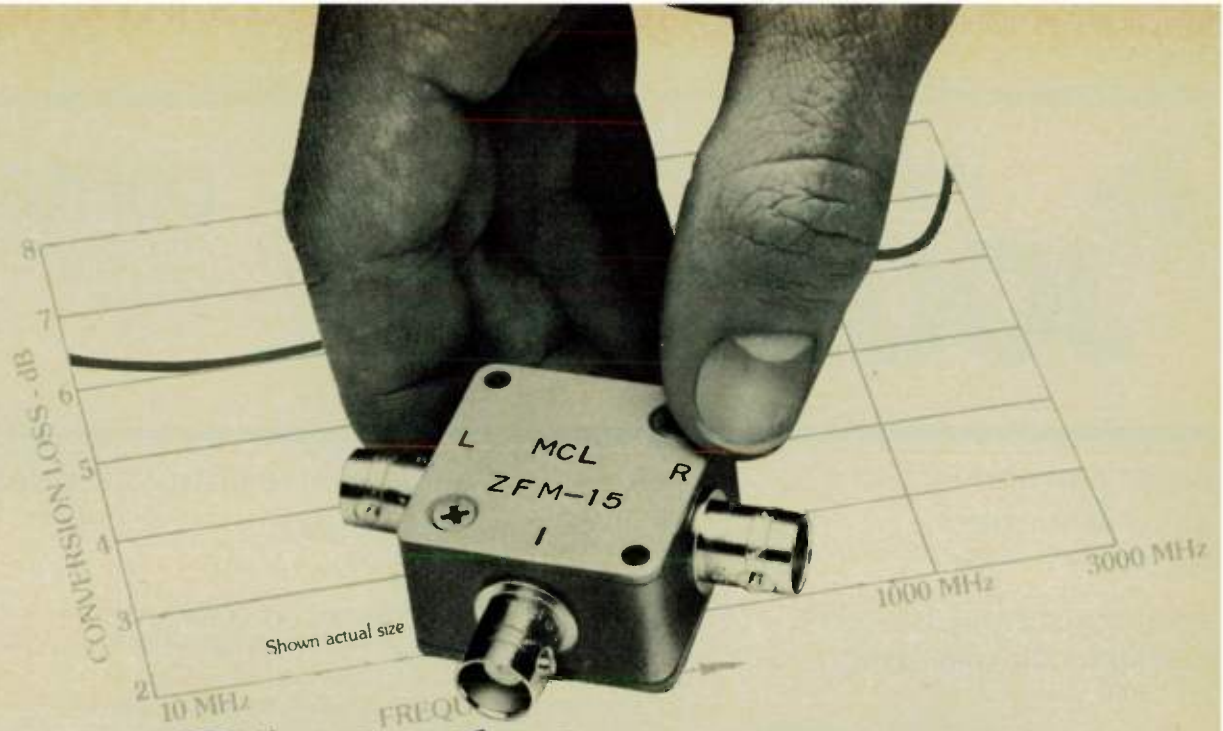

super mixer

the world's first 10-3000 MHz mixer **with only 6.5 dB conversion loss**

The ZFM-15 from Mini-Circuits $79.95 (1-9)

Specify the ZFM-15 for such applications as wideband ECM receivers where wide dynamic range is essential; the 1 dB compression point for the ZFM-15 is +5 dBm. The price/performance of the ZFM-15 even makes it ideal for narrowband applications including TACAN and S-Band telemetry.

The miniature ZFM-15 is available in 4 connector versions and 3 mounting configurations. Of course, super mixers come with Mini-Circuits' one-year guarantee and are available for immediate delivery.

ZFM 15 SPECIFICATIONS

FREQUENCY RANGE, MHz
LO 10-3000 RF 10-3000 IF 10-800
LO Power + 10 dBm

CONVERSION LOSS, dB	Typ.	Max.
20-1500 MHz	6.3	7.5
10-3000 MHz	6.5	8.5

ISOLATION, dB (10-3000 MHz)	Typ.	Min.
LO RF	30	20
LO IF	30	20

SIGNAL 1 dB Compression Level +5 dBm

IMPEDANCE all ports 50 ohms

VSWR (at ports)	Typ.
LO	2.1
RF	2.1
IF	1.8

CONNECTORS BNC STD. TNC on request Type N and SMA $5 additional

MOUNTING Thru hole. Threaded insert. Flange

SIZE 1.25" x 1.25" sq. x 0.75" high

Mini-Circuits
A Division of Scientific Components Corp.
World's largest manufacturer of Double Balanced Mixers
2625 East 14th Street, Brooklyn, New York 11235 (212)769-0200
Domestic and International Telex 125460 International Telex 620156

microwave JOURNAL

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VOLUME 24, NUMBER 5
USPS 396-250
MAY 1981

GUEST EDITORIAL

BUSINESS/SPECIAL REPORTS

TECHNICAL/APPLICATIONS SECTION

DEPARTMENTS

ON THE COVER: Avantek's AV-71826 extends the reach of fundamental YIG-tuned oscillators to 26.5 GHz. See Cover Story on p. 138.

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MINIATURE ATTENUATORS

Between these SMA connectors is a precision thin-film attenuator element providing the Narda 4780 Series with low VSWR, flat response and high power handling capability... DC to 18 GHz.

these pads are the newest member to join the ever growing family of precision attenuators by Narda

Dedicated inspection with sophisticated instrumentation guarantees that your system receives the most reliable product available today.

The performance characteristics of Narda attenuators remain the "standard" of the industry... from our precision fixed and subminiature attenuators to the variable and step attenuators. They all have one thing in common. Narda's unchanging demand for quality, availability and better than "competitive" prices.

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wherever microwaves go... narda

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See us at MTT Booth #502

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lightweight 95 GHz magnetron

EEV's MG5200 rare earth samarium cobalt magnetron weighs only 4 lbs... 50% less than Alnico types.

NEW

This pulse magnetron operates at short pulse lengths down to 4ns which makes the MG5200 ideally suited for high resolution radars.

It uses the same proven design of EEV's highly successful range of 80-96 GHz magnetrons, has an expected life of 750 hours, and is interchangeable with EEV's widely used M5163 Alnico type magnetron.

The MG5200 is another example of why system designers look to EEV for the most complete line of lightweight, compact, reliable and powerful millimeter magnetrons.

And we have many more advanced designs that include 15-96 GHz, fixed frequency, mechanically tunable and frequency agile types, and with peak output power from 250 watts to 70 KW.

In fact, we pioneered piezo-electric tuning for frequency agile millimeter magnetrons. But that is what you would expect from the company who developed the first magnetrons in 1940.

Our facilities design and produce the most comprehensive range of electronic tubes used throughout the world including TWT's, klystrons, magnetrons, duplexers, thyratrons, power grid tubes, imaging and light conversion devices including pyroelectric vidicons. **Relmag**, our California division, specializes in frequency stable coaxial magnetrons.

Whatever your requirements...call or write EEV for complete mm magnetron information and specifications.

MG5200 (3mm)
94-96 GHz
Fixed frequency
3.0 KW peak power
only 4.0 lbs.

Actual Size

M5163 (3mm). 94-96 GHz • Fixed Frequency • 3 0 KW peak power • 7 5 lbs

M5124 (4 mm). 80 5-81 5 GHz • Frequency agile over 1000 MHz • Piezo-electric tuned • 4 0 KW peak power

M5154 (8 mm). 33 0-37 0 GHz • Fixed Frequency • Pulsed anode • 1 3 KW peak power • 1 0 lbs

M5059 (8mm). 34 5-38 0 GHz • Frequency agile up to 400 MHz • Piezo-electric tuned • 40 KW peak power

EEV, INC.
7 Westchester Plaza, Elmsford, NY 10523, 914-592-6050, Telex 646180
In Canada: EEV CANADA, LTD , 67 Westmore Drive, Rexdale, Ontario, M9V 3Y6, 416-745-9494, Telex 06-989363
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Members of the GEC Group of Companies

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Coming Events

1981 IEEE/MTT-S INT'L MICROWAVE SYMPOSIUM JUNE 15-17, 1981

Sponsor: IEEE MTT-S (held jointly with IEEE AP-S and URSI on June 17-19, 1981). Place: Bonaventure Hotel, Los Angeles, CA. Theme: "Around the World with Microwaves," includes such topics as CAD and measurement techniques, microwave and mm-wave solid-state devices, IC's, low noise techniques, mw passive components and networks, microwave ferrite devices, satellite communications, submm-wave techniques and devices, mw bioeffects, etc. Contact: Al Clavin, Hughes Aircraft Co., Bldg. 268/A-55, Canoga Park, CA 91304. Tel: (213) 702-1778.

1981 IEEE INT'L SYMPOSIUM ON EM COMPATIBILITY AUG. 18-20, 1981

Sponsor: IEEE Place: Boulder, CO Subject: Problems of electromagnetic compatibility and electromagnetic interference, including EM properties of composites, FCC measurements, EM compatibility design in microelectronics, etc. Contact: Charlotte Tyson, Registration EMC '81, Int'l Business Machines, 59Z/025-1, P.O. Box 1900, Boulder, CO. 80302. Tel: (303) 447-5072.

1981 ANTENNA MEASUREMENT TECHNIQUES ASSN. SYMPOSIUM OCT. 13-15, 1981

Call for Papers. Sponsor: Antenna Measurement Techniques Association, host: Sanders Assoc. Place: King's Grant Inn, Danvers, MA. Topics: Near Field Testing, Compact Antenna Ranges, Advanced Instrumentation and Automation of Antenna Measurements. Submit four copies of a brief abstract by June 15, 1981 to George Andrews, AMTA Sec., Boeing Aerospace Co., P.O. Box 3999, M/S 8E-17, Seattle, WA 98124. Tel: (206) 773-9811. Gen. Contact: Sam Davis, Chrmn., Scientific-Atlanta, Inc., Instrumentation Div., Atlanta, GA 30340. Tel: (404) 449-2038.

'81 IR AND MM WAVE CONF. DEC. 7-12, 1981

Call for Papers. Sponsor: IEEE Microwave Theory and Techniques Society. Place: Carillon Hotel, Miami Beach, FL. Sessions: including mm sources, devices or system, mm and sub-mm propagation, spectroscopy, lasers, imaging, etc. Submit 35-40 word abstract by June 30, 1981 to: K. J. Button, M.I.T., National Magnet Lab., Cambridge, MA 02139. Tel: (617) 253-5561.

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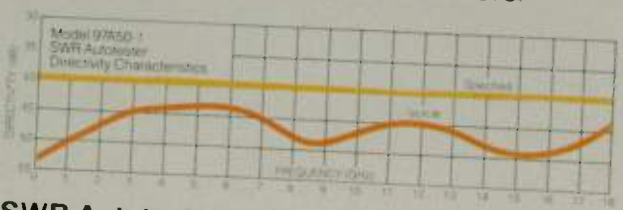
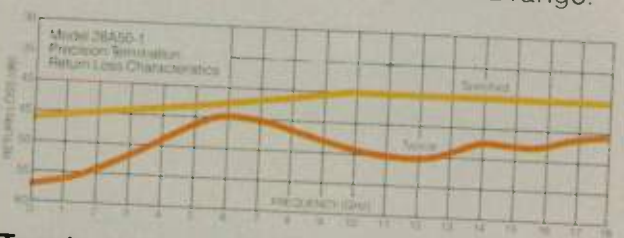
And you thought we only made quality microwave instrumentation. The U.S. National Bureau of Standards, the standards labs of Japan, West Germany, Great Britain and quite a few others know better.

Wiltron is also a precision components house. No one else is better prepared to show you how to make microwave measurements simply and accurately and then provide you with all the precision components and the measurement system you need. No one offers a comparable group of SWR Autotesters, precision air lines, terminations, adapters, SWR Bridges, open/shorts and RF detectors.



SWR Autotesters

Latest in Wiltron's family of SWR Autotesters is the Series 97. Here in one small package, we integrate a broadband microwave bridge, a precision termination, a detector and your choice of test port connectors. Performance is exceptional with directivity of 40 dB and a frequency range of 10 MHz to 18 GHz. Several other models with N or WSMA test ports offer comparable performance. The Wiltron family of SWR Bridges is equally accurate over most of its 10 MHz to 18 GHz range.

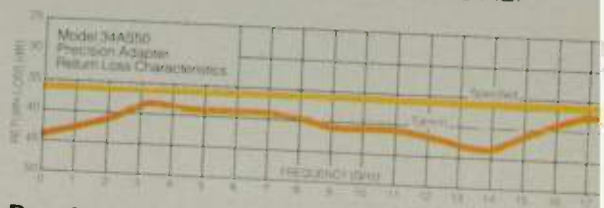


Terminations and Open/Shorts

Wiltron Terminations provide an accurate reference for SWR measurements as well as a termination for test instruments and devices under test from DC to 26.5 GHz. They are available in GPC-7, N and WSMA connectors and feature aged termination resistors for long-term stability. Maximum SWR varies from 1.002 at low frequencies to 1.135 at 26.5 GHz. Wiltron 22 Series Open/Shorts for the DC to 18 GHz range are offered with a choice of connectors.

Precision Air Lines

When you want better accuracy in measuring return losses from 0dB to 55dB, you'll need a Wiltron Air Line. These 50-ohm Air Lines provide both a standard impedance and a time delay for use in Wiltron Ripple Averaging and Magnified Reflection Measurement Techniques. Series 18 covers the 2 to 18 GHz range. The 18A50 offers a GPC-7 connector and features an SWR of 1.002. The 18N50 has an N male or female connector and an SWR of 1.006. Series 19 operates from 2 to 26.5 GHz with an SWR of 1.006 to 18 GHz and 1.01 to 26.5 GHz.



Precision Adapters for Accurate Measurements

Wiltron 50-ohm Series 34 Adapters virtually eliminate errors caused by mismatch. The adapters are available in GPC-7/N, GPC-7/WSMA, N/N and WSMA/WSMA. Range is DC to 26.5 GHz. Typical SWR ratios are 1.02 to 18 GHz and 1.1 to 26.5 GHz.

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Wiltron also offers the industry's most extensive line of RF detectors with coverage up to 34 GHz.

So go for the Gold Standard

Go Wiltron and your microwave measurements will be as good as pure gold. Remember, Wiltron offers you one source shopping for production or development measurement systems and cal lab reference standards.

For more information, call or write Walt Baxter, Wiltron, 825 East Middlefield Road, Mountain View, CA 94043. Phone (415) 969-6500.

WILTRON

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WEINSCHEL advanced technology
a new dimension in $\mu\lambda$ measurements

NOW MEASURE TRANSMISSION LOSS, GAIN, AND PHASE ... with new simplicity, speed, accuracy, and dynamic range using the Weinschel VM-4A measurement receiver and 4312 Automatic Phase Lock System.

Resident μ processors, dual-channel ratio techniques, auto-tuning signal source, tracking local oscillators, and Parallel IF Vector Substitution combine to allow system operation by semi-skilled personnel and still obtain measurements with standards lab accuracies.

NO OTHER SYSTEM AVAILABLE COMBINES ALL THESE FEATURES ... 0.01-18 GHz • 0.1, 0.01, 0.001 dB resolution • ± 0.003 dB/10 dB ± 0.005 dB accuracy (IF) • >100 dB dynamic range — single step • 0.1 degree phase resolution • high common mode rejection • adaptive averaging for noise error reduction • 140 dB channel isolation • resident programming with 4312 system • RS-232 hard copy data port • IEEE-488 Bus compatibility • built-in self-check features.

A VM-4A/4312 SYSTEM FOR YOUR APPLICATIONS? ... whether your measurement problems are in the standards lab or on the production line, engineering lab or antenna range, the VM-4A/4312 will do the job quickly and efficiently with unexcelled performance ... whether you're measuring attenuators, transmission lines, amplifiers or filters, antennas or output attenuators of signal generators, the VM-4A/4312 will do the job like no other system available.

SHOULDN'T YOU BE CONSIDERING ONE?...

Call or write for a demonstration today!

U.S. Patents 4,103,223, 4,138,637, and 4,219,770. Other patents pending.

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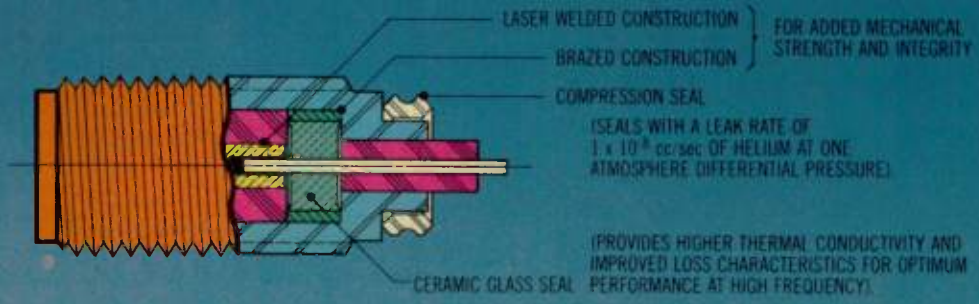
creates... the VM-4A
... 0.01-18GHz

Introducing the OSCS Series . . . the all NEW line of laser welded ceramic glass seal connectors . . . . . from Omni Spectra

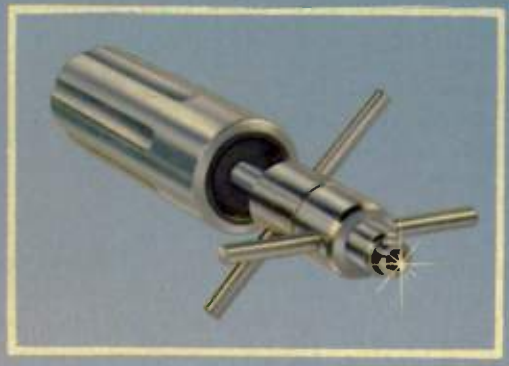
The OSCS Series is the latest addition to Omni Spectra's comprehensive line of OSM miniature hermetic seal connectors, featuring a new ceramic glass seal, brazed construction with a laser welded contact. This allows for superior performance at high frequencies and mechanical strength and integrity.



Select from flange mount, panel feedthrough, and bulkhead feedthrough types which are appropriate for a variety of critical applications including launches to microstrip in sealed packages.

Write or call today for detailed information on the OSCS Series and we will supply you with a set of applicable assembly instructions.

Omni Spectra, Inc. Microwave Connector Division
140 Fourth Ave., Waltham, MA 02254
Telephone: (617) 890-4750 TWX: 710-324-6377 Telex: 92-3474

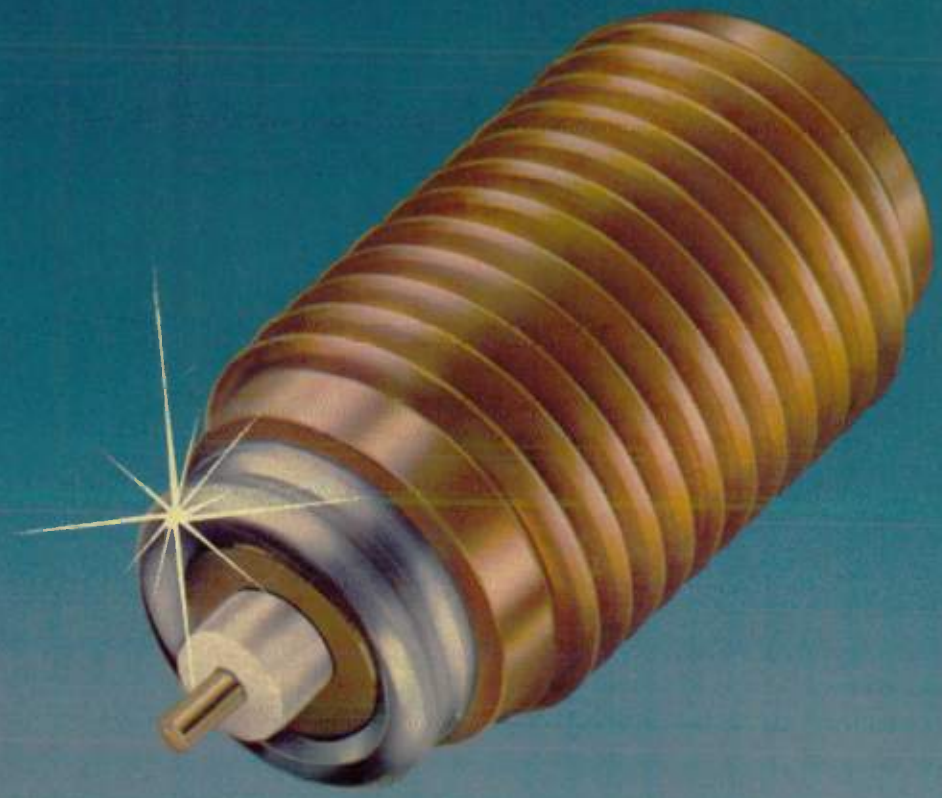


Torque Wrench Mounting Tool

Three easy steps are used to install OSM(SMA) female connectors.

- Install connectors into tool
- Thread connector into MIC package
- Tighten until torque wrench releases

....The OSCS Series



ACTUAL SIZE

Omni Spectra

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LOOK!

Yes, take a close look at this Type 23 Package which CCI has designed for microstrip and stripline use.

The leads provide good continuity of transmission line impedance to the diode.

These diodes are constructed with the CCI "Evapalloy" process which insures better control over characteristics and very low series resistance junctions.

Parameters may be varied to help solve your particular diode application problem.

CCI can provide diodes tested to MIL-STD-19500 or specific customer screening requirements.

GO!

CCI's "Evapalloy" process control and experience has proven CCI diodes to be the most consistent and reliable in the industry.

Check it out today. GO with CCI!

FEATURES:

- **High Reliability**
- **Low I/f Noise**
- **Customized Characteristics**
- **High Zero Bias Sensitivity**
- **High Radiation Resistance**
- **Excellent Linearity**
- **Extreme Flatness with Temperature**
- **Low VSWR**
- **Low Video Resistance**

Stripline Back Diode

For Video Detector Applications

CCI

CUSTOM COMPONENTS, INC.

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ELECTRICAL CHARACTERISTICS

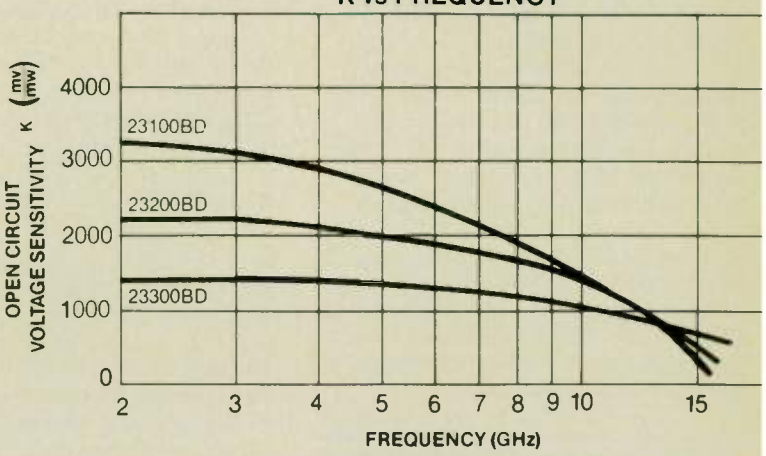
Part Number	Ip (μa)	Vr (Mv) Typ.	Vf (Mv) Typ.	Rs (Ω) Max.	Ct (pf) Max.
23100BD	50-150	540	120	12	.7
23150BD	50-150	540	100	9	1.0
23200BD	150-250	550	110	11	.7
23250BD	150-250	550	100	8	1.0
23300BD	250-350	540	110	11	.7
23350BD	250-350	540	100	8	1.0
23400BD	400-500	530	100	10	.7
23450BD	400-500	530	80	8	1.0

Typical Performance

Type	Rv (Ω)	Tss (−dbm)	M $\left(\frac{K}{\sqrt{Rv}}\right)$	K $\left(\frac{mv}{mw}\right)$
23100BD	400	−52	80	1600
23200BD	180	−51	90	1200
23300BD	80	−50	100	900

NOTES: 1. 2MHz Band Width **2.** Input Power −20 dbm **3.** Fo 10GHz

K vs FREQUENCY



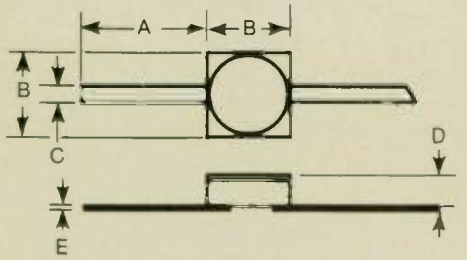
ENVIRONMENTAL RATINGS

Storage Temp.—65°C to +100°C
Operating Temp.—65°C to +100°C
Temperature Cycle—MIL-STD-202, Method 107, T.C. A
Shock—MIL-STD-750, Method 2016
Vibration—MIL-STD-750, Method 2056
Acceleration—MIL-STD-750, Method 2056
Fine Leak—MIL-STD-750, Method 1071, T.C. G
Gross Leak—MIL-STD-750, Method 1071, T.C. C

CCI's "Evapalloy" process guarantees you the most reliable & consistent diode in the industry!

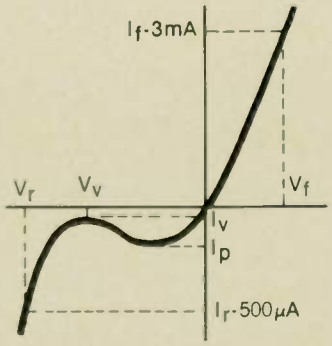
* "Evapalloy" is a registered trademark of Custom Components, Inc.

PACKAGE OUTLINE Type 23



DIM.	A	B	C	D	E
MIN.	13	064	018	026	003
MAX.	17	076	022	034	006

BACK DIODE STATIC V-I CHARACTERISTIC



CCI Capability: Tunnel Diodes for Oscillators, Dete tors, Amplifiers & Switches, Back Diodes & Schott Diodes for Detector-Mixer applications. CCI can pr vide all its products tested to MIL-STD-19500 HI-RI requirements including 100% pre-screening, x-ra environmental & accelerated aging tests. Devices w special characteristics or special packages to unique requirements can be made for you in a sho time.

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Box 334, Lebanon, New Jersey 08833
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1981 MICROWAVE MEETINGS

This year's MTT-S Symposium/Exhibition will be augmented by the coincident AP-S and URSI Symposia. All three meetings will be held during the week of June 15-19 at the Bonaventure Hotel in Los Angeles and, together with the Microwave Exhibition which will run from June 15 through 17, this promises to be the largest gathering ever of the microwave industry. Beginning with Joe White's "Attending the Conference" article, a major portion of this issue is devoted to meeting and exhibition information. Complete programs for the MTT-S, AP-S and URSI Symposia are listed. Information about evening panel sessions and special workshops is included. Complete floor plans of the meeting and exhibition and an exhibition guide are also provided.

Sum Up

I.E.E. MICROWAVE CIRCUIT COMPONENT MEETING

For the first time in approximately 10 years, the professional group on Microwave Devices and Techniques of I.E.E. convened a meeting in December in London to review microwave circuit components. The first of two sessions addressed GaAs FET's for microwave signal control, optical control of microwave semiconductors and ferrite control devices. The second session concentrated on PIN diode applications for modulation, control and switching.

MARCHAND BALUN CIRCUIT ELEMENT GRAPHS

Implementing transformer action within a Marchand balun to match the balanced load resistance of a typical antenna to the source resistance leads to optimum broadband characteristics. Graphs of the circuit element values for a fourth order balun with single section quarter wave input and output transformers are provided in this article. Bandwidth ratios ranging from 4:1 to 12:1 are covered.

AN ARCSPRAYED COATING FOR EMI/RFI SHIELDING

A system for applying molten metal particles to a surface for EMI/RFI shielding purposes which does not appreciably raise the temperature of the treated surface is described. Attenuation characteristics of the sprayed material through 10 GHz are discussed. Mechanical properties of the material and a complete description of the equipment and its operation are also included.

THE FRENCH MICROWAVE LANDING SYSTEM

The history of the development of the microwave landing system is discussed and its several advantages over present systems are described. The transition plan from ILS to MLS as currently defined by the International Civil Aviation Organization which calls for general use of MLS during the 1995 to 2000 time frame is shown. The French system presently being manufactured by Thomson-CSF is covered in detail. The design approach and performance of major subsystems is described.

Howard Ellowitz

Workshops & Courses

MICROWAVE ANTENNA MEASUREMENTS SHORT COURSE

Sponsor: California State U., Northridge
Site: CSU, Northridge, CA
Date: July 13-17, 1981
Fee: $575
Description: Measurements of microwave antenna characteristics, including planar, cylindrical and spherical near-field techniques.
Contact: Dr. Edmond S. Gillespie, School of Engineering and Computer Science CSU, Northridge 18111 Nordhoff Street Northridge, CA 91330 Tel: (213) 885-2190, 885-2146

MICROWAVE SYSTEMS PLANNING

Sponsor: George Washington U. Continuing Engrg. Ed.
Site: GWU, Washington, DC
Date: July 13-17, 1981
Fee: $715- No. 832DC
Instructor: Allan Schneider, Pres. CyberCom Corp.
Description: Concepts and principles of microwave system planning, including the impact of digital technology on mw transmission systems.
Contact: Continuing Engineering Education, George Washington University Washington, DC 20052

GIT SHORT COURSES

Sponsor: Georgia Institute of Technology
Site: Georgia Tech., Atlanta, GA
Date: July 20-22, 1981
Fee: $350
Subject: Millimeter and Microwave Ferrite Materials—Study of the structure and properties of ferrite materials and the application of these materials in microwave signal processing and control functions.
Contact: Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332 Tel: (404) 894-2400

The world is shrinking.

Former Amplifier Size

So are W-J's wideband amplifiers.

- Small size
- Low noise
- Hermetically sealed
- Wide bandwidths

As space becomes more of a premium, miniaturization becomes even more vital. At Watkins-Johnson, we never cease trying to cut things down to size.

Our latest line of small-sized, wideband solid state amplifiers offers up to a 50% reduction over conventional amplifiers for applications where size is a prime consideration. But they lose nothing in performance.

To shrink them, we compressed RF module designs onto the smallest possible substrate size, eliminated all the hard wiring for biasing, and used a thin-film hybrid chip regulator circuit. The housing can be sealed hermetically.

Our models cover all standard octave and multi-octave bands in the 2 to 20 GHz frequency range. Narrow-bandwidth models optimized for particular frequency ranges are also available. Internal modules for temperature compensation and gain control are optional. Input and output limiting and higher power will be available soon.

New Amplifier Size

For more information on how Watkins-Johnson can fit the products below into your environment, please contact Amplifier Applications Engineering in Palo Alto at (415) 493-4141, ext. 2247, or your nearest Watkins-Johnson Field Sales Office.

WJ-6852 Series	2 to 4 GHz	WJ-6856 Series	8 to 12 GHz
WJ-6853 Series	2 to 6 GHz	WJ-6857 Series	8 to 18 GHz
WJ-6854 Series	2 to 8 GHz	WJ-6858 Series	12 to 18 GHz
WJ-6855 Series	4 to 8 GHz	WJ-6859 Series	12 to 20 GHz

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ATTENDING THE CONFERENCE

JOSEPH F. WHITE, Consulting Editor

THE BONAVENTURE SITE

Coming to this year's MTT Conference at the Bonaventure Hotel in Los Angeles will be like making your own space odyssey. The Bonaventure with 1500 guest rooms, half-acre exhibit space, 37 meeting rooms and 4 ballrooms is a twenty-three story symmetric arrangement of five silo-like structures, a center one encircled by four others with a six-story skylight lobby enclosing registration, bars, restaurants, boutiques, and gardens. Adjacent to this artistic inn by architect John Portman, is a multi-story conference center with roof swimming pool. On the first floor of this exhibit structure will be found over 150 separate microwave exhibits and booths. On the next two floors are the meeting rooms in which up to four simultaneous sessions containing 160 presentations over three days will be held. The drawing on p. 30 is our attempt to help you orient yourself as you traverse the maize of corridors and towers that intervenes between your room and the papers you want to hear.

The Bonaventure is located as strategically in downtown LA as could be wished, which translated means you'll need a car, bus or taxi to get to most places of interest which aren't immediate to the hotel complex. (See L.A. Area Map, p. 28).

Conference registration (for any one or all – MTT, AP and URSI) will take place in the foyer of the Bonaventure in front of the California Ballroom from 4 PM to 9 PM on Sunday, from 7:30 AM to 9 PM on Monday, from 7:30 AM to 4 PM Tuesday through Thursday and from 7:30 AM to 12 PM on Friday. Messages can be transmitted to conference attendees through the hotel operators by calling the toll-free numbers USA 800-228-3000, Alaska and Hawaii 800-228-1212, Canada 800-268-8383 giving the name of the person to be contacted and indicating that that person is an IEEE conference attendee. Those who cannot be accommodated in the Bonaventure Hotel will be housed at the Biltmore.

There are seven different establishments within the Bonaventure with restaurant facilities. Buffet breakfast and lunches are served in the lobby court and there is a variety of restaurants within a few walking blocks of the hotel.

SPECIAL PANEL SESSIONS

This year's evening panel talks highlight the wide diversity of questions besetting the microwave industry. Monday night features "Status and Trends in Fiber Communications," a session headed by M. K. Barnoski and J. Austin of the TRW Technology Research Center describing the background of fiber optic communications, its capabilities and applications, and its relationship to competing microwave links in the market place. Actual installations and systems will be presented with experts from both the fields of fiber optics as well as microwave communications to present aspects of fiber optic communications and to respond to audience.

Another Monday evening panel covers "Microwave Devices Technology Transfer from Research and Development to Manufacturing." This panel will address the production syndrome created within the microwave industry which results because microwave devices enjoy relatively little production volume yet must meet tighter performance specifications, more stringent material parameter tolerances and more complex fabrication and testing than other goods produced within an industrial nation. Problems and challenges for automation, labor training, capital investment and cost effectiveness will be discussed by the panel, headed by John Kuno of Hughes Aircraft Company.

The "Impact of Gallium Arsenide IC's on Microwave Systems" is the subject of a Panel (meeting Wednesday night 1) organized by Paul T. Greiling. The panel members encourage audience participation in this discussion which will relate the performance of state of the art digital and analog GaAs IC's along with their potential for lower cost, lower noise, wider bandwidth or higher data rates and how these desirable performance features may be limited by material quality, power dissipation, on and off chip delays, and packaging.

Wednesday night, "Manpower Problems in Microwave and Antenna Engineering," will be addressed in a panel headed by R. McIntosh, NASA, Langley, Virginia.

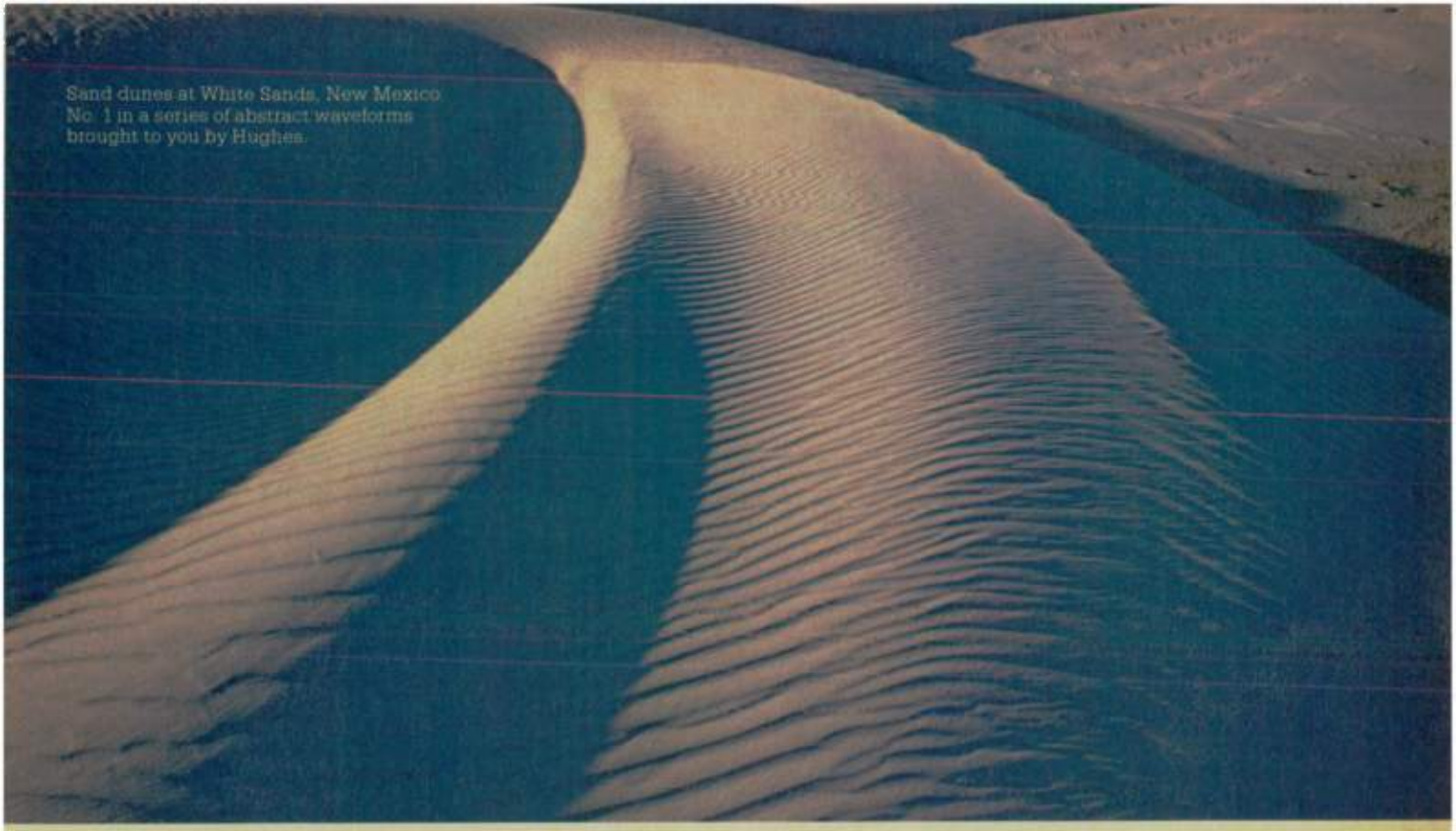
Also on Wednesday night, "State of the Art of Millimeter and Submillimeter Receivers," a panel organized by J. J. Whelehan of AIL, Melville, NY will treat the evolving state of the millimeter and submillimeter technology and the need for system trade-off decision by potential user groups which exists at this developing state of the millimeter art. A special topic will include the overlap region between millimeter and submillimeter-wave receivers.

MTT TECHNICAL PROGRAM

The 1981 MTT Symposium Technical Program includes 22 separate sessions containing over 150 papers which will be presented in four days in up to 4 simultaneous technical sessions at any one time. The old standby subjects including Computer Aided Designs, Ferrites, Passive Components, Phased Array Techniques, Low Noise Techniques and Field and Network Theory account for about half the papers. Equal representation is given newer topics of interest to the microwave community including FET's and associated Solid State devices, Millimeter Waves, 6-Port Measurement Methods, Dielectric Resonators, Printed and Monolithic Integrated Circuits, Microwave Acoustics, Guided Wave Optics and Bio-Medical Effects and Applications.

The FET papers cover some impressive accomplishments. For example, Session B includes an FET with a 0.6 dB noise figure at 4 GHz, 1.3 dB

(continued on page 28)



Hughes is making new waves with a shortcut to mm-wave radar design.

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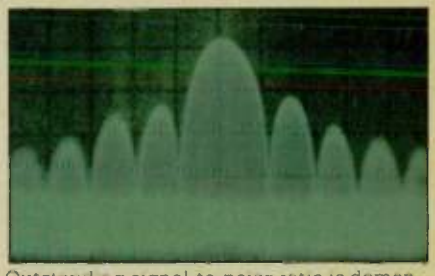

Outstanding signal to-noise ratio is demonstrated in the spectrum of pulsed IF output signal (Sin x/x). Total peak-to-valley ratio is in excess of 50 dBc/KHz

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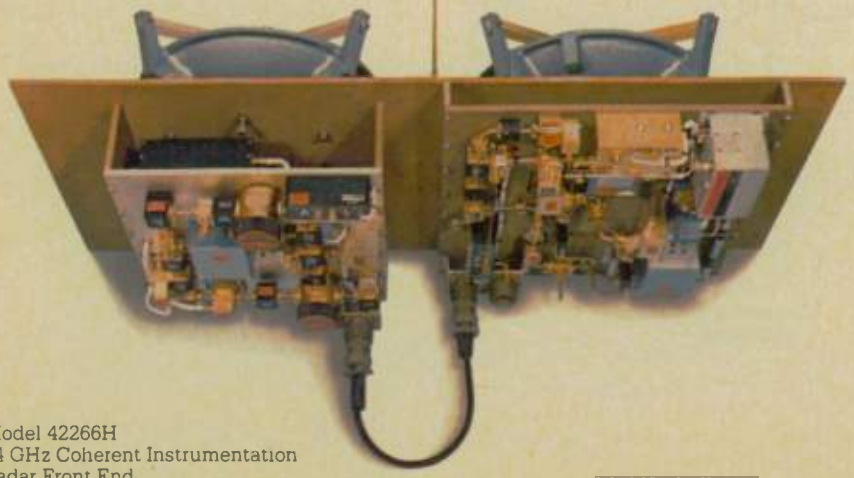

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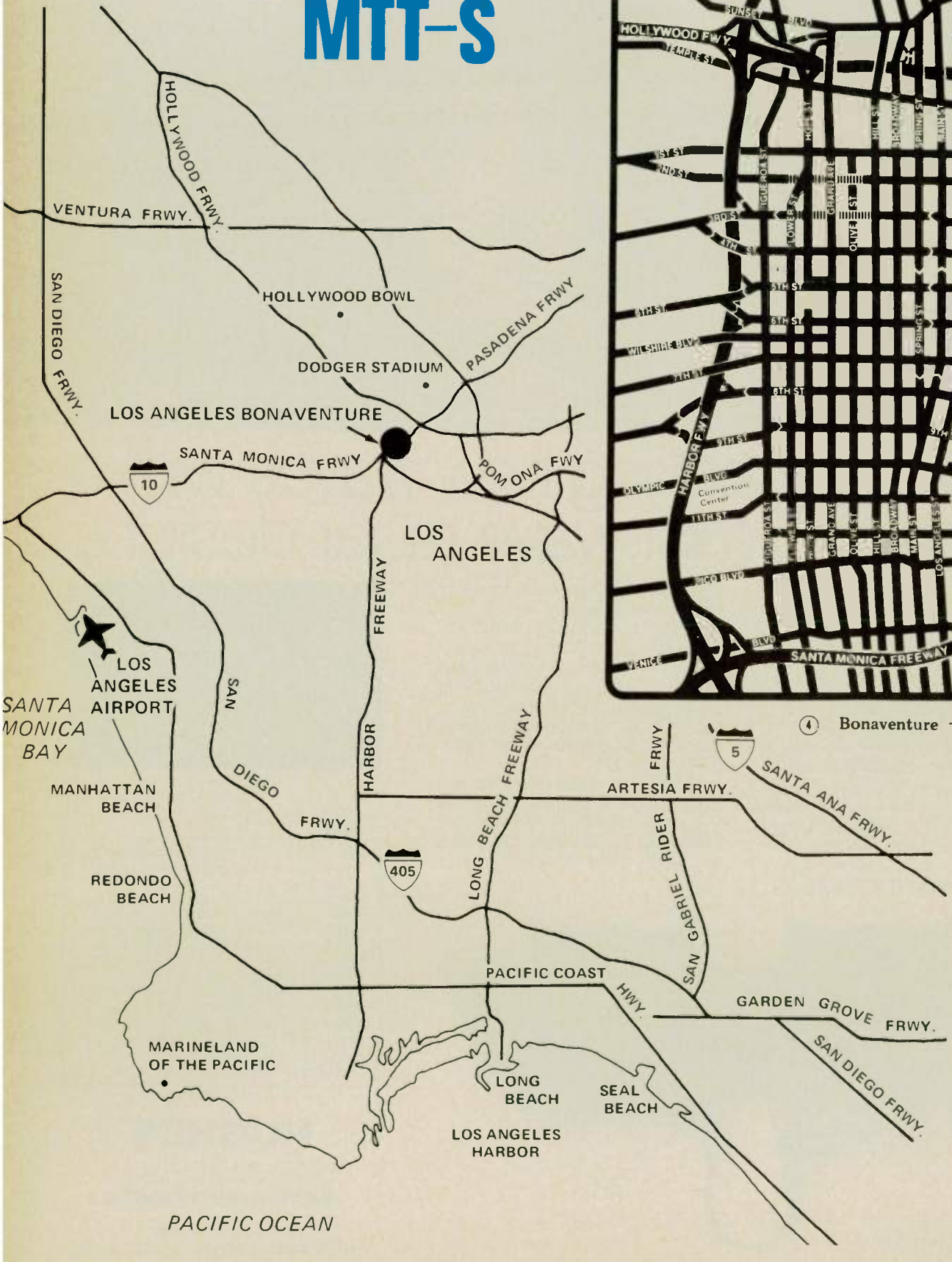

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(continued on page 30)

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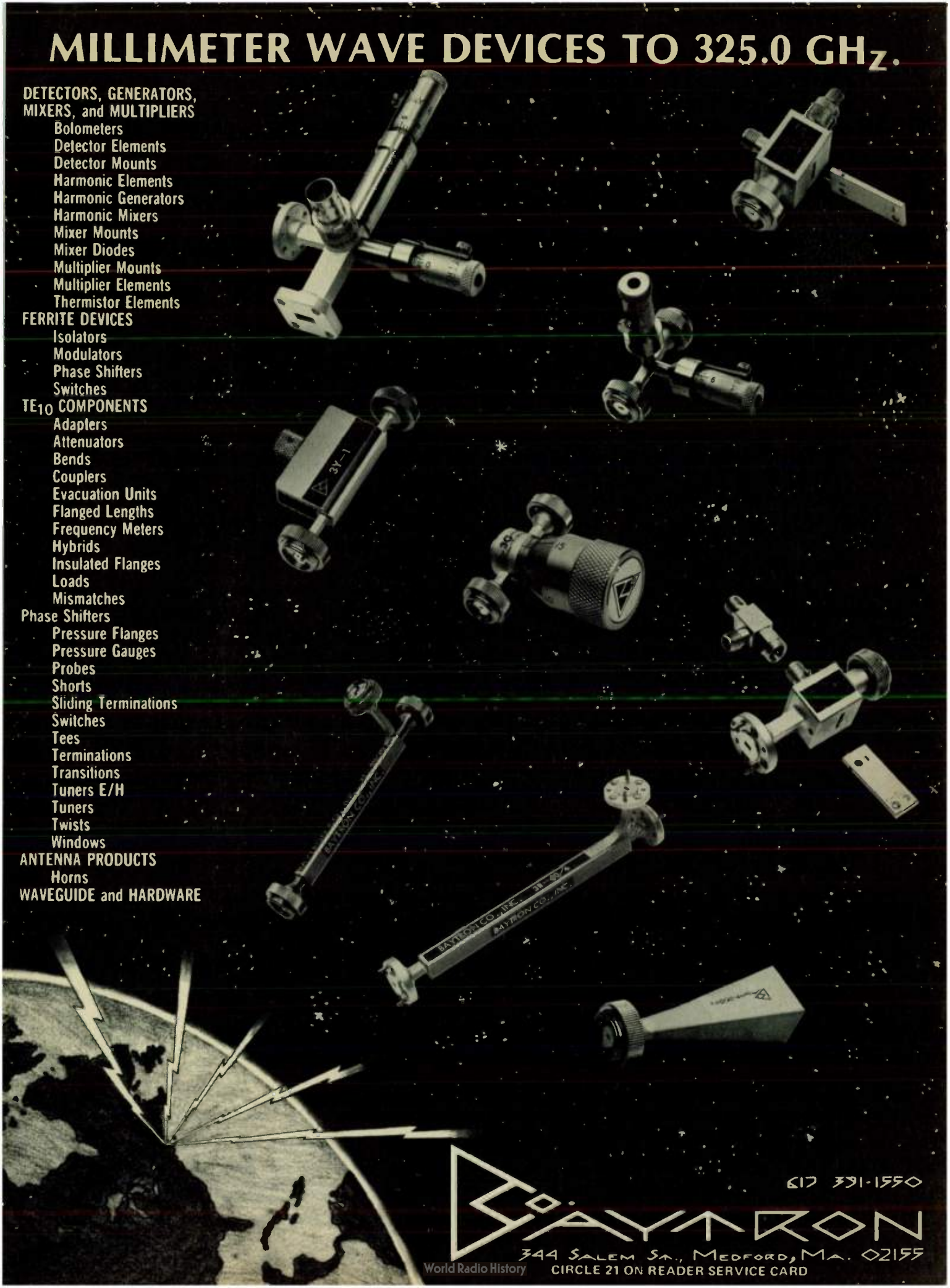

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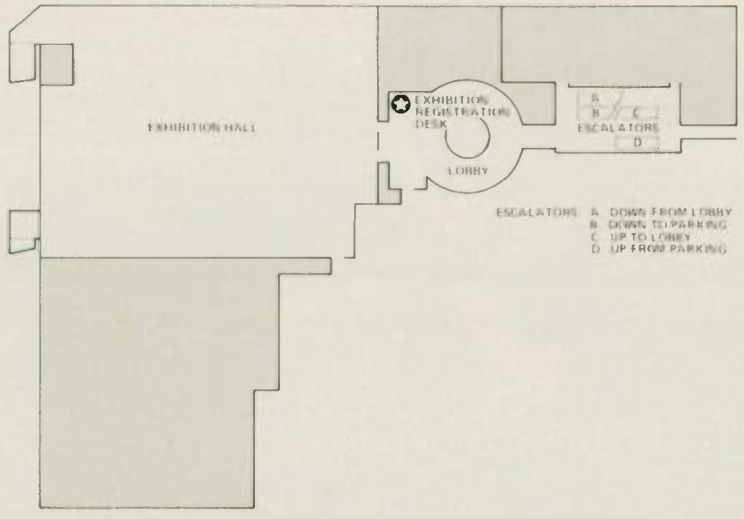
CIRCLE 21 ON READER SERVICE CARD

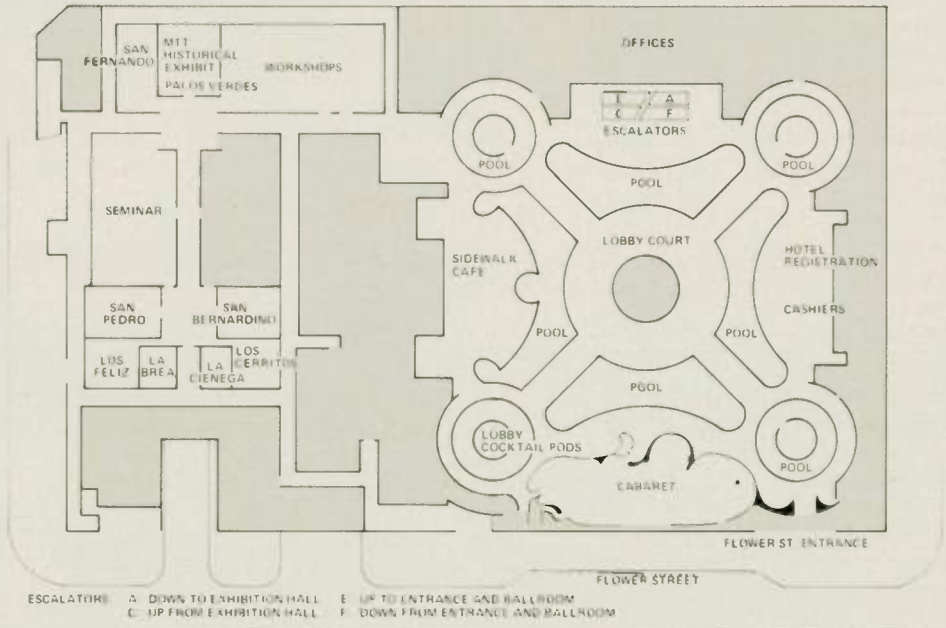
1981 INTERNATIONAL MICROWAVE SYMPOSIUM / EXHIBITION

June 15–17, 1981
Bonaventure Hotel
Los Angeles,CA

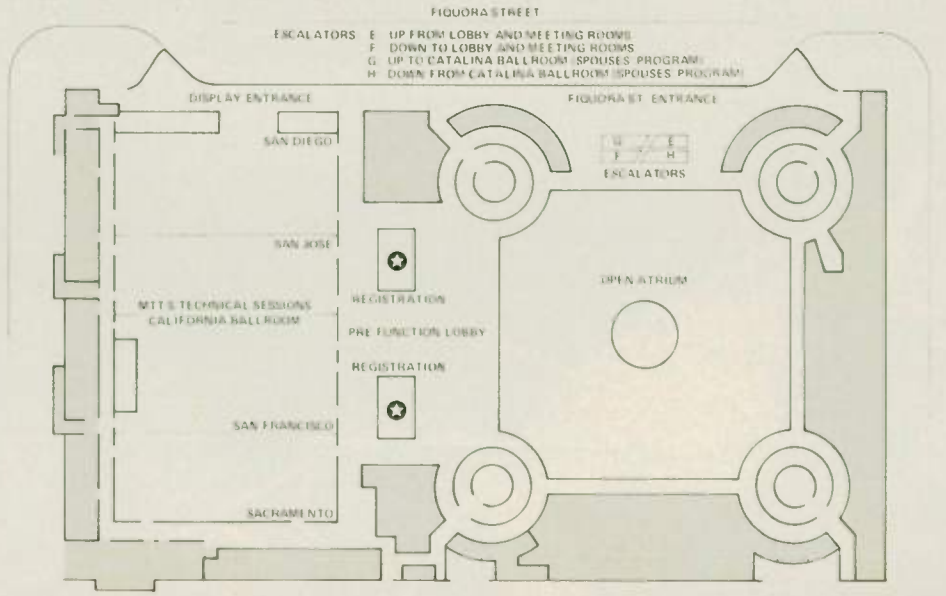
Exposition Hall (Level 2)



Lobby (Level 3)



California Ballroom (Level 4)



(continued on page 32)

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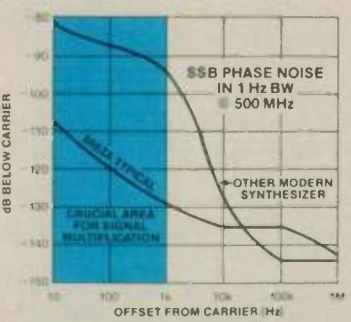

To find out how HP achieved this spectral excellence and more information on the 8662A, write for "Design Principles & Test Methods for Low-Noise RF and MW Sources." Hewlett-Packard Company, 1507 Page Mill Road, Palo Alto, CA 94304.

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(from page 30) CONFERENCE

at 12 GHz and up to 35% efficiency at K_u-band (paper B-1). Another paper describes 0.5 W at 21 GHz with a novel transition between microstrip and waveguide (B-2). A broadband high power FET amplifier operable from 2-18 GHz uses 600 micron gate width for 0.3 W output; a 1350 micron geometry extends this to 0.5 W in the 7-16 GHz range (B-3).

A silicon on sapphire (SOS) transceiver module design includes a power amplifier and phase shifter using MESFET and IGFET active devices along with thin film lumped passive elements (B-5).

Session G, relating more to FET applications, contains a paper on a 4-8 GHz, 1 W, GaAs FET amplifier in a ceramic package measuring 6 x 16 x 3.5 millimeters and offering cascadable operation (G-1). This paper is followed by a 7-12 GHz, 1 W, 4 stage GaAs FET (G-2). At 13.3 GHz, a 4.5 W, 26 dB gain, 15% efficient amplifier is described having 1 dB bandwidth of 1.7 GHz (G-3). A power combiner FET amplifier produces 9 dB gain, 1.5 W, in a 6-12 GHz MIC format (G-5).

In a third session (N) GaAs Monolithic circuits are highlighted. Papers include the description of a 0.1 to 10 GHz, 4 stage low noise amplifier with active input and output matching on a 2.5 millimeter square chip (N-2). A counter operable to 1.6 GHz using a dual gate GaAs MESFET logic is described in a coplanar circuit (N-5).

Millimeter waves are highlighted in four separate sessions (C, H, N, and R). A 94 GHz, 3 dB coupler in open dielectric waveguide is described with 25 dB directivity (C-4). A W-band receiver (about 90 GHz) with 10 GHz bandwidth and 5.5 dB noise figure using 3 milliwatts LO power with zero-biased diodes is described (H-5). A 60 GHz single slot dipole radiator on etched dielectric using a built in beam lead switching diode has 10 dB of enhanced directivity (H-6). A 94 GHz subharmonic GaAs beam lead mixer has 8.5 dB double sideband noise figure and uses a 47 GHz Gunn LO and 5-500 megahertz IF bandwidth.

A 100 milliwatt, 30 GHz FET with 5 dB gain is presented in paper (M-1). An FET oscillator operable to 69 GHz has as much as 2.5 milliwatts at 57 GHz (M-2). Dual finger beam lead Schottky diodes have 4 dB noise figure at 36 GHz and usability at 95 and 140 GHz (M-3). A peak output power, of 63 W at 92 GHz using 8 IMPATT diodes in a hybrid coupled power combiner is described (M-6). A bridged double quartz standoff package is used with pulsed silicon IMPATT sources which (used with combiners) produce 9.2 W peak at 140 GHz and 1 W peak at 217 GHz (M-7). A 9-channel down converter covering 26-60 GHz using millimeter wave IC's is described in paper (R-6). Results from testing of a 90 GHz coherent chirp radar using SAW filters and an injection locked IMPATT transmitter diode are described in paper (R-7).

Biological and medical application using microwaves are covered in papers which include a 27 megahertz waveguide application for localized hypothermia (heating) of cancerous tissue treatment (T-1). Microwave thawing of frozen packed red blood cells is described in paper (T-7).

THE AP-S & URSI TECHNICAL PROGRAM

The AP-S & URSI Symposium has been arranged to overlap (Tuesday through Friday) the MTT Conference this year at the Bonaventure. Special attention has been given to scheduling subjects of interest common to MTT Symposium participants so that they could attend (if so registered) sessions from both technical programs. No special registration is required, however, for delegates to any of the Conferences to attend the Plenary Sessions held in the San Francisco Room, Wednesday morning, 8:30 to 12 noon. The Moderator for this session, Dr. Seymour Cohn, is well known in both the microwave theory and techniques practice as well as antenna design. Four invited lectures given in this session should prove to be of keen interest to all of the technical meeting delegates. The first by T. Napier from the National Radio Astronomy Observatory, Socorro, New Mexico, is entitled "The Very Large Array Radio Telescope." The second invited lecture by S. Okwit of LNR Communications, Farmingdale, New York, is entitled "Noise and Analog and Digital Microwave Communications." This is followed by O. P. Gandi's (from the University of Utah) "Biological Effects and Medical Applications of Electro-Magnetic Fields." The final paper is by E. C. Stone of the JPL and Physics Department, California Institute of Technology and entitled "The Voyager Encounter with Saturn." These talks can be expected to be given to a packed auditorium.

Several of the sessions specific to the URSI and AP-S programs that might be of special interest to microwave theory and techniques delegates are the sessions on Waveguides (B-2 and B-4), Microstrip (AP-S1 and AP-S12), the Array Techniques (with their implications for components) Sessions AP-S7, and AP-S16, and Dielectric Waveguides (AP-S18).

(from page 24) A TALE

ware matters is very low. The number of advanced degree candidates is in even worse shape. Where will we find the people to man the exciting programs now in hand, and those yet to come?

The roots of the problem go back a decade and more. Not only were young people turned off by technology in that era, but interest in the support of research and development by the US government and even by many companies diminished. The drying up of monies to support device and hardware related studies occurred at the time of explosive growth of the computer field, principally in the area of software. Students and faculty were quite naturally attracted to these areas.

The decay of the analog/device/hardware activities in US universities has now proceeded to the point where there is little ability and not much incentive to expand programs to supply badly needed manpower. Teaching and research lab equipment is either nonexistant or badly out of date. And student interest has eroded as well. The B.S. to M.S. to Ph.D. pipeline has been breached. There is not much incentive for a B.S. student to hold himself from the job market for four or five years. Industries have not made the salary differentials between degree levels attractive enough for a student to go to graduate school. So the seed corn gets eaten.

The perception that universities provide trained manpower as a common good has brought us to the point where companies view new engineers as a resource . . . so many needed to keep tables of organization at acceptable levels. There is little thought wasted on the production of this resource. Occasionally a company will clean out a warehouse of 10-year equipment and grant it to schools, then grumble at the quality of the product trained on 10-year-old gear.

The risks to the industry of this kind of thinking are severe. There are alternate technologies capable of displacing markets, and there is competition from around the world. This place for us, as practitioners of the microwave art, to "do the far, far better thing" and examine what we and our institutions are responsible for and how we can move to improve the level and quantity of training of those to whom leadership of our industry will pass.

On behalf of the Administrative Committee of MTT-S I'd like to congratulate Al Clavin, Don Parker and the many dedicated volunteer workers who created this year's Symposium for the benefit of us all.

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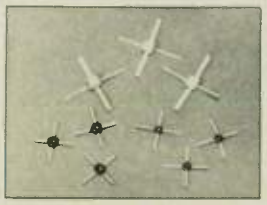

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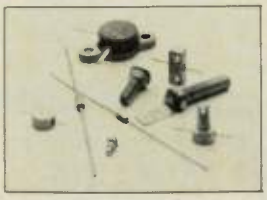

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CIRCLE 24 ON READER SERVICE CARD

1981 IEEE MTT-S TECHNICAL PROGRAM

MONDAY MORNING, JUNE 15, 1981

A. MILLIMETER-WAVE INTEGRATED CIRCUITS—DIELECTRIC AND IMAGE GUIDE
Chairman: H. J. Kuno

A1 Open Guided Wave Structures for Millimeter-Wave Circuits
T. Itoh (Invited)

A2 Directive Planar Excitation of an Image Guide
Y. Shih, J. Rivera, T. Itoh

A3 Slots as New Circuit Elements in Dielectric Image Line
K. Solbach and I. Wolff

A4 Coupler Design in Open Dielectric Waveguide with Web Registration
G. M. Lindgren

A5 Mode Conversion Effects in Bragg Reflection from Periodic Grooves in Rectangular Dielectric Image Guide
M. J. Shiau, H. Shigesawa, S. T. Peng, A. A. Oliner

A6 Field Profile in a Single Mode Curved Dielectric Waveguide
Prof. R. Mittra and T. N. Trinh

A7 Horn Image Guide Leaky-Wave Antenna
T. N. Trinh, R. Mittra and R. Paleta

B. MICROWAVE FET DEVICES
Chairman: R. L. Camisa

B1 Sub-Half-Micron GaAs FET's for Applications through K Band
C. Huang, A. Herbig, R. Anderson

B2 K-Band Power GaAs FET's
L. S. Rosenheck, D. Herstein, I. Drukier

B3 2-18 GHz, High-Efficiency, Medium-Power GaAs FET Amplifiers
H. G. Tserng, S. R. Nelson and H. M. Macksey

B4 Plated Source Bridged (PSB) GaAs Power FET with Improved Reliability
T. Suzuki, M. Kobiki, M. Wataze, K. Segawa and M. Irie

B5 Silicon-on-Sapphire (SOS) Monolithic Transceiver Module Components for L and S Band
D. Laighton, J. Sasonoff, and J. Selin

B6 Optical Tuning in GaAs MESFET Oscillators
H. J. Sun, R. J. Gutmann, and J. M. Borrego

B7 Microwave Model for the Dual GaAs MESFET
G. S. F. Mau

C. COMPUTER AIDED DESIGN & MEASUREMENTS
Chairman: H. Ku

C1 Computer-Aided Design for the 1980s (Invited Paper)
L. Besser, C. Holmes, M. Ball, Max Medley, S. March

C2 Computer-Aided Design of Microstrip Couplers with Accurate Discontinuity Models
Erik Hammerstad

C3 Microwave Filter Design in the Time Domain
E. A. Hosney and M. I. Sobhy

C4 Microwave Analysis Using Time Domain Plots Created from Frequency - Domain Reflections
H. E. Stinehelfer, Jr. and H. E. Stinehelfer, Sr.

C5 An Interactive Optimal Postproduction Tuning Technique Utilizing Simulated Sensitivities and Response Measurements
J. W. Bandler, M. R. M. Rizk and A. E. Salama

C6 A Novel Harmonic Balancing Bridge for Characterizing Microwave Modules for Phased Array Antenna Service
Donald W. Griffin

C7 A Dual Four-Port for Automatic Analysis
H. George Oltman and Herbert A. Leach

D. LATIN AMERICAN SESSION
Chairman: A. J. Giarola

D1 Finite-Difference Method for the Arbitrary Cross-Section Waveguide Using the Best-Fit Boundary Approximation
A. B. Filho

D2 A Model of the Coupling Between Posts in Waveguide Using Equivalent Transmission Lines
E. Acosta-C., H. O. Nava-J.

D3 Slotline-Microstrip Transition on ISO-Anisotropic Substrate-Broadband Design (Invited)
A. Podcameni, M. Lima Coimbra

D4 (Invited) Analysis of Single and Coupled Striplines with Anisotropic Substrates
Adaildo Gomes d'Assuncao, Attillo Jose Giarola, David Anthony Rogers

D5 (Invited) A New Method of Pulse Dispersion Analysis for Single Mode Optical Fibers
P. S. M. Pires, D. A. Rogers, E. J. Bochove and R. F. Souza

D6 A Resonator Method for Permittivity Measurements
A. O. M. Andrade, J. J. Senise; S. S. Stuchly

D7 Microwave Modelling HF Antennas Over Lossy Earth (Invited)
Benjamin Jacurd H. and Gerardo Gomez G.

D8 (Invited) The Development of Microwave Components for Earth Station Receiver
J. K. Pinto, E. Camargo, M. Luqueze, F. S. Correra, C. A. Finardi, and E. I. Ynoue

MONDAY AFTERNOON, JUNE 15, 1981

E. MILLIMETER-WAVE INTEGRATED CIRCUITS – PRINTED CIRCUITS SESSION II
Chairman: R. T. Kihm

E1 Shielded Microstrip: Transmission Media for Millimeter Integrated Circuits
Michael Dydyk

E2 Empirical Analytical Expressions for Fin-Line Design
A. K. Sharma and Wolfgang J. R. Hoefer

E3 Experimental Assessment of Bilateral Fin-line Impedance for Device Matchi
H. A. Willing and B. E. Spielman

E4 Experimental Characterization of Fin-Line Discontinuities Using Resonant Techniques
Etienne Pic and W. J. R. Hoefer

E5 A Broadband, Low-Noise Receiver at W Band
C. P. Hu and A. Denning

E6 Millimeter-Wave Planar Slot Antennas with Dielectric Feeds
P. Yen, J. A. Paul and T. Itoh

E7 94 GHz Subharmonic Mixer Using Beam Lead Diodes
J. A. Paul and P. Yen

F. FET APPLICATIONS
Chairman: R. T. Kemerley

F1 4-8 GHz High Power Cascadable Packaged GaAs FET Amplifier
S. Yamamura, M. Shigaki, N. Hidaka, H. Ishikawa

F2 Broadband Lumped-Element GaAs FET Power Amplifiers
R. L. Camisa, J. B. Klatskin, A. Mikelsons

F3 A 4.5 W, 26 dB Gain FET Power Amplifier at K_u Band
V. Sokolov and R. C. Bennett

F4 Compact Multi-Stage Single-Ended Amplifiers for S-C Band Operation
K. B. Niclas

F5 A Power FET Octave Bandwidth Traveling-Wave Combiner Amplifier
D. Kaminsky, A. G. Bert, A. Dottin

F6 Wideband Cavity Tuned GaAs FET Oscillator
Robert Joly, William W. Heinz and Edward G. Cristal

F7 Decade Bandwidth FET Functions
J. Obregon, Y. Letron, R. Funck, S. Barvet

F8 Balanced Dual Gate GaAs Frequency Doublers
Roger Stancliff

GI. THE SIX-PORT AND ITS APPLICATIONS
Chairman: S. F. Adam

GI-1 Singularities in Calibration of Six-Port Network Analyzers
H. F. Ebbesen and G. F. Engen

GI-2 The Use of a Matched Symmetrical Five-Port Junction to Make Six-Por Measurements
Gordon P. Riblet and E. R. Bertil Hansson

GI-3 A Broadband Stripline or Coaxial 'Resolver' for the Accurate Measurement of Complex Reflection Coefficients Using the Six-Port Measurement Concept
G. P. Riblet

GI-4 A High-Power Dual Six-Port ANA for Determining Biological Effects of Microwave Radiation
Cletus A. Hoer

GII. DIELECTRIC RESONATORS
Chairman: Harlan Howe

GII-1 TM_{01} Tubular and Cylindrical Dielectric Resonator Mode
P. Guillon, J. P. Balabaud, Y. Garault

GII-2 Coupling of Cylindrical Dielectric Resonators to Microstrip Lines
R. Bonetti and A. Atia

GII-3 A Dielectric Resonator Bandstop Filter
P. Guillon, S. Mekerta, Y. Garault

L. FERRITE APPLICATIONS
Chairman: C. R. Boyd

L1 Coupled-Mode Theory Analysis of Distributed Nonreciprocal Devices
I. Awai and T. Itoh

L2 Analysis of Wideband Microstrip Circulators by Point-matching Technique
A. M. Khilla

L3 Performance Characteristics of Magnetoplasma Based Submillimeter-Wave Non-reciprocal Devices
S. H. Talisa and D. M. Bolle

L4 A Ferrimagnetic Resonance Thermometer for Microwave Power Environment
J. A. Weiss, D. A. Hawks and G. F. Dionne

L5 A K-Band High Power Low Loss Latching Switch
M. J. Mlinar, W. S. Piotrowski and J. E. Raue

L6 Fin-Line Ferrite Isolator for Integrated Millimeter-wave Circuits
A. Beyer and K. Solbach

TUESDAY MORNING, JUNE 16, 1981

I. PASSIVE COMPONENTS AND NETWORKS
Chairman: H. C. Bell

I1 (Invited)
Problems in Microstrip Filter Design
R. J. Wenzel and W. G. Erlinger

I2 Design of Filters with Ideal Amplitude and any Prescribed Phase
S. A. Mohammed

I3 Miniaturized Microwave Filter Construction with Dielectric-Loaded Resonator and Space Coupling
A. Fukasawa, T. Sato and K. Hosaka

I4 A New Diplexer Realized in Stripline
I. Galin

I5 Contiguous Broadband Matching of Multiple Resonant Loads
J. D. Rhodes and M. J. Thornton

I6 Inhomogeneous Broadside-Coupled Striplines
A. G. D'Assuncao, A. J. Giarola and D. A. Rogers

I7 Rectangular Coaxial Line Split-T Power Devices
L. H. Yorkins

I8 New Differential Phase Shift Networks Combining All-Pass and Band-Pass Elements
J. K. Hunton

J. SOLID STATE CIRCUITS AND DEVICES
Chairman: C. T. Rucker

JI1 Computer-Aided Design of Microwave Parametric Frequency Dividers
A. Lipparini, E. Marazzi, Vittorio Rizzoli

JI2 Analysis of Waveguide IMPATT Oscillator Circuits
B. D. Bates and P. J. Khan

JI3 Coaxially Coupled Ridge Waveguide Tunable Oscillator
R. S. Robertson, R. L. Eisenhart

JI4 High Efficiency Mode in a 20 GHz MBE IMPATT Diode Observed by a Computer-Aided Characterization System
Hiroshi Kondoh, G. Conrad Dalman and Charles A. Lee

K. HIGH POWER CIRCUITS AND SYSTEMS
Chairman: K. Tomiyasu

(continued on page 38)

A book full of reasons for buying your bipolar transistors from an American company.

Our family of bipolar RF and microwave transistors is so large that it takes 103 pages to describe it.

Avantek covers the spectrum from 60 MHz to 4 GHz with one of the world's most complete selections of low noise, general purpose and linear power transistors in both packaged and chip form. The gain, noise figure and power output specifications in "Transistor Designer's 1981 Catalog" show why many of the world's leading military and commercial receivers are built with Avantek bipolar transistors.

Volume deliveries you can depend on.

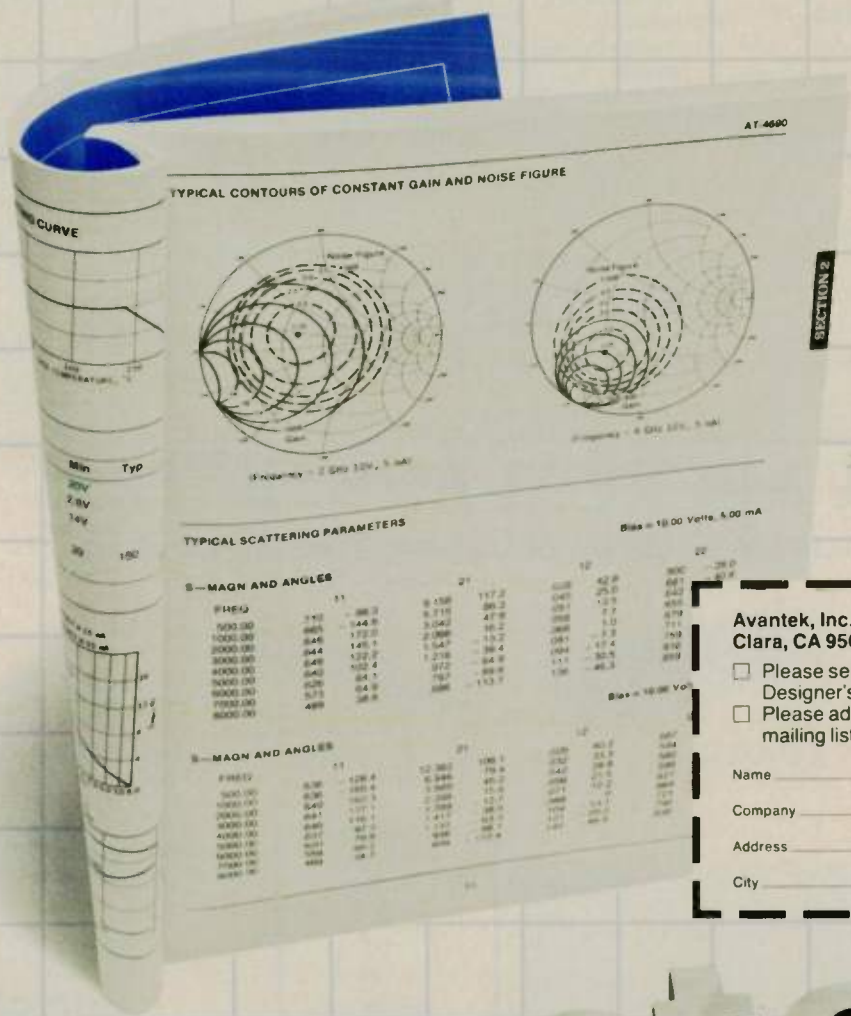
Avantek honors its delivery commitments. We are the world's leader in volume production of top-of-the-line microwave products. Our advanced manufacturing facilities turn out the transistors you need by the thousands. That means your product stays on schedule. And efficient production techniques make our prices very competitive.

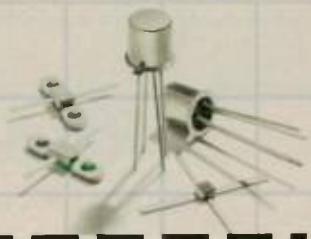
Rugged enough for the toughest places—including satellites.

When Avantek bipolar transistors go into the field they stay there. Four separate bipolars are space-qualified and the rest of the line has the same inherent characteristics.

Send in the coupon for the "Transistor Designer's 1981 Catalog."

Clip the coupon below and return it to Avantek for your copy of the "Transistor Designer's 1981 Catalog." In addition to 103 pages of data on our bipolar transistors, you'll receive 56 pages of information on Avantek's GaAs FETs. If you'd like technical information on Avantek's new transistors as they are released, just check the second box too.





Avantek, Inc., 3175 Bowers Ave., Santa Clara, CA 95051. (408) 496-6710

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☐ Please add me to your transistor mailing list.

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Company _____ Division _____
Address _____
City _____ State _____ Zip _____

Avantek

(from page 36) TECHNICAL PROGRAM

K1 A 100 kW Solid-State Coaxial Limiter for L Band
S. Patel and H. Goldie

K2 A 2 kW CW MIC 20-500 MHz SPDT Pin Diode Switch Module
R. Tenenholtz

K3 Development of High Power, Low Frequency Pin Diodes
M. Caulton, A. Rosen, P. Stabile and A. Gombar

K4 A Study of the High Power Pulsed Characteristics of Low-Noise GaAs MESFET's
D. S. James and L. Dormer

K5 Design of a Single-Anode, MIG-type Gyrotron Gun for a 35 GHz Gyro-TWT
J. M. Baird and A. C. Attard

K6 Design of a High Power Earth Station Transmitter for the Band 7.9 to 8.4 GHz
R. A. Gough

K7 Design and Operation of an Orotron – A Tunable Source of Coherent Millimeter-Wave Radiation
H. Dropkin, R. P. Leavitt and D. E. Wortman

K8 Status of the Microwave Power Transmission Components for the Solar Power Satellite
W. C. Brown

K9 A High Power Gyrotron Operating in the TE_{041} Mode
B. Arfin and M. Read

H. JAPANESE SESSION
Chairman: Y. Konishi

H1 Progress of Microwave Semiconductor Devices in Japan
K. Sekido – (NEC)

H2 (Invited)
Millimeter-wave Integrated Circuits
H. Komizo (Fujitsu)

H3 (Invited)
Advanced RF Circuit Miniaturization for 800 MHz Land Mobile Radio Unit
S. Seki, N. Kanmuri & S. Yuki (NTT)

H4 (Invited)
Miniaturized Diplexer for Land Mobile Communication Using Dielectric Ceramics
K. Wakino (Murata)

H5 (Invited)
Very Low Power Gigabit Logic Circuits with Enhancement Mode GaAs MESFET
M. Omori, T. Mizutani and K. Kato

H6 (Invited)
CH_3F Submillimeter Laser Using New Type of Resonator
M. Kawamura

H7 (Invited)
Recent Developments of Fiber Optic Devices
K. Shirahata (Mitsubishi)

H8 (Invited)
Optical Fiber Communication Systems in Japan
M. Yokubo and M. Kawamura (TIT)

TUESDAY AFTERNOON, JUNE 16, 1981

M. MICROWAVE INTEGRATED CIRCUITS
Chairman: W. E. Schroeder

M1 Asymmetric Microstrip dc Blocks with Rippled Response
Darko Kajfez, S. Bokka, and C. E. Smith

M2 Simple Balun Coupled Mixers
Ben R. Hallford

M3 Computer-Aided Design of Semi-Conductor Mounts in Fin-Line Technology
Hadia El Hennawy and Klaus Schuenemann

M4 A Measurement Method for Accurate Characterization and Modeling of MESFET Chips
D. E. Peck and D. F. Peterson

M5 A Frequency-Stabilized MIC Oscillator Using a Newly-Developed Dielectric Resonator
Y. Komatsu, Y. Murakami, T. Yamaguchi, T. Otobe, M. Hirabayashi

M6 A 1.75-6 GHz Miniaturized GaAs FET Amplifier Using Quasi-Lumped Element Impedance Matching Networks
S. Moghe, R. Gray, W. Tsai

M7 A 10.5 GHz MIC Direction Sensitive Doppler Module Using a GaAs FET and a Ag/Pd Thick Film
T. Mori, H. Sawano, K. Kusonoki, O. Ishihara

N. MILLIMETER-WAVE SOLID-STATE DEVICES
Chairman: T. T. Fong

(continued on page 40)

OMNIYIG INC.

Product Line Information Sheet

YIG FILTERS

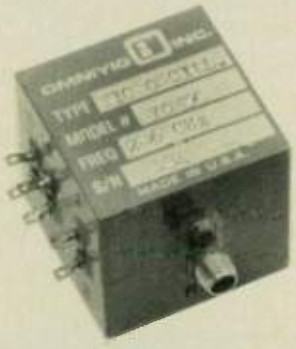
Two stage, dual two-stage, three-stage and four-stage units. Standard octave and multi-octave designs from 0.3 to 18 GHz. Fast switching octave and multi-octave designs. Minicube sizes.

YIG-TUNED ECM FRONT ENDS

YIG-tuned integrated oscillator with pre-postselector YIG filters available in various combinations covering 300 MHz to 18 GHz in octave bands. Factory adjusted to provide user with optimum tracking, maximum RF output, lowest harmonic and spurious responses.

YIG-TUNED HARMONIC GENERATORS

Step recovery diode integrated with two and three-stage YIG filter. Very compact package with high efficiency. 100 MHz input and 2.0 – 18.0 GHz output harmonics. 1.0 to 2.0 GHz continuous input and 2.0 to 18.0 GHz continuous output (minimum output at 12.4 GHz is 4 mW). 500 MHz input and 1.0 to 18.0 GHz output (1 mW at 12 GHz).



YIG OSCILLATORS

With minimum power outputs of 20, 30 and 50 mW. Standard octave bands. Fast switching. Second harmonic down greater than 20 dB. Minicube sizes. Multi-octave units have 2nd harmonic down greater than 60 dB.

GUNN-EFFECT YIG OSCILLATORS

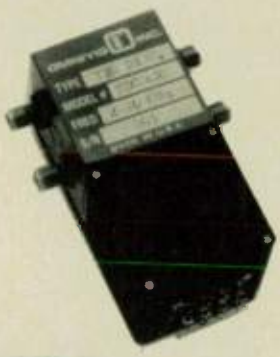
Three basic units available covering 5.9 to 6.5 GHz, 8.0 to 12.0 GHz and 12.0 to 18.0 GHz. Other bands on special order. Second harmonic down greater than 30 dB. Minimum power outputs of 40, 15 and 10 mW.

YIG DRIVERS

Very compact and available as integral component with any YIG device. Power requirements are ± 15 volts and 0 to 10 volts for tuning the YIG device over its full frequency range. Other input voltages can be accommodated on special order.

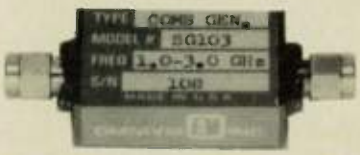
PASSIVE DEVICES FILTERS - EQUALIZERS

A complete line of filters in the frequency range of 25 MHz to 18 GHz is offered. Emphasis is placed on miniaturization (such as OMNIYIG's MICRO-PAK™) while maintaining and exceeding electrical specifications. OMNIYIG also offers a complete line of equalizers to complement its line of filters.



YIG-TUNED DISCRIMINATORS

These units consist of a power divider, offset two-stage YIG filter and two output detectors. YIG discriminator designs are available in octave and multi-octave bands from 500 MHz to 18 GHz.



COMB GENERATORS

Standard matched comb generator designs that are self biased and having integrated elements to produce harmonics up to 18 GHz. Input is matched to 50 ohms with an integrated wide-transformer circuit which can accept a tunable input frequency. Low harmonic conversion loss and high spectrum purity.

DETECTORS & LIMITERS

Narrow band, octave and multi-octave detectors 0.1 to 18 GHz designs in Tunnel, Schottky or Zero Bias Schottky diode types. Pin and Schottky Limiters for octave and multi-octave bands 0.1 to 8 GHz ranges. Many package styles available. Special requirements welcome.

OMNIYIG INC. ☐ 3350 Scott Blvd., Bldg. #66 ☐ Santa Clara, Calif. 95051 ☐ (408) 988-0843 ☐ TWX 910/338/7356

On Reader Service Card, circle 203 for Yig Devices, 204 for Passive Devices, 205 for Detectors/Limiters

(from page 38) TECHNICAL PROGRAM

N1 **A 30 GHz 100 mW GaAs FET**
Yoshinobu Kadowaki, Osamu Ishihara, Masaa Nakatani

N2 **A 69 GHz FET Oscillator**
J. M. Schellenberg, H. Yamasaki, D. W. Maki

N3 **Beam-Lead Schottky-Barrier Planar Mixer Diodes for Millimeter-Wave Applications**
S. Jamison, A. Contolatis, P. Bauhahn, M. Helix and J. Abrokwah

N4 **A Wideband, Backshort Tunable Second Harmonic W-Band Gunn Oscillator**
H. Barth

N5 **Metal-Barrier-Metal Junctions for Room Temperature Millimeter-Wave Mixing and Detection**
C. W. Slayman and T. K. Gustafson

N6 **A 63 W W-Band Injection-Locked Pulsed Solid State Transmitter**
H. C. Yen and K. Chang

N7 **Millimeter-Wave Solid State Devices**
Kai Chang, F. Thrower and G. M. Hayashibara

N8 **Chip Level IMPATT Combining at 40 GHz**
C. T. Rucker, J. W. Amoss and G. N. Hill

O. GaAs MONOLITHIC CIRCUITS
Chairman: G. Chao

O1 **A Study of Optional Matching Circuit Topologies for Broadband Monolithic Power Amplifiers**
J. E. Degenford, D. C. Boire, R. G. Freitag and M. Cohn

O2 **A Monolithic GaAs 0.1 to 10 GHz Amplifier**
W. C. Peterson, D. R. Decker, A. K. Gupta, J. Dully, D. R. Chen

O3 **A 2-12 GHz Feedback Amplifier or GaAs**
K. B. Niclas and W. T. Wilson

O4 **A Planar-Type Low-Noise GaAs Monolithic Microwave Amplifier**
Deng Xian-can and Zhu Guo-liang

O5 **A High-Speed Monolithic GaAs 10/11 Counter**
R. E. Lundgren, D. E. Synder

O6 **An 8 GHz MMIC Preamplifier**
D. R. Decker, A. K. Gupta, W. C. Peterson and D. R. Ch'en

O7 **A Comparison Between Actively and Passively Matched S-Band GaAs Monolithic FET Amplifiers**
J. R. Suffolk, R. S. Pengelly, Jr., R. Cockrill and J. A. Turner

O8 **Use of Switching Q in the Design of FET Microwave Switches**
H. A. Atwater and R. W. Sudbury

P. MICROWAVE ACOUSTICS
Chairman: T. Lukazek

P1 **SAW Based Direct Frequency Synthesizer**
Allan Budreau

P2 **SAW Stabilized Radiosonde**
D. J. Dodson, K. F. Lau, M. Y. Haung and T. J. Lukaszek

P3 **SAW Oscillators UHF Transit Satellite**
B. Y. Lao, N. J. Schneier, D. A. Rowe, R. E. Dietterle, J. S. Schoenwald, E. J. Staples and J. Wise

P4 **Tunable Magnetostatic Surface Wave Oscillator at 4 GHz**
R. L. Carter, J. M. Owens, W. R. Brinlee, Y. W. Sam and C. V. Smith, Jr.

P5 **IC Compatible SAW Device on GaAs (Invited)**
T. Grudkowski

P6 **SAW Bandpass Filter Components for Microwave Systems**
D. E. Allen, F. S. Hicknernell

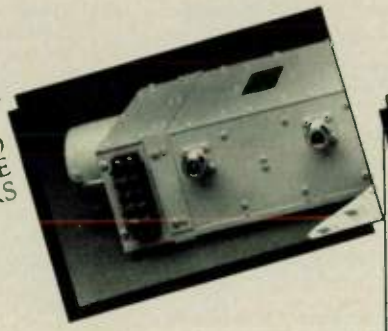
P7 **A SAW Interferometer Direction-Finding and Frequency Identification Method**
Dirk Klose, William Skudera

P8 **Magnetostatic Wave Compressive Receiver**
C. E. Nothnick, J. F. Billing, M. R. Daniel, and T. D. Adams

(continued on page 42)

NEW

DIGITALLY CONTROLLED TUNABLE RF FILTERS



Do you need to: Eliminate cross talk in installations with antennas in close proximity?; Isolate and identify signals coming in to wideband receiver systems?; Preselect frequencies in automatic test equipment? Is a tunable filter the last remaining piece of manual equipment in your digital system?

Telonic's new digitally addressable tunable rf filters can solve these problems. They're offered in 22 standard models (3 or 5 sections) covering 11 frequency bands between 48 MHz and 4 GHz. Each capacitively loaded Chebyschev filter model tunes over a 2:1 frequency range for full octave coverage.

Integration of the filter into your digital system is made easy by a wide choice of standard interfaces, such as RS-232, TTL serial, and IEEE STD-488 (GPIB) parallel.

The combination of time-proven, rugged tunable filter technology with state-of-the-art microprocessor-based control results in a highly stable, repeatable system which can't drift, requires no daily recalibration, and has been extensively field-tested in hostile environments.

Call us with your tunable filter needs. Small quantities can be delivered in as little as one week. Send for new technical data sheet.

CIRCLE 8

CONTIGUOUS BAND MULTIPLEXERS

Telonic Berkeley now offers custom designs of two to five-channel contiguous band multiplexers with up to seven sections per channel.

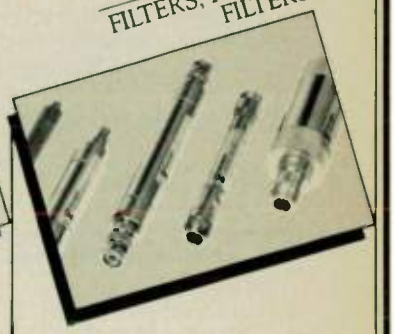
The multiplexers are 0.1 dB ripple Chebyschev type with housings milled from a single aluminum block for package integrity and mechanical stability.

A typical design may have passbands of 100 to 200 MHz, 200 to 400 MHz, and 400 to 1000 MHz. The upper section can be either a bandpass or highpass filter, and the lower section can be either a bandpass or lowpass filter—to fit your exact needs.

The units have a typical insertion loss of 0.2 to 0.3 dB with a crossover insertion loss less than 5.0 dB.

CIRCLE 9

FILTERS, FILTERS, FILTERS



If you're looking for an RF or microwave filter in the 20 MHz to 12 GHz range, we probably have a model to match your exact application.

We offer more than 23 types of filters, including highpass and subminiature series, and the new computer-controlled tunable RF filter. We also offer tubular lowpass, tubular bandpass, cavity interdigital bandpass, tunable cavity bandpass, combline, miniature and tunable band reject filters.

Our new filter catalog (shown below) provides an easy-to-use filter selection guide, frequency and bandwidth tolerance curves, passband relationships and performance curves for each filter type.

Send for your free copy.

CIRCLE 10

MJS/81

☐ SEND ME YOUR NEW FILTER CATALOG.

☐ SEND ME YOUR ATTENUATOR CATALOG.

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COMPANY

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A SUBSIDIARY OF BERKELEY INDUSTRIES

THE BIGGEST LITTLE HIGH-TECHNOLOGY COMPANY IN LAGUNA BEACH.

(from page 40) TECHNICAL PROGRAM

WEDNESDAY, JUNE 17, 1981

PLENARY SESSION JOINT IEEE AP-S, MTT-S, URSI
Moderator: Dr. Seymour Cohn

1. **The Very Large Array Radio Telescope**
   Dr. Peter Napier
2. **Noise and Analog and Digital Microwave Communications**
   S. Okwit
3. **Biological Effects and Medical Applications of Electro-magnetic Fields**
   O. P. Gandhi
4. **Voyager Encounter with Saturn**
   Dr. E. C. Stone

WEDNESDAY AFTERNOON, JUNE 17, 1981

Q. MICROWAVE AND MILLIMETER-WAVE SYSTEMS
Co-Chairmen: H. Sobol, J. B. Horton

Q1 **A Phase Alignment Network for Space Diversity Combining**
G. L. Heiter, H. Miedema

Q2 **Direct Generation of MSK Modulation at Microwave Frequencies**
S. Kumar, W. J. Chudobiak and J. S. Wight

Q3 **A Dielectric Resonator Filter as Low-Loss Delay Element for 14 GHz On-Board 4-phase PSK Demodulation**
L. Accatino, A. Angelucci

Q4 **14-GHz Differential QPSK Demodulator for Regenerative Satellite Repeater**
G. Ohm, M. Alberty, and D. Rosowsky

Q5 **Channelized Receiver Covering 26 to 60 GHz with Planar Integrated Circuit Components**
P. J. Meier, K. D. Breuer, L. D. Cohen, N. Worontzoff, J. Lepore and J. Gunther

Q6 **A W-Band Coherent Pulse-Compression Radar Transceiver Using Linear Frequency Modulation**
C. Brenneise, M. Beebe, T. Kihm and R. D. Weglein

R. PHASED AND ACTIVE ARRAY TECHNIQUES
Chairman: R. Van Wagoner

R1 **A Scanning Switch Matrix for a Cylindrical Array**
K. J. Keeping, D. S. Rogers and J. C. Sureau

R2 **Beam Steering Antenna Control Techniques**
A. R. Skatvold

R3 **35 GHz Active Aperture**
M. F. Durkin, R. J. Eckstein, M. D. Mills, M. S. Stringfellow and R. A. Neidhard

R4 **The Use of IMPATTS in Active Arrays**
S. Hamilton, G. Stern

R5 **Broadband Dual-Gate GaAs FET Continuously Variable Phase Shifter**
M. Kumar, H.C. Huang and R. J. Menna

R6 **Active Microwave Power Combiner/Divider Using Dual Gate MESFET**
J. J. Pan

R7 **A Continuously Variable K_u-Band Phase/Amplitude Control Module**
Y. Gazit, H. C. Johnson

THURSDAY MORNING, JUNE 18, 1981

S. LOW NOISE TECHNIQUES
Chairman: S. Okwit

S1 **A Low Noise Solid State Amplifier for Replacement of a K_a-Band TWTA**
P. H. Wolfert, J. D. Crowley, F. B. Fank

S2 **Cooled Low Noise GaAs Monolithic Mixers at 110 GHz**
B. J. Clifton, G. D. Alley, R. A. Murphy, W. J. Piacentini, I. H. Mroczkowski and W. Macropoulos

S3 **A 4 GHz Low Noise GaAs FET Amp**
Li Hao-Mo

S4 **Impact of Low Noise Technology on Present and Future Satcom Systems (Invited)**
H. C. Okean

(continued on page 44)

THE GREAT CATALOG

81-82 EDITION

COMB GENERATORS

HARMONIC GENERATORS

Model Number	3900-1210	3900-1900	3900-1203	3900-1200
Frequency range	.5 - 18 GHz	0.5 - 12 GHz	.95 - 13.3 GHz	0.1 - 18 GHz
Comb Spacing (MHz)	500	500	950	100
Freq Stability (ppm)	30	30	30	30
Power Output (dBm)	-40 min.	+6 max -22 min.	-20 min.	0 max. -40 min
Load VSWR (max.)	1.5:1	1.5:1	1.5:1	1.5:1
In-band Spurious (dBc max.)	>24	>30	>40	>60
Power Supply	+15 Vdc at 200mA max.	+15Vdc at 200mA max.	+15Vdc at 150mA max.	+15Vdc at 300mA max.
Size (inches nominal)	1.9 x 1.33 x .5	1.33 x 1.33 x .15	1.9 x 1.33 x 0.6	1.9 x 1.33 x 0.6

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NAME _____ TITLE _____

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FERRITES

OCTAVE AND BROAD BANDWIDTH CIRCULATORS AND ISOLATORS

Freq. Range (GHz)	MODEL # Circulators	Isolators	Isolation dB Min.	Insertion Loss dB Max.	VSWR Max.
1.0 - 2.0	50A1021	60A1021	16	0.6	1.35
2.0 - 4.0	50A3001	60A3001	18	0.5	1.30
2.6 - 5.2	50A3011	60A3011	18	0.5	1.30
4.0 - 8.0	50A6001	60A6001	18	0.5	1.30
5.0 - 10.0	50A6071	60A6071	18	0.5	1.30
8.0 - 12.4	10B9201	20B9201	20	0.4	1.30
8.0 - 16.0	50A2001	60A2001	17	0.5	1.35
12.0 - 18.0	10B2201	20B2201	18	0.5	1.30
8.0 - 18.0	50A2051	60A2051	16	0.6	1.50

please update me. CIRCLE 208 ON READER SERVICE CARD

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FIRM _____ PHONE _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

OSCILLATORS

DIELECTRICALLY STABILIZED OSCILLATORS (DSO)

Model Number	Frequency Range (GHz)	Output Power (mw Minimum)	Size, inches nominal
6600 - 1300	3.65 - 4.05	30	2.7 x 1.7 x 1
6600 - 1610	4.25 - 4.75	30	2.6 x 1.5 x .9
6600 - 1611	4.75 - 5.25	30	2.5 x 1.5 x .9
6600 - 1612	5.10 - 5.60	30	2.5 x 1.5 x .9
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6600 - 1614	5.60 - 6.10	30	2.5 x 1.5 x .9
6600 - 1615	5.70 - 6.20	30	2.5 x 1.5 x .9
6600 - 1616	5.90 - 6.40	30	2.5 x 1.5 x.9
6600 - 1617	6.40 - 6.90	30	2.5 x 1.5 x .9
6600 - 1618	7.00 - 7.45	15	2.2 x 1.3 x .9
6600 - 1910	8.00 - 8.40	15	2.2 x 1.3 x .9
6600 - 1911	8.60 - 9.00	15	2.2 x 1.3 x .9
6600 - 1912	9.00 - 9.50	15	2.2 x 1.3 x .9

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(from page 42) TECHNICAL PROGRAM

S5 **Highly Reliable Low Noise MM-Wave Mixers with Whisker-Contacted Honeycomb Diodes**
Joerg Schroth

S6 **A Subharmonically Pumped Fin-Line Mixer for Satellite TV Receiver Applications**
Gunther Begemann

T. BIOLOGICAL EFFECTS AND MEDICAL APPLICATION
Chairman: W. R. Adey

T1 **27 MHz Waveguide Applicators for Localized Hyperthermia Treatment of Cancer**
R. W. Paglione, F. Sterzer, J. Mendecki, E. Friedenthal and C. Botstein

T2 **Microstrip Loop Radiators for Local Hyperthermia**
I. J. Bahl, S. S. Stuchly, J. W. Lagendijk and M. A. Stuchly

T3 **A New Optical Technique for the Measurement of Temperature in RF and Microwave Fields**
K. A. Wickerhsheim and R. V. Alves

T4 **Non-Perturbing Temperature Probe and Thermography Measurements in Microwave Diathermy**
G. Kantor and C. Hochuli

T5 **Clinical RF Hyperthermia (Invited)**
F. Krishan Storm

T6 **The Effects of High Power Microwave Pulses on Red Blood Cells and the Relation to Transmembrane Thermal Gradients**
Susan L. Gartner, A. W. Friend, K. R. Foster and H. Howe, Jr.

T7 **Microwave Thawing of Frozen Packed Red Blood Cells**
Nancy L. Campbell; J. Drewe

T8 **Application of Moment-Methods to Electromagnetic Biological Imaging**
M. J. Hagmann, O. P. Gandhi, D. K. Ghodgaonkar

T9 **Microwave Imaging: Numerical Simulation and Results**
M. F. Ishkander, R. Maini, C. H. Durney

U. MICROWAVE FIELD AND NETWORK THEORY
Chairman: S. March

U1 **Propagation Parameters of Coupled Microstrip-like Transmission**
S. K. Koul, B. Bhat

U2 **Hybrid Mode Analysis of Microstrip Lines on Anisotropic Substrates**
A. M. El-Sherbiny

U3 **Analysis of Microstrip Line on Semiconductor Substrate**
M. Anbourg, J. P. Villotte, F. Godon and Y. Garault

U4 **Wave Propagation in Inhomogeneous Anisotropic Rectangular Waveguides by the Effective Index Method**
M. N. Armenise, M. De Sario

U5 **Improved Technique for Evaluation of Slot Discontinuities in Rectangular Waveguide**
P. K. Park, G. J. Stern

U6 **Desegmentation of Two-Dimensional Microwave Circuits and its Application to Stripline Power Dividers**
K. C. Gupta, P. C. Sharma and R. Chadha

V. GUIDED WAVE OPTICS AND SIGNAL PROCESSING
Chairman: J. K. Butler

V1 **The Integrated Optic Spectrum Analyzer – A First Demonstration**
T. R. Raganath, J. Lee and T. Josephf

V2 **Guided Wave Optical RF Spectrum Analyzer (Invited)**
D. Mergerian, E. C. Malarky, R. P. Pantiemis, J. C. Bardley and A. L. Kellner

V3 **A Generalized Two-Dimensional Coupled-Mode Analysis of Curved and Chirped Periodic Structures in Open Dielectric Waveguides**
Zong-Q. Lin, Shu-Tong Zhou, William S. C. Chang, S. Forouhar and J. Delavaux

V4 **Nonreciprocal Propagation Characteristics of YIG Thin Film**
Tetsuya Mizumoto, Yoshiyuki Naito

V5 **Experiment on Light Intensity Modulation Based on Guided-to Radiation Mode Coupling in Hetero-Structure Thin Film Waveguide**
H. Onodera, I. Awai, M. Nakajima and J. Ikenoue

V6 **Polarization-Rotated Radiations Conversion in Electroptic Waveguides**
S. Yamamoto

(continued on page 46)

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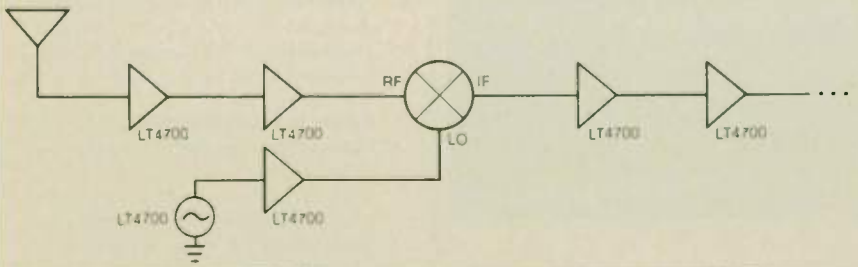

*Noise measure M_{min} is the system noise figure of an infinite cascaded chain of identical amplifier stages

$$M_{min} = 10 \log_{10}\left(1 + \frac{NF_{min} - 1}{1 - 1/G_{ANF}}\right)$$

where NF_{min}, minimum noise figure, and G_{ANF}, gain at associated noise figure, are specified as power ratios.

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1981 IEEE/AP-S & URSI TECHNICAL PROGRAM

TUESDAY MORNING, JUNE 16, 1981

AP-S SESSION 1
MICROSTRIP ANTENNAS (I)
Chairman: Prof. S. Long

1. Resonant Frequency of Rectangular Microstrip Antennas, M. C. Bailey and M. D. Deshpande
2. A Wide-Band, Multiport Theory for Thin Microstrip Antennas, W. F. Richards, and Y. T. Lo
3. Cylindrical-Rectangular Microstrip Antenna Radiation Efficiency Based on Cavity Q Factor, C. M. Krowne
4. Comparison of Radiation Characteristics of Microstrip Patch Antennas, I. J. Bahl and P. Bhartia
5. Segmentation and Desegmentation Techniques for Analysis of Planar Microstrip Antennas, K. C. Gupta and P. C. Sharma
6. A Simple Accurate Formula for the Radiation Conductance of a Rectangular Microstrip Antenna, H. Pues and A. Van de Capelle
7. Characteristic of Microstrip Ring Antennas, I. J. Bahl and S. S. Stuchly
8. Cross-Polarized Radiation from Metal Patch Type Microstrip Antenna Elements, Donald W. Griffin

URSI SESSION B-1
SCATTERING I
Chairman: Dr. G. A. Thiele
Commission B

1. Electromagnetic Scattering by Open Circular Waveguides, T. W. Johnson, and D. L. Moffatt
2. Scattering from Open Cylinders, L. N. Medgyesi-Mitschang, and C. Eftimiu
3. Diffraction by a Perfectly-Conducting Plane Angular Sector: Improvements on the Eigenfunction Solution and Some Numerical Results, J. N. Sahalos, and G. A. Thiele
4. Plane Wave Diffraction by a Wedge — A Spectral Domain Approach, Clarkowski and R. Mittra
5. New Asymptotic Wedge Diffraction Coefficients, A. Mohsen
6. Interaction of a Plane Electromagnetic Wave with a Dielectric Body: A New Hybrid Iterative Solution, R. Bansal, T. T. Wu and R. W. P. King
7. Boundary Integral Equations for Scattering from Complex Dielectric Structures, R. E. Kleinman, N. J. Damaskos and J. R. Jameson
8. Reflection from Gyroelectromagnetic Layered Media, N. J. Damaskos, A. L. Maffett and P. L. E. Uslenghi
9. High Frequency Diffraction from a Strip in a Flat Plane with Arbitrary Impedance Boundary Conditions, R. Tiberio and G. Pelosi

AP-S SESSION 2
ARRAY PATTERN SYNTHESIS
Chairman: Dr. W. A. Imbriale

1. A New Approach to the SNR Optimization of Lossy Receiving Arrays, G. Y. Delisle, M. G. Pelletier, J. A. Cummins and J. Murner
2. Theory of Null Synthesis of Planar Arrays, Sharad R. Laxpati and J. Paul Shelton
3. Applications of Null Synthesis to Hexagonal Arrays, J. Paul Shelton and Sharad R. Laxpati
4. Performance of Thinned Antenna Arrays, D. S. Hicks and D. C. Patel
5. Elimination of the Dummy Elements in Thinned Phased Arrays, F. Beltran, and F. King
6. Approximate Methods of Solution for Element Patterns in Thinned Arrays, F. Beltran
7. A General Theory of Weighted Phased-Array Antenna and the Analysis of Phase Weighting, Fang Neng-hang

URSI SESSION B-2
WAVEGUIDES I
Chairman: Prof. S. T. Peng
Commission B

1. Axisymmetric TM Modes in Open Cylindrical Waveguides with Central

(continued on page 48)

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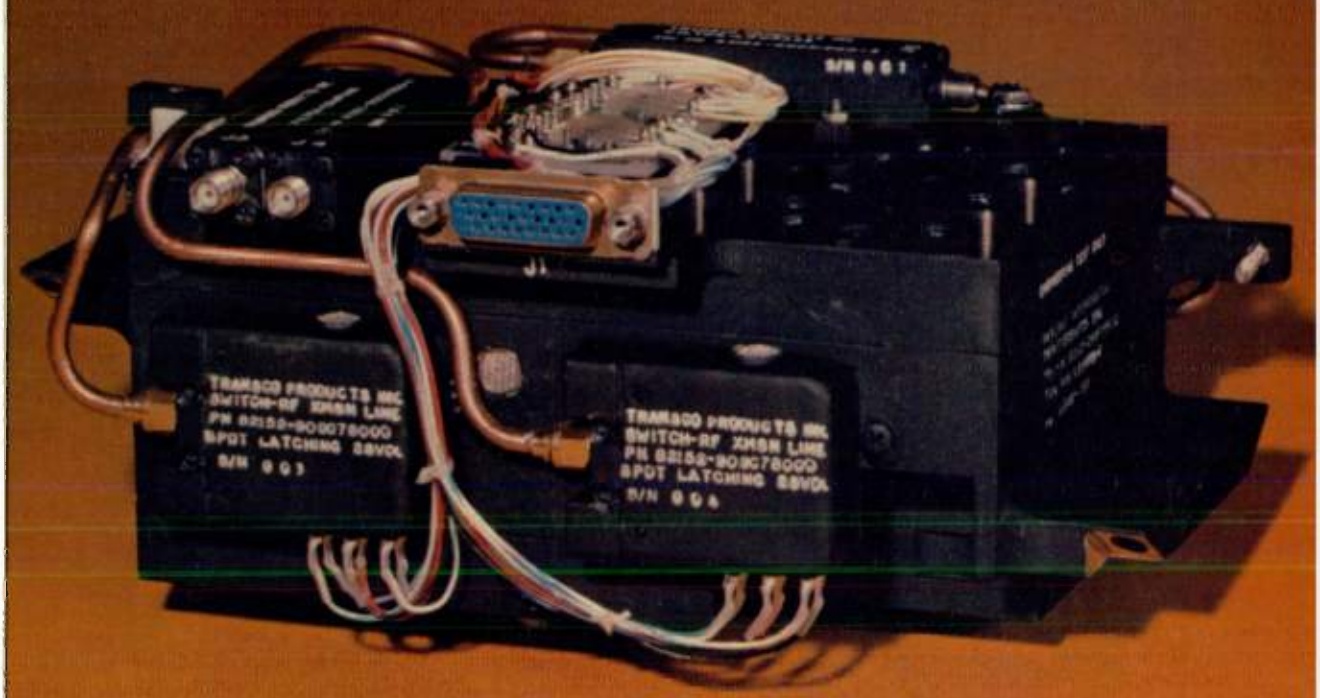

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(from page 46) TECHNICAL PROGRAM

Conductor, G. C. Sherman and C. Hennessy

2. **Analysis of a Tunnel Waveguide Junction**, D. A. Hill
3. **Mode-Conversion Effects in Radiation from Periodically-Corrugated Dielectric Structures**, A. A. Oliner and S. T. Peng
4. **Quasi-Optics of the Coupling of Guided Modes in a Corrugated Dielectric Waveguide**, S. R. Seshadri
5. **Mode Filters for Integrated Optics: Application of Anisotropic Dielectrics**, B. B. Chaudhuri and D. K. Paul
6. **Spectral Domain Analysis of Discontinuity Microstrip Structures**, A. K. Sharma, and B. Bhat
7. **An Experimental Study of Nonuniform Surface Reactances Synthesized Using a Grounded Pin-Bed Structure**, K. S. Park, D. V. Thiel, R. J. King and W. S. Park
8. **Some Applications of Non-Uniform Waveguides**, N. Berkane and J. Ch. Bolomey
9. **Modes of an Array of Dielectric Waveguides**, Leonard Eyges

AP-S SESSION 3
HORN FEEDS
Chairman: Dr. S. J. Hamada

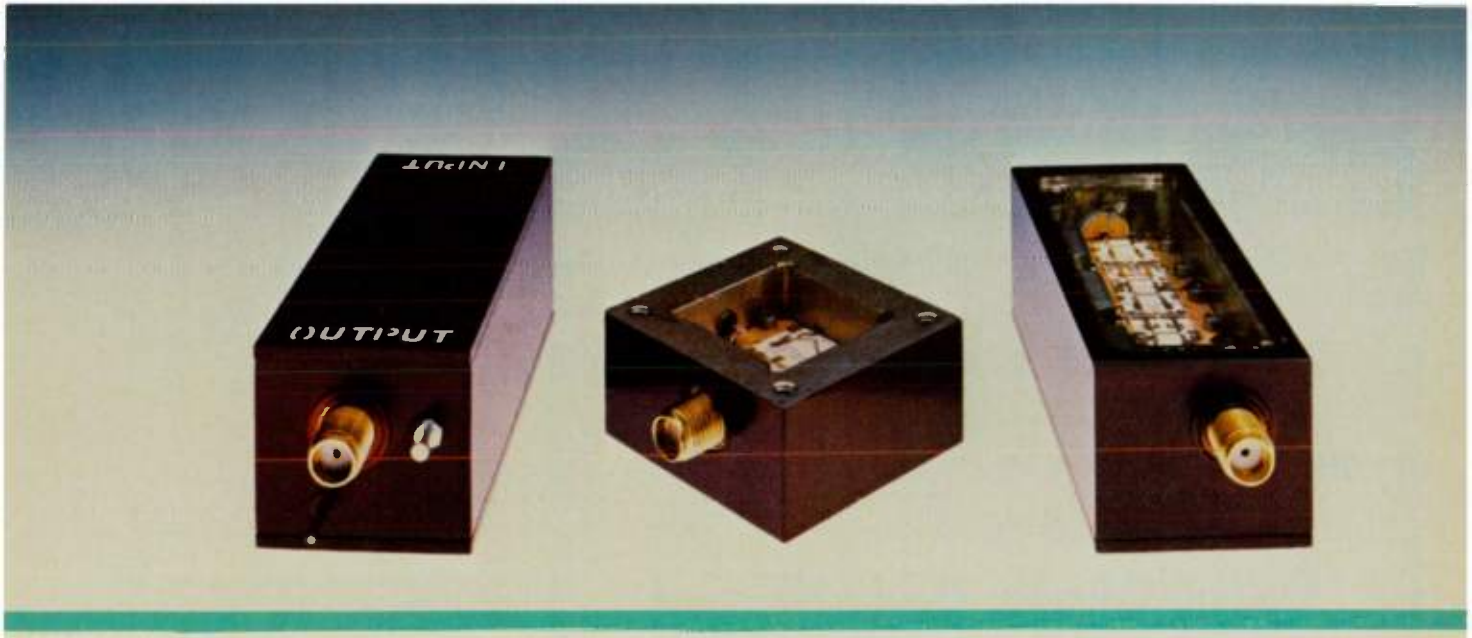
1. **Corrugated Waveguide Monopulse Feed**, P. J. B. Clarricoats, and R. Elliot
2. **Cross-Polar Behavior of Wide-Angle Corrugated Horns**, P. J. B. Clarricoats, S. Mahmoud and A. D. Olver
3. **High Performance Dual-Band Corrugated Feed for TVBS Antenna for the Italian Region**, S. Ghosh, N. A. Adatia, B. K. Watson
4. **Control of Modal Amplitudes in Over-moded Waveguides**, N. Sridhar, T. K. Sen and G. P. Srivastava
5. **A Circular Horn with a Dielectric Coated Flange as a Feed for Prime Focus Paraboloidal Reflectors**, A. Ittipiboon, L. Shafai, E. Bridges and F. Rahman
6. **Radiation from Coaxial Cavity Feed with Aperture Reactance (IRIS) Loading**, Yeong-ming Hwang, Levent Ersoy, and Lawrence F. Brokish
7. **An X-Band Single Horn Autotrack Antenna Feed System**, T. Yodokawa and S. J. Hamada

URSI SESSION F-1
REFRACTION EFFECTS
Chairman: Dr. C. Crain

Commission F

1. **A Simplified Model for Interpreting the Doppler Spectrum of Forward Scatter Radar Signals**, R. E. Post and H. M. Ibrahim
2. **A Study of Troposcatter Signal Behaviour**, N. C. Mathur, P. R. Pande, R. K. Bassi and V. K. Girdhar
3. **Improving Knowledge of Multipath Fading**, L. F. Mojoli
4. **A Technique for Obtaining Tropospheric Refractive Range Error Corrections from Angle Error Measurements**, E. E. Altshuler and K. Mano
5. **On the Maxwell-Equation Basis for Radiative Transport Theory**, R. L. Fante

(continued on page 50)



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	SDA 9398-01	9.3 – 9.8	30	3.0	+13	+23
	SDA 117122-01	11.7 – 12.2	30	3.5	+13	+23
Broad band	SDA 2080-13	2 – 8	34	6.0	+18	+28
	SDA 80180-05	8 – 18	24	7.5	+10	+20
Medium power	SDA 2040-13	2 – 4	38	6.5	+21	+30
	SDA 4080-17	4 – 8	38	6.0	+21	+30
	SDA 80124-17	8 – 12.4	32	7.5	+21	+30

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(from page 48) TECHNICAL PROGRAM

6. **Analytic Solution for the Two-Frequency Mutual Coherence Function for Spherical Wave Propagation**, D. L. Knepp
7. **On Field Computation in Radio Frequency Interferometry**, A. Mohsen
8. **Convergence Characteristics of Geophysical Tomography Using Iterative Ray Tracing**, R. D. Radcliff, C. A. Balanis, H. W. Hill, Jr. and G. E. Trapp, Jr.

AP-S SESSION 4
SCATTERING AND MEASUREMENTS
Chairman: Dr. Cleyon O. Yowell

1. **Microwave Backscatter Measurements on Transmission Lines**, D. L. Odom and N. C. Currie
2. **Millimeter-Wave Backscatter of Transmission Cables**, H. H. Al-Khatib and J. Fielding
3. **RCS Measurements of Cavities**, R. B. Dybdal and H. E. King
4. **Characterization of the Scattering Properties of an Antenna by Rapid Swept-Frequency Measurements**, Johnson J. H. Wang
5. **Rapid Broadband Swept-Frequency Automated Scattering Measurement**, C. D. Papanicolopulos, R. L. Moore, and J. J. H. Wang
6. **Radar Antenna/Mast Near-Field Interactions**, Werner Koppl
7. **Field Analysis of a Class of RF Intrusion Sensor Systems**, Harold R. Raemer
8. **High Sensitivity Millimeter-Wave Instrumentation**, R. B. Dybdal, T. T. Mori and H. E. King

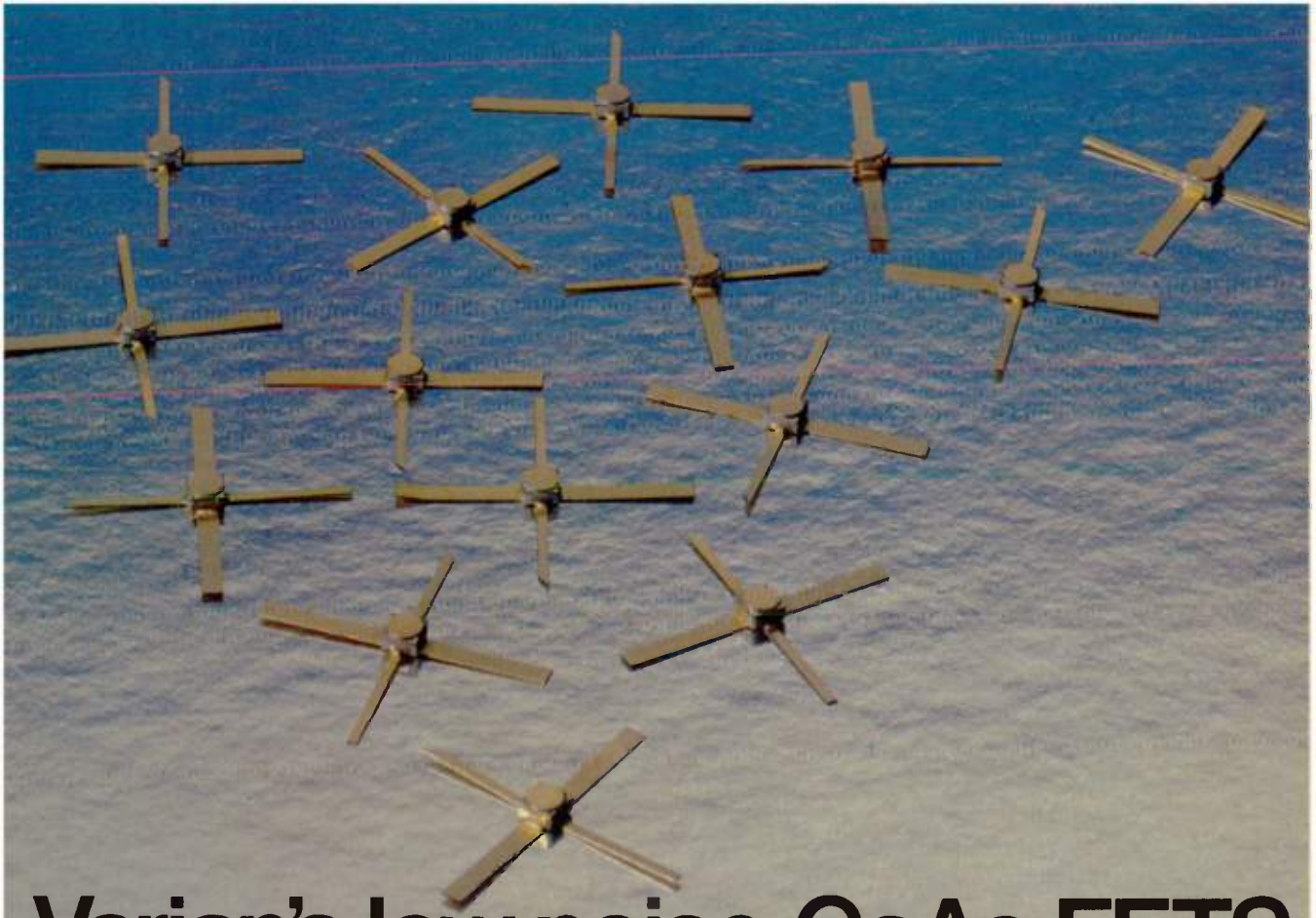
AP-S SESSION 5
APERTURE AND LENS ANTENNAS
Chairman: Dr. W. C. Wong

1. **High Efficiency V-Band Fan Beam Antenna**, C. C. Chen
2. **A New Method for Waveguide Lens Analysis**, L. Grun and S. W. Lee
3. **Broadband Astigmatic Compensation**, T. S. Chu
4. **Vectorial and Scalar Approaches for Determination of Interbeam Isolation of Multiple Beam Antennas – A Comparative Study**, Y. Rahmat-Samii and A. B. Salmasi
5. **A New Approach to Random Aperture Errors**, Victor K. Tripp
6. **Ray Structure Method for Coupling Coefficient Analysis of the Two Dimensional Rotman Lens**, Michael J. Maybell
7. **Aperture Field Nodes Generated by a Butler Matrix for the Design of Very Low Side Lobe Electronic Scanning Reflector Antennas**, Shii-Shyong Wang and Hang-Kam Izaguirre
8. **The Solution to the Problem of the Circular Aperture Distribution with One Parameter in Antenna Design**, Yu-Kuan Mao and Kaizhou Chen

TUESDAY AFTERNOON, JUNE 16, 1981

URSI SESSION B-3
SCATTERING II
Chairman: Prof. R. E. Kleinman
Commission B

(continued on page 53)



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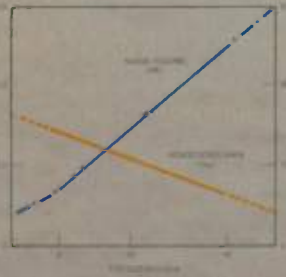

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(from page 50) TECHNICAL PROGRAM

1. A Simple Technique for Solving E-Field and H-Field Integral Equations for Conducting Bodies at Internal Resources, T. K. Sarkar
2. On Improving the Stability of the Electric Field Integral Equation at Low Frequencies, D. R. Wilton and A. W. Glisson
3. A Hybrid Technique Which Combines the Moment Method with an Asymptotic Current, T. J. Kim, and G. A. Thiele
4. An Improved Mode-Matching Method for the Problem of Scattering by Conducting Cylinders with Arbitrary Shape, M. Nishimura, S. Takamatsu and H. Shigesawa
5. On the Scattering from an L-Shaped Wire, C. D. Taylor
6. Electromagnetic Diffraction by a Narrow Slit in an Impedance Sheet — E-Polarization, D. F. Hanson
7. Comparisons Between Measurements and Computations of HF Radar Backscatter from Canonical Ship-Like Structures, E. K. Walton and E. H. Newman
8. Scattering Area of a Large Wind Turbine Blade, D. L. Sengupta and J. E. Ferris
9. Experimental Determination of Electromagnetic Energy Absorption on Complex Shapes; A Progress Report, R. M. Sega, V. M. Martin, and R. W. Burton

URSI SESSION B-4
WAVEGUIDES II; OPTICAL AND MILLIMETER WAVEGUIDES
Chairman: Dr. E. F. Kuester
Commission B

1. Propagation Constants for Step-Index Optical Fibers of Arbitrary Cross-Section at High Frequency, E. F. Kuester and R. Ebrahimian
2. On the Analysis of Inhomogenities in Optical Waveguides, T. C. Kaladhar Rao
3. Optical Communications with Elliptical Fibers, R. Y. Wong and S. R. Rengarajan
4. Investigating the Properties of the Radially Inhomogeneous Optical Fibers Using the Predictor-Corrector Method, H. H. Yao and G. L. Yip
5. A Numerical Solution for Inhomogeneous Dielectric Waveguides, Ch. Pichot
6. Scattering of Surface-Waves by a Dielectric Step Discontinuity, H. Shigesawa and M. Tsuji
7. Suspended and Inverted Microstrips for Millimeter-Wave Applications, J. Rivera and T. Itoh
8. New Polarization Preserving Single-Mode Fibers — The Layered Fibers, C. Yeh, and A. R. Johnston

AP-S SESSION 6
SIGNAL PROCESSING ANTENNAS
Chairman: Dr. J. B. Damonte

1. Radar Waveform Synthesis for Target Discrimination, Kun-Mu Chen, Dennis P. Nyquist, Doug Westmoreland, Che-I Chuang and Byron Drachman
2. Correlation of Masquerading Multimode, Keith A. Struckman
3. Effective Pattern and Anti-Clutter Performance of Frequency Scanning Radar Antennas, Ji Sheng Zhong

(continued on page 54)

(from page 53) TECHNICAL PROGRAM

4. **Direction-Finding Using a Discrete Space-Matched Filter**, J. Munier, G. Y. Delisle, J. A. Cummins, and B. Faure
5. **Comparison of Signal-to-Noise Ratio in the UHF Band for Antennas with Linear and Circular Polarization**, Victor Lander
6. **Electric Field Induced Rate Effects in Pharmacokinetic Systems**, Y. J. Seto and S. T. Hsieh
7. **Analysis of the Time Domain Aperture Antenna with Theory of Linear System**, Shi-ming Lin
8. **Time Domain Analysis of the Transient Behavior of an Aperture Antenna**, Shi-ming Lin

AP-S SESSION 7
ARRAY TECHNIQUES
Chairman: Dr. Giorgio Borgiotti

1. **The SHF Hybrid Scan Array**, A. J. Kelly, E. Pinck, J. F. Pedersen and W. W. Bogin
2. **A Wideband Shaped-Beam Low-Sidelobe Conformal Array Step-Scannable via a Modified Blass Network**, P. J. McVeigh and R. M. Rudish
3. **Near Field Transmission Lines Feed Linearly Polarized Array Antenna for Built-In Test**, Shu-Shyong Wang and Ruey-Shi Chu
4. **Radiation Performance of a Large Slotted Waveguide Array for Satellite Borne Radiometric Applications**, Mostafa Afifi Ray Meier, and Louis Dod
5. **Sidelobe Requirements for the Microwave Landing System**, Alfred R. Lopez
6. **A Simple Coaxial FED Planar Microstrip Slot Array**, F. Rahman, L. Shafai, E. Bridges, and A. Ittipiboon
7. **Kevlar Armored Phased-Array**, S. Y. Peng, R. S. Chu, N. S. Wong and R. Tang
8. **Large X-Band Electronically Scanned Array**, D. E. Bostrom, J. A. Castaneda, R. E. Hodges and P. Fujii

AP-S SESSION 8
HORN ANTENNAS
Chairman: Dr. P. G. Ingerson

1. **Characteristics of a Square Coaxial Waveguide Feed for a Reflector Antenna**, Sharad R. Laxpati, C. Q. Lee, and Craig M. Skarpiak
2. **A GTD Parametric Study of Pyramidal Horns for Reflector Applications**, J. Huang, Y. Rahmat-Samii, and K. Woo
3. **A Wideband Low-Sidelobe Disc-O-Cone Antenna**, J. L. Wong and H. E. King
4. **Surface Wave Launched and Scattered on the Discontinued Impedance Surface and the Radiation Theory of the Surface Wave Antenna**, Ri-rong Zhang and Xiao-Jie Gao
5. **Mode Coupling Coefficients in Conical Horn Junction**, V. Daniele, M. Orefice and R. Zich
6. **An Octave Bandwidth Meanderline Polarizer Consisting of Five Identical Sheets**, Derek A. McNamara

AP-S SESSION 9
ANTENNA MEASUREMENTS (I)
Chairman: Prof. Edmond S. Gillespie

. Verification Testing of a Spherical Near-Field Algorithm and Comparison to Compact Range Measurements, Doren W. Hess and Joseph J. Tavormina
. Spherical Scanning Data Processing; An Algorithm for Halving the Data Processing Effort When the Radiation into the Back Hemisphere is Negligible, Richard Lewis
. A Second-Generation Near-Field Range, C. P. Burns, V. V. Jory, D. F. Tsao, R. B. Cotton, E. N. Bone and A. N. Morrison
. A Highly Accurate Planar Near-Field Scanner, F. E. Shannon and J. L. Luzwick
. Near-Field Measurements of Broad Beam Antennas, T. B. Wells
. Spherical-Wave Source-Scattering-Matrix Analysis of the Mutual Coupling Between Two Antennas, Richard Lewis
. An Improved Design of the Swept-Frequency Automatic-Z-Measuring Schemes Using Multiple Probes, Chia-Lun J. Hu
. The Gain Measurement of Large Antennas with Cosmic Radio Sources at Frequencies above 10 GHz, Noriyuki Kawaguichi and Noakazu Hamamoto

IRSI SESSION F-2
ATMOSPHERIC ATTENUATION, CATTERING, AND ABSORPTION
Chairman: Dr. R. T. Woo
Commission F

. Attenuation and Depolarization Over an Earth-Space Path at 12 GHz: Measurement Results for Path Elevation Angles of 27 and 9 Degrees Using the CTS Satellite, A. J. Rustako, Jr.
. Measured Bounds on Rain-Scatter Coupling Between Space-Earth Radio Paths, D. C. Cox, H. W. Arnold and H. H. Hoffman
. Fade Duration and Interfade Interval Statistics Measured on a 19 GHz Earth-Space Path, H. W. Arnold, D. C. Cox and H. H. Hoffman
. A Site Diversity Experiment Using the Sirio Spacecraft, C. W. Bostian, R. E. Marshall, W. L. Stutzman and W. P. Overstreet
. Transmission and Backscattering of Optical Waves through Fog, R. L-T Cheung and A. Ishimaru
. Application of Satellite Microwave Radiometry in Meteorology, N. C. Grody
. Some Results of HF Radio Noise Measurements in Nigeria Using Directional Antenna, C. O. G. Obah
. Crosspolarization of Ice Particles at 30 GHz, C. Yeh; R. Woo and J. W. Armstrong, and A. Ishimaru
. Microwave Depolarization and Raindrop Canting Angles, R. S. Butler
0. Earth-Space Rain Attenuation Measurements at 13 GHz for Several Sites in Canada, R. V. Webber, J. I. Strickland and J. J. Schlesak

(continued on page 56)

(from page 55) TECHNICAL PROGRAM

WEDNESDAY MORNING, JUNE 17, 1981

PLENARY SESSION
JOINT IEEE AP-S, MTT-S, URSI
Moderator: Dr. Seymour Cohn, Consultant

1. **The Very Large Array Radio Telescope**, Dr. P. Napier
2. **Noise and Analog and Digital Microwave Communications**, Dr. S. Okwit
3. **Biological Effects and Medical Applications of Electromagnetic Fields**, Dr. O. P. Gandhi
4. **The Voyager Encounter with Saturn**, Dr. E. C. Stone

WEDNESDAY AFTERNOON, JUNE 17, 1981

SESSION B-6
GOUBAU MEMORIAL SESSION
Commission B
Organizer: David C. Chang
Session Chairman: James W. Mink
Eulogy: Felix Schwering
Leo Felsen, Chairman International Commission B on Fields and Waves

1. **Theory of Beam Waveguides: A Review**, F. Schwering
2. **Some Aspects of Georg Goubau's Experimental Investigations at Fort Monmouth**, J. R. Christian and J. W. Mink
3. **Mathematical Model of Multi-Element Monopole Antennas**, G. Goubau (deceased), N. N. Puri and F. Schwering
4. **Guiding Mechanisms on Open, Planar Structures**, D. C. Chang, and T. Itoh
5. **Radiation Characteristics of Leaky Dielectric Waveguides**, R. Mittra
6. **Bending Losses of Open Waveguides**, E. F. Kuester
7. **New Physical Effects Due to Mode Coupling in Various Dielectric Structures**, A. A. Oliner and S. T. Peng

AP-S SESSION 10
ADAPTIVE ANTENNAS
Chairman: Prof. J. G. Fikioris

1. **Adaptive Antenna/Receiver-Processor System**, G. G. Chadwick, J. G. Charitat, W. Gee, C. C. Hung and J. L. McFarland
2. **A UHF Communication Antenna Employing Open Loop Control Null Steering**, D. E. N. Davies and J. R. F. Guy
3. **Maximally Flat Second Order Feedback Loops for Fast Adaptive Antenna Arrays**, I. A. Mandour, S. E. El-Khamy and M. A. Abouldahb
4. **Design Limitations on Adaptive Array Control Loop Nulling Time**, Lawrence R. Burgess, and Dr. Raymond S. Berkowitz
5. **Weight Dynamic Range in Power Suppression Adaptive Arrays**, Heng Cheng Lin
6. **Cross Coupled Boot Strapped Interference Canceler**, Yeheskel Bar-Ness, and J. Rokach
7. **Angle of Arrival Performance Bounds in an Interfering Environment**, E. and A. Mendelovicz and E. T. Oestreich
8. **Angular Tracking Results for a Highly Quantized Adaptive Array**, Lloyd J. Griffiths and Charles W. Jim

AP-S SESSION 11
NUMERICAL METHODS AND FORMULATIONS
Chairman: Prof. K. Mei

1. **Scattering and Absorption of Lossy Dielectric Objects Irradiated by the Near Fields of Aperture Source**, A. Lakhtakia, M. F. Iskander, C. H. Durney and H. Massoudi
2. **Cutoff in Fin Lines Evaluated with the Spectral Domain Technique and with the Finite Element Method**, A. K. Sharma, G. I. Costache and W. J. R. Hoefer
3. **A Spectral-Iteration Technique for Analyzing Scattering from Arbitrary Bodies**, Raphael Kastner and Raj Mittra
4. **A Generalized Numerical Expression for the Three-Dimensional LaPlacian Operator**, E. E. Okon
5. **Effect of the MFIE Resonance on the Approximate Solution of the Reaction Matching Integral Equation Applied to a Rotationally Symmetric Antenna**, A. Hizal, K. Aydin and F. Canatan
6. **Application of the Boundary Element Method to Electromagnetic-Scattering Problems**, M. H. Lean and A. Wexler
7. **Electromagnetic Waves on Cylindrical Structures Calculated by the Method of Moments and by the Point-Matching Technique**, C. Hafner and R. Ballisti
8. **A Delta-Distribution Derivation of the Electric Field in the Source Region**, Arthur D. Yaghjian

AP-S SESSION 12
MICROSTRIP ANTENNAS (II)
Chairman: Prof. T. Itoh

1. **A Perturbation Approach to the Design of Circularly Polarized Microstrip Antennas**, Y. T. Lo, and W. F. Richards
2. **Microstrip Backfire Antenna**, C. M. Kalor, D. Hatfield and P. Simon
3. **Temperature Compensation of Microstrip Antennas**, M. A. Weiss
4. **Input Impedance Smith Chart Curves for H-Plane Mutual Coupling Between Two Rectangular Microstrip Antennas**, C. W. Krowne, and A. R. Sindoris
5. **The Impedance of an Elliptical Printed-Circuit Antenna**, Stuart A. Long and Mark W. McAllister
6. **Printed Circuit Antenna for Wide Bandwidth Requirements**, Kenneth D. Arkind and Richard L. Powers
7. **Broadbanding of Microstrip Antennas by Orthogonal Polarizations**, Sazanami Yano, and Akira Ishimaru
8. **Expanding the Frequency Bandwidth of a Microstrip Antenna**, Yasuo Suzuki, Noriaki Miyano and Taneaki Chiba

THURSDAY MORNING, JUNE 18, 1981

URSI SESSION H-1
LABORATORY, SPACE AND FUSION PLASMAS
Organizer and Session Chairman: Prof. N. C. Luhmann, Jr.

Commission H
INVITED PAPERS

1. **Magnetic Field Line Reconnection Experiments**, R. L. Stenzel and W. Gekelman
2. **Plasma Waves in Saturn's Magnetosphere**, F. Scharf
3. **Recent Theoretical and Experimental Progress in Heating in the Vicinity of Cyclotron Harmonics of Fusion Plasmas**, J. Scharer
4. **Lower Hybrid Heating**, T. Yamamoto
5. **Particle Beam Experiments in Space**, D. Papadopoulos
6. **Ion Bernstein Waves: Plasma Heating, Ion Temperature Diagnostics and Current Drive Feasibility**, M. Ono

URSI SESSION B-6
RADAR WAVEFORMS AND IDENTIFICATION
Chairman: Prof. A. A. Ksienski

Commission B

1. **Radar Spectroscopy: T-Matrix Approach**, P. J. Moser, and H. Uberall
2. **R-Matrix Theory of Radar Scattering**, P. J. Moser; J. D. Murphy, A. Nagl and E. Uberall
3. **Synthesis of Radar Signal for Exciting a Single-Mode Backscatter from a Sphere**, K-M Chen and D. Westmoreland
4. **An Approach to Radar Target Identification**, S. W. Lee, R. Mittra and M. Hurst
5. **Modelling of Nonlinear Scatterers with Nonlinear Radar Cross Sections**, J. Y. Hong, Y. C. Kim and E. J. Powers
6. **Hypothesis Testing Applied to Radio Direction Finding**, S. Rashba and I. Kohlberg
7. **An Automated Microwave Measurement Facility for Three-Dimensional Tomographic Imaging by Wavelength Diversity**, N. H. Farhat and C. W. Werner

URSI SESSION B-7
INVERSE SCATTERING
Chairman: Prof. P. L. E. Uslenghi
Commission B

1. **An Inverse Scattering Method for One-Dimensional Problems in Absorbing Media**, A. K. Jordan
2. **Direct and Inverse Scattering of Combined Fields**, P. L. E. Uslenghi
3. **An Algorithm for Profile Inversion**, C. Q. Lee
4. **On Some Aspects of Microwave Imaging**, J. Ch. Bolomey, A. Izadneghadar and M. Solaimani
5. **Characterization of a Cylindrical Shell. A Geometrical Optics Approach to an Inverse Scattering Problem**, B. Duchene, and W. Tabbara
6. **Inverse Scattering – Inverse Source Theory**, N. N. Bojarski
7. **An Exact, Closed-Form Solution for the Source Term in the Inverse Source/Inverse Scattering Problem, and an Analytic Solution for the Scattering Potential**, W. R. Stone
8. **Unique, Well-Posed, and "Real World" Considerations for an Analytic, Closed-Form Solution to the Inverse Scattering Problem**, W. R. Stone
9. **The Application of the Exact, Closed-Form Solution to the Inverse Scattering Problem to the Remote Probing of Inhomogeneous Media**, W. R. Stone

AP-S SESSION 13
PROPAGATION
Chairman: Prof. Akira Ishimari

1. **Fading Statistics on a 23 km Link at 9.6 and 28.6 GHz**, R. H. Ott
2. **Antenna Beamwidth Independence of Measured Rain Attenuation on a 28 GHz Earth-Space Path**, H. W. Arnold, D. C. Cox and H. H. Hoffman
3. **Transequatorial Propagation on VHF and Low UHF Bands During the Peak of Solar Cycle 21 for the Euro-African Sector**, C. Fimerelis and N. K. Uzunoglu
4. **Scattering of a Plane Wave from Cylindrical Tunnels Inside a Lossy Medium**, N. K. Uzunoglu and J. D. Kanellopoulos
5. **Scattering of Electromagnetic Plane Wave from a Slightly Random Surface**, H. Ogura, J. Nakayama and M. Sakata
6. **An Experimental Study of VLF Waveguide Propagation**, Fu Yaozong

AP-S SESSION 14-A
TRANSIENTS
Chairman: Dr. Jeremy Landt

1. **Wideband Radar Target Response Modeling**, H. Mieras and C. L. Bennett
2. **Transient and Broadband Analysis of Aircraft Fixed-Wire Antennas**, Lennart Marin
3. **A Preprocessing Technique for Identification of Scatterer Resonances from Measured Transient Response**, J. R. Auton and M. L. Van Blaricum

AP-S SESSION 14-B
SEM
Chairman: Dr. Carl Baum

1. **Source-Synthesis Considerations in SEM Equivalent Circuits for Energy-Collecting Structures**, Krzysztof A. Michalski and L. Wilson Pearson
2. **Distortion Analysis of Non-Linearly Loaded Antennas**, C. Naldi and R. Zich
3. **A Modified Time-Domain Inverse Scattering Scheme in Presence of Random Noise and System Distortions**, Sujeet K. Chaudhuri and Paul A. Lenz
4. **Some Physical Constraints on the Use of Nonsinusoidal Electromagnetic Waves Radiation**, Kai-hsienk Jen

AP-S SESSION 15
SLOTTED ANTENNAS
Chairman: Mr. D. K. Waineo

1. **Attenuation in Slot Antennas Due to Waveguide Wall Thickness**, R. W. Lyon and A. J. Sangster
2. **Design of Transverse Slot Arrays Fed by Boxed Stripline**, P. K. Park and R. S. Elliott

(continued on page 58)

(from page 57) **TECHNICAL PROGRAM**

3. **An Evanescent-Mode Waveguide Frequency-Scanning Feed**, R. I. Wolfson, C. F. Cho and G. A. Hockham
4. **Millimeter-Wave W-Band Slotted Waveguide Antennas**, F. G. Farrar
5. **Effect of Baffles on the Mutual Admittance Between Slot Antennas**, N. G. Alexopoulos, P. J. Contoyannis and G. Franceschetti
6. **Near Field Investigation of Coupling Between Two Horns**, Letitia V. Muresan and T. J. F. Pavlesek
7. **Fields at the Aperture of Pyramidal Horns**, S. I. Ghobrial

AP-S SESSION 16-A
PHASED ARRAY ANALYSIS
Chairman: Dr. N. Amitay

1. **Radiation from Infinite Arrays of Arbitrarily Shaped Thin Wire Antennas**, H. K. Schuman, D. R. Pflug and L. D. Thompson
2. **Performance of a Two-Dimensional Microstrip "Patch" Element in a Phased Array**, C. C. Liu, J. Shmoys and A. Hessel
3. **Transform Feed for Low Sidelobe Space-Fed Lens Phased Array Antenna**, Jerome D. Hanfling and Bradley R. Herrick
4. **Narrow Multibeam Satellite Ground Station Antenna Employing a Linear Array with a Geosynchronous Arc Coverage of 60°**, N. Amitay and M. J. Gans

AP-S SESSION 16-B
CONFORMAL ARRAYS
Chairman: Dr. Y. Rahmat-Samii

1. **A Conical Array of Dielectric Filled Edge Slot Antennas**, A. R. Sindoris and S. T. Hayes
2. **Mutual Coupling in Rotationally Symmetric Arrays of Circular Apertures on Conducting Spherical Surfaces**, P. K. Bondyopadhyay and A. Hessel
3. **Conical Phased Array Antenna Investigations**, A. T. Villeneuve and W. H. Kummer
4. **A Low-Cost Lightweight C-Band Cylindrical Array**, K. J. Keeping, D. S. Rogers and J-C. Sureau

AP-S SESSION 17
REFLECTOR ANTENNAS – I
Chairman: Dr. C. C. Chen

1. **The Use of GTD in the Design and Analysis of Low Sidelobe Reflector Antennas**, Yeogming Hwang and C. C. Han
2. **Dual Polarized Elliptical Beam Antenna for Satellite Application**, N. Adatia, B. K. Watson and S. Ghosh
3. **Radiation Pattern Prediction for Arbitrary Reflector Antennas**, M. C. Bailey, and Steven M. Moskowitz
4. **Sidelobe Level Reduction by Improvement of Strut Shape**, Naota Matsunaka, Shinichi Betsudan, and Takashi Katagi
5. **A Compact and Low Sidelobe Offset Antenna for 4/5/6 GHz Band Terrestrial Communication Links**, Nobuo Nakajima and Yoshitaro Shimanuki
6. **Reduction of the Strut Radiation of Reflector Antennas**, Herbert Thielen
7. **A Rigorous Approach to the Theory of Paraboloidal Antenna**, Lang Jen

URSI SESSION F-3
SENSING SURFACES
Chairman: Dr. E. K. Smith
Commission F

1. **Surface-Current Solution for Rough-Surface Scattering**, J. C. Leader
2. **Remote Sensing of Ocean Surface Current and Current Shear by Microwave Radar**, D. L. Schuler
3. **Polarization Effects in Scattering from Breaking Waves**, L. B. Wetzel
4. **Emission from an Irregular Layer Embedded with MIE Scatterers**, A. K. Fung, K. K. Lee and H. J. Eom
5. **Radiative Transfer Theory for Microwave Remote Sensing of an Inhomogeneous Medium with Rough Surfaces**, R. T. Shin, S. L. Chuang and J. A. Kong
6. **Random Medium Model for Microwave Remote Sensing of Earth Terrain**, J. A. Kong, R. T. Shin, F. J. Vallese, S. L. Chuang and J. K. Lee
7. **Ocean Surface Area Coverage by Satellite-Mounted Radars**, R. E. McIntosh and R. S. Raghavan
8. **Another Look at Ocean Surface Current Measurements from Satellites**, C. T. Swift and R. E. McIntosh

URSI SESSION B-8
TRANSIENTS AND SEM
Chairman: L. Bennett
Commission B

1. Volterra Series Solution of Maxwell Equations in Nonlinear Media, G. Franceschetti and I. Pinto
2. The Natural Frequencies of the Axisymmetric TE Modes of a Hollow Conducting Sphere with a Circular Aperture, K. F. Casey
3. Pole Extraction in the Frequency Domain, J. M. Pond and T. B. A. Senior
4. Physical Basis of the Singularity Expansion Method in Terms of Creeping Waves (Theory and Experiment), H. Uberall, A. Nagl and J. V. Subrahmanyam, B. Z. Hollmann, G. C. Gaunaurd, and J. D. Murphy
5. Practical Solutions to Transient Electromagnetic Probing of Stratified Lossy Media, J. Ch. Bolomey, D. Lesselier and G. Peronnet
6. Identification of Scatterer Resonances by Reversing the Measured Unforced Response in Time, M. L. Van Blaricum and J. R. Auton
7. Data Acquisition and Processing in Transient Scattering Measurements, M. A. Morgan and C. W. Hammond
8. Transient Measurements of Linear Antenna Arrays in Free Space and Over Perfectly Conducting Ground, K. D. Rech, K. J. Langenberg, P. Fellinger and K. Mayer

URSI SESSION B-9
NUMERICAL AND ANALYTIC TECHNIQUES
Chairman: Dr. D. R. Wilton
Commission B

1. Optical Wavelength Calculation of Scattering Cross Sections with the Numerical Electromagnetic Code (NEC), B. A. Blevins
2. Quadrifilar Helix Antenna Design for Satellite Communications Using the Numerical Electromagnetic Code, D. E. Fessenden
3. A New Local-File Manipulation Technique for Solving the Scattering of Large Objects, C. D. Papanicolopulos and J. J. H. Wang
4. Two Hybrid Techniques for the Treatment of Wire Antennas Near an Elliptic Cylinder, K. Siakavara and H. Papadimitraki-Chlichlia; J. N. Sahalos, and G. A. Thiele
5. A Hybrid FD-TD Approach to Electromagnetic Wave Backscattering, A. Taflove and K. Umashankar
6. FFT Utilization in Moment Method Solutions Using Entire Domain Bases, M. Tew and A. Q. Martin
7. A Moment Solution of the Diffusion Equation Using Measured Boundary Conditions, N. J. Damaskos
8. The Best Least Squares Rational Approximation of Transfer Functions by Solution of a Linear Uncoupled Eigenvalue Problem, T. K. Sarkar

AP-S SESSION 18-A
DIELECTRIC WAVEGUIDES
Chairman: Prof. C. Yeh

1. Quasi-Optics of Magnetic Waves Guided by a Planar Film, S. R. Seshadri
2. Cut-Off Wavenumbers of the Symmetrical Modes for an Eccentric Cladded, Three Layer, Dielectric Waveguide, N. Metrou, J. D. Kanellopoulos, J. A. Roumeliotis and J. G. Fikioris
3. On Plane Wave Propagation in Composite Dielectrics, Benjamin Rulf and Herbert Feldman
4. Analysis of Propagation Characteristics of Light Waves in a Periodically Corrugated Dielectric Film by Perturbation Method, N. S. Chang and Y. Matsuo

AP-S SESSION 18-B
ANTENNAS AND DIELECTRIC INTERFACE
Chairman: Prof. C. Yeh

1. Theory of Dielectric Grating Antennas of Finite Width, S. T. Peng and A. A. Oliner, and F. Schwering
2. A Modified Normal Mode Helix with High Impedance and Bandwidth, Mario Orefice
3. The Circular Loop Antenna Near a Material Interface, L. N. An and G. S. Smith
4. Improved 243 MHz Homing Antenna System for Use on Helicopters, F. Klinker

(continued on page 60)

(from page 59) TECHNICAL PROGRAM

AP-SESSION 19-A
RADIATION AND E/M RESONANCE
Chairman: Dr. Ken Casey

1. **Group and Representation Theory of Finite Groups and Its Application to Field Computational Problems with Symmetrical Boundaries**, C. Hafner and P. Leuchtmann
2. **Characteristics of Double Aperture-Cavity Resonances**, C. H. Liang and D. K. Cheng
3. **Inductive Shielding of Single- and Multi-Layered Enclosures – A Review**, K. S. H. Lee
4. **Radiation Fields of Metallic Prolate Spheroid Excited by Any Circumferential Slot**, Lang Jen and Chuan-Shui Hu

AP-S SESSION 19-B
ANTENNA MEASUREMENTS (II)
Chairman: Mr. R. I. Wolfson

1. **Proposed Method to Eliminate Errors in Antenna Pattern Measurements Due to Reflections**, Jose Perini
2. **Range Distance Requirements for Measuring Low and Ultralow Sidelobe Antenna Patterns**, P. S. Hacker and H. E. Schrank
3. **Measurement of Low Cross-Polarized Patterns**, Donald G. Bodnar
4. **Synthesis and Evaluation of Spherical Quasi Plane Wave Regions for Antenna Pattern Measurements**, Jorgen Hald

AP-S SESSION 20
LOW FREQUENCY ANTENNAS
Chairman: Prof. C. A. Balanis

1. **A Frequency Tracking, Tuned, Receiving Monopole**, Gerome Reeve and Arthur Wainwright
2. **A Compact Wideband HF Transmitting Antenna**, Richard K. Royce
3. **Broadband Trapped Multiple-Wire Antennas**, W. A. Edson
4. **Analysis of a V-Loop Antenna**, Naomi Amano, and Risaburo Sato
5. **Decoupling of a Monopole Antenna with a Radial-Transmission-Line Choke**, T. G. Dalby
6. **Monopole Antenna Patterns on Finite Size Composite Ground Planes**, Constantine A. Balanis, and Dennis DeCarlo

URSI SESSION B-10
ANTENNAS I: REFLECTORS AND RADOMES
Chairman: Dr. Y. Ranmat-Samii

Commission B

1. **Some Limitations in the Broadband Operation of Segmented Reflectors**, J. M. Tranquilla, P. J. Sutherland and R. H. Joyce
2. **Beam-Broadening Techniques for High-Gain Reflector Antennas**, E. W. Smith, J. C. Brand and F. Q. Herschelman
3. **Phase Error Analysis in Communications Antennas**, P. E. Butzien
4. **Multiple Scattering Contributions of Multiple Circular Conducting Cylinders to Antenna Gain Loss**, R. L. Moore and B. J. Cown
5. **Guided Waves and Their Consequences for Radome Analysis and Performance**, G. Tricoles, R. A. Hayward and E. L. Rope
6. **Rigorous Asymptotic Analysis of Transmission through a Curved Dielectric Slab**, P. D. Einziger, L. B. Felsen and A. Hessel
7. **Analysis and Applications of Active Microwave Reflectors**, M. Hamid and R. Antebi
8. **A Novel Microstrip Antenna Feed for a Paraboloidal Reflector with Simultaneous RCP and LCP Polarization**, C. C. Post, and K. R. Carver

URSI SESSION H-2
WAVES IN PLASMAS
Chairman: Dr. R. W. Fredricks
Commission H

1. **Impedance of a Plane Capacitor in a Beam-Plasma System**, T. Fujita and S. Adachi
2. **Some Amplification Properties of Electromagnetic mm-Waves in a Plasma Tube**, A. Rosenberg, J. Politch, Y. Ben-Aryeh and J. Felsteiner
3. **Pulse Propagation in Dispersive Media Brillouin's Signal Velocity**, R. J. Vidmar
4. **A Theory of Coupling Propagation for Electromagnetic and Electron Acoustic Wave in Inhomogeneous Magneto-Plasma**, C. Man and Z. Yan-Zheng
5. **Frequency Shift of a Signal Propagating in a Time-Dependent Environment**, H. Gelman and I. Kohlberg

FRIDAY MORNING, JUNE 19, 1981

URSI SESSION B-11
ANTENNAS II: ARRAYS AND RADIATING ELEMENTS
Chairman: Prof. C. M. Butler

Commission B

1. **Analysis of a Slot Radiator in a Dielectric-Covered Parallel-Plate Waveguide**, R. D. Nevels
2. **Radiation Characteristics of Slot Antenna on Large Body-of-Revolution**, T-K Wu
3. **Effect of Array Size and Shape on Element Patterns**, W. K. Kahn
4. **Sidelobe Control in Partially Excited Cylindrical Arrays**, K. J. Keeping and J-C. Sureau
5. **Plane Wave Spectrum Analysis of Coupling Between a Pair of Near-Field Directive Antennas**, B. J. Cown and D. H. Ryan, Jr., and P. A. Major
6. **Mutual Impedance from Far Field Data**, S. Chaiken, G. Franceschetti and N. G. Alexopoulos
7. **Monopole Antennas on Lossy Ground Planes**, J. D. Lilly and C. A. Balanis

(continued on page 62)

CHALLENGE

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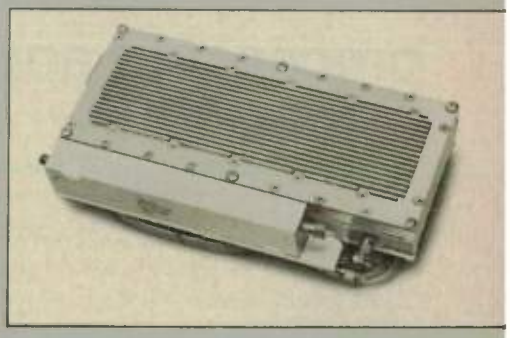

IFM brochure describes our newest IFM Discriminators, which measure the frequency of an RF input signal and generate an 11 bit TTL or ECL compatible digital output word. Send for brochure.

(from page 60) TECHNICAL PROGRAM

8. **Resonance and Q Properties of Isosceles Triangular Patch Antennas of 60° and 90° Vertex**, E. P. Kuester and D. C. Chang

9. **Microstrip Dipoles on Spherical Structures**, N. G. Alexopoulos, and P. L. E. Uslenghi

AP-S SESSION 21
RADOMES/SCATTERING
Chairman: Dr. A. C. Ludwig

1. **Measurement, Calculation, and Reduction of Radome Wave Aberrations**, G. Tricoles, R. A. Hayward and E. L. Rope

2. **The Internal Fields of a Layered Radome Excited by a Plane Wave**, Terry M. Kvam, and K. K. Mei

3. **Ray Analysis of a Cylindrical Dielectric Radome**, P. D. Einziger and L. B. Felsen

4. **Scattering of a Surface Wave Incident on a Nonuniform Transition in Surface Reactance**, K. S. Park and R. J. King

5. **A New Approach to Three-Dimensional Multistatic Target Imaging**, Gregory E. Heath

6. **Electromagnetic Scattering from a Thin Rectangular Plate**, Joseph R. Mautz and Arlon T. Adams

7. **Ray Analysis of EM Backscatter from a Jet Intake Configuration**, P. H. Pathak and C. C. Huang

8. **Efficient Calculation of Scattering from a Hyperboloidal Subreflector**, Ronald J. Pogorzelski

AP-S SESSION 22-A
INTEGRAL EQUATION MODELING
Chairman: Prof. Tapan Sarkar

1. **Computer Graphics Applications in Electromagnetic Computer Modeling**, E. K. Miller, F. J. Deadrick and G. J. Burke, and J. A. Landt

2. **A Numerical Analysis of Mutual Coupling Between Thin Linear Antennas in the Presence of a Metallic Scatterer**, M. F. Catedra

3. **Radiation from Dipoles Near a Finite Length Cylinder**, M. A. Hassan

4. **Numerical and Experimental Results for Two Thick Monopole Antennas**, A. Hizal and M. Qureshi

AP-S SESSION 22-B
LAYERED MEDIA
Chairman: Prof. Tapan Sarkar

1. **Plane Wave Scattering from an Infinite Loaded Dipole Planar Array Over a Lossy Half Space**, Takunori Mashiko and Saburo Adachi

(continued on page 64)

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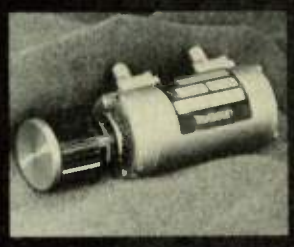

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(from page 62) TECHNICAL PROGRAM

2. **Scattering of EM Waves by Buried or Partly Buried Body of Revolution**, Henry Chang, and Kenneth K. Mei
3. **Exact Scattering from a Thick Imperfectly Conducting Half-Plane**, V. Daniele, and P. L. E. Uslenghi
4. **Spatial Fourier Transforms and Equivalent Circuits. A Novel View in Electromagnetic Waves**, C. D. Papageorgiou, J. D. Kanellopoulos and J. G. Fikioris

AP-S SESSION 23
WIRE ANTENNAS
Chairman: Dr. A. W. Love

1. **An Invertigation of the Effects of Ice on Microwave Dipole Receiving Antenna Elements**, I. M. Burdeaux, and W. L. Wilson, Jr.
2. **Design Method for Fine Impedance Matching of Superturnstile Antenna and Characteristics of the Modified Batwing Antenna**, Gentei Sato and Haruo Kawakami, Hirofumi Sato, and R. Wayne Masters
3. **Moment Method for a Twin Loop Antenna**, Keiji Endo; Gentei Sato, Haruo Kawakami and Mitsuhisa Sato
4. **Axial Ratios of Spiral Antennas**, Hisamatsu Nakano and Junji Yamauchi
5. **Backfire Bifilar Helical Antenna with Tapered Feed End**, Junji Yamauchi, Hisamatsu Nakano and Hiroaki Mimaki
6. **Unipole-Notch Array Antennas**, Takayuki Ishizone, Katsuhiro Yamamoto, Kunio Sawaya and Yasuto Mushiake
7. **Frequency Response of Uniform and Non-uniform Helical Antennas Radiating in the Axial Mode**, Ping-Fai Wong, Kang-Fong Larm and Kai-Fong Lee
8. **Driving-Point Impedance of Corner-Reflector Antenna with Tilted Dipole**, Kai-Fong Lee

AP-S SESSION 24
REFLECTOR ANTENNAS – II
Chairman: Dr. James W. Duncan

1. **Optimum Feed Locus for General Three-Dimensional Beam Scanning in Offset Cassegrain Antenna**, V. Krichevsky and D. F. DiFonzo
2. **On the Computation of the Radiation Pattern of Shaped Cassegrainian Reflector Systems**, R. Mittra, W. L. Ko and M. S. Sheshadri, and V. Galindo-Israel
3. **The Design of Wide-Band, Sharp Cut-Off Dichroic**, C. A. Chen, P. G. Ingerson and C. C. Chen
4. **Millimeter-Wave Beam Steering by Motion of Cassegrain Antenna Subreflector**, R. W. McMillan, R. C. Rogers, III and G. F. Smith
5. **A Scanning Offset-Fed, Near-Field Gregorian Reflector Antenna**, Yeongming Hwang and C. C. Han
6. **A Study of Gravitational Astigmatism Compensation of Large Cassegrain Antennas**, Shun-Shi Zhong
7. **Influence of the Beam Waveguide System on the Cross-Polar Radiation from Symmetrical Reflector Antennas**, Ynag Kezhong

URSI SESSION B-12
MEDIA AND EARTH INTERACTION
Chairman: Dr. G. Brown

Commission B

1. **Transmitter and Receiver Aperture Averaging Effects for the Intensity Fluctuations of a Beam Wave in the Turbulent Atmosphere**, Y. Baykal, C. F. Ouyang, M. A. Plonus and S-J Wang
2. **A Coordinate-Free Approach to Wave Reflection from a Moving Medium**, H. C. Chen
3. **Scattering from a Random Slab**, H. M. Huby and K. Sivaprasad, and R. Vasudevan
4. **Attenuation Constant of Coherent Field in Dense Spherical Particles**, Y. Kuga and A. Ishimaru
5. **Scattering Cross Sections for Composite Random Surfaces – Full Wave Analysis**, E. Bahar
6. **Bistatic Scattering from a Lossy, Random, Composite Surface**, G. S. Brown
7. **An Improved Model for Scattering from Rough Terrain**, R. J. Papa, J. F. Lennon and R. L. Taylor
8. **A Dual Approach for Wave Packets and Solitary Waves in Nonlinear Systems**, D. Censor
9. **Magnetic Field Analysis of an Infinite Line Current Over a Plane Layered Earth**, O. Aboul-Atta, L. Shafai and M. Z. Tarnawekcy

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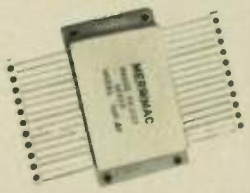

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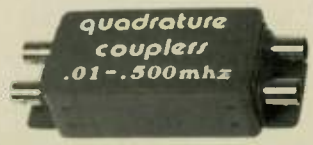

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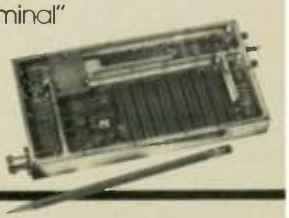

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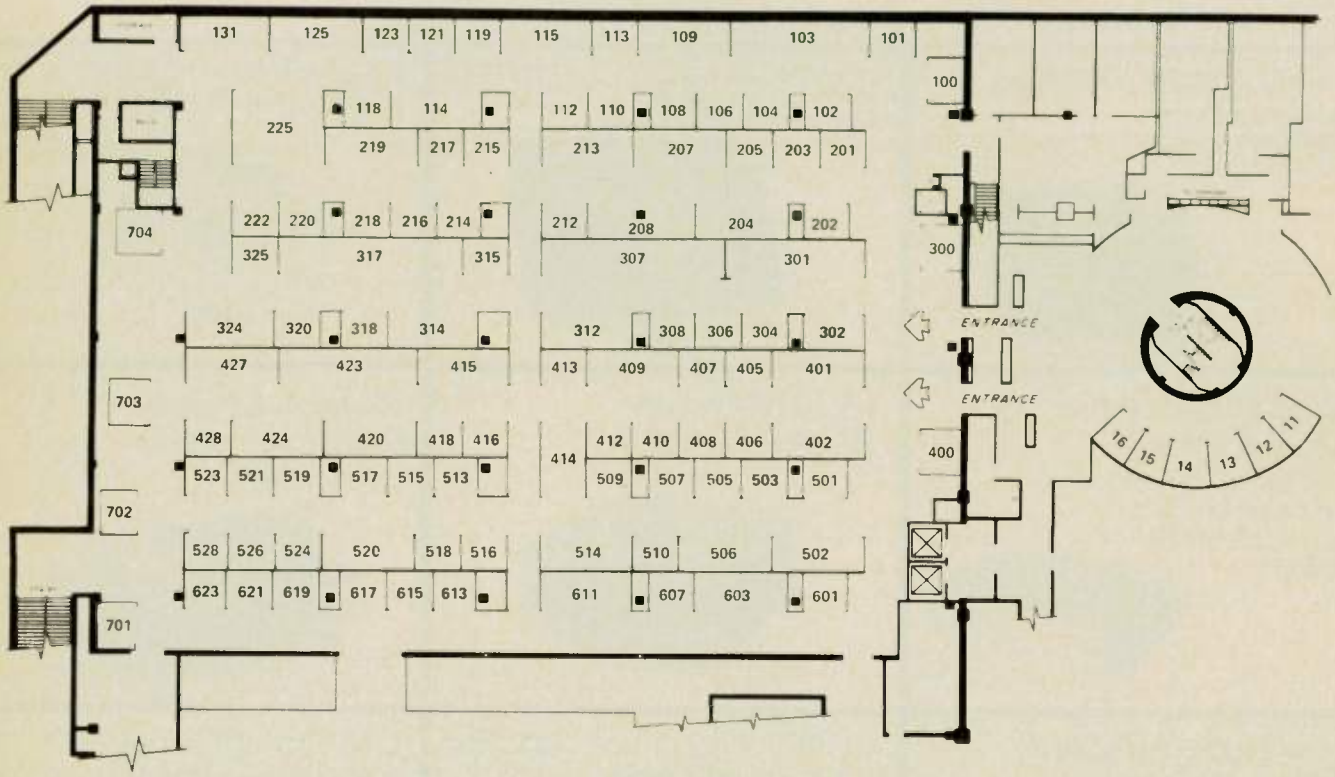

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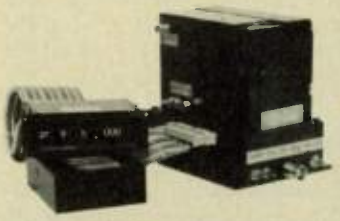

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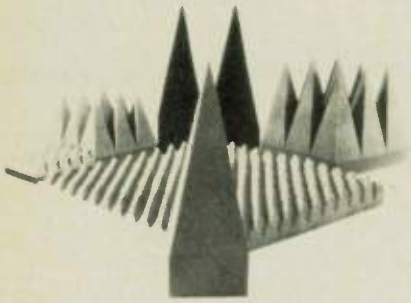

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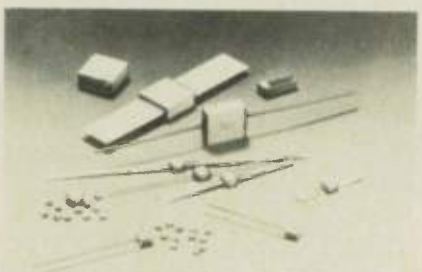

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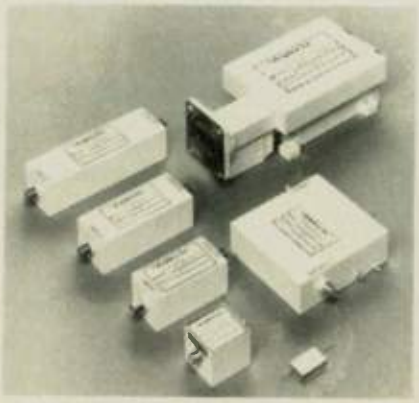

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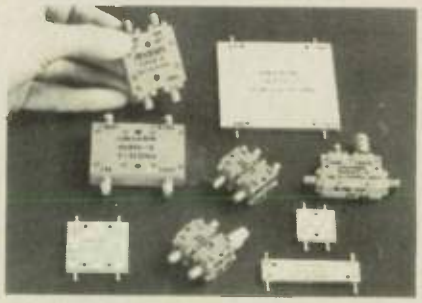

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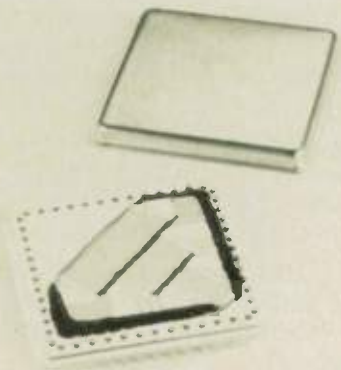

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(continued on page 72)

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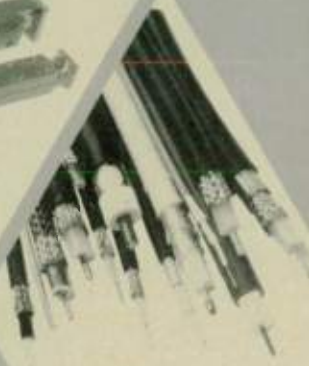

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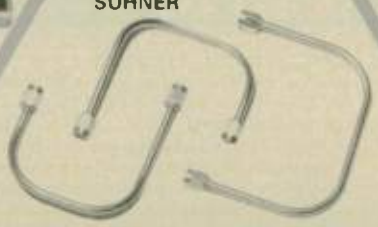

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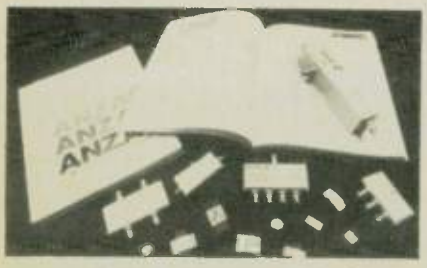

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Artech House books reflect expert authorship from every perspective of technology relevant to you. Data Communications, Microwave Components, Radar and Telecommunications are areas.

AUTOMATIC CONNECTOR, INC. 100
Commack, NY

L. Eichenseer, S. Eisenberg, C. Ott

RF coaxial connectors, wedge-lock, cable assemblies, switches.

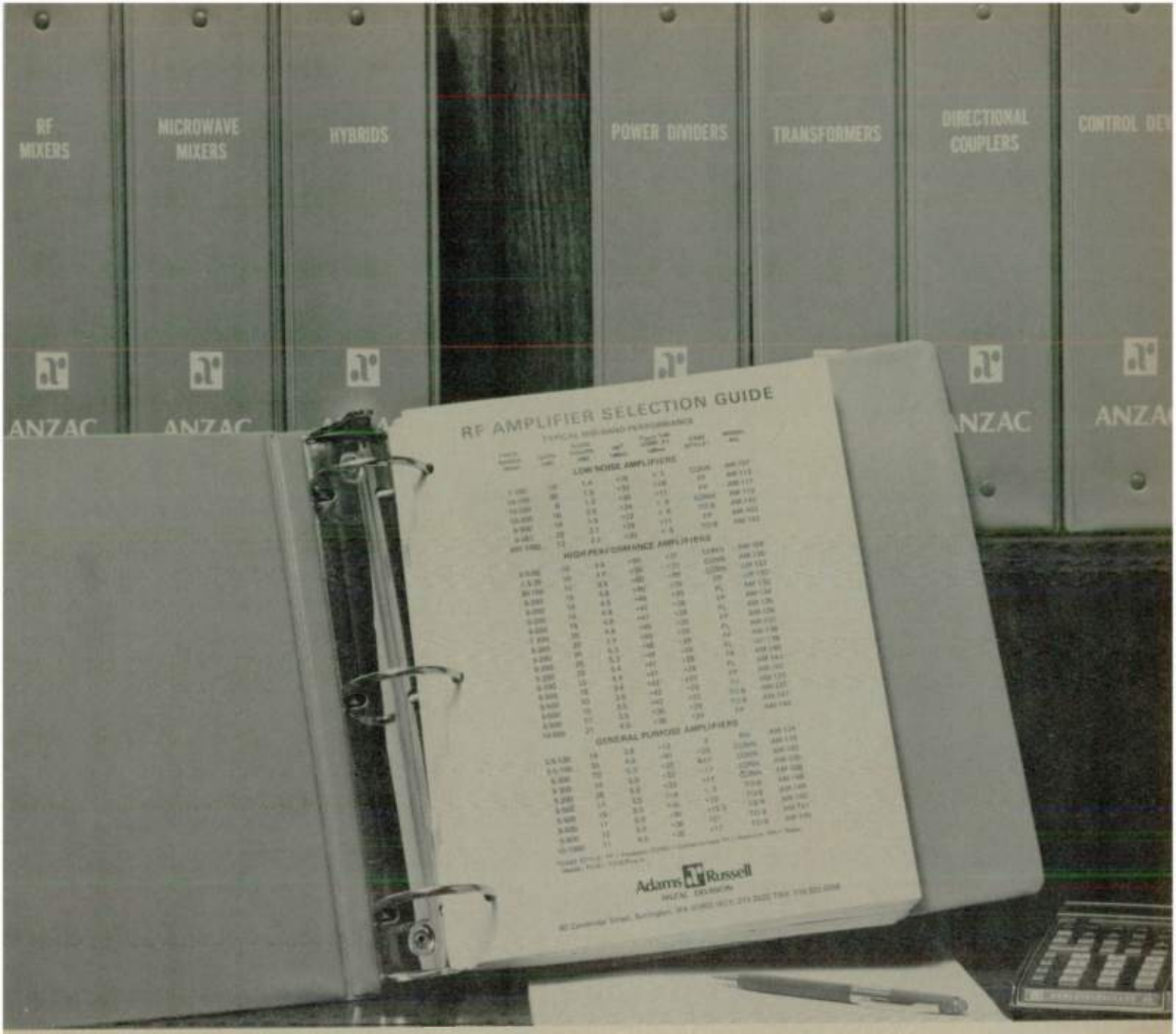
AVANTEK, INC. 420
Santa Clara, CA

Wideband GaAs FET amplifiers, dual gate GaAs FET limiting amplifiers, TWT replacement amplifiers, YIG and varactor-tuned oscillators, double balanced microwave mixers and modular products in the Avantek® miniature flatpak.

AYDIN MICROWAVE 15
San Jose, CA

H. Sawert

(continued on page 74)



RF AMPLIFIERS OFF THE SHELF

At Anzac, it's not just data that's off the shelf. Our million-dollar-plus inventory of RF and microwave components allows us to literally ship off the shelf within 48 hours of your order! All the selection data is packaged in an easy-to-use 272-page catalog which is yours for the asking. So, ask. Please.

Adams Russell
ANZAC DIVISION

80 Cambridge Street • Burlington, MA 01803 • (617) 273-3333 • TWX 710-332-0258

CIRCLE 59 ON READER SERVICE CARD

GaAs FET amplifiers, low-noise, GaAs FET limiting amplifiers.

BAYTRON COMPANY, INC. 218
Medford, MA
R. McLaughlin, M. F. Kozul, M. Kozul, T. Kozul

Millimeter devices.

THE BENDIX CORPORATION 623
Electrical Components Division
Sidney, NY
G. Collins, W. Flanders, E. Butts, R. Penny, L. LaFornara, R. Eddy

The SMA represents the latest development in Bendix Square-Cut RF connectors meeting all MIL-C-39023 requirements for material, performance and finish. These threaded coupling, sub-miniature, lightweight connectors offer excellent operating characteristics up to 18 GHz. Square-Cut termination system allows assembly time as low as 30 seconds and with a stainless steel, passivated finish, the SMA possesses excellent corrosion resistant qualities.

CABLEWAVE SYSTEMS, INC. 517
North Haven, CT

S. Raucci, Jr., R. Avery, M. Caputo

Complete line of SMA, SMB and SMC coaxial connectors hermetic sealed SMA MIC launchers, terminations, miniature semi-rigid coaxial cables, coaxial cable assemblies, coaxial delay lines.

CALIFORNIA EASTERN LABS 312
Santa Clara, CA

J. Arden, D. Bunnell, N. Corpron, S. Sando, Y. Tateyama, G. Medley

Small signal and power bipolars, small signal and power GaAs FET's. Tecdia line of chip capacitors. Low noise amplifiers.

CENTRAL MICROWAVE 519
St. Charles, MO

J. Caldwell, D. Bengfort

Gunn oscillators and amplifiers.

CLELAND & CO. INC. 603
Playa del Rey, CA
Erik Mjorud, J. Cleland, A. McCabke, J. Tschida, M. Cleland.

Representing
Advanced Absorber Products, EMF Systems, Locus Inc., Microwave Supply Center, Div. Cleland & Co., Sivers Lab.

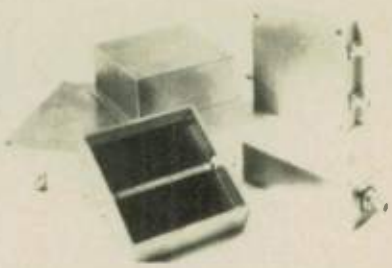
COMMUNITRONICS LTD. 307
Bohemia, NY

R. Delia, J. Ciral, D. Martinson, L. McCreddin, G. Seiver, L. Fisher

VHF/UHF Receivers, Status/Control Systems.

COMPAC DEVELOPMENT CORPORATION 320
Deer Park, NY

K. Bardon, S. Desloges, S. MacDonald, K. Wicks



RF shielded enclosures, cable assemblies, RF connectors, attenuators, terminations. Complete low cost RF packaging system and accessories.

OMPACT ENGINEERING, INC. 324
alo Alto, CA

. Besser, B. Childs, C. Holmes, J. Lindauer, . March, M. Medley, G. Szentirmai

Computer-Aided Design Programs and Training for microwave circuit designers.

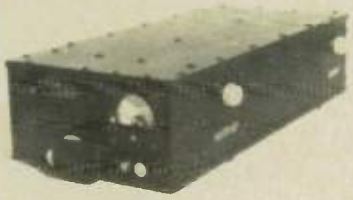
OMPEX CORPORATION 601
herry Hill, NJ

. Gordon, H. Stout, P. Simon

Manufactures single layer parallel plate icrowave chip capacitors with gold elec- odes for T.C. and ultrasonic bonding and retinned electrodes for solder reflow. Split lectrodes and arrays also available.

ADEN ASSOCIATES, INC. 519
aguna Hills, CA

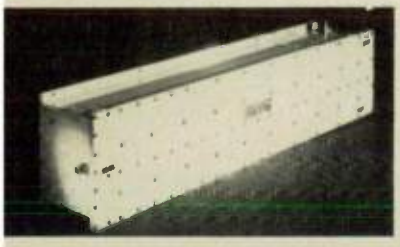
. Henry, D. Hook



IL-STD-810 Qualified VHF tunable band- ass filter. Range: 116–15 MHz; power: 0 W CW; passband: 1.5 MHz typ.; insertion oss: 3 dB max.; attenuation: 30 dB min. @ MHz BW; SWR: 1.5/1 max. Direct fre uency dial plus peaking meter.

ELTA MICROWAVE 306
Vestlake Village, CA

. Moreno, R. Reed



The U5902 Diplexer is used in a shipboard military communication satellite system. ully qualified, the diplexer features low assband insertion loss, high isolation be- ween channels and low intermodulation roduct generation.

EXCEL, INC. 108
anta Clara, CA

Duder, S. Kakihmana, P. Tipon

GaAs FET's, low noise amplifiers, oscilla- ors, wideband amplifiers.

IAMOND ANTENNA AND MICROWAVE CORP.
Winchester, MA

. Hovanesian, B. LaPage, P. Simon, H. Tiger

Model DIC-2505 is a high power 5-channel S and L band rotary joint typical of the larger units manufactured. The single chan- nel unit DIC-2124 weighs less than 1 oz.

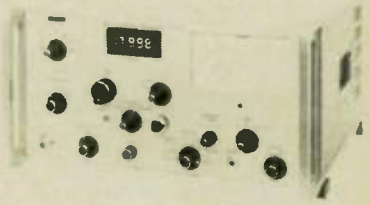
DIELECTRIC LABS INC. 413
Cazenovia, NY

R. Baker, D. Lupfer

RF and Microwave capacitors for use in microcircuits, hybrids and spacecraft equip- ment, as by-pass, coupling tuning and fil- tering elements, and are capable of operat- ing over the temperature range of −55 C to +150 C and frequency ranges up to 36 GHz.

EATON CORP. 219
Electronic Instrumentation Div.
Los Angeles, CA

J. Molt, W. Purdy, C. Sorensen



AILTECH electronic instruments for micro- wave test and measurement. Frequency syn-
(continued on page 76)

(from page 75) GUIDE

thesizers, spectrum analyzers, EMI test systems, noise figure instrumentation, sweep oscillators, RF power sources, broadband amplifiers.

EEV, INC. 516
Elmsford, NY

I. Buick, P. Butcher, T. Soldano, J. Wadkowski

Television transmitter klystrons, magnetrons for marine airborne radars, missile applications, TWT's for telecommunications, microwave links and electronic countermeasures, TR cells, balanced duplexers, noise generators, backward wave oscillators.

EIP MICROWAVE, INC. 507
San Jose, CA

R. Bush, R. Loft, H. Lurie

First – and only – automatic microwave frequency counter (microprocessor based) @ 10 Hz – 110 GHz; Pulsed RF counters to 18 GHz; Source locking counters to 18 GHz.

EMC TECHNOLOGY INC. 701
Cherry Hill, NJ

B. Latin, M. Steidlitz

Coaxial attenuators and terminations; Stripline and microstrip attenuators and terminations; Microstrip resistors; RF Connectors; High power dissipative devices.

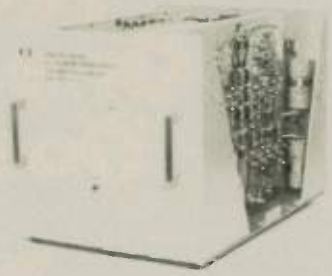
EMF SYSTEMS INC. 603
State College, PA

Marshall Cleland

Develops and manufactures solid state oscillators covering the 10 MHz to 12 GHz frequency range; these include phase-locked VCO's, crystals, multipliers and synthesizers.

ELECTRONIC NAVIGATION INDUSTRIES, INC. 519
Rochester, NY

L. Salmen, M. Damon, M. McDougall, R. McLaughlin



With a linear output rating of 100 watts from 1.5 to 400 MHz and a flat 50 dB gain, this extraordinary amplifier can provide 200 watt of output over the frequency range of 1.5 to 200 MHz when driven by any standard signal or sweep generator.

ENGELMANN MICROWAVE CO. 106
Montville, NJ

R. Hartwig, C. Schraufnagl

Coax and stripline components and transistor cavity oscillators. Attenuators, programmable and fixed, phase shifters. Terminations, couplers, dividers, hybrids, mixers, front-ends and subassemblies. Cost effective products for TVRO applications will be featured.

EPSILON LAMBDA ELECT. CORP. 325
Geneva, IL

Robert Knox

Gunn oscillators, microwave filters, millimeter transmitters and receivers.

EPSCO MICROWAVE, INC. 406
Westwood, MA

W. Coffin, W. Currier, J. Shalhoub

On display will be EP250C, a CW signal source with 250 W of output power over frequency range; with plug-in heads, average of better than 300 W; the 2076, a high pulsed oscillator and a MIL-qualified ss modulator used in peak power calibration unit; and EP5000L, a high power pulsed signal source which features a MIL-qualified high power pulsed cavity oscillator and ss modulator.

FILTRONIC COMP. LTD. 509
Leeds, England

R. A. Gough, J. D. Rhodes, M. J. Thornton

FCL-7 Series bandpass filters in 1-18 GHz frequency range featured. Low passband insertion loss (0.75 dB maximum) and selectivity – 60 dB points achieved within 5% low side and 7% (high side) of the band-edge frequency. Range of bandwidth and center frequencies offered – from FCL-712 at 1-2 GHz to FCL-71218 at 12-18 GHz. Power handling for models more than 50 W.

FREQUENCY SOURCES INC. 503
Chelmsford, MA

L. Becker, L. Moore, E. Brown, D. Colletta, G. Tamas, B. Bruce

Solid state sources, control devices, microwave filters, multiplexers, gain equalizers, isolators, silicon GaAs diodes.

FUJITSU MICROELECTRONICS, INC. 401
Santa Clara, CA

B. Adachi, Y. Arai, S. Erickson, M. Itoh, S. Murai, T. Shintani, J. Tomaisaka

Small signal and power bipolar transistors, VHF-microwave; Small signal and power GaAs FET's up to GHz; GaAs FET power amplifiers to 10 W covering communication and octave bandwidths; optoelectronic diodes for fiber optic data communications.

GAMMA-f CORPORATION 315
Torrance, CA

C. Goss, L. Alford, R. Terry, M. Stupnik and L. Fox

Passive waveguide components spanning 4 to 100 GHz fabricated to customer requirements utilizing electroforming techniques. Bandpass, band stop, high pass and low pass waveguide filter designed and fabricated to customer requirements. High-sensitivity waveguide detector for K_u-Band.

GENERAL MICROWAVE CORP. 307
Farmingdale, L.I., NY

J. Ciral, L. Fisher, D. Martinson, L. McCreddin, S. Rinkel, Gordon Seiver, M. Wind

Microwave power meters, PIN diode modulators, attenuators, switches; also "RAHAM" Radiation Hazard Meters (YA Series).

W. L. GORE & ASSOCIATES, INC. 125
Newark, DE

R. Wisniewski, C. Carroll, D. Baechtel, H. Walling, T. Whitten, R. Kauffman, K. Moll, S. Dippel, T. Saia, C. Lee, B. Hasselman

Featureing GORE-TEX® Microwave and RF Coaxial assemblies.

HEWLETT-PACKARD COMPANY 317
Network Measurement Div.
Santa Rosa, CA

RF and mw sweepers and network analyzers

HEWLETT-PACKARD CO. 317
Signal Analysis Div.
Santa Rosa, CA

RF and microwave spectrum analyzers.

HEWLETT-PACKARD COMPANY 317
Stanford Park Div.
Palo Alto, CA

RF and mw signal generation equipment and passive microwave equipment.

HONEYWELL, INC. 515
Santa Barbara, CA

E. Speer, M. Zepeda

Millimeter-wave components, mixers, receivers, converters, assemblies, subsystems, radiometers, MIC mixers.

HORIZON HOUSE 207
Dedham, MA

W. Bazzy, C. Berman, B. Bossard, J. Cotsworth, H. Ellowitz, C. Hangen, R. Howland, E. Johnson, S. Pasqualucci.

Artech House, Journal of Electronic Defense, Microwave Journal, Telecommunications, INTELECT.

(continued on page 78)

(from page 77) **GUIDE**

HUBER + SUHNER LTD. 520
Herisau, Switzerland

P. Schläpfer, A. Bosshard

High directivity couplers with minimum 50 dB directivity. Six Models available covering 5, 8 to 40 GHz. These couplers drastically increase accuracy of return loss measurements without the need for expensive ANA systems.

HUGHES AIRCRAFT CO. 409
Electron Dynamics Division
Torrance, CA

P. Crandell, R. Johnson, R. Larson, J. Kuno, D. Rasmussen, L. Forant, L. Mohrfeld, M. Talley

Pulsed transmitter module, 94 GHz receiver module, CW transmitter, 3 head full W-Band sweeper (75-110 GHz), phase locked oscillator, 9000H Series of communication HPAs, 1077H 26-40 GHz TWTA.

INTERNATIONAL MICROWAVE CORP. 216
Cos Cob, CT

Arnold Newton, Bruce Smith

Low noise amplifiers, Gunn and tunnel diode oscillators, noise sources, downconverters, electronic journalism system, mixer-preamps.

ITM SYSTEMS INC. 12
Sunnyvale, CA

W. I. Berg, D. T. Mounts

Featuring Model PK-38, Peak RF Power Meter ($2,200 price), with 1-14.5 GHz frequency range, 20 dB single range, zero drift, LED and digital RF meter; MP 24, CW RF Power Meter ($545 price) with 20 dB range and digital readout of power in milliwatts; and Model ITM-141, an automatic 3 kW switching system which is one for one totally self-contained.

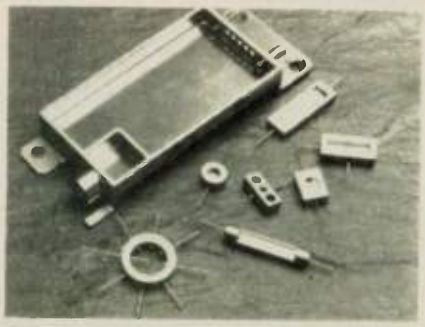
INTEGRA MICROWAVE 213
Santa Clara, CA

L. Johnson, W. Schuerch

Microwave sweepers (2-40 GHz), wide dispersion spectrum analyzers, YIG-tuned wavemeters (1-26.5 GHz), YIG-tuned filters (2-26.5 GHz), VCO test set (2-18 GHz), mixer/down converter test set (3.7-4.2 GHz).

ISOTRONICS 109
New Bedford, MA

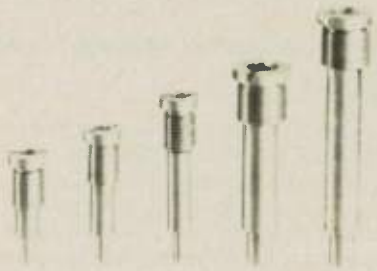
M. LoFrumento, C. Roellig, A. Kirkaldy



High reliability, all metal hybrid microcircuit packages.

JOHANSON MANUFACTURING CORP. 400
Boonton, NJ

E. Fagerlund, R. Kappner, R. Goldstein



Variable air capacitors and variable ceramic capacitors, microwave tuning elements.

JOURNAL OF ELECTRONIC DEFENSE 207
(see Horizon House)
Dedham, MA

W. Bazzy, C. Berman, B. Bossard, J. Cotsworth, H. Ellowitz, C. Hangen, R. Howland, E. Johnson, S. Pasqualucci

Journal of Electronic Defense, editorial and Association of Old Crows information.

KDI PYROFILM CORP. 201
Whippany, NJ

A. Arfin, J. Crowley, B. Friedman, J. Henn, J. Lahey, D. Louro

Micro-resistive products such as microstrip and stripline attenuators, resistors and terminations in flat flange type, pill shape, chip and rod configurations. Power levels up to 800 W are available.

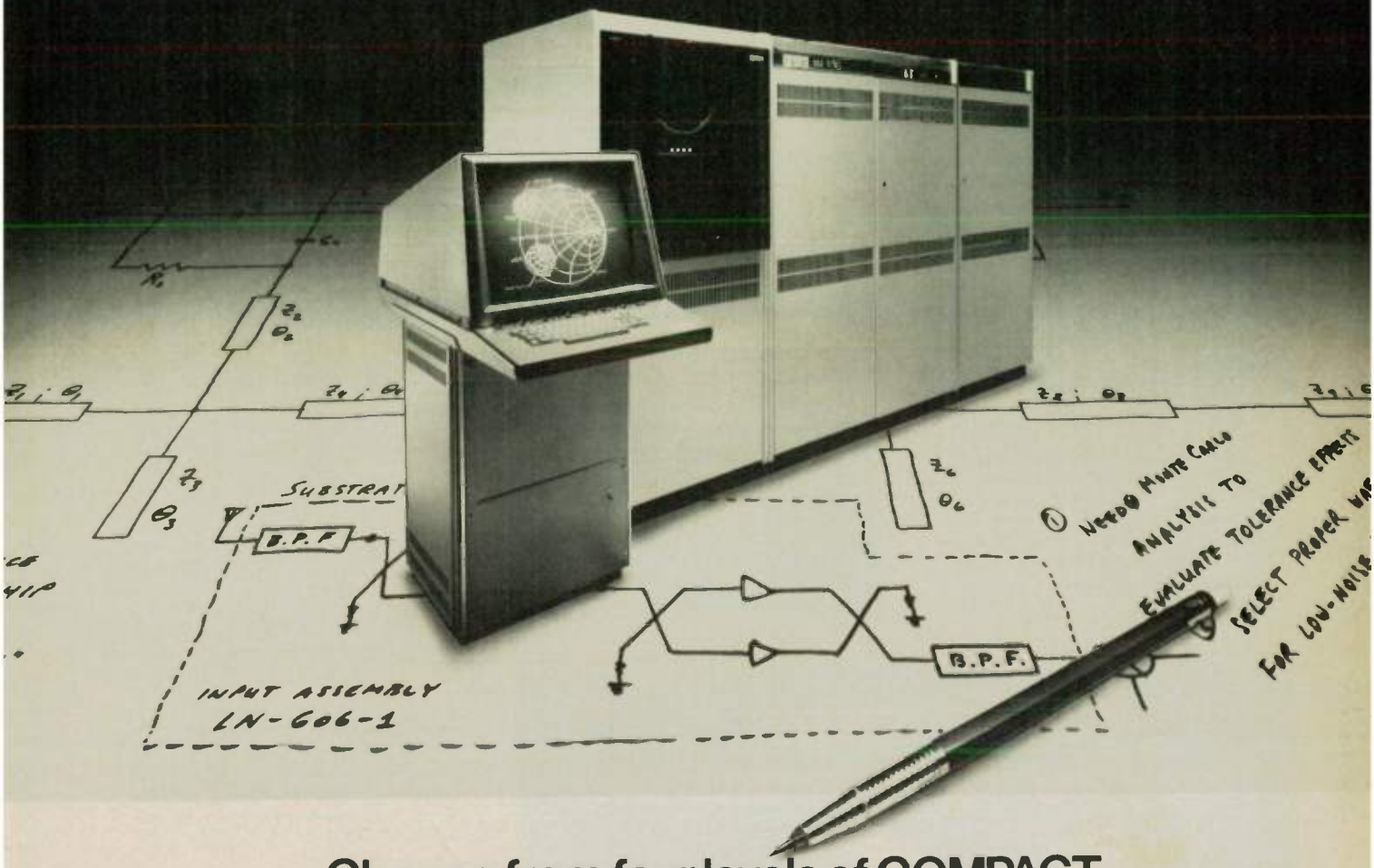
K&L MICROWAVE 215
Salisbury, MD

R. Bernstein, C. Schaub

Complete line RF and Microwave filters, K&L featuring new line (Series FV) of evanescent mode filters, microminiature filters, digitally controlled tunable bandpass filters.

(continued on page 80)

Now a COMPACT solution for every circuit designer.



Choose from four levels of COMPACT– The one for your application...your computer...your budget...

For large computers and big mini's, there's SUPER-COMPACT™. A completely new, more powerful version of COMPACT™, the industry standard used by more than 400 companies worldwide. You have unparalleled capability for real-time circuit synthesis and optimization with graphics enhancements. License it permanently for the cost of hiring one good technician for a year, or access it through commercial timesharing.

Then there's MINI-COMPACT™. An amazing array of features at a remarkably modest price. Includes much of the capabilities of SUPER-COMPACT, yet runs effectively on small computers.

MICRO-COMPACT™. Interactive graphics and optimization in a desk-top computer program? You bet! New versatility on a small budget.

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COMPACT increases the horsepower of your manpower.

Why have a design team spend *months* on a circuit they could complete in minutes with COMPACT? *Our* experts can fully support your team with comprehensive documentation, updates, and consulting.

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TWX: 910 370 7457

COMPACT™

CIRCLE 64 ON READER SERVICE CARD

(from page 78) GUIDE

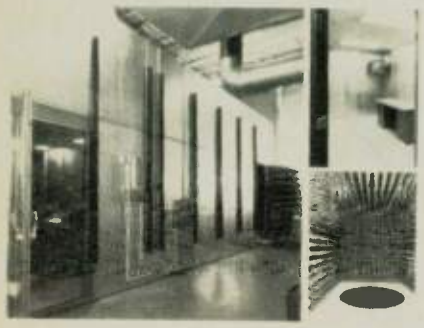
KEENE CORPORATION/ Chase Foster Div. 418
Bear, DE

M. Johnson, R. Tull, J. Martin

Di-Clad™ teflon impregnated glass fabric and ceramic filled teflon copper clad laminates.

KEENE CORP./Ray Proof Div. 613
Norwalk, CT

B. Lawrence, K. Makowski, E. Kesney



Ray Proof System 86/3 Shielded Anechoic Range, an indoor ground reflection EMC measurement facility with RF shielding from 14 kHz up to 100 GHz to 120 dB attenuation. RF Anechoic treatment to provide controlled ambient amplitude levels to below ± 2 dB from 30 MHz to 1 GHz and above. Custom systems and turnkey installation available.

KEVLIN 307
Woburn, MA

L. Fisher, J. Ciral, D. Martinson, L. McCreddin, G. Seiver, E. Lattanzi

Rotary joints, hybrids, high frequency coaxial connectors.

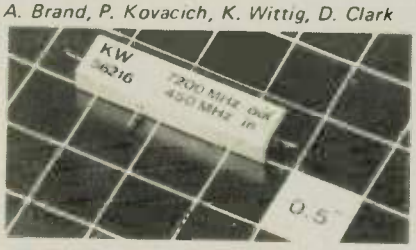
KRYTAR, INC. 212
Sunnyvale, CA

T. Russell, C. Gentile, M. Molley, D. Yoshii

Broadband directional couplers, directional detectors and crystal detectors.

KW ENGINEERING, INC. 119
San Diego, CA

A. Brand, P. Kovacich, K. Wittig, D. Clark



Miniature microwave filters, miniature microwave frequency multipliers, microwave subassemblies.

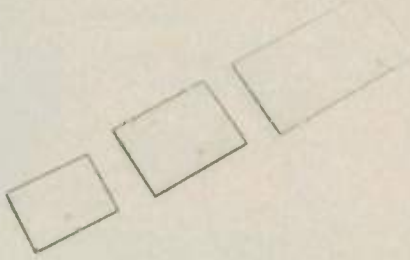
LITCHFIELD MICROWAVE LABORATORY 12
Campbell, CA

M. Litchfield, J. Barinka

Detectors, limiters, diode switches (less drivers), limiter-detectors, switch-limiter-detectors, isodetectors, comb generators, coupler detectors, low frequency VCO's to 2 GHz.

LOCUS, INC. 603
State College, PA

W. L. Coyle, J. Hess



RF devices, featuring image-reject mixers (MC2008 Series), active power dividers (MC200 Series) as well as high power, broadband quadrature hybrids (3C200 Series), and communications simulator (Model SG-122).

LOGIMETRICS, INC. 304
Plainview, NY

J. Deutsch, M. Feigenbaum

TWT amplifiers, signal generators, wideband power amplifiers, systems and subsystems, including: EM field generating system, militarized systems, susceptibility test set, transceiver test set.

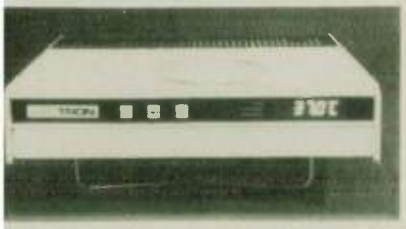
LORCH ELECTRONICS 15
Englewood, NJ

J. Lorch

Amplifiers, attenuators, hybrid functions, filters, passive microwave components, IF mixers, power splitters, digital attenuators, and RF switches.

LUXTRON CORPORATION 703
Mountain View, CA

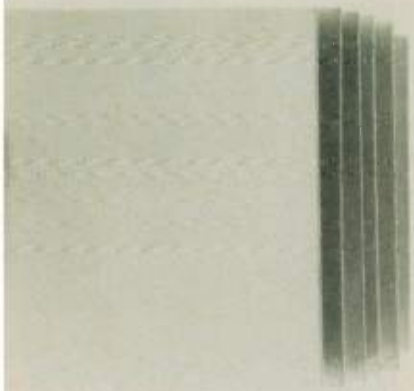
A. Cheng, K. Wickersheim



Will demonstrate the Fluoroptic Thermometer — the first instrument designed for precise temperature measurement within microwave or RF fields. The sensor is a non-metallic, fiberoptic probe.

M ELECTRONIC PRODUCTS 204
St. Paul, MN

J. Bond, J. Cavanaugh, R. Goff, C. Johnson, T. McCauley



Cu Clad 217, 233 and 250 types LX, GX and GT low loss microwave substrates; Epsilam 6 and 10 high dielectric constant bonding film.

M/A-COM COMPONENT 301
COMPANIES
Burlington, MA

D. Gallagher, T. Rose, T. Pina, T. Argiropoulos

Microwave semiconductor devices; solid state circuits, sources, amplifiers; microwave ferrite devices, high power control devices; transmission line components, precision investment castings, microwave subsystems, coaxial cable, connectors, adapters, antennas, earth stations.

(continued on page 82)

(from page 81) GUIDE

MAGNUM MICROWAVE CORP. 118
Sunnyvale, CA

D. Fealkoff, H. McGrath, H. Soza

Microwave signal processing components, mixers, oscillators, amplifiers.

MAST MICROWAVE 217
Burlington, MA

C. Theophile

Complete line rotary joints from dc to 40 GHz, single and multichannel, waveguide and coaxial type transmission line.

MATERIALS RESEARCH 101
Orangeburg, NY

V. Borase, F. Lavelle, R. McPhillips, T. Pappas, T. Stensgard

Ceramic substrates, coded and uncoded. High purity materials for evaporation and sputtering, IOCHROME™, highest purity chromium produced.

MAURY MICROWAVE CORP. 115
Cucamonga, CA

M. A. Maury, Jr., M. A. Maury, D. Payette, D. A. Smith

Complete line of microwave components and instruments, including such items as APC3.5 precision coaxial connectors and components and measuring instruments; broadband dc to 18 GHz noise measurement equipment including cold, hot, and ambient loads; state-of-the-art full band width rotary joints in WR42 and WR28 waveguide featuring low SWR and insertion loss; double-ridged waveguide isolator covering 18-40 GHz in WRD180D24 waveguide. Calibration kit line for automatic network analyzers will be featured, as well as coaxial and waveguide adapters, high directivity directional couplers, connector gauges, ferrite devices, broadband coaxial slide screw tuners and other coaxial and waveguide devices.

McDOUGALL/McLAUGHLIN CO. 519
Los Angeles, CA

Merle McDougall, Dick McLaughlin.

Representing:
Central Microwave, Daden Associates, Electronic Navigation Industries, Passive Microwave Technology, Spacekom

MERRIMAC INDUSTRIES, INC. 405
West Caldwell, NJ

M. Asnes, A. Egger, G. Tahlmore

This comprehensive 320 page catalog describes our complete line of IF and RF frequency components and subassemblies using distributed element and lumped element designs.

METELICS 15
Sunnyvale, CA

R. Dorilag

Microwave diodes, beam lead, beam lead quad diodes, step recovery diodes, varactor diodes, high voltage.

MICROLAB/FXR 521
Livingston, NJ

A. Augenblick, M. Bruno, R. Vincent

Miniature 3 dB couplers, octave and multi-octave, 50 W average.

MICRONETICS INC. 307
Norwood, NJ

G. Simonyan, L. Fisher, J. Ciral, G. Seiver, D. Martinson, L. McCreddin

(continued on page 86)

THERE ARE STILL SOME RADAR SYSTEMS WE DON'T MAKE A RADOME FOR.

Increasingly, designers and engineers are including protective radomes in their plans for new radar systems. With good reason.

They've found that radome-enclosed radar systems provide better performance over considerably longer periods of time than exposed radar systems.

Radomes dramatically reduce radar failure rates, prolong system life, and allow routine maintenance without weather interruptions.

And radomes prove to be a cost-effective investment that pays for itself quickly. Radar system maintenance and repair costs are cut considerably. Severe damage from heavy snow, strong winds, and massive ice build-ups is eliminated. As are the corrosive effects of sand, salt, dust, and chemical pollutants.

A radome will also reduce electromagnetic degradation from wind, rain, snow, and thermal loads.

You'll not only get protection, but performance as well. In bad weather, when performance is critical, radome-enclosed systems perform better than exposed systems.

Since 1961, we've designed and delivered more than 700 radomes for all types of radar systems and communications antennas. Our fabrication and installation process enables us to build a radome for any radar system at any time.

Let us design one for you. Call or write: Electronic Space Systems Corporation, Old Powder Mill Road, Concord, Massachusetts 01742. (617) 369-7200. Telex: 92-3480.

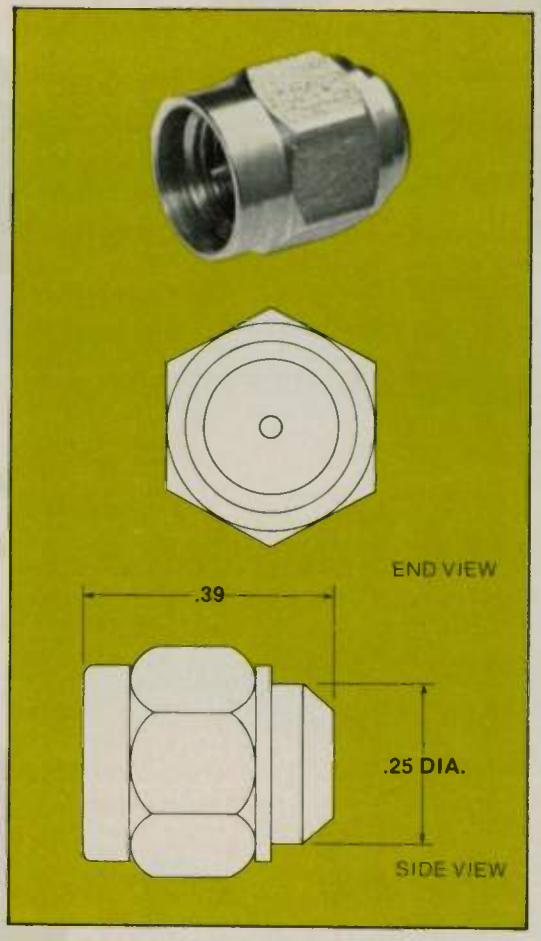
ESSCO

SMA TERMINATIONS

0.5, 1, 2, 5 AND 10 WATTS

- DC to 18.0 GHz
- SMA Connectors
- 1.05 + 0.008 fGHz Maximum VSWR
- -54°C to +125°C
- Excellent Reliability
- Stainless Steel Connectors

These high performance SMA Terminations have been designed for today's sophisticated Microwave Systems. The connectors are fabricated from stainless steel and do meet the requirements of MIL-C-39012. The close tolerance machining plus the precise captivation techniques ensure an excellent match over the complete frequency range. All MMI Terminations are production tested using the latest state-of-the-art swept frequency techniques.



MMI 2444* **

Input Power @ 25°C:	0.5 watt
Frequency Range:	DC to 18.0 GHz
Connector:	SMA M/F
Impedance:	50 ohms
VSWR, Maximum:	1.05 + 0.008 f(GHz)
Temperature Range:	-54°C to + 125°C
Construction:	
Connector:	Stainless Steel
Body:	Stainless Steel
Length, Maximum:	0.44"
Diameter:	0.25"
Delivery:	Stock to 30 days ARO

***ALL MMI SERIES TERMINATIONS ARE AVAILABLE WITH 3.5" BEAD CHAINS**

-add suffix "C" to model number

**Add M or F to model number to specify Male or Female.

MMI MODEL 2055* **

Input Power @ 25°C:	1.0 watt
Frequency Range:	DC to 18.0 GHz
Connector:	SMA M/F
Impedance:	50 ohms
VSWR, Maximum:	1.05 + 0.008 f(GHz)
Temperature Range:	-54°C to +125°C
Construction:	
Connector:	Stainless Steel
Body:	Stainless Steel
Length, Maximum:	0.58"
Diameter, Maximum:	0.29"
Delivery:	Stock to 30 days ARO

MMI MODEL 2057* **

Input Power @ 25°C:	2.0 watts
Frequency Range:	DC to 18.0 GHz
Connector:	SMA M/F
Impedance:	50 ohms
VSWR, Maximum:	1.05 + 0.008 f(GHz)
Temperature Range:	-54° to +125°C
Construction:	
Connector:	Stainless Steel
Body:	Black Anodized Aluminum
Length, Maximum:	0.92"
Diameter, Maximum:	0.50"
Delivery:	Stock to 30 days ARO

MMI MODEL 2010* **

Input Power @ 25°C:	5.0 watts
Frequency Range:	DC to 18.0 GHz
Connector:	SMA M/F
Impedance:	50 ohms
VSWR, Maximum:	1.05 + 0.01 f(GHz)
Temperature Range:	-54° to +125°C
Construction:	
Connector:	Stainless Steel
Body:	Black Anodized Aluminum
Length, Maximum:	1.30"
Diameter, Maximum:	1.00"
Delivery:	Stock to 30 days ARO

MMI MODEL 2013* **

Input Power @ 25°C:	10.0 watts
Frequency Range:	DC to 18.0 GHz
Connector:	SMA M/F
Impedance:	50 ohms
VSWR, Maximum:	1.05 + 0.01 f(GHz)
Temperature Range:	-54° to +125°C
Construction:	
Connector:	Stainless Steel
Body:	Black Anodized Aluminum
Length, Maximum:	1.62"
Diameter, Maximum:	1.30"
Delivery:	Stock to 30 days ARO

CALL TOLL FREE: 1-800-521-4410

MIDWEST MICROWAVE

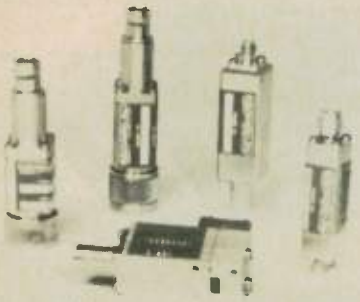
U.S.A.: 3800 Packard Rd., Ann Arbor, Michigan 48104
(313) 971-1992 • TWX 810-223-6031

ENGLAND: Walmore Electronics Ltd.
01-836-1228

ISRAEL: Racom Electronics Co., Ltd.
03-453151

JAPAN: Toko Trading, Inc.
03-409-5831

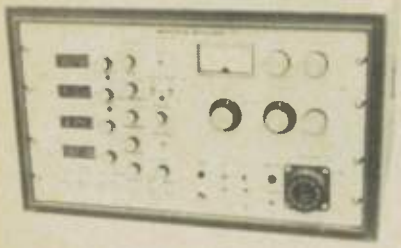
W. GERMANY: Omecon Elektronik Gmbh • 089-6094084



Solid state noise sources – diodes, generators and programmable noise sources; Microwave Components – WG and coax switches; Dummy loads, crystal detectors; bolometers.

MICRO-NOW INSTRUMENT CO., INC. **524**
Chicago, IL

Clarence L. Arnow, Dick McLauglin, Merle McDougall



Millimeter-Wave Sweeper Model No. 705 Microprocessor-based and IEEE 488 Compatible. Shown with Siemens BWO type RWO 170 covering 110 to 170 GHz. Features direct digital frequency displays.

MICROPHASE CORPORATION **518**
Cos Cob, CT

J. Chiappetta, P. Ferri, F. Parin, H. Schumacker

Miniature band pass, low pass and high pass filters, contiguous multiplexers, (both comb line and stub types) back detectors, Schottky detectors, video detector logarithmic amplifiers, threshold detector amplifiers, microwave integrated assemblies and 18 to 40 GHz components.

MICROTEK CO. LTD. **13**
Bangkok, Thailand

Microwave ferrite isolators and circulators.

MICROWAVE APPLICATIONS GROUP **308**
Santa Maria, CA

C. Boyd, W. R. Reed, T. Stokes

Rotary-field phase shifter and dual-mode phase shifter line.

MICROWAVE EXHIBITIONS & PUBLISHERS LTD. **617**
Sevenoaks, Kent, UK

R. Marriott

International exhibition and conference organizers for the microwave community.

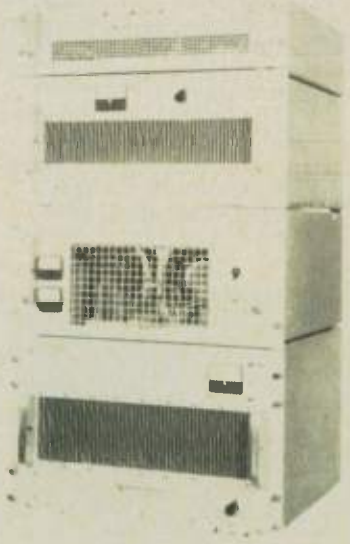
MICROWAVE JOURNAL **207**
(see Horizon House)
Dedham, MA

W. Bazzy, C. Berman, B. Bossard, J. Cotsworth, H. Ellowitz, C. Hangen, R. Howland, E. Johnson, S. Pasqualucci

Microwave Journal Magazine, subscription and editorial information.

MICROWAVE POWER DEVICES, INC. **300**
Hauppauge, NY

D. Mazziota, W. Liebman, R. Sheloff



Solid state RF and microwave power amplifiers and related subsystems for military space and industrial applications.

MICROWAVE SEMICONDUCTOR CORP. **402**
Somerset, NJ

J. Holmquest, M-S Zapsky, C. Lump, A. Middlecamp, H. Bruning

Microwave bipolar power transistors, mw GaAs FET's, GaAs and Si power amplifiers, ss noise sources, ss low noise transistors,

(continued on page 88)

The source for power sources

High-power signal generation Model EP250C 250W CW

For use in:

- Metrology
- EMC
- Medical Research
- Simulation
- Component Testing
- Plasma Research

Features

- 10-2000 MHz tuning range
- Digital readout forward and reflected power
- Solid-state main frame
- Short and open circuit protection
- Low tube cost/operating hour
- Overload protected
- Direct reading frequency dial
- Regulated supply voltages
- Wide range power adjustment
- Plug-in RF heads

High-power, pulsed oscillator/ modulator Model 2076

For use in:

- ECM
- Simulation
- Test Systems

Features

- Fully integrated subsystem is easily incorporated into a transmitter's overall design
- High-power, pulsed cavity oscillator with MIL-qualified solid-state modulator
- Requires only a TTL-compatible input pulse and various supply voltages
- Pulse-shaping circuit virtually eliminates overshoot
- Single knob tuning, four-digit readout

High-power, pulsed signal source Model EP5000L

For use in:

- Component Testing
- Calibrations
- EMI Testing

Features

- MIL-qualified high-power, pulsed cavity oscillator
- Tunable from 925 to 1225 MHz
- Delivers up to 5000 W of power
- Solid-state modulator
- Excellent pulse characteristics with low rise and fall times
- Pulse-shaping circuit virtually eliminates overshoot
- High resolution MIL-quality tuning knob with four-digit readout
- Capable of remote operation and monitoring (except frequency)
- Isolator protected (optional)

Plus hundreds more like them

EPSCO **Microwave**

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Westwood, MA 02090
(617) 329-1500 • TWX (710) 348-0464

PIN and Schottky diodes and diode modules.

MICROWAVE SUPPLY CENTER 603
DIV. Cleland & Co. Inc.
Los Angeles, CA

M. Cleland, J. Tschida, E. Mjorud, A. Scott, A. McCabe, J. Cleland, C. Goshay

Manufactures and designs simple waveguide assemblies, machined parts, microwave devices and electro mechanical assemblies.

MICROWAVE SYSTEMS NEWS 607
Palo Alto, CA

J. Collins, B. Eustace, H. Eustace, J. Fawcette, C. Flinn, H. Martin, M. Smith, A. St. John, Mr. and Mrs. A. Yaconetti

Magazine.

MICROWAVES 114
Rochelle Park, NJ

S. Bearse, H. Bierman, W. Bojsza

MicroWaves Magazine, MicroWaves Product Data Directory.

MIDISCO 526
Commack, NY

A. L. Leiman, D. Leiman

RF components, including attenuators, cable assemblies, coaxial detectors, shorts, terminations, directional couplers, hybrids, mixers, phase adjusters, RFI shielded cases, and inter/intra-series adapters.

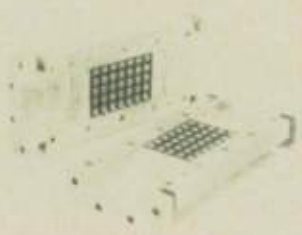
MILLIS RESEARCH 307
Millis, MA

J. Ciral, L. Fisher, D. Martinson, L. McCreddin, L. Searle, G. Seiver

Polished quartz substrates, with thin-film chrome gold, chrome copper gold coating. Precision thin film nichrome nickel gold chip resistors and large area substrates.

MITEC ELECTRONICS 11
Montreal, Quebec, CANADA

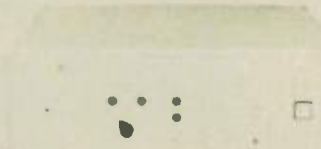
M. Bentob, T. Robinson



Waveguide, coaxial components and sub systems, transmission line systems, complete antenna systems for terrestrial microwave systems and ground satellite stations, and microwave instrumentation.

MITEQ, INC. 410
Hauppauge, NY

A. and H. Kliss



Amplifiers, oscillators, synthesized sources, mixers, mixer preamplifiers, signal processing components (including limiters, log amplifiers, phase detectors) and completely integrated signal processing section of receivers. Components and subsytems for satellite communications, including upconverters, downconverters, frequency translators and video receivers.

MITSUBISHI ELECTRONICS AMERICA, INC. 112
Sunnyvale, CA

J. Iizuka, T. Ishii

Low noise and high power GaAs FET and oscillator.

MOTOROLA, INC. 14
Phoenix, AZ

Alan Wagstaffe, Steve Lazar, Ed Reimanis, Tom Bishop

RF microwave transistors.

THE NARDA MICROWAVE CORPORATION 502
Plainview, NY

J. Coppola, W. Bourke, A. LeMay, G. DeBella, G. Gianatasio, C. Buntschuh, E. McSweeney, J. Reid, W. Lamb, R. Vaccarino

The Microwave Multimeter, a completely self-contained microwave test station, the first GaAs FET amplifier to cover the entire frequency range from 6-18 GHz, Gunn Oscillators, Radiation Monitoring Systems.

NORSAL INDUSTRIES, INC. 414
Central Islip, NY

N. Spector, K. Kraker, T. Mendolia

Will be showing full line of microwave components and passive systems along with a line demonstration on PIN diode switches and RF mixers.

(continued on page 90)

It's a High Speed Synthesizer

a Signal Generator

a High Technology Laboratory Instrument

a Programmable Microprocessor Controlled Device

a Standards Lab Calibrator

a Fast Quality Control Check-Out Station

It's the AILTECH 380 Synthesizer-Signal Generator

- Fast Delivery
- 10KHz to 2000MHz
- Fast Switching, 20μs
- Direct Synthesis
- SSB Phase Noise −135 dbc/Hz
- Keyboard Control of all functions
- Frequency Shift Keying
- Digital Sweep
- GPIB Programming of all functions & levels
- AM-FM-Phase Modulation
- Store/Recall

You have to see the AILTECH 380 in operation to really appreciate it ...and don't forget to ask about our new Eaton Credit Corporation equipment leasing plan.

For literature and a demonstration at your own facility, call or write Eaton Corporaton, Electronic Instrumentation Division, 2070 Fifth Avenue, Ronkonkoma, New York 11779, (516) 588-3600.

EATON
Advanced Electronics

OKI 307
Ft. Lauderdale, FL

L. Fisher, J. Ciral, G. Seiver, (All are R.F. Associates Personnel) L. McCreddin D. Martinson.

Klystrons provide highly stable, high-power service throughout their long life. Available from 15 to 178 GHz, each klystron may be mechanically tuned ± 5% off center frequency.

OMEGA LABORATORIES 307
Rowley, MA

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Waveguide components.

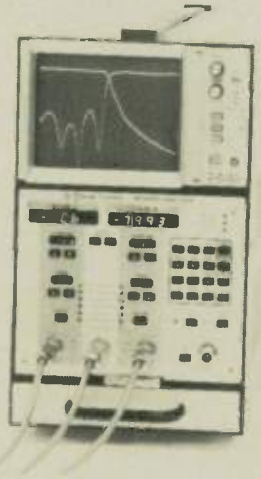
OMNI-WAVE ELECTRONICS 307
Gloucester, MA

J. Ciral, M. Hamilton, L. Fisher, D. Martinson, J. Fossiano, L. McCreddin, G. Seiver, S. Brennan

Microwave radar components, duplexers, klystrons.

PACIFIC MEASUREMENTS INC. 102
Sunnyvale, CA

D. Armann, D. Bradley, E. Mendel



The Model 1038-D14 mainframe has refresh memory (and IEEE Bus capability). Our new 1038-N10 plug-in, when used with the 1038-D14, is capable of fully automating all swept measurements. Frequency range is 1 MHz to 220 GHz; dynamic range is 76 dB.

PARAMETRIC INDUSTRIES, INC. 104
Winchester, MA

R. Fallon, G. Sotiropoulos, L. Covino

Tuning varactors, harmonic generator varactors, PIN and PN junction switching diodes, limiter diodes, parametric amplifier varactors, point contact mixer and detector diodes, Schottky barrier mixer and detector diodes, noise diodes, military approved point contact mixer and detector diodes, diode chips.

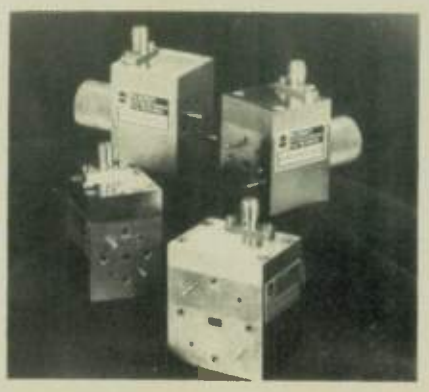
PASSIVE MICROWAVE TECHNOLOGY 519
Canoga Park, CA

George Grund, Bob Weiss

Coaxial and waveguide isolators and circulators.

PLESSEY OPTOELECTRONICS AND MICROWAVE 528
Irvine, CA

P. Minett, E. Bell, D. Bell, G. Youngdahl

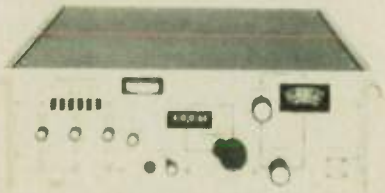


(continued on page 91)

IMPATT oscillators cover the range 40-140 GHz with power levels up to 200-10 mW. Wideband tunable versions with excellent noise characteristics are also available, particularly in the 80 to 120 GHz region.

POLARAD ELECTRONICS, INC. 513
New York, NY

J. Schindler, E. Kushner, S. Abrams



Microwave Signal Generators; RF/Microwave Spectrum Analyzers.

PREMIER MICROWAVE 307
Port Chester, NY

J. Simmonds, L. Fisher, J. Ciral, G. Seiver, L. McCreddin, D. Martinson

Ferrite devices, rotary joints, antenna feeds, diplexers, fitters and other passive microwave devices from 400 MHz to 40 GHz.

Q-BIT CORPORATION 412
Palm Bay, FL

M. Rogers, D. Harriey, G. Callaway, H. Mead

RF Amplifiers, both Hybrid TO-8 packaged and connectorized units in the .5 to 1300 MHz frequency range. CATV Receivers and Preamplifiers.

RAYTHEON COMPANY 314
Waltham, MA

R. Roberts, A. Elicone, J. Hieber, M. LaPrelle, T. White, R. Mattson, W. Berwick, R. Bishop, R. Mason

Microwave tubes, solid state microwave products, ferrite devices.

RF ASSOCIATES, INC. 307
Los Angeles, CA

Louis H. Fisher, Jerome L. Ciral, Gordon Seiver, F. Larry McCreddin, Darryl Martinson

Representing
General Microwave, Texscan, OKI, Aercom, ARRA, Premier, Kevlin, AEL, Alford, Communitronics, Millis Research, Omega, Solid State Technology, Sprague Goodman, TRM, Omni-Wave, Micronetics

RHG ELECTRONICS LAB., INC. 15
Deer Park, NY

R. Hirsch

(continued on page 92)

RF broadband mixers, video transmitters and receiver links, IF log amps, IF linear amps, IF limiters and discriminators.

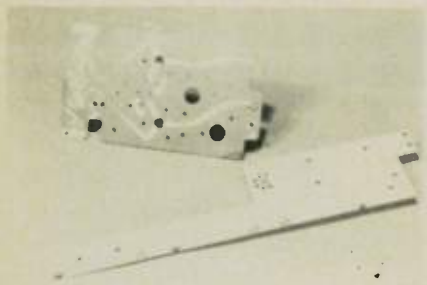
R. L. COMPONENTS, INC. 701
Marina del Rey, CA

Bob Latin

Representing:
EMC, Struthers Electronics Corp.

ROGERS CORPORATION 113
Chandler, AZ

G. Archer, R. Desilets, F. Keahey, R. Sanders, G. Traut, L. Wigman



RT/duroid microwave laminated materials; stripline and microstrip circuits; radomes.

SAGE LABORATORIES, INC. 501
Natick, MA

H. Chapell, T. Cieri, C. Marguerite, B. McNeice, K. Paradiso, T. Saad, B. Stone, G. Ufen

Designers and manufactures of microwave amplifiers, attenuators, couplers, filters, hybrids, mixers, phase shifters, power dividers, rotary joints, switches, terminations, detectors, crystal holders, and wireline.

SIVERS LAB 603
Stockholm, SWEDEN

M. Cleland, R. Gustafsson, P. Fredholm, A. Scott

Develops and manufactures microwave training test bench equipment as well as RF switches, RF rotary joints, YIG and microwave devices.

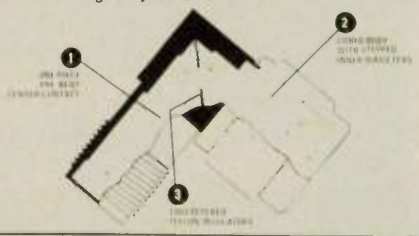
SOLID STATE TECHNOLOGY 307
Sunnyvale, CA

L. Fisher, J. Ciral, G. Seiver, L. McCreddin, D. Martinson

Solid state microwave signal sources.

SOLITRON/MICROWAVE 208
Port Salerno, FL

G. Van Krugel, D. Gartzke, R. Busch, J. Conroy, E. Pigdvat, A. Sokyra, N. Lee, D. McLaughlin, G. Shuf



Low cost super cubed right angle connector with improved VSWR having one piece center contact – SMA flange type coaxial field replacement units for MIC package designs.

SPACE MICROWAVE INC. 523
Santa Rosa, CA

F. Miller, J. Paul

Microwave transmitters: 1000 W transmitter and 10,000 W transmitter.

SPRAGUE GOODMAN ELECT., INC. 307
Garden City Park, NY

C. Fisher, L. McCreddin, D. Martinson, J. Ciral, G. Seiver

Ceramic dielectric and sapphire dielectric trimmer capacitors, designed to work at UHF and GHz frequencies.

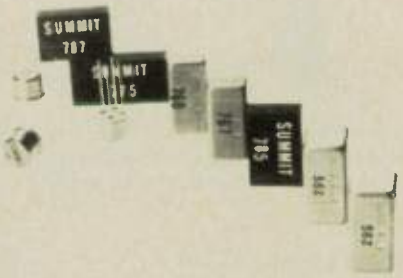
STRUTHERS ELECTRONICS CORP. 701
Farmingdale, NY

B. Latin, B. Damiano

Broadband couplers and power dividers, coax, waveguide and stripline, waveguide switches, attenuators, horns, adapters, high power dummy loads, switches, terminations waveguide assemblies.

SUMMIT ENGINEERING 407
Bozeman, MT

C. Curtis, A. Olson



Passive components, mixers, transformers, RF switches, power dividers.

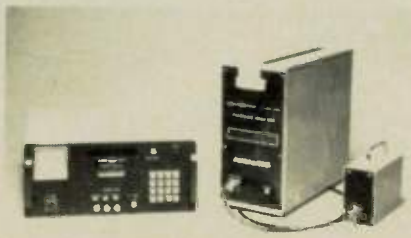
SYSTRON-DONNER CORP. 415
Advanced Components Div.
Sunnyvale, CA

N. Kelley

Oscillators and filters.

SYSTRON-DONNER CORP. 704
Microwave Div.
Van Nuys, CA

G. Archuleta, D. Hall, F. Brown, T. Meehan, F. Borghetti



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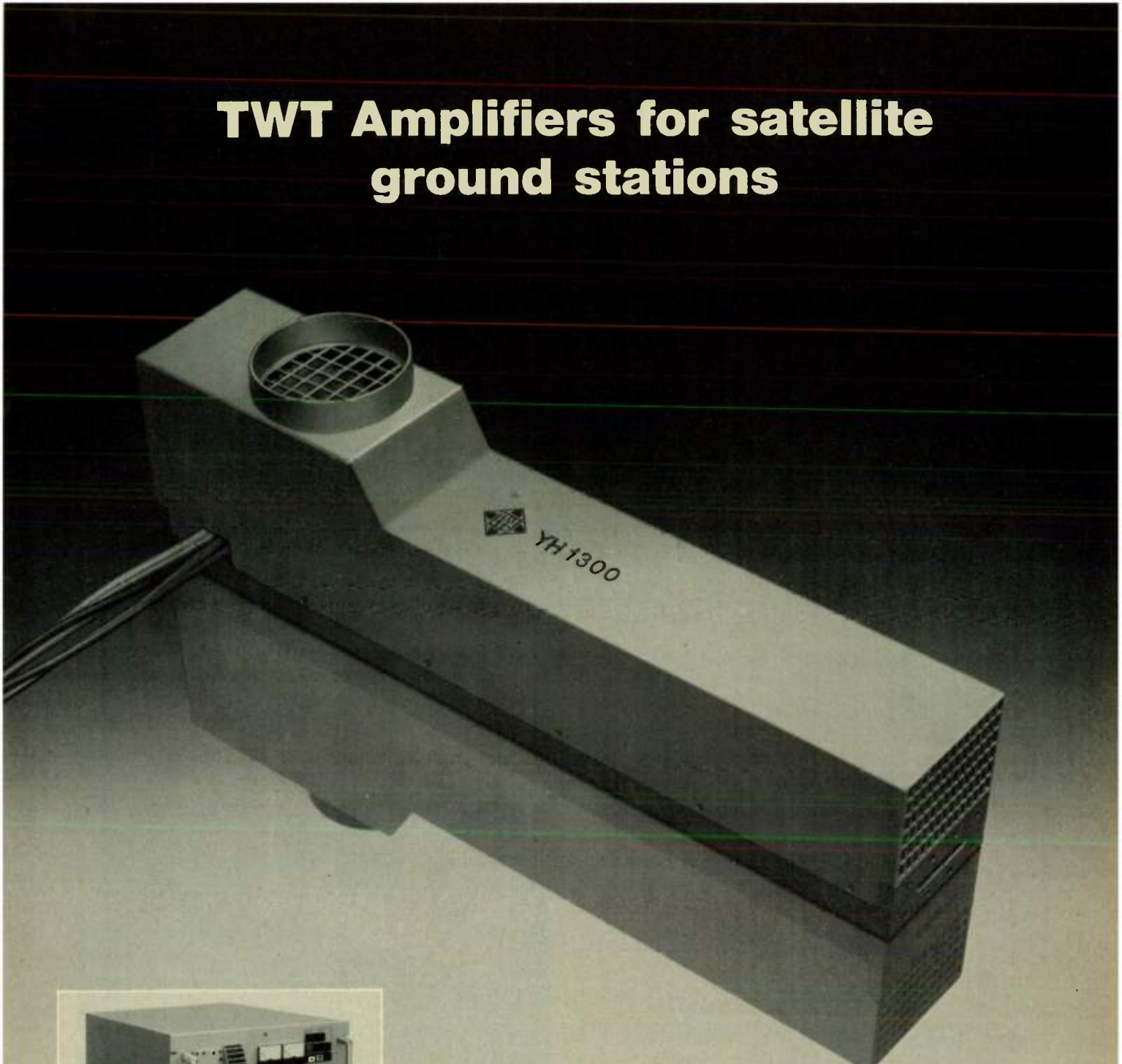
TWT Amplifiers for satellite ground stations



Amplifier unit VYH 1300

The next generation of satellite small ground stations will be using power amplifiers in the 200 Watt range. To meet these requirements AEG-TELEFUNKEN has a tube already developed and tested. The YH 1300.

Operating in the 5.8 to 6.4 GHz frequency band, the YH 1300 has an output power of 200 W and a small signal gain of 43 dB. Forced-air cooling, integral ppm focussing, waveguide input and output are other important features. As is the reliability common to all modern AEG-TELEFUNKEN TWT's.

For customers wanting a complete amplifier package, there is the VYH 1300. This comprises the YH 1300 TWT and power supply, a driver TWT with its own power supply, cooling fan, output circulator as well as monitoring and control circuits, all in a compact 19 inch rack-mounted unit.

And the company? AEG-TELEFUNKEN has systems experience in satellite ground stations, from large 30 m antennae down to portable 3 m terminals. We also have wide experience with tropo-scatter and other high-power TWT's.

For further details please contact us at the address below.

AEG-TELEFUNKEN
Serienprodukte
Geschäftsbereich Röhren
und Baugruppen
Söflinger Straße 100
7900 Ulm (Donau)
Telephone (07 31) 191 359
Telex 712601

TELE FUN KEN

CIRCLE 77 ON READER SERVICE CARD

(from page 92) **GUIDE**

Featuring the Model 5220 Transline Analyzer, a fully automated microprocessor based system which uses advanced digital techniques for fault analysis along a transmission line (coaxial and waveguide). It measures the attenuation, return loss and SWR of the line under test in addition to accurately locating single and multiple faults. Human interface software provides step-by-step instructions to the user to perform the measurements. A hard copy printout of the test conditions are results of the measurement is provided.

TECHNICAL RESEARCH & MANUFACTURING INC. 307
Nashua, NH

J. Ciral, L. Fisher, D. Martinson, L. McCreddin, G. Seiver

Mixers, couplers, power dividers, amplifiers.

TEKFORM PRODUCTS COMPANY 222
Anaheim, CA

M. Byrnes, B. Gaunt, D. Scoville

Microelectronic packages for microwave circuits.

TEKTRONIX, INC. 203
Beaverton, OR

Ken Andrew, Alton Carter, Bill Green, Everett Hayes

Tektronix will display laboratory precision spectrum analyzers and related products.

TELECOMMUNICATIONS 207
Dedham, MA

W. Bazzy, C. Berman, B. Bossard, J. Cotsworth, H. Ellowitz, C. Hangen, R. Howland, E.Johnson, S. Pasqualucci

The international monthly published for qualified persons working in the communication industry and covering the merging communications-data communications-computer fields.

TELEDYNE MICROWAVE 205
Mountain View, CA

R. Roy, P. Gruver, A. Campbell, P. McLaughlin, R. Jones, J. Matson

Will display a broad range of circulators and isolators, coaxial switches, filter/multiplexers, switchable filter arrays, MIC subsystems, and fast-switching voltage controlled oscillators, for ECM, communications, radar, and space applications.

TEXSCAN CORP. 307
Indianapolis, IN

John R. Shaw, J. Ciral, L. Fisher, D. Martinson, L. McCreddin, G. Seiver

Attenuators, fitters and oscillators in our RF and microwave component line. New LN-70 Logarithmic Amplifier, XR-1500A Sweep Generagor, AL-51A Spectrum Analyzer and DU-127 scope.

THINCO Div., Hull Corp. 601
Hatboro, PA

H. DePalma, H. Stout

Microminiature multilayer thin film chip inductors capacitors and LC integrated circuits.

THOMSON-CSF COMPONENTS CORP. 423
Electron Tube Div.
Clifton, NJ

S. Barthelmes, J. Boulange, A. Laconti

(continued on page 95)

from page 94) GUIDE

Microwave klystrons, TWT's, TWTA's for satellite ground stations, radio links, and EW applications in C, X and K_u band. Power levels range from 15 W to 2.3 kW. Millimeter wave components — frequency meters, directional couplers, attenuators, polarization duplexers, etc. Millimeter wave BWO carcinotrons up to 450 GHz.

THOMSON-CSF COMPONENTS CORP. 423
Semiconductor Div.
Canoga Park, CA

J. Kupinewicz, L. Kilpatrick, J. Walsh

Complete line of RF and microwave transistors, power transistors, small signal transistors, small signal diodes, Zener diodes, rectifiers, thyristors, TRIACS, active components for hybrid circuits, moulded bridges and metal stacks.

THORSON COMPANY 15
Goleta, CA

W. Reddoch, W. Jellison, B. McMan, J. Ledindecker, D. Thompson, H. Koch, J. Hendrickx

Representing
EHG Electronics Lab., Inc., Wincom Corp., Aydin Microwave, Metelics, Inc., Lorch Electronics.

TRAK MICROWAVE CORP. 505
Tampa, FL

R. Disman, R. Latin, G. Pate, T. Roberts, H. Weil

GaAs FET amplifiers 2-18 GHz coaxial and microstrip isolators and circulators coaxial microstrip and waveguide oscillators, especially dielectrically stabilized (DSO's), comb generators, IF and power amplifiers, frequency multipliers.

TRW RF SEMICONDUCTORS 427
Lawndale, CA

G. Berger, D. Biddle, G. Brannock, L. Brown, D. Feeney, J. Humphrey

Microwave, RF linear hybrids and small signal, low noise transistors, high power microwave transistors.

TRANSCO PRODUCTS, INC. 510
Venice, CA

R. Williams, J. Fricke, T. Koster, D. Heydon, M. Felix, B. Lyman

Microwave airborne antennas, coaxial and waveguide RF switches, microwave components, waveguide, stripline and integrated packages high rel. space qualified RF filters, power dividers and switch devices.

U. J. TUCK COMPANY 208
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T. Anderson, A. Tuck IV

Precision electroforming for the microwave industry, transitions, precision feeds, millimeter wave components, overmoded wave-

guides, filters and miniature precision bellows.

UNIFORM TUBES, INC. 318
Collegeville, PA

R. Schafer, L. Deery, B. Lyon, B. Thue, and F. Braunlich

In-A-Cable Band Pass and Low Pass Filters, Semi-Rigid Coaxial Cable and Cable Assemblies.

U-Z INC., Div. Dynatech 416

J. Hoffman, N. Feigenbaum, B. Hamilton, B. Morgen, F. Bennett, V. Woods, R. Resnick

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VARIAN ASSOCIATES 225
San Carlos, CA

W. Johnson

Modulators, microwave transistors, millimeter wave components, klystrons TWT's.

VECTRONICS 16
Middlesex, NJ

John Vogler

(continued on page 96)

MIC's and microstrip components, digital phase shifters, digital attenuators, custom MIC assemblies.

VICHEM CORP., Gel Pak Div. 123
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V. E. Althouse, S. E. Graves, P. Ravenscroft

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WATKINS-JOHNSON COMPANY 506
Palo Alto, CA

V. Castellano, R. Reynolds, R. Smith, R. Hoover, R. Davenport, L. Crossman, K. Pitt

Microwave electronic devices, components and subsystems for defense electronics and communications applications. Features new series of high efficiency TO-8 amplifiers.

WAVETEK 103
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Featuring Model 907A — a solid-state 7 to 12.4 GHz signal generator with +1 to −127 dBm calibrated output. Provides pulse modulation with 35 ns transition times and 80 dB ON/OFF ratio with automatically leveled full range self-sweep. A 3 dBm (2 mW) unleveled output and IEEE-488-1978 GPIB option offered. Model 3010 is a 1 to 1000 MHz signal generator with 100 Hz resolution and 0.001% accuracy. Complex modulation: AM/FM, FM/FM, AM/AM offered plus four internal modulation frequencies. Output of +13 to −137 dBm with ± 1.0 dB flatness to −7 dBm provided as well as frequency programmability, standard, GPIB, optional. The Model 5130A is a direct VHF synthesizer which is phase continuous with true phase continuity plus spurious-free switching. It covers the 0.1 Hz to 160 MHz frequency range.

WEINSCHEL ENGINEERING CO., INC. 131
Gaithersburg, MD

H. Banning, G. McNamara, J. Parker, R. Ramirez, B. Server, B. Weinschel

VM-4A Microprocessor Controlled Measurement Receiver is a high performance instrument capable of rapid single-step insertion loss measurements in excess of 100 dB over a 0.01-18 GHz frequency range. Model design is based on the principle of Automatic IF Vector Substitution. Features measurement resolutions of 0.1, 0.01, and 0.001 dB; phase measurements possible with 0.10 resolution and unit typically makes measurements at a rate of 5 frequencies per second.

WESTERN MICROWAVE 110
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R. G. Sanders, R. Jacobsen, R. Craig, H. Danforth Von Jenef

Isolators, circulators, mixers, amplifiers (bipolar and GaAs FET's) mixer preamplifiers, voltage variable attenuators, couplers, dividers, microwave integrated subassemblies.

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Hi temp. brazing alloys — precious metals, deposition materials, electronic alloys, pure gold, platinum, palladium & silver, hi purity copper & nickel, reclaiming service.

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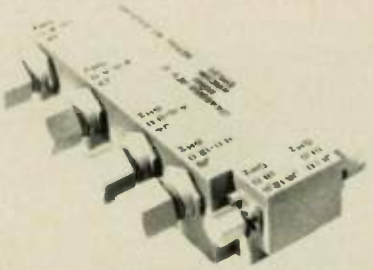
WINCOM CORPORATION 15
Lawrence, MA

B. Antonucci



Microwave passive components, filters, diplexers, power combiners, power splitters.

ZETA LABORATORIES 202
Santa Clara, CA

C. Frank, D. French, R. Burtrum, R. Reak, R. Ho

RF & microwave components & subsystems, including crystal oscillators, frequency multipliers, up/down converters, signal simulators, programmable synthesizers, voltage controlled oscillators & tunable filters.

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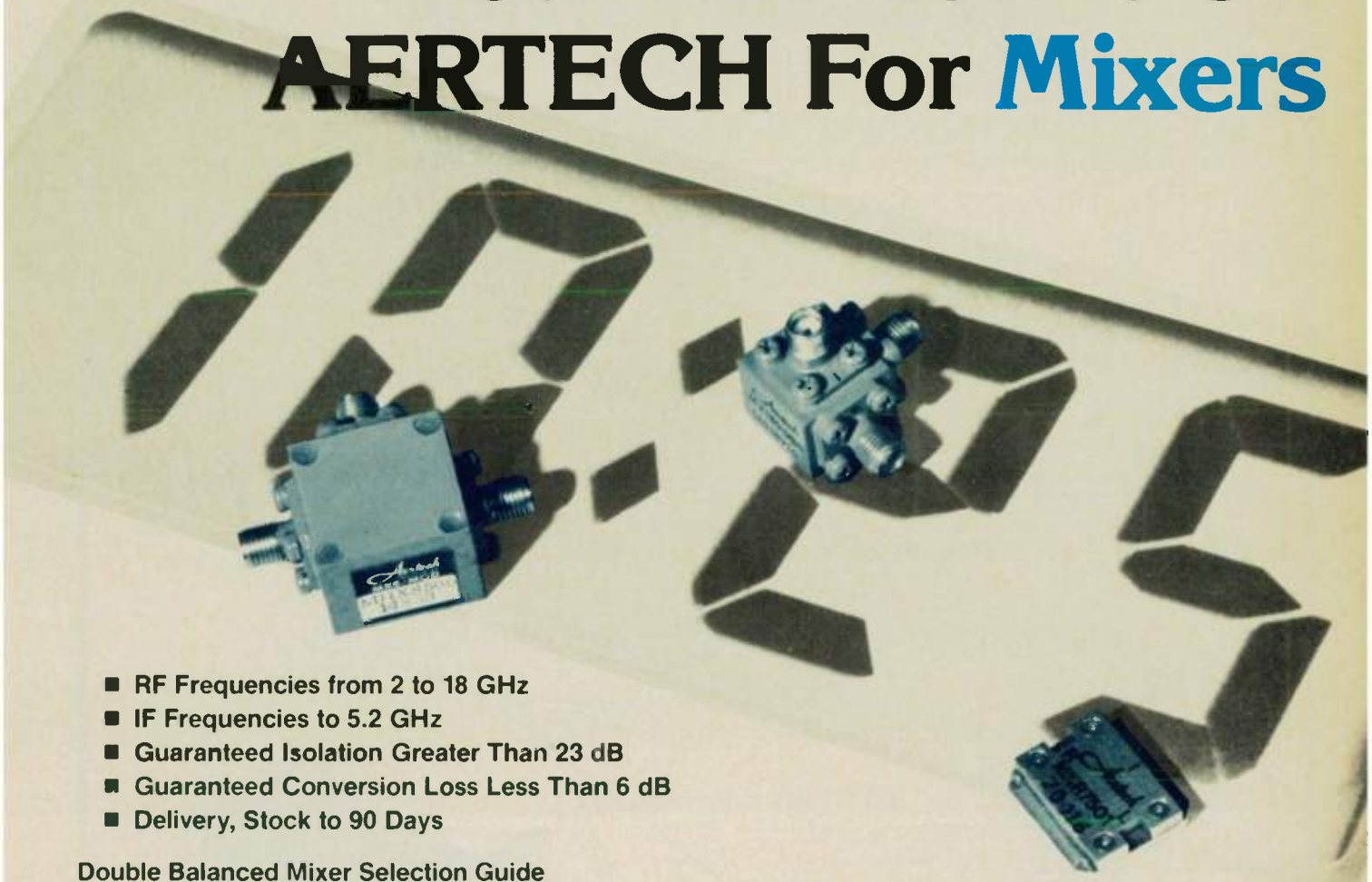

- RF Frequencies from 2 to 18 GHz
- IF Frequencies to 5.2 GHz
- Guaranteed Isolation Greater Than 23 dB
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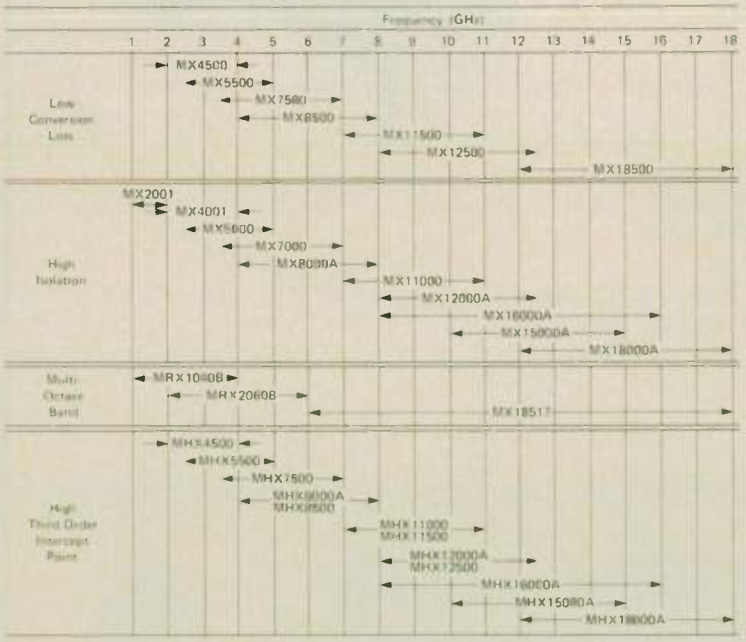
- Delivery, Stock to 90 Days

Double Balanced Mixer Selection Guide



Whether your application is communications, EW, or radar, Aertech can deliver mixers when you need them . . . in fact many of the standard production units shown here are available from stock. In addition, mixers can be integrated with other Aertech components such as amplifiers, isolators, and PIN diode modules to provide complete subsystems.

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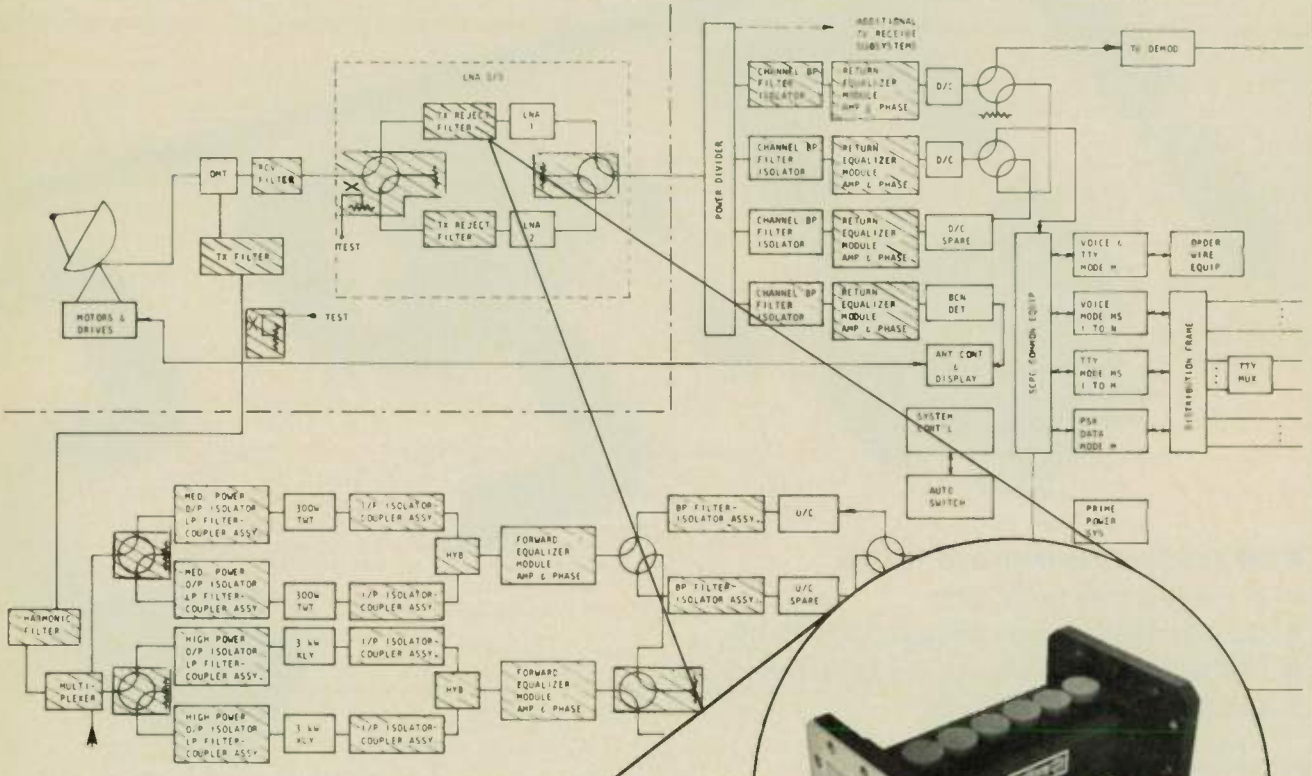
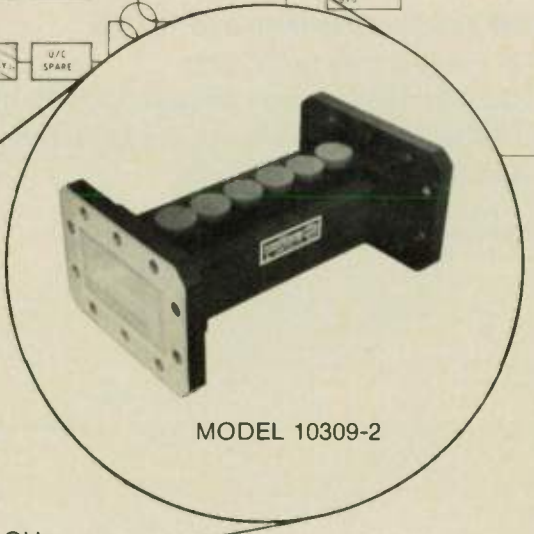
#1 4 GHz LOW LOSS TX. REJECT FILTERS





MODEL 10309-2

Passband - 3.7 - 4.2 GHz
Loss - 0.045 dB max.
(0.035 typ.)
VSWR - 1.1 Max.
Reject Band - 5.925 - 6.425 GHz
Rejection - 55 dB min.

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MICROWAVE DEVICES AND SUBSYSTEMS FOR TERRESTRIAL AND SATELLITE COMMUNICATIONS

News from Washington

GERALD GREEN, Washington Editor

DARPA Delineates Advanced Technologies in FY 1982 Budget Request

Since the Defense Advanced Research Projects Agency (DARPA) serves in a "corporate research" role for the Department of Defense (DoD), the agency's projects provide good guidance as to the direction of future technology applied to military systems.

This assessment is certainly borne out when one considers the presentation to Congress by Dr. Robert R. Fossum, the Director of DARPA. In making his presentation to the Research & Development Subcommittee of the House Armed Services Committee, in support of DARPA's fiscal year 1982 budget request, Dr. Fossum delineated a roadmap of future "revolutionary" technology being studied and developed for military applications. Of particular interest to the microwave industry:

- **New Transistors** A new ultra-high frequency transistor, called the permeable base transistor (PBT), is believed capable of operating at frequencies above 500 GHz. A preliminary version of the PBT has been developed and demonstrated to operate at frequencies above 30 GHz.

  The smallest feature (0.1 micron) silicon transistor ever fabricated was realized through a highly innovative process technology that uses conventional optical lithographic techniques. The feasibility of using highly focused ion beams to fabricate submicron feature devices without the use of photomasks was demonstrated.

- **Monolithic Gallium Arsenide (GaAs) Integrated Circuits (IC's)** These circuits, based on GaAs rather than silicon, offer substantial speed and/or power advantages if the problems in fabrication that control circuit yield can be resolved. The results of this program could permit space surveillance programs to meet their goals for low-power and high-radiation-tolerant signal processing digital integrated circuits.

  The process technology underlying the DARPA program of direct ion implantation into semi-insulating GaAs substrates has been adopted industry-wide and is utilized by R&D programs of all three military services and the intelligence community. Solid-state radar transceiver IC's are also evolving from this research and will affect space-based radar, airborne radar, and electronic countermeasures systems.

- **High Resolution Calibrated Airborne Measurement Program (HI-CAMP)** The HI-CAMP sensor is an advanced, infrared measurement system designed to make high resolution, two-dimensional measurements of earth backgrounds and mobile and stationary air, sea, and land targets. The HI-CAMP sensor has two types of advanced two-dimensional monolithic infrared arrays with charge coupled device multiplexers capable of providing data in two broad infrared bands.

  HI-CAMP will demonstrate the infrared charge coupled device (IRCCD) technology and develop a two-dimensional data-base of high spectral, spatial, and temporal resolution background and selected target measurements.

- **Space-Based Radar** Developments have been in progress in such critical areas as transceiver modules, antenna membranes, and target identification. The program is oriented towards component technology and will consider major subsystem development. Achievements to date include the development and testing of a three-layer antenna membrane that is considered a breakthrough in space antenna development. In the area of transceiver development, significant breakthroughs have been achieved in the areas of weight and cost.

The total estimated budget for DARPA in FY 1982 is $655.0 million. The estimated FY 1983 budget is $691.3 million.

ECAC Move Studied

The Air Force is studying relocation of the Electromagnetic Compatibility Analysis Center (ECAC) from Annapolis, MD to Duluth, MN, as part of a plan to close its active installation at Duluth International Airport (IAP).

ECAC is DoD's center of expertise on electromagnetic compatibility and plays an important role in an effort to reduce interference between friendly, as well as enemy transmissions. ECAC's role is becoming steadily more important since the number of signals being transmitted is increasing at a rapid rate.

According to the Air Force study, 771 military, civilian, and contractor personnel would be transferred to Duluth, if the planned relocation is approved.

News from Washington

RFPS Issued for SPADOC Four

Request for Proposals (RFP's) for a multi-million dollar contract have been issued to companies interested in becoming contractors for the Space Defense Operations Center – Phase 4 (SPADOC - 4) Program by the Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA.

The SPADOC - 4 program will consolidate command, control and communications functions from many sources allowing SPADOC personnel to determine actions and issue timely directions for Space Defense Operations.

SPADOC -4 will be implemented via an "evolutionary acquisition strategy" that is designed to build on the experience gained by actual system-use in its own operational environment.

According to Lt. Col. Peter R. Wilkinson, Program Manager, the program will involve a one-year development segment. During development, specific operational capabilities will be delivered through a series of "acquisition blocks."

A contract award for the definition part of the program is expected to be awarded by November 1981.

Navy Awards $3.9 Million JTIDS Contract

The Naval Electronics Systems Command has awarded a $3.9 million contract to TADCOM, a joint venture of ITT and Hughes Aircraft Company, for design studies of several classes of terminals for the Joint Tactical Information Distribution System (JTIDS).

The JTIDS military information exchange system, sponsored by the Department of Defense (DoD), will allow US naval shipboard, ground, and airborne forces to communicate over voice and data channels that are secure and jam-resistant. The system also provides navigation information that will give grid lock and facilitates indentification of friendly or hostile forces.

Robert Kramp, President of TADCOM, said the contract involves design of engineering development units of Class 1 surface command terminals, Class 1A airborne command terminals and Class 2 airborne tactical terminals.

The terminals will operate on the principle of both distributed time division multiple access (DTDMA), an ITT development, and time division multiple access (TDMA).

DoD has encouraged formation of industry teams as a means of developing dual, highly qualified sources for volume production of JTIDS terminals.

Development of JTIDS terminals has been performed by the Naval Electronic Systems Command under the direction of Capt. Robert May, USN. TADCOM's Program Director is Frederick A. Modavis.

British Aerospace and COMSAT Gen. to form Joint Venture

Following a Memorandum of Understanding signed several months ago, COMSAT General Corporation (CGC) and British Aerospace (BAe), in anticipation of the award of a contract to provide leased communications services to the British Ministry of Defence, have announced their plans to form a joint venture.

COMSAT General and British Aerospace have a long history of involvement in the field of satellite communications. Over the past 15 years CGC established communications system comprising a total of 32 satellites. BAe has been chosen as prime contractor for all European Space Agency communications programs.

COMSAT General is also currently under contract to the UK Royal Navy to provide defence communications service via satellite through the MARISAT System. Established in 1976, the MARISAT System provides worldwide service to the U.S. Navy and the commercial maritime and offshore industries.

It is considered likely that future defense communications systems spawned by this joint venture could result in a substantial increase in the UK aerospace industry's participation in the design and construction of major satellite programs throughout the world.

USAF Group Formed to Study Atmospheric Effects on Radio and Radar

A newly formed Air Force Joint Management Group on Tropospheric Propagation will focus on natural events which impact on radio and radar communications.

Chaired by Capt. Ruth B. Kaplan of the Electronic Systems Division's Deputy for Development Plans at Hanscom AFB, MA, the group brings together hardware-engineering skills of the Electronic Systems Division, propagation and engineering research knowledge of the Rome Air Development Center, atmospheric research experience of the Air Force Geophysics Laboratory, and field-test environment and operational support of the Air Weather Service.

DELIVERY. . . . shouldn't be a limitation.

Because you can't afford to wait months for limiting amplifiers, Aydin Microwave delivers Solid State GaAs FET Limiting Amplifiers quickly—in many cases weeks ahead of the competition.

Whether you require a standard model or a custom designed amplifier, Aydin offers the performance and the reliability you expect. Models are available to cover the spectrum from 755 MHz to 18 GHz. State-of-the-art IC technology and computer-aided thin film design permit the highest degree of miniaturization, definition and precision available. Low power consumption, excellent gain flatness and extremely fast pulse response make Aydin Limiting Amplifiers ideal—and you won't have to wait months for delivery.

For more information about Aydin Limiting Amplifiers as well as other Aydin Solid State Amplifiers, contact Hal Sawert at (408) 946-5600, or write:

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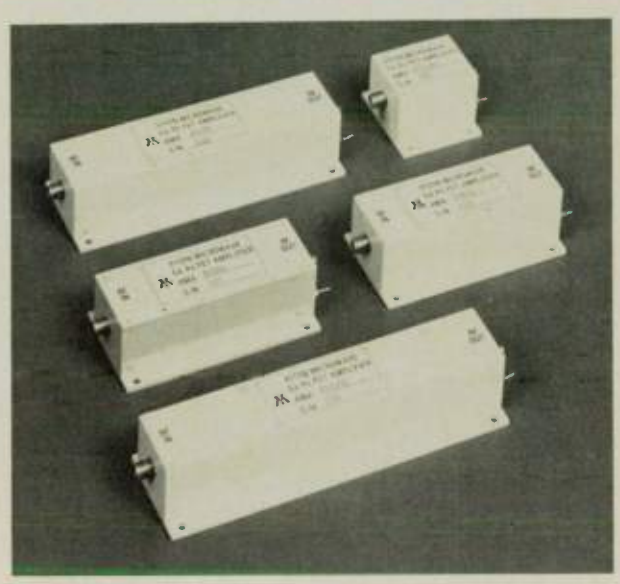

LIMITING AMPLIFIERS — **BASIC LIST**

AYDIN MODEL NUMBER AMA-	FREQUENCY RANGE (GHz)	GAIN dB MIN.	GAIN VAR. ±dB MAX.	NOISE FIGURE dB MAX.	VSWR MAX. IN/OUT	SATURATED POWER OUT dBm	SATURATED POWER VAR. dB	BIAS VOLTS	BIAS mA
1020L	1.0-2.0	40	1.0	3.5	2.0	+12	1.0	+12	220
1530L	1.5-3.0	40	1.0	4.0	2.0	+12	1.0	+12	220
2040L	2.0-4.0	40	1.0	4.5	2.0	+12	1.0	+12	220
2652L	2.6-5.2	40	1.0	5.5	2.0	+12	1.0	+12	270
2756L	2.7-5.6	65	1.0	6.0	2.0	+12	1.0	+12	400
2756L1	2.7-5.6	40	1.0	6.0	2.0	+12	1.0	+12	300
2060L	2.0-6.0	40	2.0	6.5	2.0	+12	1.0	+12	350
4080L	4.0-8.0	40	1.0	6.5	2.0	+12	1.0	+12	300
70120L	7.0-12.0	40	1.5	8.0	2.0	+12	1.5	+12	400
80120L	8.0-12.0	40	1.5	8.0	2.0	+12	1.5	+12	400
80160L	8.0-16.0	30	2.0	10.0	2.0	+12	1.5	+12	450
80180L	8.0-18.0	30	2.5	10.0	2.0	+12	2.0	+12	500
60180L	6.0-18.0	30	2.5	10.0	2.0	+12	±2.0	+12	550

1. Connectors are SMA-F, unless otherwise requested.
2. Base plate temperature is 0° to 50° C.
3. Many other performance characteristics plus a wide range of options are available.

AYDIN MICROWAVE
IN TOUCH WITH THE WORLD

Around the Circuit

PERSONNEL

Recent management appointments include **Ronald Richards** to the post of Marketing Manager at Instruments for Industry, Inc. and **Barry Hampton** as Applications Mgr., Microwave Operations at Fujitsu Microelectronics. . .Filling the new position of V.P. of Advanced Systems and Technology at the Applied Technology Div. of Itek Corp. is Dr. **Eckhard J. Schulz**. . . Microdyne Corp. has promoted **George A. Bell** from Dir. of Marketing to V.P., Marketing, Satellite TV Products; **Richard B. Elsea** from Dir. of Marketing to V.P., Marketing, Telemetry Products and **William E. Droullard**, from Gen. Mgr. to V.P. of Antennas for Communications. . . Narda Microwave Corp. appointed **Henry Suri** as Customer Service Administrator. . .**James H. Hamm** was appointed as Materials Research Corp.'s V.P. for the Ceramic Substrate and Process Equipment Divisions. . . **Arnold Newton** has joined International Microwave Corp. in the new position of Dir. of Engineering and **Jack C. Paterno** was elected V.P. of Finance. . .Texscan Corp. announced the promotion of **Raleigh B. Stelle III** from Sales Manager for the Indianapolis office to Vice President and **Norrie Westcott** from Operations Manager for the Indianapolis manufacturing facility to Vice President. . .General Microwave Corp. appointed **Leonard Trugman** as V.P.-Manufacturing. . .Microdyne Corp. appointed **Kenneth B. Boothe** as International Sales Manager. . .**Louis J. Nielsen** was appointed Components Marketing Mgr. at Anaren Microwave, Inc.

CONTRACTS

Warner Robins Air Logistics Center awarded a $2M contract to **Narda Microwave Corp.** for GaAs FET amplifiers to be used to upgrade the ALR-20A EW system on the B-52. . .**E-Systems, Inc.** was granted a $13.1M award from US Navy's Sea Systems Command for the production of 7 AN/SYR-1 systems and spares for downlink communications tracking sets used with the extended range Standard Missile-Two. . .**American Electronic Labs** announced the receipt of a $6.4M USAF award for production of RF Amplifiers and antennas for the EF-111A aircraft. . .AT&T Long Lines Department granted **California Microwave, Inc.** a $797K order for 2 satellite communications earth stations to be provided by CM's subsidiary, **Satellite Transmission Systems, Inc.** . .**Wold Communications, Inc.**, a subsidiary of **Robert Wold Co. Inc.**, granted a contract valued at over $4M to **Microdyne Corp.** to manufacture and install at least 100 satellite receive only earth stations, to add to the 50-plus 7-meter stations ordered last year. . .**RCA Missile and Surface Radar** received a $109.7M contract from the US Navy for purchase of long lead items for the third and fourth AEGIS Weapon Systems. . .**Hughes Aircraft Co. Ground Systems Group**, awarded a subcontract valued at $500K to **TRAK Microwave Corp.**, the **Tech-Sym Corp.** subsidiary, for transistor power amplifiers for JTIDS. . .AT&T Co. has entered into a national supply contract with **Avantek, Inc.** for its DR2C and DR2R 2 GHz digital microwave radio equipment and associated services.

INDUSTRY NEWS

KW Engineering has occupied a new 8300 sq. ft. facility at 4565 Ruffner Street in San Diego, CA. . . **Tecom Industries** announced the acquisition of the **Technetics Div.** of **Duntech Industries, Inc.**, Las Cruces, NM for an undisclosed sum of cash. The Technetics Div. manufactures electrically small, very wideband and compact antennas particularly suited to mobile applications. . . . **K & L Microwave** has occupied an addition to their facility which brings total manufacturing space to 38,000 sq. ft. . .**Alpha Industries, Inc.** has agreed in principle to acquire **Trans-Tech., Inc.** of Gaithersburg, MD, a producer of mw ceramic and ferrite materials,and **Central Microwave Co.**, of St. Charles, MO., a manufacturer of GaAs mm and mw signal sources. Alpha plans to issue approximately 350K new shares of common stock in exchange for the outstanding stock of the two companies. . . .Board of Directors of **Aeroflex** (Plainview, NY) and **Comtech Telecommunications Corp.** (Smithtown, NY) jointly announced the approval for negotiation of a merger of the two companies on the basis of 1 common share of Aeroflex for each 3 common shares of Comtech. . . .**Diamond Antenna & Microwave Corp.**, incorporated by its current President, Albert S. Hovannesian, in 1956, is celebrating its 25th year as a designer and manufacturer of rotary joints, antennas and passive components. . . .All outstanding stock of **Cincinnati Electronics Corp.**, was purchased by **Marconi Electronics Inc.**, a subsidiary of the **General Electric Co. Ltd.**

NEW MARKET ENTRY

PMH, Inc. has been founded to supply precision machines housings for EMI/RFI suppression applications. The new company will rely heavily on computer-aided machining to produce close tolerance, custom designs. Contact: Robert Price, 410 Coles Circle, Salisbury, MD. Tel: (301) 749-2424.

FINANCIAL NEWS

Comtech Telecommunications Corp. reported second quarter results for the period ended January 31, 1981 of net sales of $10.9M, net income of $2.0M or 55¢ per share. This compares with 1980 quarterly net sales of $5.6M, net loss of $377K or 11¢ per share. . . **Narda Microwave Corporation** reported net sales for the third quarter ended March 31, 1981 of $6.5M, net income of $523K and earnings per share of 34¢. In the 1980 third quarter, sales totaled $5.7M, net income was $304K, 27¢ per share. . .**Raytheon Co.** reported a net income of $73.2M for the first quarter ended March 29, 1981, sales of $1.3B and earnings per share of $1.75. In the comparable 1980 quarter, net income was $65.2M, $1.57 per share on net sales of $1.197B. . .For the year ended November 2, 1980, **Microdyne Corporation** reported sales of $23.7M, net income of $3.2M or 77¢ per share. . .This compares with 1979 year-end net sales of $17.5M, net income of $2.9M or 79¢ per share. . . **EPSCO, Inc.**'s results from operations for the year ended December 31, 1980 were net sales of $16M, net income of $935K or 96¢ per share. This compares with 1979 year-end net sales of $13.3M, net income from operations of $876K, 94¢ per share.

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- GaAs FET power amplifiers, up to 8.4 GHz
- 1 and 5 MHz distribution amplifiers, up to 26 outputs
- FM carrier baseband video distribution amplifiers
- IF amplifiers, 70, 700 and 1100 MHz

Terrestrial Microwave Amplifiers
- Microwave LOS, 100 watts
- High power troposcatter, L-band, 1000 watts
- Microwave and UHF radio relay, 1000 watts

Broadcast
- UHF/VHF color TV transmitters, up to 1.5 KW peak synch
- Airborne TV visual/sound power amplifiers
- FCC type-accepted driver amplifiers
- UHF TV internal 3-tone amplifiers

Avionics
- FAA and MIL TACAN transmitter systems— power amplifiers, modulators, synthesizers, power supplies
- L-band digital transmitters (JTIDS)
- Data link transmitters
- Up/down converters
- Airborne pulse amplifiers

Missile Systems
- Command/destruct transmitters
- Guided weapon data link amplifiers
- Military drone transmitters

Radar Amplifiers
- L-band transmitters
- S-band pulse drivers for 3-D radar
- Shipboard drivers for AN/SPS-48 radars

Electronic Warfare
- Communication jammers
- Class A linear power amplifiers
- Linear AB wideband jammers
- Jamming simulators

Military Communications Amplifiers
- Long-pulse data links
- Communication command links
- UHF transceiver amplifiers/modulators
- MIL RF power boosters (ECCM)

Laboratory Instrumentation/Test
- Class A linear amplifiers
- RFI/EMI test amplifiers
- Power meter calibration systems
- Commercial and MIL power supplies— high efficiency, compact packaging, up to 6000 watts
- DC-DC converters

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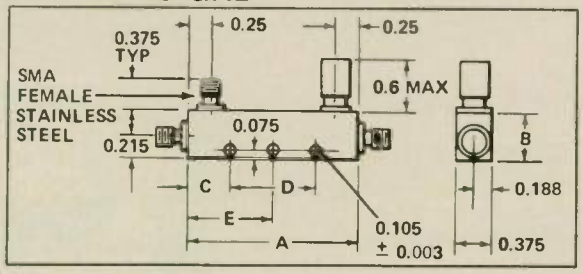
MIDISCO offers a line of standard, multi-octave, dual directional and high power units. These couplers exhibit excellent flatness and directivity characteristics in small packages. **They are available from stock.**



OUTLINE DRAWING NUMBER	A	B	C	D	E
1	3.10	0.50	0.80	1.50	—
2	3.10	0.55	0.80	1.50	—
3	1.80	0.50	0.43	0.94	—
4	1.80	0.55	0.43	0.94	—
5	1.20	0.50	0.43	0.34	—
6	1.20	0.55	0.43	0.34	—
7	1.00	0.50	—	—	0.50
8	1.00	0.55	—	—	0.50
9	1.00	0.60	—	—	0.50

MODEL NO.	FREQUENCY RANGE (GHz)	COUPLING* (dB)	FREQ. SENS. (dB)	INSERTION LOSS (dB) EXCL. CPLD PWR.	INSERTION LOSS (dB) TRUE	DIRECTIVITY (dB MIN.)	VSWR MAX. PRIMARY LINE	VSWR MAX. SECONDARY LINE	POWER AVERAGE INCIDENT (W)	POWER AVG. REFLD. (W)	POWER PEAK (kW)	OUTLINE DWG. NO.
MDC6223-6	0.5-1.0	6 ±1.00	±0.60	0.20	1.80	23	1.15	1.15	50	2	3	1
MDC6223-10	0.5-1.0	10 ±1.25	±0.75	0.20	0.80	25	1.15	1.15	50	5	3	1
MDC6223-20	0.5-1.0	20 ±1.25	±0.75	0.20	0.20	25	1.15	1.15	50	50	3	1
MDC6223-30	0.5-1.0	30 ±1.25	±0.75	0.20	0.20	25	1.15	1.15	50	50	3	2
MDC6224-6	1.0-2.0	6 ±1.00	±0.60	0.20	1.80	25	1.15	1.15	50	2	3	3
MDC6224-10	1.0-2.0	10 ±1.25	±0.75	0.20	0.80	25	1.10	1.10	50	5	3	3
MDC6224-20	1.0-2.0	20 ±1.25	±0.75	0.20	0.20	27	1.10	1.10	50	50	3	3
MDC6224-30	1.0-2.0	30 ±1.25	±0.75	0.20	0.20	27	1.10	1.10	50	50	3	4
MDC6225-6	2.0-4.0	6 ±1.00	±0.60	0.20	1.80	22	1.15	1.15	50	2	3	5
MDC6225-10	2.0-4.0	10 ±1.25	±0.75	0.20	0.80	22	1.15	1.15	50	5	3	5
MDC6225-20	2.0-4.0	20 ±1.25	±0.75	0.20	0.20	22	1.15	1.15	50	50	3	5
MDC6225-30	2.0-4.0	30 ±1.25	±0.75	0.20	0.20	22	1.15	1.15	50	50	3	6
MDC6266-6	2.6-5.2	6 ±1.00	±0.60	0.25	1.80	18	1.25	1.25	50	2	3	7
MDC6266-10	2.6-5.2	10 ±1.25	±0.75	0.25	0.80	20	1.25	1.25	50	5	3	7
MDC6266-20	2.6-5.2	20 ±1.25	±0.75	0.25	0.25	20	1.25	1.25	50	50	3	7
MDC6266-30	2.6-5.2	30 ±1.25	±0.75	0.25	0.20	20	1.25	1.25	50	50	3	8
MDC6226-6	4.0-8.0	6 ±1.00	±0.60	0.25	2.00	18	1.25	1.25	50	2	3	7
MDC6226-10	4.0-8.0	10 ±1.25	±0.75	0.25	1.00	20	1.25	1.25	50	5	3	7
MDC6226-20	4.0-8.0	20 ±1.25	±0.75	0.25	0.30	20	1.25	1.25	50	50	3	7
MDC6226-30	4.0-8.0	30 ±1.25	±0.75	0.25	0.25	20	1.25	1.25	50	50	3	8
MDC6227-6	7.0-12.4	6 ±1.00	±0.50	0.40	2.00	15	1.30	1.30	50	2	3	7
MDC6227-10	7.0-12.4	10 ±1.25	±0.50	0.40	1.00	17	1.30	1.30	50	5	3	7
MDC6227-20	7.0-12.4	20 ±1.00	±0.50	0.30	0.35	17	1.25	1.25	50	50	3	7
MDC6227-30	7.0-12.4	30 ±1.00	±0.50	0.30	0.30	17	1.25	1.25	50	50	3	8
MDC6288-6	7.5-16.0	6 ±1.10	±0.60	0.60	2.00	12	1.35	1.40	50	2	2	7
MDC6288-10	7.5-16.0	10 ±1.50	±0.75	0.60	1.00	12	1.35	1.40	50	5	2	7
MDC6288-20	7.5-16.0	20 ±1.25	±0.75	0.50	0.50	15	1.35	1.40	50	50	2	7
MDC6288-30	7.5-16.0	30 ±1.25	±0.75	0.50	0.50	15	1.35	1.40	50	50	2	8
MDC6228-6	12.4-18.0	6 ±1.00	±0.50	0.30	2.00	15	1.35	1.40	50	2	1	7
MDC6228-10	12.4-18.0	10 ±1.00	±0.50	0.30	1.10	15	1.30	1.40	50	5	1	7
MDC6228-20	12.4-18.0	20 ±1.00	±0.50	0.30	0.50	15	1.30	1.40	50	50	1	9
MDC6228-30	12.4-18.0	30 ±1.00	±0.50	0.30	0.50	15	1.30	1.40	50	50	1	9

*Includes Frequency Sensitivity.

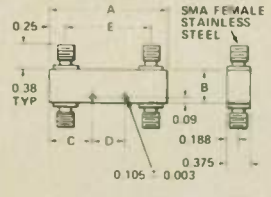


FIGURE 1

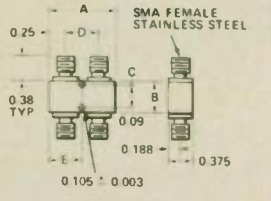


FIGURE 2

HYBRIDS/90° mini

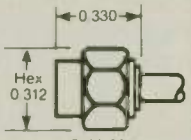
MIDISCO offers this series of 3 dB Miniature Hybrids with excellent electrical performance. These devices are useful as signal and power splitters in both laboratory and system applications. **They are available from stock.**

MODEL	FREQUENCY RANGE (GHz)	COUPLED (dB) NOM.	DEV. FROM NOM. MAX. (dB)	VSWR MAX.	ISOL. (MIN.) (dB)	INPUT PWR. AVG. (W)	INPUT PWR. PEAK (kW)	FIG. NO.	A	B	C	D	E
MDC7223	0.5-0.1	$3\ ^{+0.2}_{-0}$	±0.5	1.25	20	50	5	1	3.06	0.50	0.64	1.780	2.56
MDC7224	1.0-2.0	$3\ ^{+0.2}_{-0}$	±0.5	1.10	30	50	5	1	1.78	0.50	0.64	1.500	1.28
MDC7225	2.0-4.0	$3\ ^{+0.2}_{-0}$	±0.5	1.20	22	50	5	1	1.15	0.50	0.314	0.66	0.58
MDC7266	2.6-5.2	$3\ ^{+0.3}_{-0}$	±0.5	1.25	20	50	5	2	1.00	0.50	0.314	0.50	0.50
MDC7226	4.0-8.0	$3\ ^{+0.3}_{-0}$	±0.5	1.25	20	50	5	2	1.00	0.50	0.314	0.50	0.50
MDC7227	7.0-12.4	$3\ ^{+0.4}_{-0}$	±0.5	1.30	18	50	5	2	1.00	0.50	0.314	0.50	0.50
MDC7288	7.5-16.0	$3\ ^{+0.6}_{-0}$	±0.6	1.35	15	50	5	2	1.00	0.58	0.392	0.50	0.50
MDC7228	12.4-18.0	$3\ ^{+0.6}_{-0}$	±0.7	1.40	15	50	5	2	1.00	0.58	0.392	0.50	0.50
MDC7267	2.0-8.0	$3\ ^{+0.8}_{-0}$	±0.6	1.30	17	50	5	1	2.54	0.75	0.64	1.260	2.04

No need to hunt any further, the mystery is solved. Midisco has your microwave component attenuator, cable assembly, coaxial detector & short, directional coupler, hybrid, mixer, phas adjuster, RFI shielded case, inter & intra series adapter, termination, test cable.

SMA SEMI-RIGID MIDGETS

Smallest available, solder type in BeCu or Stainless Steel with passivated or gold-plated coupling nut per MIL-C-39012. 0.312D x 0.330. For .141 (RG402/u) cable, order MDC1141 (25 to a bag) $2.35 ea. For .085 (RG405/u) cable, order MDC1085 (25 to a bag) $2.95 ea.



RIGHT ANGLE BENT ASSEMBLY

Get the performance of a straight connector and the dimensions of a right angle plug in one assembly. Order MDC1052 for 0.141 cable or MDC1053 for 0.085 cable. 2" to 8" assemblies, MDC1052 or MDC1053 (10 piece price) $24.00 each, any length available.

Conventional Method **Bent Cable Methods**

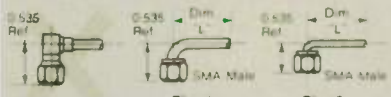
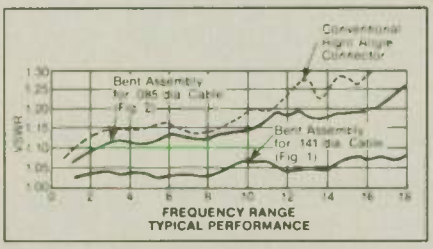


Fig. 1 Fig. 2



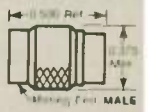
Make the proper connection,
call Midisco for a solution (516) 543-4774 or TWX 510-226-7839 and end your search.

PRECISION SMA TERMINATIONS all stainless steel with 50 ohm impedance and −50° C to +125° C temperature range

Part No.	Av. PWR (Watts)	DC-4GHz	VSWR (max.) 4-8GHz	8-12GHz	12-18GHz	Dimensions L. x W.	Price (Each in quantity of 10)
MDC1075	½	1.05	1.10	1.15	1.20	55 x .31D	$18.00
MDC1075H	2	1.05	1.10	1.15	1.25	69 x .31D	$28.00
MDC1091M	5	1.05	1.10	1.15	1.20	32 x .31D	$18.00
MDC1091MX	½	1.03	1.04	1.08	1.12	32 x .31D	$35.00
MDC1076	½	1.05	1.10	1.15	1.20	52 x .31D	$18.00
MDC1090F	5	1.05	1.30	1.50	—	755 x .5 sq.	$35.00
MDC1090M	5	1.05	1.30	1.50	—	895 x .5 sq.	$35.00

SMA KWIK-SLIP TERMINATIONS

Snaps onto any SMA female connector, rated to 18GHz MDC1075Q stainless steel-gold plated, 1 watt average power, 50 ohm imp., 1.05 + 0.010F (GHz) VSWR, −55° C to + 125° C temp. range, 500 cycle (min.) durability, 10 lb. axial engagement force, 10 piece price, each $38. Model MDC1075QC, with bead chain, 10 piece price, each $48.

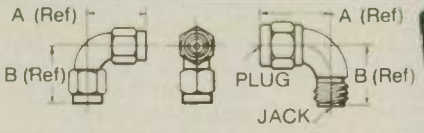


Precision Adapters

Every combination, inter & intra series adapter between N, BNC, TNC, SMA, SMB, SMC and 7mm in straight, bulkhead, panel and bent versions.

MIDISCO'S Number System makes it so easy. Type N=N, TNC=T, BNC=B, 7mm=7, SMA=S, Male=M, Female=F. So a TNC male to SMA female is TM-SF. Prefix with B, bulkhead; P, panel; R, right angle; RR, radius right angle.

7mm TO	PART NO.	MAX. SWR
N female N male	NF-7 NM-7	1.03 @ 4 GHz 1.04 @ 9 GHz 1.08 @ 18 GHz
BNC female BNC male	BF-7 BM-7	1.03 @ 4 GHz 1.045 @ 9 GHz 1.06 @ 12 GHz 1.12 @ 18 GHz
TNC female TNC male	TF-7 TM-7	Same as BNC
SMA female SMA male	SF-7 SM-7	1.07 @ 12.4 GHz 1.15 @ 18 GHz

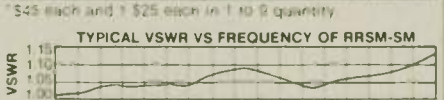


MIDISCO Radius Adapters consist of a bent section with a one piece center conductor eliminating vibration & shock failures that are normal with solder joints. VSWR to 18 GHz is superior to mitered right angle adapters.

Type	PART NO.	A	B
N Male—N Male	RRNM-NM*	1.094	1.094
N Male—N Female	RRNM-NF*	1.109	1.000
SMA Male—SMA Male	RRSM-SM*	0.550	0.550
SMA Male—SMA Female	RRSM-SF*	0.550	0.460
TNC Male—TNC Male	RRTM-TM*	1.060	1.060
TNC Male—TNC Female	RRTM-TF*	0.953	1.060

*$45 each and $25 each in 1 to 9 quantity.

TYPICAL VSWR VS FREQUENCY OF RRSM-SM



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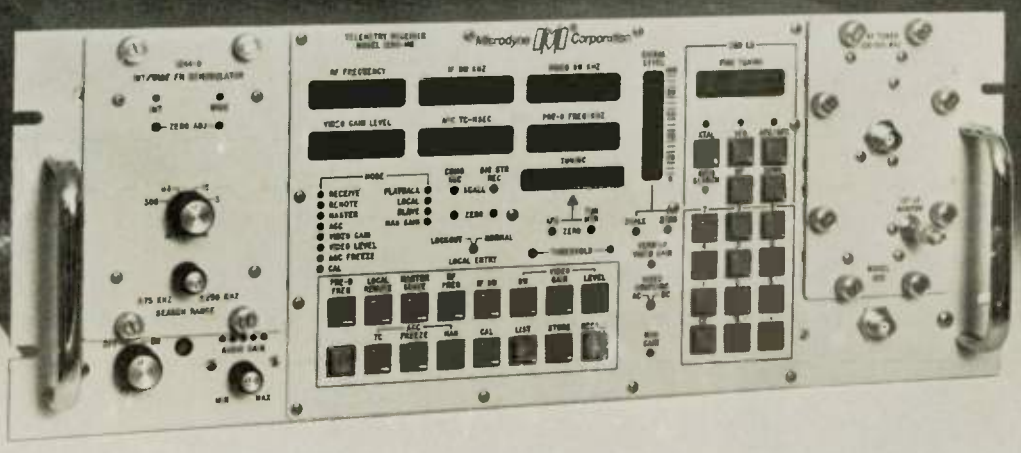
CIRCLE 86 ON READER SERVICE CARD

the telemetry receiver your computer really understands



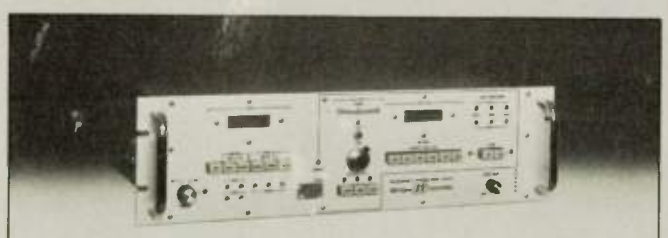
Microdyne's New 1200-MR

Both remotely and manually controllable, the 1200-MR double conversion receiver is the first to anticipate and meet the many telemetry requirements of the 1980's. Consider just some of the features:

- IEEE-488 or optional RS-232 interface
- Keyboard entry for manual control
- Discrete tuning ranges, voltage controlled from 215 MHz to 4.2 GHz
- AM, FM, PM and Bi-Phase Demodulation Modes
- DC to 5 MHz video Baseband response
- Synthesized LO's, phase locked to a common 5 MHz reference, with 1 x 10^{-7} stability
- Up to seven internal 2nd IF filters, switch selectable with BW's up to 10 MHz
- Ruggedized design allows installation on aircraft, land vehicles, ships and submarines

For free technical brochures describing the 1200-MR receiver, and/or the 3200-PC and 3200-PC(10) Diversity Combiners call or write: Microdyne Corporation, 627 Lofstrand Lane, Rockville, Maryland 20850. Telephone (301) 762-8500.

Microdyne Corporation



Now - Extremely fast fade rate combiners for dramatic BER and SNR improvements

The new 3200-PC and 3200-PC(10) are the first and only commercial Pre/Post-D Diversity Combiners offering the following unique features:

Fast Fade Rates —Optimal Ratio Combining maintained with two randomly phased RF signals that vary up to 20 dB in relative amplitude at fade rates up to 20,000 c.p.s.!

AM/AGC Combining — AM Function insures Optimal Ratio Combining when fade rates exceed limited receiver AGC response times.

BER and SNR Improvements — Dramatic BER reductions and SNR improvements under severe multipath, flame attenuation and pseudo-random noise conditions.

Receivers Required — Two 1200-MR receivers are used with the 3200-PC Combiner. Two 1100-AR or similar type receivers, with 10 MHz and appropriate logic outputs are used with the 3200-PC(10) Combiner.

Replaces Other Combiners — The 3200-PC(10) replaces Microdyne 3300-C or similar type 10 MHz input combiners with BER and SNR limitations.

Ruggedized Design — Both combiners are ideally suited for ground stations and installation on aircraft, mobile vehicles, surface ships and submarines.

CIRCLE 87 ON READER SERVICE CARD

MW/MM-Wave Tube and Transmitter Technology Development Contracts at ERADCOM

NELSON J. WILSON
US Army Electronics Technology and Devices Laboratory
Fort Monmouth, NJ

This report will review and update the status and progress of the ERADCOM contractual programs for development of tubes and modulator subsystems.

Varian-Canada under contract DAAB07-78-C-2948 has continued to make excellent progress with development of the four-cavity, extended interaction amplifier (EIA) operating from 94.0-96.0 GHz. The initial electromagnet (EM) focused amplifier has been packaged with a samarium-cobalt magnet and weighs approximately 6.6 kg. Operation at 2.4 kW, 43-46 dB gain, 19% efficiency duplicates the earlier EM performance. The tube is mechanically tunable from 94-96 GHz with an electronic bandwidth of 180 MHz at the 1 dB power point. The maximum average power obtained to date is 50 watts under liquid-cooled operation. Typical average power is approximately 30 watts using a 0.4 μsec pulse width. Excellent stability was demonstrated in a recent pulsed evaluation at Electronics Technology and Devices Laboratory (ET&DL). Plans are to reduce the overall weight, provide for mod-anode or grid controlled pulsing and to extend the design to 220 GHz.

Hughes Electron Dynamics Division (EDD) under contract DAAB07-78-C-3015 has completed the design for a 100 watt peak power periodic permanent magnet (PPM) focused coupled-cavity TWT (*Microwave Journal*), July 1980 p. 40). An electron beam tester was fabricated and evaluated. The desired 95% (minimum) beam transmission was not achieved and a refinement of the magnet stack was completed. Plans are to fabricate a new electron gun and assemble the available circuit parts with a new magnet stack to obtain the first 94 GHz model.

Hughes EDD has completed contract DAAB07-77-C-2713, "Linear 1 kW Multitone TROSCATTER TWT," by constructing a high power TWT utilizing a four-stage depressed collector to enhance efficiency. This PPM focused coupled-cavity TWT operates in a non-saturated drive region to limit intermodulation distortion to -20 dB. The massive copper four-stage depressed collector contains machined relief slots to minimize thermal expansion while collecting a total power of 4.3 kW. This 1.0 kW amplifier operates across the 4.4-5.0 GHz frequency band at a minimum gain of 40 dB. Final evaluation will be completed by Sept. 1981.

Parallel advanced development contracts at Varian (DAAB07-78-C-3007) and Hughes (DAAB07-78-C-3008) have resulted in obtaining improved 125 kW peak power transmitter tubes for ground radars operating in S Band. Improvements in amplitude linearity, reduced cathode temperature and increased resistance to load mismatch (1.5:1 min.) have been demonstrated during evaluation on contract DAAB07-78-C-3010, Transmitter Test Bed Program. A microprocessor-controlled transmitter has operated in excess of 400 hours with no degradation in either tube or transmitter performance. Evaluation will continue until 1,000 hours of operation has been attained on each of two tubes.

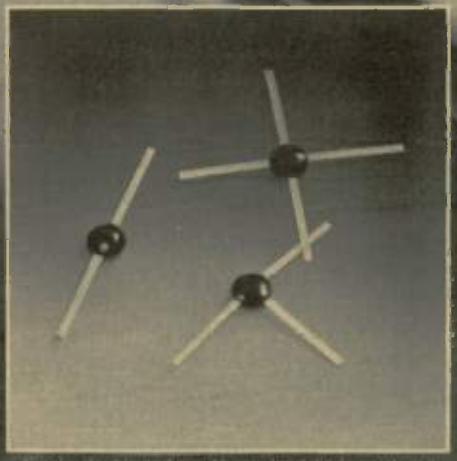
In companion programs at Litton (DAAB07-80-C-0294) and Hughes (DAAB07-80-C-0295), development is underway to improve an X-Band, 25 kW peak power traveling-wave tube. Tungsten-iridium cathodes will be employed to reduce cathode temperature and provide for longer life. Room temperature (passive) getters will be introduced to inhibit the effects of gases evolved during extended shelf life. An external network will be incorporated with each tube to eliminate improper tube voltage settings, and heater and beam current timers are also being provided to assist in gathering and evaluating life data in the field. The development includes demonstration of a 1,500-hour life test when operat in a microprocessor controlled transmitter test bed.

PULSERS AND SWITCH TUBES

Applications for high resolution radars operating at millimeter wave lengths have led to the development nanosecond pulse lengths at the 2-3 k level. Under contract DAAB07-78-C-2991, Hughes Ground System Divisic has extended the capability of their 1.0 kV avalanche transistor pulser. Pulse step-up of 2:1 and 3:1 has beer achieved by fabricating coaxial line transformers wrapped on microwave ferrite core. Using a 50 ohm input im pedance and terminating the transformer into a 200 Ω load resulted in obtaining a uniform pulse at the 2.0 kV level, while maintaining a 0.4 nan second rise time. In order to obtain higher current levels, Hughes will con centrate on designing transformers with lower characteristic impedance levels. The 2-3 kV pulse will provide sufficient pulse drive for gridded extended interaction amplifiers and TWT's.

Instant start thyratrons provide a technology that reduces equipment turn-on time by eliminating the relatively long term warm-up usually ass ciated with thyratron pulsers. The re sultant performance and small size of the instant start thyratrons is being e ploited for short pulse millimeter wa transmitters. EG&G under contract DAAK20-80-C-0282 is developing a modified HY3013L to provide 25 kV pulses in a low inductance pulser design. The first model thyratron was aged at a pulse voltage of 26 kV with an anode fall time of 2 nanoseconds. Additional characterization testing w be conducted to measure recovery time.

Bond Alpha quality beam lead diodes and minimize your costs.



Single, double and quad beam lead diodes pictured above are magnified to illustrate detail.

When you need high performance capability at competitive prices, you don't waste time looking around. You get the Alpha Advantage with their single, double or quad beam lead schottky diodes.

Alpha uses a custom designed process control system which has no equal in the industry. It ensures high yield so you can get low cost diodes that are completely passivated and exhibit low inductance and high repeatability. Additional benefits from these series of diodes include low 1/f noise, low noise figure, high cut off frequency and zero bias. They are available from stock in frequencies from 100 MHz to over 100 GHz.

The Alpha Advantage extends to important services as well:

- ☐ Quick reaction to design application inquiries.
- ☐ Complete information from Alpha's engineers on beam lead diodes for mixers, detectors, switches and modulators.
- ☐ Available on a wide variety of standard substrates or custom mounted on your circuits.
- ☐ Free samples for evaluation.

Call or write: Alpha Industries, Inc., Semiconductor Division, 20 Sylvan Road, Woburn, MA 01801, (617) 935-5150. TWX 710-393-1236. Telex 949436.

When the performance is more than you paid for, you've got the Alpha Advantage.

Alpha

The Alpha Advantage

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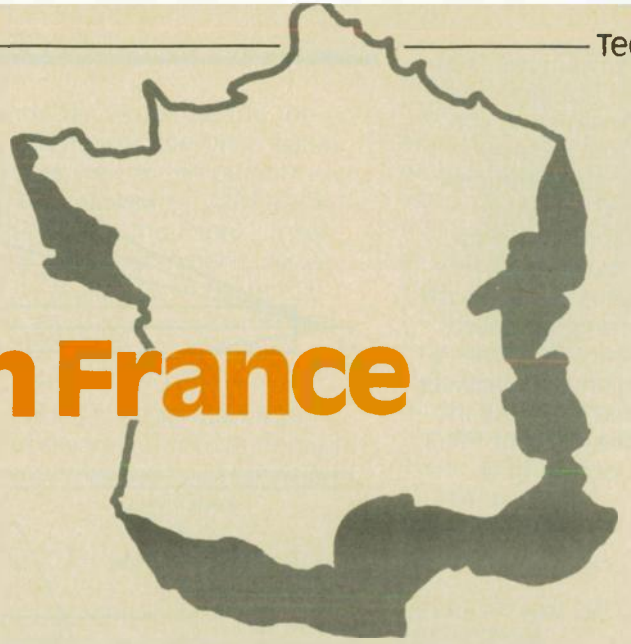

The MLS in France

BRUNO LÉTOQUART
Thomson-CSF
St. Denis, France

INTRODUCTION

The MLS (Microwave Landing System) is presently being developed in several countries, including USA and France. The MLS is the international landing system of the future, and will gradually replace the ILS (Instrument Landing System) used at airfields all through the world.

The MLS characteristics are defined by ICAO,* as well for the performance and for the technical characteristics of the transmission. The MLS, as an advanced landing system, will offer the same integrity and guidance accuracy as the modern ILS's; moreover, it will offer several other advantages:

- complete position information in 3 coordinates
- wide angular coverage
- good performances even in difficult sites (mountains, etc.)
- easy implantation due to the relative small size of its antennas
- presence of a ground-to-air data link.

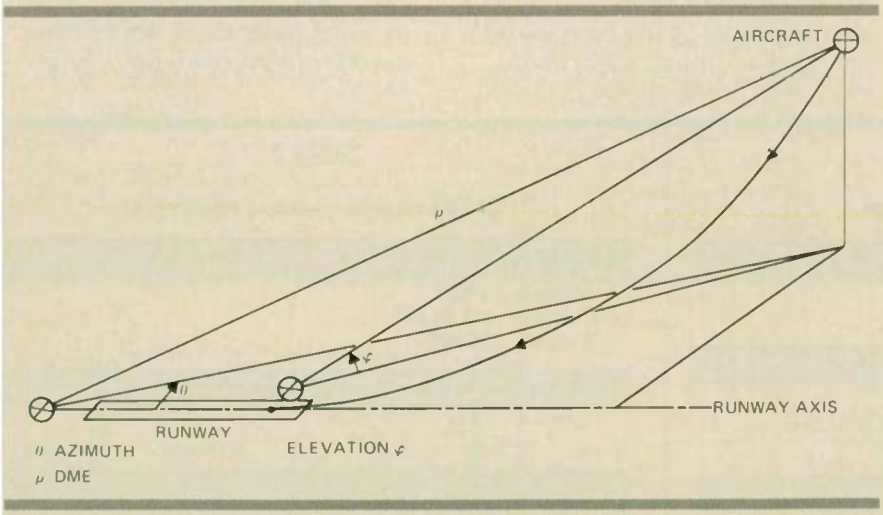

Fig. 1 MLS geometry.

MAIN FEATURES OF THE MLS

The Microwave Landing System, when installed along a runway, gives to an aircraft its actual position related to the runway and therefore enables it to land even in poor visibility conditions.

The MLS system consists of the three following functions (see Figure 1):

Azimuth: it generates the azimuth angle with reference to the runway axis.

Elevation: it generates the elevation angle with reference to the horizontal.

Distance: it generates the distance to a reference point along the runway.

It appears that the MLS gives to the aircraft its position in a quasi-spherical coordinate system related to the runway. The aircraft is therefore able to follow its desired landing path, by determining at each moment in three coordinates its position error compared to the desired path. The main difference between ILS and MLS appears now: ILS gives a position error in relation to a fixed straight landing path, corresponding to $\theta = 0°$ (azimuth) and $\varphi = \varphi_0$ (3° or 2.5°, elevation) angles, while MLS enables an aircraft to follow every desired approach and landing path, including curved approaches.

The distance information is generated by a DME(Distance Measuring Equipment) including an airborne interrogator and a ground transponder. This DME may be either the conventional DME-N as defined presently by ICAO, or a precision DME which characteristics are now discussed at ICAO, but which shall be interoperable with DME-N.

*ICAO: International Civil Aviation Organization

Scanning Beam Antenna

This is the main part of the equipment as it defines the guidance accuracy. A block diagram of the antenna is given in Figure 6. A phased array, it includes:

- A *power divider*, which splits the transmitter power to the various phase-shifters and waveguides. It gives an amplitude tapering on the array for obtaining a low sidelobes level and is realized in microstrip technology.

- *Phase-shifters*, which generate the scanning beam, is explained in Appendix 1. The phase-shifters are controlled at each time so as to generate a beam in the desired direction. By suitable switching of the phase-shifters, it is possible to scan the beam at constant angular speed in a TO-FRO sequence, as required. The phase-shifters are 4 bits digital phase-shifters using PIN diodes, which sample a 360° phase-shift into 16 steps of 22.5°. They are realized in stripline technology. The RF part of the phase-shifters presently used are manufactured by Microwave Associates. The drivers include a BIT(Built in Test) which enables to detect a failure of a single PIN diode, for monitoring and maintenance purposes.

- *Slotted waveguides*, which are the radiating elements. Their coverage defines the coverage of the azimuth antenna. But their main purpose is to avoid reflections of RF waves on the ground in front of the antenna, and to avoid guidance noise. Therefore, their elevation pattern presents a sharp cutoff around horizontal (better than 7 dB/deg) and low sidelobes at negative elevation angles. Slotted waveguides were chosen as radiating elements because they enable good radiation patterns with little hardware, but they require elaborated computer programs for design and precision tooling of the slots. To obtain vertical polarization of the RF waves, the slots are on the small side of the waveguide.

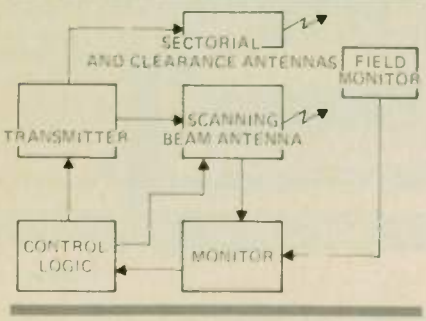

Fig. 5 Azimuth station – block diagram.

TABLE 3

MAIN TECHNICAL CHARACTERISTICS OF MLS 800 A 30

COVERAGE

- Azimuth ± 40°
- Elevation 0.9° to 15°
- Distance 20 NM

- Proportional azimuth information over ± 10°
- Clearance information between 10° and 40° (fly right or fly left information)

ACCURACY AT RUNWAY THRESHOLD

- Bias error ± 3 m
- Noise error (CMN at 2σ) ± 1 m

FORMAT as required by ICAO standards:

- Frequency: 5031 to 5090.7 MHz (200 channels with 300 kHz spacing)
- Time division multiplex between Azimuth, Elevation and Basic data informations
- Average rates: Azimuth: 39 Hz
  Elevation: 39 Hz
  Basic data (variable according data)
- Modulation of preamble and basic data: DPSK at 15.625 kHz.

MECHANICAL CHARACTERISTICS

- Approximate dimensions of Azimuth station:
  - height 2 m
  - max height above ground 2.8 m
  - width 2 m
  - depth 1 m
- Approximate weight of Azimuth station: 350 kgs.

Transmitter

The transmitter includes the following sub-assemblies:

- A frequency synthesizer generating the 200 MLS channels spaced at 300 kHz between 5031 and 5090.7 MHz. It is a phase-locked loop frequency

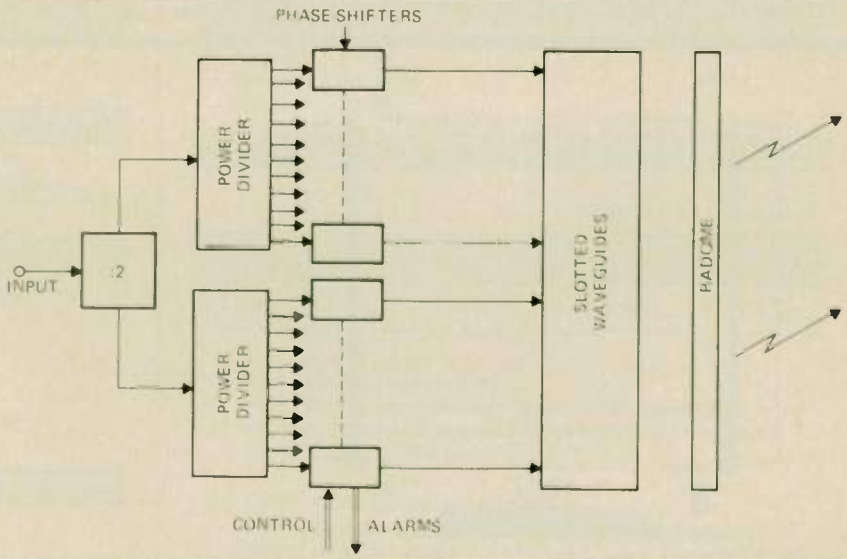

Fig. 6 Scanning beam antenna.

(continued on page 118)

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- A 0-180° phase modulator, generating the DPSK phase modulation of the preamble and of the data. It is a PIN diode phase-shifter.
- A power amplifier, with a 20 W output level. A TWT (travelling-wave tube) amplifier is presently used for the prototype. Later on, solid state power amplifiers will be used when 5 GHz power transistors will be available with sufficient output power; at present time, the maximum output power of a single transistor is around 4 W.

Control Logic

The control logic includes two major sub-assemblies:

- *Scanning antenna control logic:* These circuits control at each time the position of each phase-shifter, according to an optimized sequence to ensure soft scanning of the beam and correct beam pointing. They are realized with conventional wired logic, as conventional microprocessors are not fast enough for this purpose.
- *Time sequence control microprocessor:* It generates the time sequence of MLS, with time sharing of all various functions. According to its complexity, it is generated by a microprocessor. The microprocessor drives the various sub-assemblies of the station: phase modulator, antenna switch, control logic, etc.

Sectorial and Clearance Antennas

The Azimuth station includes other antennas, also realized with slotted waveguides.

- *Sectorial antenna:* This antenna radiates the DPSK messages (preamble and data) in the MLS coverage.
- *Clearance antennas:* They radiate "fly left" and "fly right" information outside the proportional coverage (between 10 and 40°).

A PIN diode switch enables the selection of the radiating antenna.

Monitoring

The monitoring system is single in the MLS 800. It includes both internal and external monitoring with a field monitor. The field monitor checks the main parameters radiated by the azimuth station and performs an angular measurement in the field and generates an alarm to stop the radiation if the accuracy limits are exceeded. It also performs power level monitoring for both sectorial and scanning beam transmissions and includes a receiving horn, a Schottky detector, a video amplifier and measurement circuits.

The internal monitor checks the DPSK modulation and the time sequence, to ensure that the MLS message has the characteristics defined by ICAO. These parameters may be monitored internally without loss of integrity. Instrument includes a phase detector and a microprocessor which monitors at each time the characteristics of the time sequence.

APPENDIX I

PRINCIPLE OF THE SCANNING BEAM ANTENNA

The principle of operation of a scanning beam antenna is described in **Figure 7**: as said before, a phased array is used, the block diagram of which is given in **Figure 6**; electronic scanning is obtained through digital phase-shifters.

The power divider splits the power to the various phase-shifters and radiators; to obtain a pattern with low sidelobes, unequal power splitting is implemented in order to realize an amplitude tapering on the array. Several mathematical models may be used for the amplitude tapering: Gaussian, Tchebycheff, Taylor; they enable theoretically sidelobes as low as −30 to −40 dB. The general shape of amplitude tapering is given in **Figure 7** (in the power divider).

Phase-shifters generate the electronic scanning of the main lobe of the antenna; according to antennas theory, the angular direction θ_o of the maximum of the main lobe is perpendicular to an "equiphase" plane, which means a plane in space where waves have the same phase. The phase-shifters enable to generate such an equiphase plane.

Assumptions generally made in the design of a phased array are:

- symmetrical amplitude distribution
- uniform spacing d of radiators
- anti-symmetrical phase distribution: two symmetrical phase-shifters have opposite phase
- the outputs of power divider are all in phase.

Consider two phase-shifters symmetrical in the array, called N on **Figure 7** (N = 1 for the two central phase-shifters). To generate an equiphase plane, they must generate opposite $+\Delta\varphi$ phase-shifts so that electrical lengths PQ = RS. A simple geometrical calculation shows that, for a pointing angle θ_o, theoretical value of $\Delta\varphi$ is:

$$\Delta\varphi = \pi\,(2N - 1)\,\frac{d}{\lambda}\,\sin\theta_o \qquad (1)$$

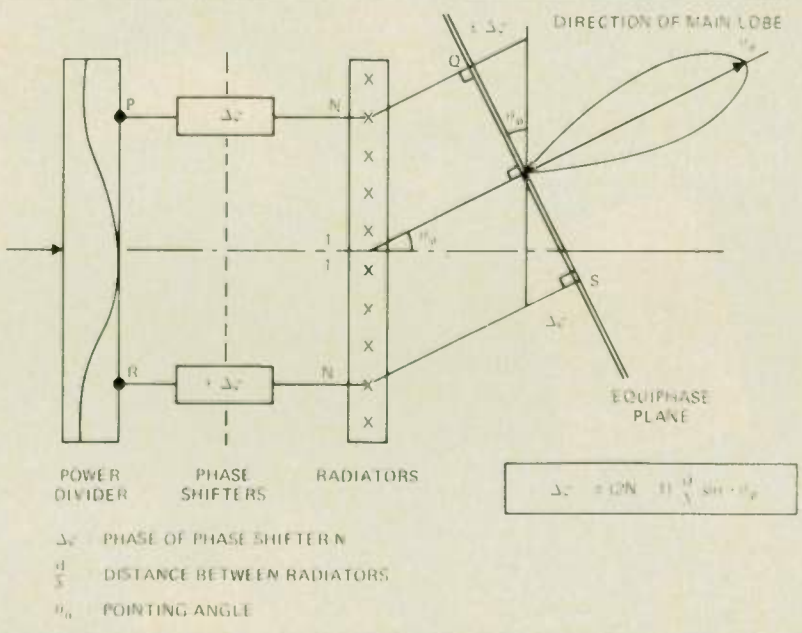

Fig. 7 Principle of the phased array.

(continued on page 120)

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(from page 118) **THE MLS**

where:

N = number of considered phase shifter (with reference to the center)
d = spacing of radiators
λ = wavelength
θ_o = pointing angle (angle of the maximum of the main lobe)

The equation of the antenna pattern is then (as a function of angle θ):

$$F(\theta) = \sum_{N=1}^{N_o} A(N) \cos [(2N - 1)(u - u_o)] \quad (2)$$

where:

$u = \pi \frac{d}{\lambda} \sin \theta$ θ angle

$u_o = \pi \frac{d}{\lambda} \sin \theta_o$ θ_o maximum

A(N) amplitude of radiators N.

The way of generating a scanning beam includes: suitable control of the phase-shifters is made so as to scan angle θ_o with a constant angular speed. θ_o is sampled with a small step at successive values θ_1, θ_2, θ_3 etc. ., and for each value θ_i, phase shifters are positioned according Equation 1 to the required value.

When using digital phase-shifters, the exact value of $\Delta\varphi$ given by Equation 1 cannot be realized, and a small phase error occurs on each radiator. The consequence of this phase error is to raise the level of the sidelobes and to give a small pointing error. The control of the phase-shifters must therefore be designed to keep those two effects to a low level.

Bruno Létoquart received an electronic, engineer diploma in 1970 from the "École Superieure d'Electricite" in France. He joined in 1970 Thomson-CSF, Division DRS-TVT, in France. This division deals with radars, ATC and NAVAIDS for both civil and military applications. Mon. Létoquart worked on MLS since 1970, and also on various radar projects. He is now at Thomson-CSF in charge of the MLS program, for studying and manufacturing the MLS ground equipments.

(from page 110) **I.E.E. MEETING**

quired in the system, one to prevent pulse breakthrough and the other to eliminate excess noise. Both of these gates employed PIN diode switches. A further PIN diode was used in conjunction with a temperature-sensitive resistor for thermal compensation of the delay line attenuation and for overall trimming.

As one or other of the gates was always closed, fast diodes were not required, so that use could be made of large robust devices offering ease of assembly, high switching performance and reliability and the total current demand was constant at substantially 50 mA independent of prf. Attenuation variations were kept to ± 2 dB over 500 MHz bandwidth and a temperature variation of 80°C.

The drive circuit was fairly conventional, using compact printed circuit board, accepting a slightly early trigger pulse through an opto-isolator and generating the required waveforms.

K. Harris of Microwave Associates, Dunstable, described practical examples of diverse uses of the PIN diode in microwave switching circuits, explaining how the design is determined by the application. For high power usage particular attention had to be paid to thermal resistance, tending to result in large diodes of high capacitance and long minority carrier lifetime, good for slow switching at 20 MHz - 1 GHz but far from ideal at frequencies of 10 GHz and upwards. Conversely, small diodes had limited power capability. Whereas few problems in tradeoffs were involved in many low power applications, optimization of diode parameters was important where high power or fast switching capability was required.

The diverse switching applications described included a 1500 CW switching operating from 20 100 MHz, using hermetically sealed CERMACHIP PIN diodes, a T.R./A.T.R. fast X-band switch with 200 W CW power capability, using low thermal resistive plated heat sink diodes and a 60 GHz switch suitable for data link applications at powers of up to 1 W, using unencapsulated plated heat sink diodes. Discussed also, was an experimental bulk window design for use over 26 - 40 GHz instantaneous bandwidth, with a peak power capability in excess of 10 kW.

The final contribution was from R. N. Bates and M. D. Coleman of the Philips Research Laboratories, Redhill, discussing millimeter-wave finline PIN switches for use in the frequency ranges 30 - 40 GHz and 80 - 90 GHz. Two types of switch were described, the one a two-port arrangement for use as an attenuator or modulator and the other a three-port device for use as a Dicke switch in radiometer receivers.

The circuits discussed were all prepared on thin low dielectric constant substrates, the patterns being defined via conventional printed circuit board techniques and hence potentially cheap to produce. They were mounted in the "E"-plane of a rectangular waveguide and incorporated finline, microstrip and coplanar line.

The two-port switch or attenuator comprised a short section of isolated unilateral finline in rectangular waveguide shunted by two or more PIN beam lead diodes, the fin-line being cosine taper matched. By connecting suitable modulators to the loaded fin-line sections, voltage controlled attenuators and switches were realized. For K_a-band (26.5 - 40 GHz) twin-diode units had given attenuation from 0.5 - 20 dB and quad-diode units correspondingly 1 - 30 dB, with "On" current of 2 mA and 1.4 mA, respectively and "Off" voltage 12 V in each case. Corresponding figures for twin-diode units in O-band (80 90 GHz) were 1.7 - 20 dB, 1 mA, 15 V.

Three-port switches employed symmetrical "Y" junctions of three isolated unilateral finlines in rectangular waveguide. Using pairs of diodes across each of the output fin-lines, switching over 30 to 40 GHz was obtained with an insertion loss of 1.5 dB and isolation of 20 dB, corresponding figures over 80 to 90 GHz being 2.5 dB, and 20 dB, the "On" current being 8 mA and "Off" voltage 10 V in each case.

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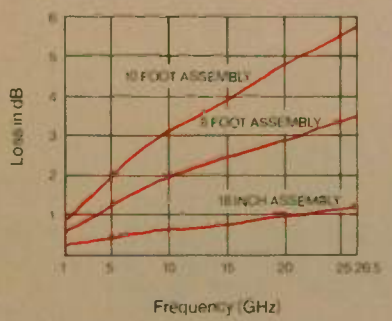

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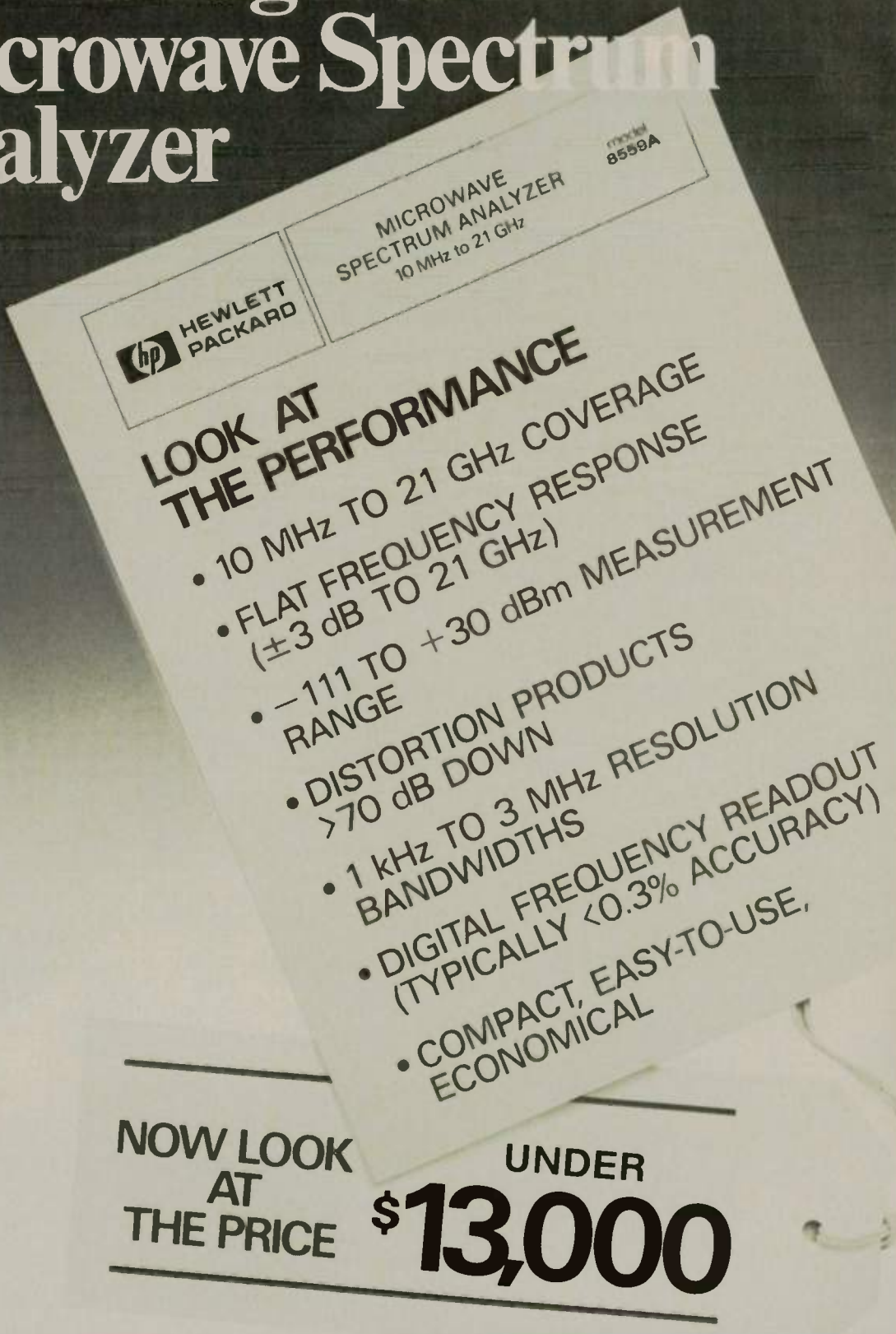

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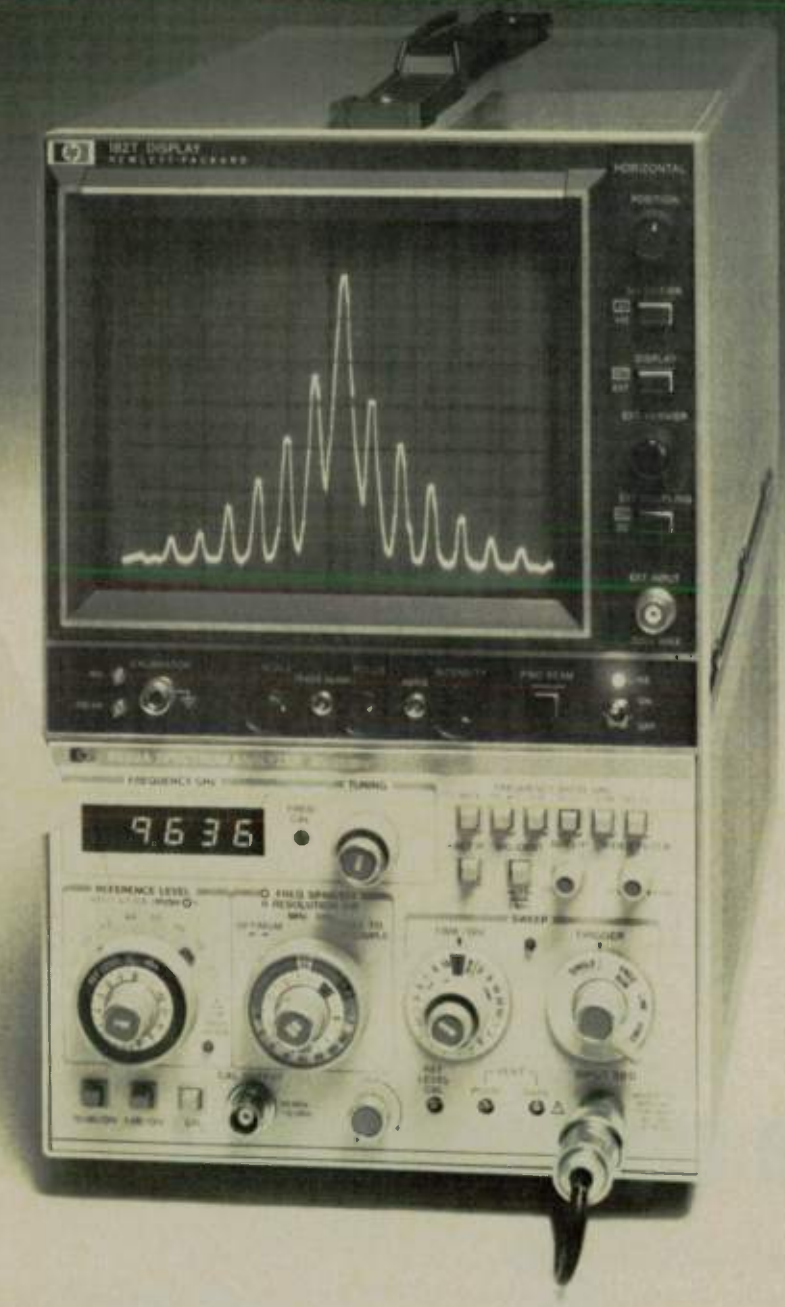

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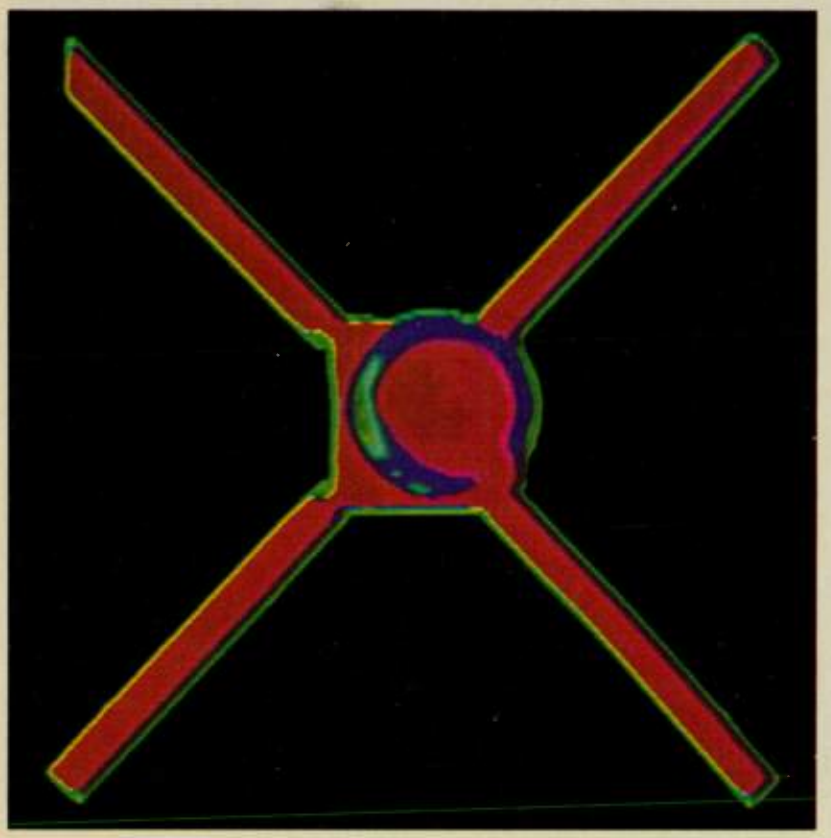

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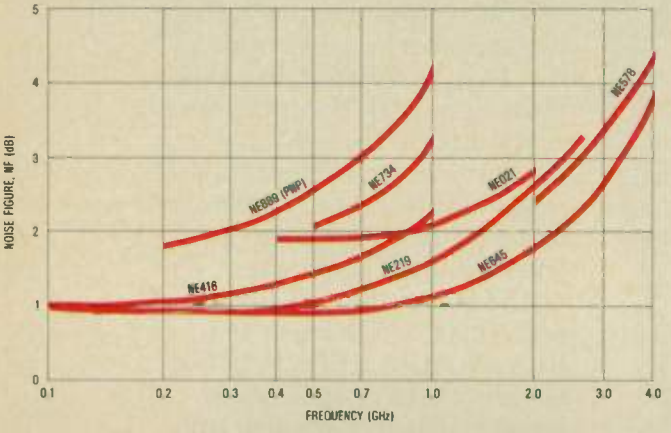

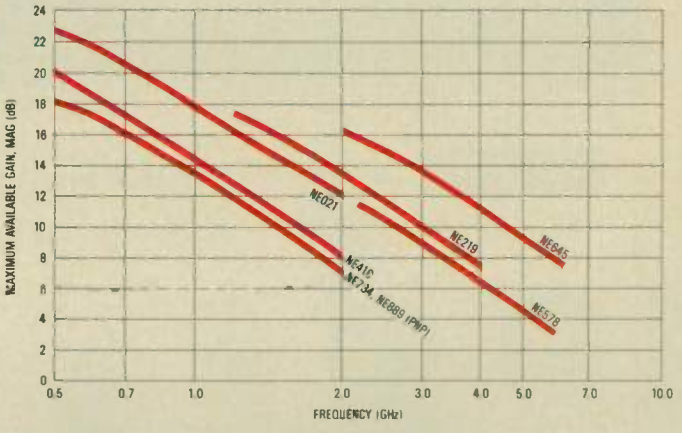

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Graphs of Circuit Elements for the Marchand Balun

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National Institute for Aeronautics and Systems Technology, CSIR, Pretoria, South Africa

INTRODUCTION

The Marchand balun[1] exhibits excellent amplitude balance for bandwidth ratios in excess of a decade. In addition, it can be designed to incorporate transformer action for applications where the load and source resistances differ.[2] The Marchand balun has been used in a variety of physical implementations, including coaxial and planar, for applications like spiral antennas[3] and balanced mixers.[4]

In typical antenna applications the balanced load resistance differs significantly from the source resistance and it is necessary to implement transformer action in the balun in order to achieve an acceptable match. For example, in the case of spiral antennas the balanced load impedance generally has a nominal real part in excess of 100 Ω which must be matched to 50 Ω. A popular design approach to this problem is to design a balun for a 50 Ω load, and then to incorporate a tapered line section to transform the balanced load resistance to approximately 50 Ω. However, failure to take the interaction between the balun and transformer into account properly can lead to unnecessarily degraded frequency response for broadband designs.

An alternative approach to achieve transformer action is the use of quarter-wave sections instead of a tapered line. This method has the advantage that exact synthesis techniques can be used to include the transformer sections in the balun, thus allowing designs with accurately predictable performance to be implemented. In a recent paper the existence of graphs for the design of a third order balun with a single section quarter-wave output transformer, and a fourth order balun with single section quarter-wave input and output transformers was announced.[2]

The purpose of this paper is to publish a set of these graphs for the design of the fourth order balun shown in Figure 1. Graphs for the third order balun will not be published since approximate closed form equations for the element values are available.[5]

Both the third and fourth order baluns have maximum bandwidth ratios in the order of 12:1 due to the high characteristic impedance Z_3, required for the shunt stub, becoming practically unrealizable. The advantage of the fourth order balun over the third order balun is that for a given load resistance, a significant reduction in passband reflection coefficient can be obtained, depending on the required bandwidth. The improved match is achieved without compromising on the compact physical structure of the Marchand balun, but does involve increased manufacturing expense due to the input quarter-wave line, Z_1.

THE GRAPHS OF ELEMENT VALUES

The graphs of fourth order Marchand balun circuit element values are given in Figures 2 to 6

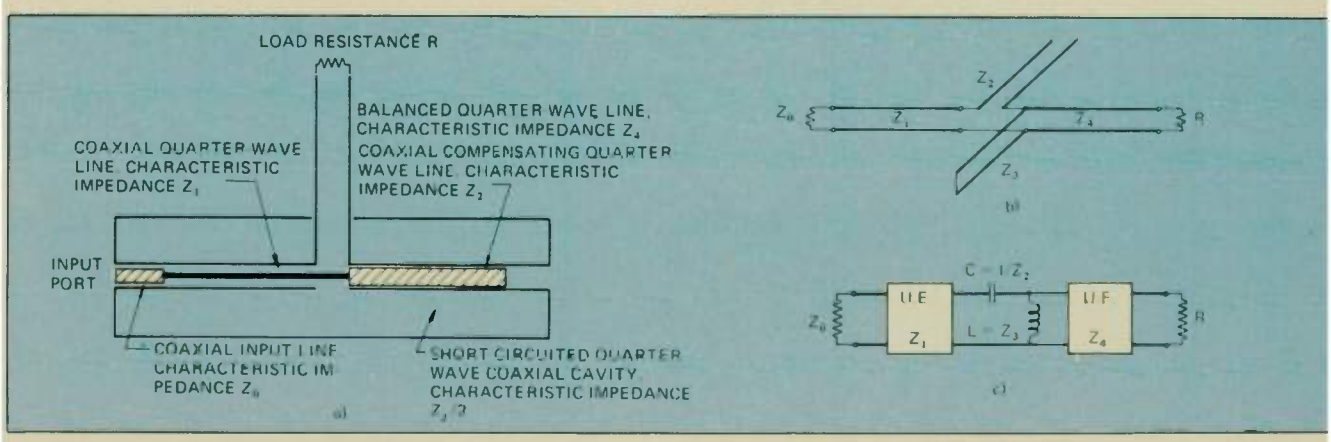

Fig. 1 The fourth order Marchand balun a) Physical circuit; b) Transmission line equivalent circuit; c) Equivalent circuit using distributed element notation.

for five bandwidth ratios ranging from 4:1 to 12:1, and realize the Tchebysheff bandpass response.

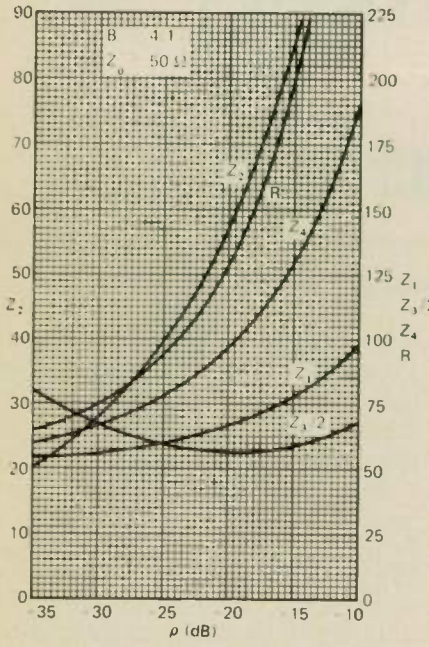

Fig. 2 Graphs of element values for the fourth order balun with source resistance $Z_0 = 50\ \Omega$ and bandwidth ratio B = 4:1.

For each bandwidth ratio, the element values are plotted as a function of maximum passband reflection coefficient. The notation used in the graphs is consistent with that of **Figure 1**.

The graphs were produced using the exact, non-redundant method for the synthesis of commensurate length distributed networks described by Horton and Wenzel.[6] The synthesis program is highly accurate, however, the price to pay for the convenience of the graphs is a loss of accuracy due to read-off errors. In the case of Z_2, the characteristic impedance of the series open circuit stub, the error should typically be less than ± 0.5 Ω, and for the other elements the error should typically be less than ± 1 Ω.

A simple check on the accuracy of the values obtained from the graphs can be made by using the following symmetry equations[7] for the element values of the balun,

$$Z_1 Z_4 / R = Z_2 Z_3 / R = Z_0$$

where $Z_0 = 50\ \Omega$ for the graphs. (see Table II)

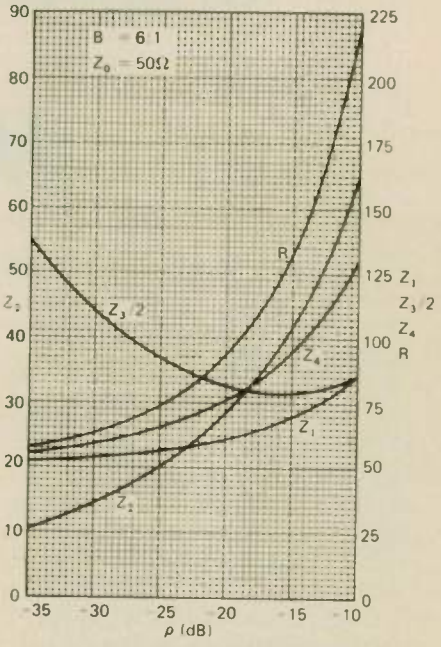

Fig. 3 Graphs of element values for the fourth order balun with source resistance $Z_0 = 50\ \Omega$ and bandwidth ratio B = 6:1.

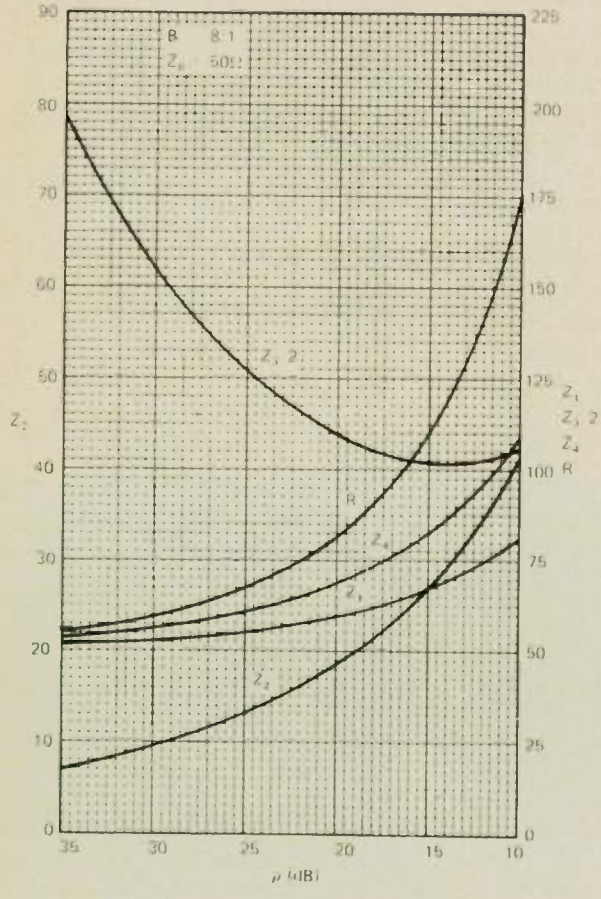

Fig. 4 Graphs of element values for the fourth order balun with source resistance $Z_0 = 50\ \Omega$ and bandwidth ratio B = 8:1.

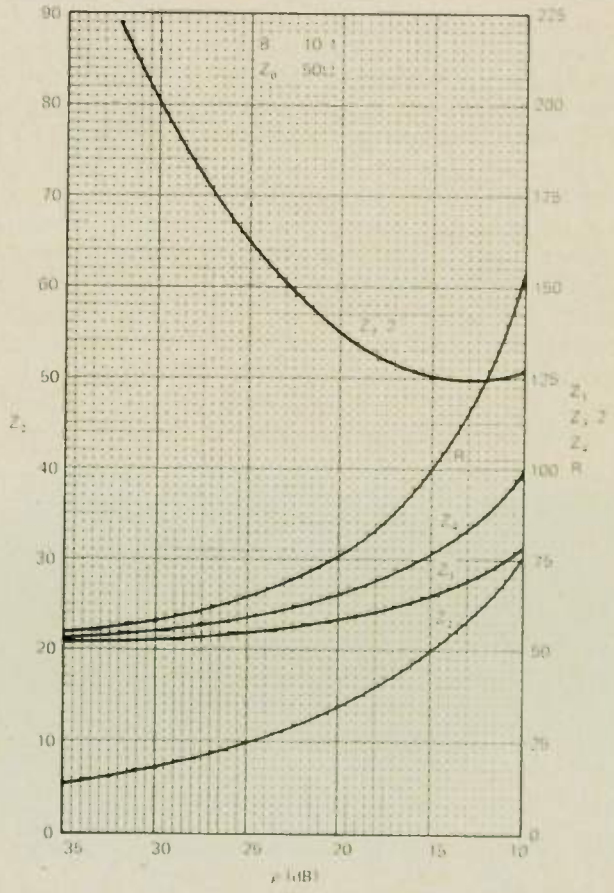

Fig. 5 Graphs of element values for the fourth order balun with source resistance $Z_0 = 50\ \Omega$ and bandwidth ratio B = 10:1.

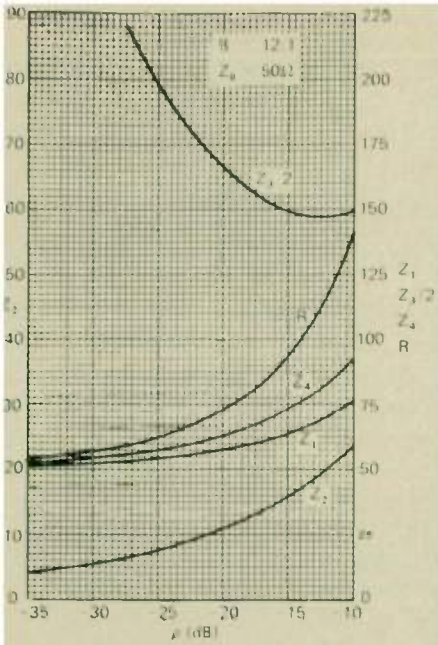

Fig. 6 Graphs of element values for the fourth order balun with source resistance Z_0 = 50 Ω and bandwidth ratio B = 12:1.

DESIGN EXAMPLE

To illustrate the use of the graphs consider the design of a balun with bandwidth ratio 10:1, source resistance 50 Ω, and load resistance 100 Ω. The element values and maximum passband reflection coefficient are found from Figure 5 and given in Table 1. For comparison, the exact values as computed by the synthesis program are also tabulated. It is seen that the errors are insignificant from a practical viewpoint when manufacturing tolerances are considered. In addition, the

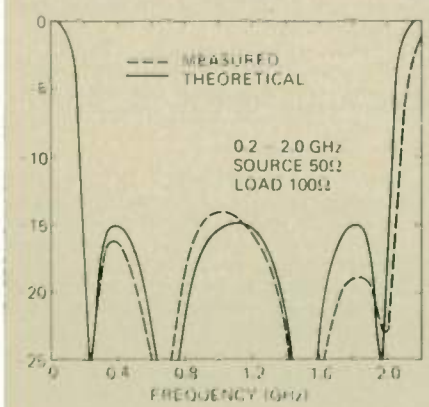

Fig. 7 Measured and theoretical frequency response of an experimental 10:1 bandwidth fourth order Marchand balun with 50 Ω source resistance and 100 Ω load resistance.

TABLE 1

ELEMENT VALUES FOR A FOURTH ORDER BALUN

	Z_1 (Ω)	Z_2 (Ω)	Z_3 (Ω)	Z_4 (Ω)	ρ(dB)
Exact values	65.14	19.99	250.18	76.75	-14.87
Values from Fig. 5	65.0	20.0	250.0	76.0	-14.9
Error magnitude	0.14	0.01	0.18	0.75	0.03

Bandwidth ratio B = 10:1, Source resistance Z_0 = 50 Ω, Load resistance R = 100 Ω

TABLE II

ELEMENT VALUES FOR FOURTH ORDER MARCHAND BALUN AS COMPUTED BY THE SYNTHESIS PROGRAM

FOURTH ORDER MARCHAND BALUN WITH IN AND OUTPUT TRANSFORMERS

BANDWIDTH RATIO = 10

RHO(DB)	Z_1	Z_2	$Z_1/2$	Z_4	R
-35.00	51.58	5.35	255.44	52.97	54.65
50.00	50.00				
-34.00	51.77	5.68	242.96	53.32	55.20
50.00	50.00				
-33.00	51.97	6.03	231.29	53.70	55.82
50.00	50.00				
-32.00	52.21	6.41	220.37	54.12	56.51
50.00	50.00				
-31.00	52.46	6.81	210.17	54.59	57.28
50.00	50.00				
-30.00	52.75	7.25	200.66	55.12	58.15
50.00	50.00				
-29.00	53.00	7.71	191.81	55.71	59.13
50.00	50.00				
-28.00	53.44	8.20	183.58	56.36	60.23
50.00	50.00				
-27.00	53.84	8.73	175.95	57.08	61.47
50.00	50.00				
-26.00	54.29	9.30	168.90	57.89	62.86
50.00	50.00				
-25.00	54.79	9.92	162.40	58.79	64.43
50.00	50.00				
-24.00	55.36	10.58	156.44	59.80	66.20
50.00	50.00				
-23.00	55.99	11.29	151.00	60.92	68.21
50.00	50.00				
-22.00	56.69	12.06	146.06	62.17	70.49
50.00	50.00				
-21.00	57.49	12.90	141.62	63.56	73.08
50.00	50.00				
-20.00	58.38	13.81	137.67	65.13	76.04
50.00	50.00				
-19.00	59.39	14.80	134.20	66.88	79.43
50.00	50.00				
-18.00	60.52	15.88	131.21	68.84	83.33
50.00	50.00				
-17.00	61.80	17.06	128.72	71.05	87.82
50.00	50.00				
-16.00	63.26	18.35	126.72	73.54	93.04
50.00	50.00				
-15.00	64.91	19.79	125.25	76.36	99.12
50.00	50.00				
-14.00	66.80	21.37	124.32	79.55	106.27
50.00	50.00				
-13.00	68.96	23.14	123.98	83.20	114.75
50.00	50.00				
-12.00	71.46	25.12	124.29	87.37	124.88
50.00	50.00				
-11.00	74.37	27.36	125.32	92.19	137.14
50.00	50.00				
-10.00	77.79	29.91	127.18	97.81	152.16
50.00	50.00				

(continued on page 12

values satisfy the symmetry equations.

The element values of Table 1 were used to design a 0.2 GHz to 2 GHz bandwidth balun and Figure 7 shows good agreement between the theoretical and measured frequency responses of the experimental balun.

CONCLUSIONS

A set of graphs has been presented which enables fourth order Marchand baluns with Tchebysheff passband responses to be designed rapidly for a large range of load resistances and bandwidth ratios, without the designer having to resort to the numerically complicated synthesis procedure.

ACKNOWLEDGEMENT

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1 Kw Peak

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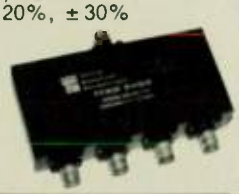
Isol.	30dB
VSWR	1.3:1



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HS 152	0.1 - 100
HS 153	20 - 200
HS 154	100 - 400
HS 155	.2 - 200
HS 156	5 - 500

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Isolation	30dB
VSWR	1.5:1
Phase Bal.	3°
Amp. Bal.	0.3dB
Input Power	2.5w

IMPEDANCE Avail. 50 or 75Ω

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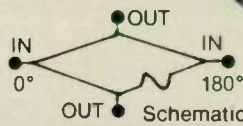
Loss	.3dB
Isolation	30dB
VSWR	1.3:1
Phase Bal.	2°
Amp. Bal.	.2dB
In Power	60 w



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TYP. SPEC.			
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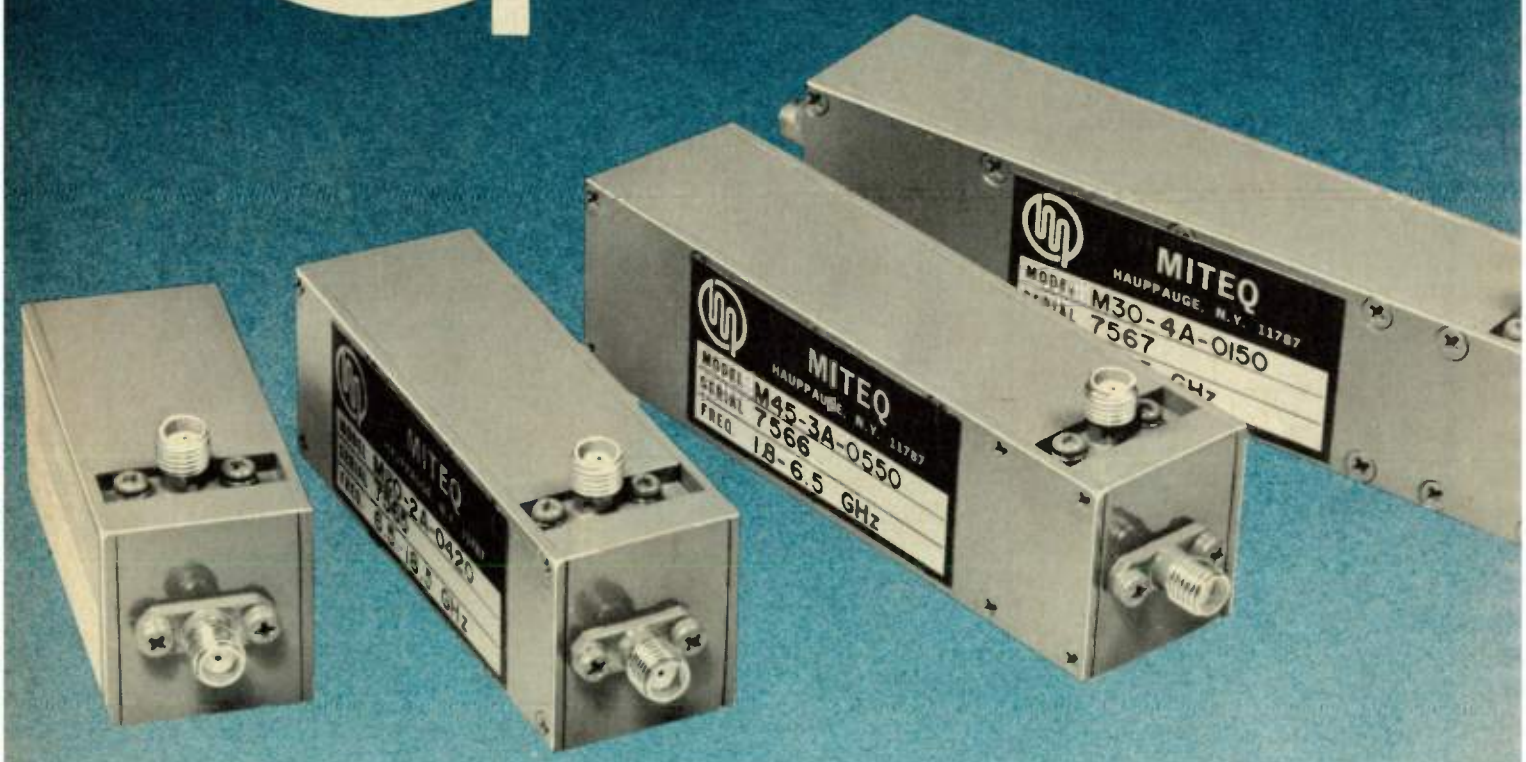

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2-STAGE IF AMPLIFIER (2A SERIES)*							
1-150 MHz IF AMPLIFIER							
MLO-2A-0115	1-2	22	6.5	7.5	0	40	2
M45-2A-0115	1.8-6.5	22	7.0	8.0	0	40	6
M35-2A-0115	3-10	22	7.5	8.5	0	40	6
M30-2A-0115	4-15	22	7.5	8.5	0	40	6
M20-2A-0115	6.5-18.5	22	8.0	9.0	0	40	6
M2C-2A-0115	2-18.5	22	8.0	9.0	0	40	6
1-500 MHz IF AMPLIFIER							
MLO-2A-0150	1-2	22	7.0	8.0	8	55	2
M45-2A-0150	1.8-6.5	22	7.5	8.5	8	55	2
M35-2A-0150	3-10	22	7.5	8.5	8	55	6
M30-2A-0150	4-15	22	8.0	9.0	8	55	6
M20-2A-0150	6.5-18.5	22	8.5	9.5	8	55	6
M2C-2A-0150	2-18.5	22	8.5	9.5	8	55	6
5-1000 MHz IF AMPLIFIER							
M45-2A-000510	2-6	17	8.5	9.5	0	35	6
M35-2A-000510	3-10	17	9.5	10.5	0	35	6
M30-2A-000510	4-15	16	9.5	10.5	0	35	6
M20-2A-000510	6.5-18.5	16	10.5	11.5	0	35	6
400-2000 MHz IF AMPLIFIER							
M35-2A-0420	3-10	14	8.0	9.0	5	35	6
M30-2A-0420	4-15	14	8.5	9.5	5	35	6
M20-2A-0420	6.5-18.5	14	9.0	10.0	5	35	6

MIXERS

Model	RF & LO Band (GHz)	IF Band (GHz)	Conv. Loss (dB) Typ.	Conv. Loss (dB) Max.	Min Isolation LO/RF	Min Isolation LO/IF
OCTAVE BAND DESIGNS						
MLO	1-2	0-0.5	5.0	6.0	25	15
MSO	2-4	0-1.0	5.0	6.0	25	20
MCO	4-8	0-2.0	6.0	7.0	25	20
MXO	8-12.5	0-3.0	6.5	7.5	25	20
MKO	12-18.5	0-3.0	6.6	7.5	20	15
M2D	4-8	8-16	7.5	8.5	25	25
M4D	2-4	4-8	7.5	8.5	25	25
WIDEBAND MULTIOCTAVE DESIGNS						
M45	1.8-6.5	0-1.0	6.0	7.0	25	20
M35	3-10	0-2.0	6.0	7.0	20	20
M30	4-15	0-2.5	6.5	7.5	20	15
M20	6.5-18.5	0-3.0	7.0	8.0	20	15
M2C	2-18.5	0-.6	7.0	8.0	20	15
M2C	3-12	0-.6	6.5	7.5	25	25

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Arcsprayed Metal Coating For EMI/RFI Shielding

MERLE L. THORPE
TAFA Metallisation, Inc.
Bow (Concord), NH

INTRODUCTION

Stray signals of EMI (electromagnetic interference) and RFI generated by static sparks or outside signals can effect many types of sensitive and critical electronic equipment such as computers, medical equipment, navigational instruments, and process controls. EMI/RFI from auto ignition can produce radio static; likewise, EMI/RFI can result in transit errors in computer operations and cause pacemakers to faulter. Electromagnetic interference has become a serious problem, even to the laymen, with the advent of hand tools, household appliances, CB's, and the like.

Conventional shielding methods include foil, tape, screening, plating, vacuum metallizing, conductive paint coatings and metal spraying. The Arcspray process discussed here is a significant improvement over conventional metal spraying techniques. Prior to the development of this process, metal spraying required the use of flames which produce more oxide in the coatings, lower bond strengths, and significant substrate heating. The Arcspray process is a novel system for melting and spraying any conductive material available in a wire form. It minimizes or eliminates the problems previously associated with flame spraying.

Metal spraying equipment which utilizes a heat source, compressed air and metal wire feedstock has been in existence for a long time. The process involves melting wire, atomizing it and propelling the molten metal particles to the surface to be coated. In the case of EMI shielding, the most desirable metal is zinc because of cost, physical properties, ease of application, minimum toxicology problems, inertness, stability and superior film properties once sprayed. Prior to the advent of Arcspray, metal spraying systems for the application of zinc required the use of an oxygen fuel combustion flame to melt zinc wire (see Figure 1).

A single 11 gauge or 1/8" wire is surrounded by the flame and about 2 kW is transferred to the wire. The remainder of the energy exists as a hot gas stream impinging on the substrate. This creates problems with the properties of the coating and more importantly, overheats and warps the substrate. The system, by comparison, (see Figure 2) can melt zinc at the same rate with only 2 kW with essentially all the energy used to melt the zinc. Cool compressed air then atomizes the molten surfaces on the melting wires and produces a stream of fine droplets (5-100 micron) suspended in a cool air stream. This permits 1-10 mil coatings to be built up on plastic substrates at rates up to 312 ft.^{2}/hr. without noticeable heating — the substrate temperatures never rising above 100-110°F even though zinc melts at 770°F (see Figure 3).

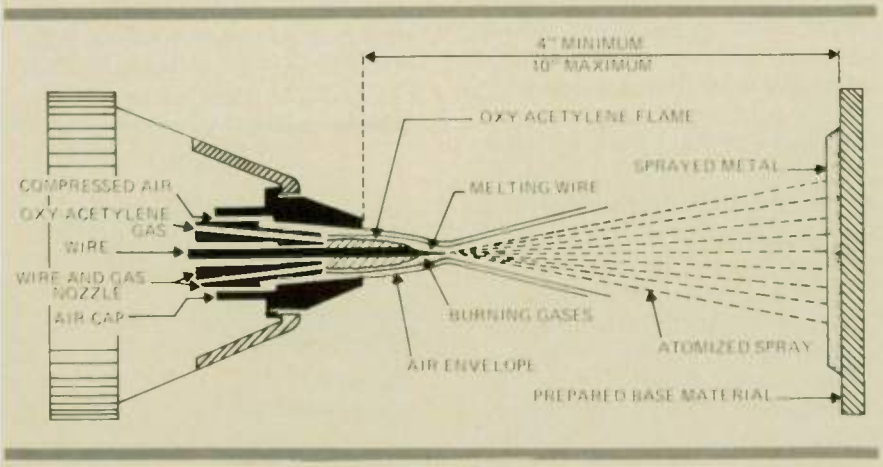

Fig. 1 Oxy fuel combustion metallizing gun.

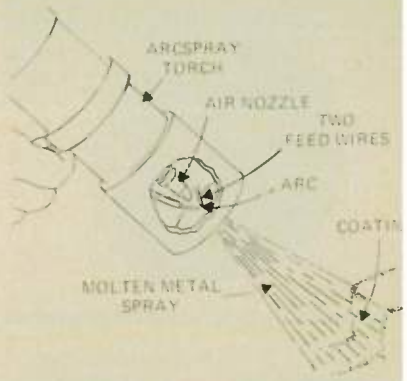

Fig. 2 Arcspray metallizing system.

HOW THE SYSTEM WORKS

The system is, simple and easy to use. Two electrically isolated wires—the coating metal—are fed into the gun so that only the ends of the wires come into contact. An electric arc melts the

TABLE I

ARCSPRAYED ZINC COATING PROPERTIES

Tensile strength of zinc coating material	13,200 psi
Density	6.42 gm/cc
Density percent of theoretical	90 percent
Coating weight	0.0334 lbs/ft^2/mil
Conductivity (2 mil coating)	20 milliohms/square
Hardness (Knoop$_{100}$)	142
Surface finish	55-100 rms
Melting point	770°F
Zinc wire purity (min)	99.99 percent
Life of coating	unlimited
Bond strength	See Table III

TABLE II

SPRAY CONDITIONS

Wire size	1/16" (1.6 mm)
dc Amperes	50-125
dc Volts	20
Air flow	35 SCFM
Air pressure	90 psig
Standoff	6-12 inches
Area coverage (50-125 amps)	
1 mil	124-312 ft^2/hr.
4 mil	31-78 ft^2/hr.

Fig. 3 Zinc with 770°F melting point can be sprayed on any substrate without overheating.

Fig. 4 TAFA Arcspray zinc spraying system with bulk wire dispensers.

ends and the molten material is blown off as fine particles by an air atomizing jet to form a dense, well-bonded, instantly dry metallic coating on the part being sprayed.

The spray gun is similar in size and appearance to those used for paint spraying with the wire feedstock fed automatically. Although the deposits are applied in a molten state, a significant characteristic is that the substrate undergoes only a small temperature rise. The system consists of a spray gun, constant potential power supply, simple control unit and wire dispensing system as shown in Figure 4. Spray rate is controlled by one valve on the spray gun. Input requirements are only 5 kVA and 35 CFM compressed air.

PROPERTIES OF THE COATING

It should be noted that the coating is all metal using 99.99 percent zinc as feedstock, and as long as there is visual coverage, adequate shielding is achieved for most purposes. Zinc coatings have been applied for corrosion protection for many years and considerable technical data is available relative to the life of the zinc coating.

Zinc coatings (unlike paints) have demonstrated a life expectancy of over 40 years in rural outdoor applications. In the case of shielding applications where the environment is even less severe, one could expect unlimited life of the zinc coating. In addition, if the zinc coating ages, this new surface is also conductive. This eliminates any concern relative to performance of zinc coatings in any forseeable atmosphere related to electrical and electronic work.

The tables shown above present coating properties and application data. Similar properties are achieved (except for coating finish and visual cosmetic appearance) at 65 psi atomizing but 90 psi is recommended.

The bond of the coating to the plastic substrate is a mechanical one. Thus, the substrate must be either naturally rough as produced or roughened by some artificial procedure. The latter is normally accomplished in production by light grit blasting of the surface of smooth materials such as Lexan, Noryl and smooth structural foams. On a surface blasted with 80 mesh aluminum oxide at 80 psi (standard production procedure) the following bond strengths to the substrate plastic have been achieved:

TABLE III

TENSILE BOND STRENGTHS* (psi) ARCSPRAYED ZINC

Noryl	350
Polycarbonate	380
Structural Foam	425
ABS	240
Phenolic	450
Glass Filled Nylon	1050

*Coating pulled at right angles to plastic substrate.

(continued on page 136)

Introducing... the Smallest, Lightest, Most Selective Bandpass Filters in the World.

FCL-7 Series

1 to 18 GHz

Our unique designs of Suspended Substrate Stripline filters offer incredible selectivity coupled with very low passband insertion loss.

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All this in the smallest, lightest package on the market.

JUST LOOK AT THESE SPECIFICATIONS

SPECIFICATIONS

	Passband (GHz)	Insertion Loss (dB Max)	VSWR (Max)	Stopbands (GHz) 60 dB Min	Power Rating (Watts, average)	Weight (Oz)	Size (inches) Excluding connectors
FCL-712	1.0 — 2.0	0.75	1.5	DC — 0.95 2.15 — 6.0	100	1.5	.5 x 1.35 x 2.5
FCL-714	1.0 — 4.0	0.75	1.5	DC — 0.95 4.3 — 13.0	100	1.25	.5 x 1.09 x 2.29
FCL-718	1.0 — 8.0	0.75	1.6	DC — 0.95 8.6 — 20.0	50	1.25	.5 x 1.09 x 2.22
FCL-724	2.0 — 4.0	0.75	1.5	DC — 1.9 4.3 — 13.0	50	1.0	.375 x .9 x 1.85
FCL-728	2.0 — 8.0	0.75	1.5	DC — 1.9 8.6 — 20.00	50	1.0	.375 x .9 x 1.78
FCL-7212	2.0 — 12.0	0.75	1.6	DC — 1.9 12.9 — 20.00	50	1.0	.375 x .9 x 1.72
FCL-748	4.0 — 8.0	0.75	1.5	DC — 3.8 8.6 — 20.00	50	1.0	.375 x .69 x 1.61
FCL-7412	4.0 — 12.0	0.75	1.5	DC — 3.8 12.9 — 20.00	50	1.0	.375 x .69 x 1.57
FCL-7418	4.0 — 18.0	0.75	1.6	DC — 3.8 19.3 — 26.5	50	1.0	.375 x .69 x 1.56
FCL-7812	8.0 — 12.0	0.75	1.5	DC — 7.6 12.0 — 20.00	50	0.75	.375 x .82 x 1.45
FCL-7818	8.0 — 18.0	0.75	1.6	DC — 7.6 19.3 — 26.5	50	0.75	.375 x .82 x 1.42
FCL-71218	12.0 — 18.0	0.75	1.6	DC — 11.4 19.3 — 26.5	50	0.75	.375 x .68 x 1.28

SSS High pass, low pass, bandpass, bandstop Filters.

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INTERFERENCE SIGNAL ATTENUATION

Normally 2 to 5 mils of zinc spray is adequate to achieve 20 milliohms or less per square surface resistivity. Typically, in shielding, 1-10 ohms per square is considered a good number; 500 ohms per square is adequate for some shielding and electrostatic dissipation, and 2000 ohms per square is effective only for electrostatic discharge, not shielding.

Figure 5 shows the attenuation of a typical 4 mil zinc coating on Lexan polycarbonate. All tests discussed were made in the same apparatus using 4 x 5 panels 1/8" thick. The general conclusions drawn are that for most shielding and all static discharge applications a 2-4 mil coating of zinc is more than adequate. In special cases, additional material or an overlay of copper can improve attenuation performance in certain narrow bands.

A variety of zinc coating thicknesses were tested from 2-10 mils and all exhibited similar characteristics in the 0-400 and 770-1000 MHz range. At 400-770 MHz thicker coatings exhibited greater attenuation. For example, 10 mils gave 20 dB more attenuation than 4 mils at 600 MHz. Overlays of 1, 3 and 5 mils of copper on 4 mils of zinc were also evaluated. As an approximation, all the copper coatings increased attenuation in the 200-450 MHz range (about 20 dB) and a similar improvement was achieved in the 850-950 MHz range.

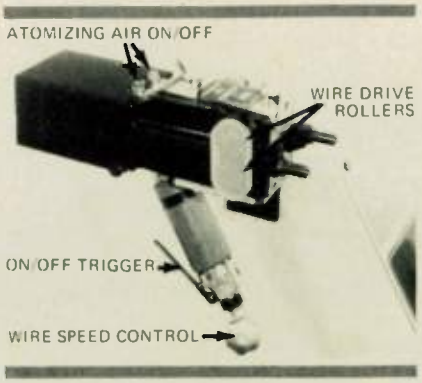

Fig. 6 Arcspray shielding gun.

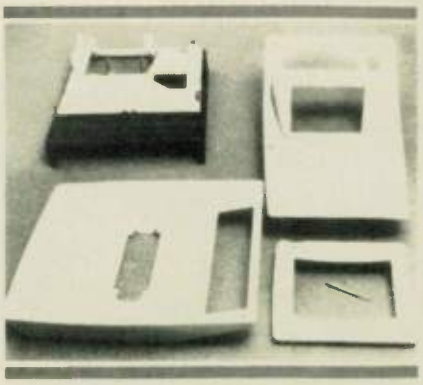

Fig. 7 Arcspray zinc shielded plastic housings.

As a generalization, 1-2 mils of Arcsprayed zinc appears adequate for static discharge shielding. However, 3-4 mils is usually specified since coating application is by hand and visual coverage results in this thickness when the coating is applied in production.

In the case where waveforms must be attenuated entering or leaving an enclosure, the frequency spectrum should be known and tests run on the specific enclosure. However, it would appear from these measurements that Arcsprayed zinc gives adequate shielding except for very special high energy applications.

EQUIPMENT FEATURES AND PROCESS ADVANTAGES

The Arcspray shielding system is shown in Figure 4. The bulk wire source (drum) is used for volume applications to reduce wire cost through direct mill shipments, elimination of spooling costs, and reduced down-time for wire pack changes. Twelve hundred pounds of wire is attached to the gun at each loading. This allows continuous spraying for approximately 48 hours. The barrels of zinc are capped with a dispensing system which eliminates tangles, wipes the wire clean of any residual debris, and prevents dust from collecting on the wire prior to feeding. Wire is fed directly into lightweight conduits which are attached to the manual or automated spray gun. The distance from the zinc source to the gun is limited to ten feet of conduit to minimize friction.

The spray gun is shown schematically in Figures 2 and 6 and incorporates a 1/3 horse-power, simple air motor drive, which is positively connected to all four drive rolls. Wire drive rolls are external for easy cleaning and inspection. The wire is pulled from the source to the gun, and pushed an additional four inches through metal tubes which serve as electrical contact for the wires and a guide so that the wires intersect precisely for consistent arcing and efficient atomization. Guide tubes are made in two parts – a permanent tube and an inexpensive replacement tip which can be changed without effecting alignment. Typically such tips are replaced between 200 and 1,000 pounds of sprayed wire. A trigger control lever is located on the spray gun handle to instantly turn the spray on and off.

The general characteristics of this technique which should be considered in any design application include:

- One hundred percent metal coating which gives excellent

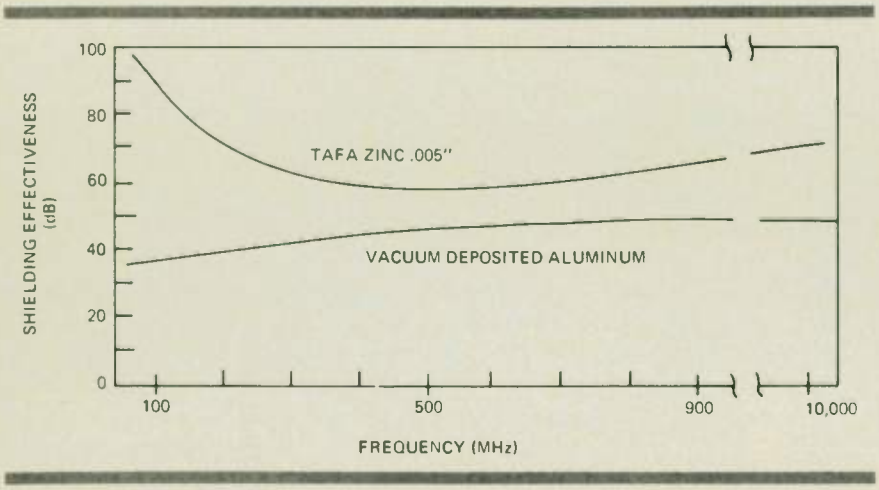

Fig. 5 EMI shielding effectiveness vs. frequency.

(continued on page 138)

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mating surface conductivity, as well as strength and integrity, permits rough handling and attachment of screws and star washers.

- Low temperature application with no after processing or parts heating.
- Instantly dry-part can be handled and used immediately after spraying.
- Easy masking of areas which do not require a coating.
- Instant startup and shutdown and no cleanup of guns, pots and hoses as with paints.
- Unlimited coating life with no deterioration.
- Requires inexperienced operator, visual coverage adequate.
- Application to all types of plastics.
- Low initial investment and coating costs.

ECONOMICS

Estimated costs of the application of the Arcspray zinc coating depends on the number of parts to be sprayed, their complexity, and size. It is difficult to arrive at a generalized cost number.

A survey has indicated the lowest vendor price for a simple Arcspray shielded part (which included no masking) was in the range of $1.25 per square foot and upward depending on complexity and volume. Depending on the complexity of the part and the number of bosses, screw holes, etc., the survey indicated masking costs could add from 10 percent to 100 percent. Also, one should note, that one coat with a metal is sufficient to produce the shielding results required.

Merle L. Thorpe has been President of TAFA since 1961. He has been an innovator in high temperature technology for the past 25 years, having founded and developed numerous companies in that field. Since 1970, his company has been active in the sprayed metal tooling field. He holds over 30 patents in the field, is a member of the American Welding Society Thermal Spray Executive Committee, and is a member of numerous technical societies including the Society of Plastics Engineers. Mr. Thorpe holds an A.B. and M.S. in Engineering Science from Dartmouth College. In addition to his industrial activity, he has been a Professor and Assistant Dean at Dartmouth.

Cover Story

K-Band Fundamental YIG-Tuned Oscillator

AVANTEK, INC.

An 18-26.5 GHz YIG tuned oscillator integrated with a multi-stage buffer amplifier extends the range in which fundamental transistor oscillator sources may be applied and their inherent advantages enjoyed.

The Avantek AV-71826 employs 15 μm gate width, submicron gate length GaAs FET's in its fundamental oscillator and buffer amplifier stages to deliver a minimum of 20 mW over the full 18-26.5 GHz range. Peripheral characteristics offer significant benefits when compared to available bulk diode and multiplied bipolar transistor sources in that frequency band.

Over the 18-26.5 GHz band, maximum output power variation is ± 3.0 dB; pulling at 12 dB return loss is 0.5 MHz, typical; frequency drift over the rated case temperature range of 0° to 65°C is 60 MHz maximum; spurious output is 60 dBc, minimum and, with all harmonics above 36 GHz, filtering for harmonics poses no particular problem.

The main tuning port characteristics of the AV-71826 include a typical current sensitivity of 27 MHz/mA, 3 dB bandwidth of 5 kHz typical and typical linearity of 0.1%. Its FM port sensitivity is typically 450 kHz/mA, its typical 3 dB bandwidth is 400 kHz and its maximum deviation at 400 kHz is 90 MHz.

With a dc drive of 150 mA maximum at 15 volts, the AV-71826 bias power requirement is well below those of bulk diode designs in its frequency range.

The new oscillator is well suited to instrument and EW system applications. The similarities of its operating characteristics and power requirements to those of its lower frequency predecessors make it a particularly attractive option for extending the range of existing designs and for new broadband equipment which must cover the 18-26.5 GHz band.

Complete specifications are listed in Table I.

TABLE I

AV-71826
Oscillator Specifications
(At 25°C Case Temperature)

Frequency Range	18 to 26.5 GHz
Power Output (50 ohm load), Min.	20 mW (+13 dBm)
Power Output Variation, Max.	±3.0 dB
Operating Case Temperature Range	0 to 65°C
Frequency Drift over Operating Temperature, Max.	60 MHz
Pulling Figure (12 dB return loss), Typ.	0.5 MHz
Pushing Figure, Typ. +15 V Supply	1 MHz/V
Magnetic Susceptibility, Typ. @ 60 Hz	50 kHz/Gauss
Spurious Output (below carrier), Min.	60 dB
Main Tuning Port Characteristics	
Sensitivity, Typ.	27 MHz/mA
Bandwidth (3 dB), Typ.	5 kHz
Linearity, Typical	1%
Hysteresis, Typ.	12 MHz
Input Impedance, Typ. @ 1 kHz	12 Ω in series with 85 mH
FM Port Characteristics	
Sensitivity, Typ.	450 kHz/mA
Bandwidth (3 dB), Typ	400 kHz
Deviation @ 400 kHz Rate, Max.	90 MHz
Input Impedance, Typ.	1 ohm in series with 1.25 μH
DC Circuit Power, Max.	+15V @ 150 mA Max.
YIG Heater Power	20 to 28 VDC, 2 W max. @ 25° C 3 W max. @ 0°C
Weight, Nominal	17 oz.
Outline Dimension	YIG M3 with no −5V connection and center to connector spacing of .600

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- *Power GaAs FET's.*
  Organizers: J. W. Gewartowski, H. Q. Tserng. Sponsors: MTT-6, MTT-7.

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The 1300 MHz Network Analyzer—

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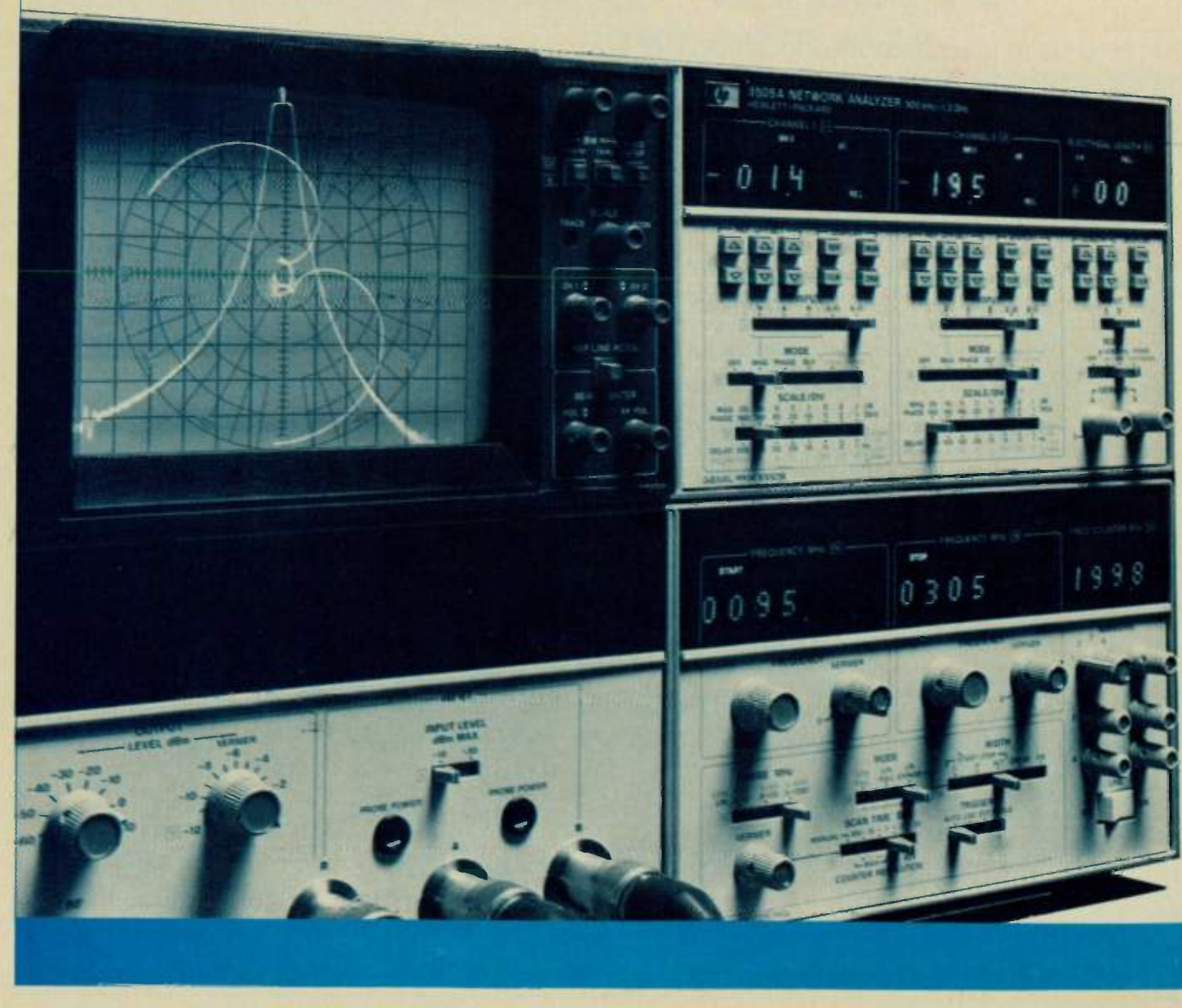

• Over 3 Decades of Swept Frequency Coverage
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• Direct Measurement of Group Delay

HP's 8505A Network Analyzer brings the precision, resolution and range you need for the measurement of phase and magnitude of transmission and reflection, group delay and deviation from linear phase. And any two parameters can be measured and displayed simultaneously.

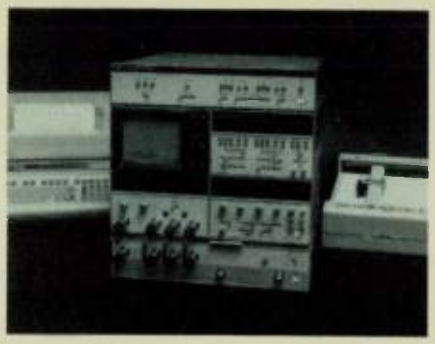
• Test signals come from the 8505A's built-in high performance sweeper with exceptional spectral characteristics and a wide variety of sweep modes (including two independent start/stop sweeps) to accommodate virtually any test requirement.

• The 8505A's 500 kHz to 1.3 GHz frequency range gives you the broad coverage you need to characterize such networks as filters, transistors, antennas, cables, SAW devices and crystals.

• Your measurements are fast and accurate thanks to a swept display with a marker system that provides a high resolution digital readout of the parameter's value at the frequency of any of five variable markers. And group delay measurements are made directly; no calculations required. Or you can observe phase distortions directly in the form of *deviation* from linear phase using the 8505A's revolutionary electronic line stretcher.

• With optional phase-lock capability, the 8505A can be locked to such precision signal sources as the HP 8640 and 8660 Signal Generators. This provides the stability and resolution needed to characterize ultra narrowband devices such as crystal filters.

Get the speed, precision and efficiency of automatic measurements.



Because the analyzer is programmable, via the Hewlett-Packard Interface Bus (IEEE-488), you can combine the 8505A with a computing controller such as HP Model 9825A Desktop Computer to configure a powerful automatic measurement system. With remarkably simple programming you can make many measurements quickly and with enhanced accuracy, and easily format the data to the form you want. The result is high throughput for cost-effective operation in both production test and design lab applications.

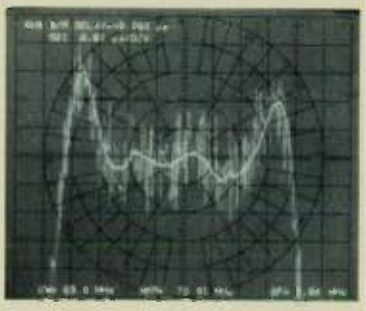
Find Out More.

We've only touched on the highlights of the 8505A's performance and capabilities here. For complete data, contact your nearby HP field sales office, or write 1507 Page Mill Road, Palo Alto, CA 94304.

Add capability with HP's Storage-Normalizer.

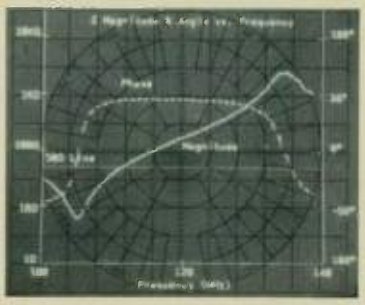
The companion HP 8501A Storage-Normalizer brings these additional features to the 8505A Analyzer:

- *Digital storage* for flicker-free displays.
- *Normalization* to remove errors and make direct comparisons.
- *Magnifier* for up to a tenfold increase in resolution.
- *CRT Labeling* that presents major 8505A settings and marker data.
- *Signal Averaging* that raises signal-to-noise ratio, thereby improving narrowband group delay and low signal level measurements.



Group Delay of 70 MHz bandpass filter with and without averaging (Vert scale 5nsec/div)

When the HP-IB programmable 8501A is combined with the automatic 8505A/computing controller combination, the system offers versatile display capabilities for text and graphics plus high-speed digitizing for fast, yet precise and comprehensive measurements.



Reflection Coefficient data reformatted to impedance magnitude and angle

45906A

HEWLETT PACKARD

Product Feature

Precision 3.5 mm Fixed Short

MAURY MICROWAVE CORP.
Cucamonga, CA

Precise measurements of components employing SMA coaxial connectors have been hampered by the lack of an efficient reference plane short circuit device. The characteristics of the widely used "buried contact" design are far from ideal beginning at 3 GHz and they deteriorate rapidly and continuously as frequency increases.

Designed to eliminate these deficiencies, Maury Microwaves' Model 360D Precision Female Fixed Short employs a large slotted female contact whose outside diameter equals the outside diameter of the mating plug and the entire face of the slotted piece serves as the shorting plane. Upon mating, the outer conductor of the male connector bottoms on the face of the slotted contact. When the coupling is tightened, the slotted contact is compressed around the male pin to complete the short circuit.

Figure 1 illustrates the characteristics of two SMA "buried contact" shorts and one Model 360D short measured against a standard 0.5 cm. offset fixed short. Tabulated amplitude and phase data for one sample of each design are shown in Table 1.

The Model 360D mates with APC 3.5, SMA, MPC3 and MPC4 connectors and is designed for use to 40 GHz. Minimum reflection coefficient through 18 GHz is 0.98; the company will supply specification data at frequencies between 18 and 40 GHz.

The original design for the Model 360D was developed by R. Stewart of Hewlett-Packard.

Circle 132 on Reader Service Card.

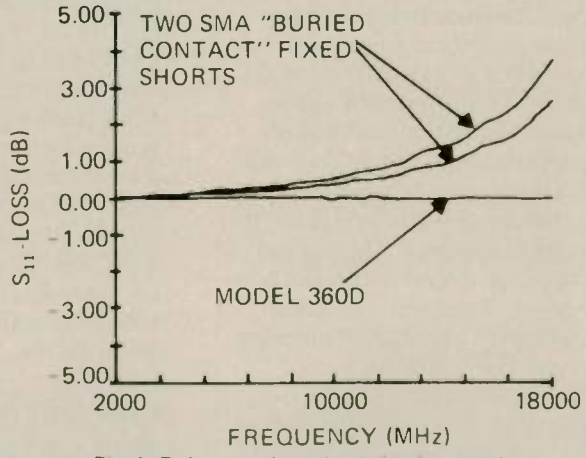


Fig. 1 Reference phase short circuit return loss.

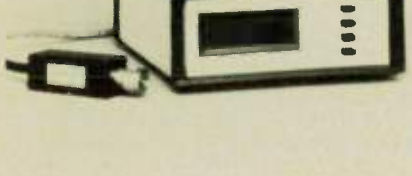
TABLE I

MODEL 360D FREQUENCY	RETURN LOSS-IN S_{11}		SMA "BURIED CONTACT" SHORT RETURN LOSS-IN S_{11}	
MHz	dB	Ang	dB	Ang
2000	-.00	-180.0	.07	178.4
10000	-.00	-179.9	.20	169.1
18000	-.01	-179.9	4.46	123.0

Microwave Products

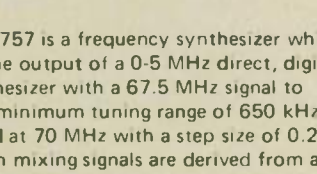
Instrumentation

PEAK RF POWER METER



The PK-38 is a peak RF power meter designed to indicate the peak value in dBm, of an RF pulse, at least 10 μs wide in any time frame at any repetition rate. This time rep-rate range also includes CW. The 3-digit LED display indicates peak power in a 20 dBm range. Offset adjustments have a range of + 99.9 dBm. Frequency range is 1 GHz to 13.5 GHz. The meter can be calibrated from either a peak or CW source. Price: $2,200, per unit. Del: 90 days. ITM Systems, Inc., Sunnyvale, CA. Walter Berg, (408) 745-6247. Circle 163.

PHASE-CONTINUOUS FREQUENCY SYNTHESIZER



Model 6757 is a frequency synthesizer which mixes the output of a 0-5 MHz direct, digital synthesizer with a 67.5 MHz signal to cover a minimum tuning range of 650 kHz centered at 70 MHz with a step size of 0.298 Hz. Both mixing signals are derived from an external 10 MHz reference. The absence of phase-locked loops yields sub-microsecond switching; frequency changes are phase-continuous and phase is digitally-controllable to within 0.1 degree. Output power is + 10 dBm, spurious outputs are −50 dBc, and single sideband noise is −95 dBc/Hz from 75 Hz to 3 MHz from the carrier. Inputs are + 15 and −5.2 V and commands are ECL-compatible. Meets requirements of MIL-E-5400R, Class II environment and MIL-P-11268, MIL-S-19500 and MIL-M-38510. Size: 70 cu. in. Weight: 4 lbs. Zeta Labs, Inc., Santa Clara, CA. (408) 727-6001. Circle 180.

MICROPROCESSOR BASED COUNTER EXTENDS CAPABILITY TO 110 GHz

Automatic frequency measurement from 10 Hz to 110 GHz is available from the Model 548A microprocessor-based microwave counter equipped with Option 06 Frequency Extension Module, Model 590 Frequency Extension Cable and a series of Remote Sensors. A readout up to 12 digits at all frequencies is displayed in approximately 1 second. Exclusive of options, the Model 548A range extends to 26.5 GHz. The full option set provides 26.5-40, 40-60, 60-90 and 90-110 GHz measurement bands. Sensor sensitivity is −25 dBm typical, with typical maximum input at + 5 dBm, and damage level at + 10 dBm. Standard features include multiple signal discrimination, frequency offsets, internal diagnostics and signature analysis and front-panel keyboard control. Price: Model 548A, $6,300, the complete option set, $1,550. Avail: 16 weeks ARO. EIP Microwave, Inc., San Jose, CA. Howard Lurie, (408) 946-5700. Circle 177.

FULLY PROGRAMMABLE UNIVERSAL COUNTER

Option 040 full programmability for the HP Model 5335A Universal Counter provides complete front panel programming of the instrument from an interface bus (IEEE-488). Complete control over all of the counter's front panel measurement and input signal conditioning controls and full remote programmability for single-shot time interval measurements is provided. The option also allows the remote matching of the counter's input to various signal level and input matching situations. Option 040 adds $700 to the base price of the Model 5335A counter. Hewlett-Packard, Palo Alto, CA. (415) 857-1501. Circle 178.

LOGARITHMIC AMPLIFIER/METER

Model LN-70 is a logarithmic amplifier/meter with a dynamic range of 70 dB, + 20 to −50 dBm. An offset control on the front panel enables the instrument to measure either gain or loss directly to 0.1 dB resolution. Measurements are taken directly from a digital readout; powering is from 115/230 Vac, 50/60 Hz, with a power consumption of less than 15 W. Price: $595. Texscan Corporation, Indianapolis, IN. Raleigh B. Stelle, III, (317) 357-8781. Circle 215.

DUAL FREQUENCY LOCKBOX

The MOSP 3000 Series can be used to phas lock two RF sources at a constant offset frequency or to stabilize a single source to the stability of an internal quartz crystal oscillator. Reference to an external 5 MHz standard is optionally available. 11 standar offset frequencies are available and others may be predetermined. The instrument wil phase lock both solid state and tube source up to 18 GHz, special models are available to 40 GHz. Price: $4,500. Microwave Systems, Inc., East Syracuse, NY. (315) 437-9951. Circle 17

BUS INTERFACE UNIT TIES RF WATTMETERS TO GPIB

An IEEE-488 Bus Interface Unit (Model 4380-488) provides connection of an RF wattmeter line to a General Purpose Instrumentation Bus (GPIB) for automatic measurement and recording of data. Digital THRULINE® Wattmeters equipped with a bus-compatible output can now become a talker and a listener via GPIB control. Line of digital RF Power Analyst™ Wattmeters operate from .5 to 2300 MHz at 100 mW to 250 kW, depending on model and plug-in elements. Model 4380-488 price: $975. Del 4 wks. ARO. Bird Electronic Corporation, Cleveland, OH. H. H. Heller, (216) 248-1200. Circle 21

(continued on page 14

(from page 143) **PRODUCTS**

CONNECTOR GAGE SETS

GS series connector gage sets are offered for measuring longitudinal dimension deviations in SMA, N and TNC/BNC connectors. Sets contain two gages, one for measuring male and the other for measuring female contact pin location. Gages are portable and self-calibrating and are packaged in their own case. The SMA set includes a gage for measuring the height of the insulator. Size: dial indicator – 2.25" diameter, dial calibrator – 0.001" increments, 100/360°; case dimension – 6" D x 10" W x 3 5/8" H. **RLC Electronics, Mt. Kisco, NY. (914) 241-1334. Circle 164.**

Systems

200 kW, X-BAND RADAR SUBSYSTEM

A 200 kW, X-Band (8.6-9.4 GHz) radar subsystem, Model VZX-3424, is designed for shipboard applications, particularly moving-target indicator systems. Unit uses a multichannel, crystal-referenced lobal oscillator (STALO) and an integral transmitter AFC that permits high-speed selectivity of up to 12 separate frequency channels by panel control or TTL signal. Minimum peak output power is 200 kW, pulse width is 0.5 μsec and repetition rates to 1800 Hz can be accommodated. Subsystem includes a solid state modulator, magnetron, magnetron tuner, power supply, control/monitor panel, an RF isolator and cooling fan. **Varian Associates, Beverly, MA. (617) 922-6000. Circle 169.**

OSCILLOSCOPE MEASUREMENT SYSTEM

HP 1980 is a microprocessor-controlled oscilloscope measurement system for automated measurements. This a complete stand-alone instrument that does not require plug-ins or enhancement to make measurements. The HP-IB (IEEE-488) capability is standard and allows programming of eight complete front panel set-ups. Deflection factors are 2 mV per div. at 100 MHz. Two independent 5 ns sweep speeds for both main and delayed sweeps, main and delay trigger view, a 10 cm by 12 cm CRT with a 10 x 10 division internal graticule, a dual (main and delayed) sweep mode, both delta time and delta voltage measurements, and menu capabilities are all standard. The HP 1980 has automatic signal acquisition capability and selective autoscope function, as well as continuous calibration and CRT and character readout. Price: $8,500. Del: from November 1980. **Hewlett-Packard Co., Palo Alto, CA. (415) 857-1501. Circle 216.**

Materials

ELECTRICALLY CONDUCTIVE PRESSURE SENSITIVE ADHESIVE

A series of low cost, electrically conductive pressure sensitive tapes, ECCOSHIELD™ PST-C, are designed for EMI/RFI shielding applications. Product uses a conductive pressure sensitive adhesive applied to a foil backing. Tape has measured attenuation up to 100 dB over a wide frequency range (30 Hz to 500 MHz). Material is offered in ready-to-use 180 ft. rolls in widths to 10 inches. Price: From 5¢ to 15¢ per lineal ft. depending on width. **Emerson & Cuming, Dewey & Almy Div., W. R. Grace & Co., Canton, MA. Joe Flaherty, (617) 828-3300. Circle 165.**

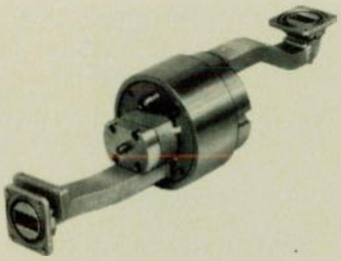
Hardware

RF ENCLOSURES WITH INTERCHANGEABLE CONNECTORS

A line of RF enclosures with interchangeable SMA, BNC, TNC and N connectors is offered. Users can purchase standard enclosures and additional quantities of connectors (COMPAC SMA, BNC, TNC or N Types). Interchangeable flange mounted "female" connectors have four uniform screw holes matching the screw holes in the enclosure and are usable with standard or custom Compac enclosures. Price: from $11.75 per unit. Del: From stock. **COMPAC, Deer Park, NY. Susan MacDonald, (516) 667-3933. Circle 142.**

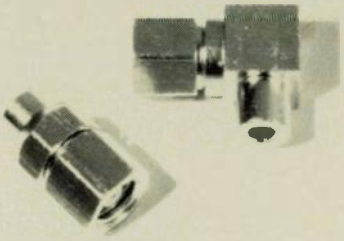
Components

THREE-CHANNEL ROTARY JOINT WAVEGUIDE SPANS 8.5-10 GHz



Model 1379 is a three-channel rotary joint with waveguide channel operating in the 8.5-10 GHz frequency range at 500 kW peak with 100 W average. The center coaxial channel operates at 1-10 GHz with 2 W peak power and 1 W average power. Outer coaxial channel operates from .5 to 1.1 GHz with 6 kW peak power and 20 W average power. **Kevlin Manufacturing, Woburn, MA. Ernest Lattanzi, (617) 935-4800. Circle 212.**

ONE-PIECE, SOLDER TYPE SMC SCREW-ON PLUGS



One-piece, semi-rigid SMC cable plugs (straight Pt. No. 701803 and right-angle Pt. No. 701892 varieties) are designed for .086" cable. These screw-on plugs feature assembly by inserting the cable into the captivated contact and soldering the jacket. Units meet MIL-C-39012B specifications and all metal parts are gold-plated per MIL-G-45204, Type 1, Class 2, Grade C over copper plate per MIL-C-14550, Class 4. **Cablewave Systems, Inc., North Haven, CT. Steven Raucci, Jr., (203) 239-3311. Circle 183.**

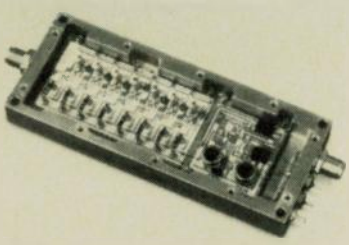
BROADBAND PHASE SHIFTER COVERS dc TO 4 GHz

A broadband phase shifter, Model 9428C, operates from dc to 4 GHz and has a linear phase shift of 180° at 1 GHz and 360° at 2 GHz. Insertion loss is less than .5 dB to 2 GHz, 0.75 dB to 4 GHz; SWR is 1.3 max. Size: 12" x 2" x 1"; connectors are SMA. Price: $475, small qty. Del: 6 wks ARO. **Arra, Inc., Bay Shore, NY. Mike Geraci, (516) 231-8400. Circle 182.**

SATELLITE COMMUNICATIONS SWITCHES

Waveguide satellite communication switches in WR-229 are intended for both low noise amplifier and high power amplifier earth station systems. Typical performance specifications include SWR of 1.04; 0.01 dB insertion loss and 90 dB isolation. **Logus Manufacturing Company, Deer Park, NY. (516) 242-5970. Circle 162.**

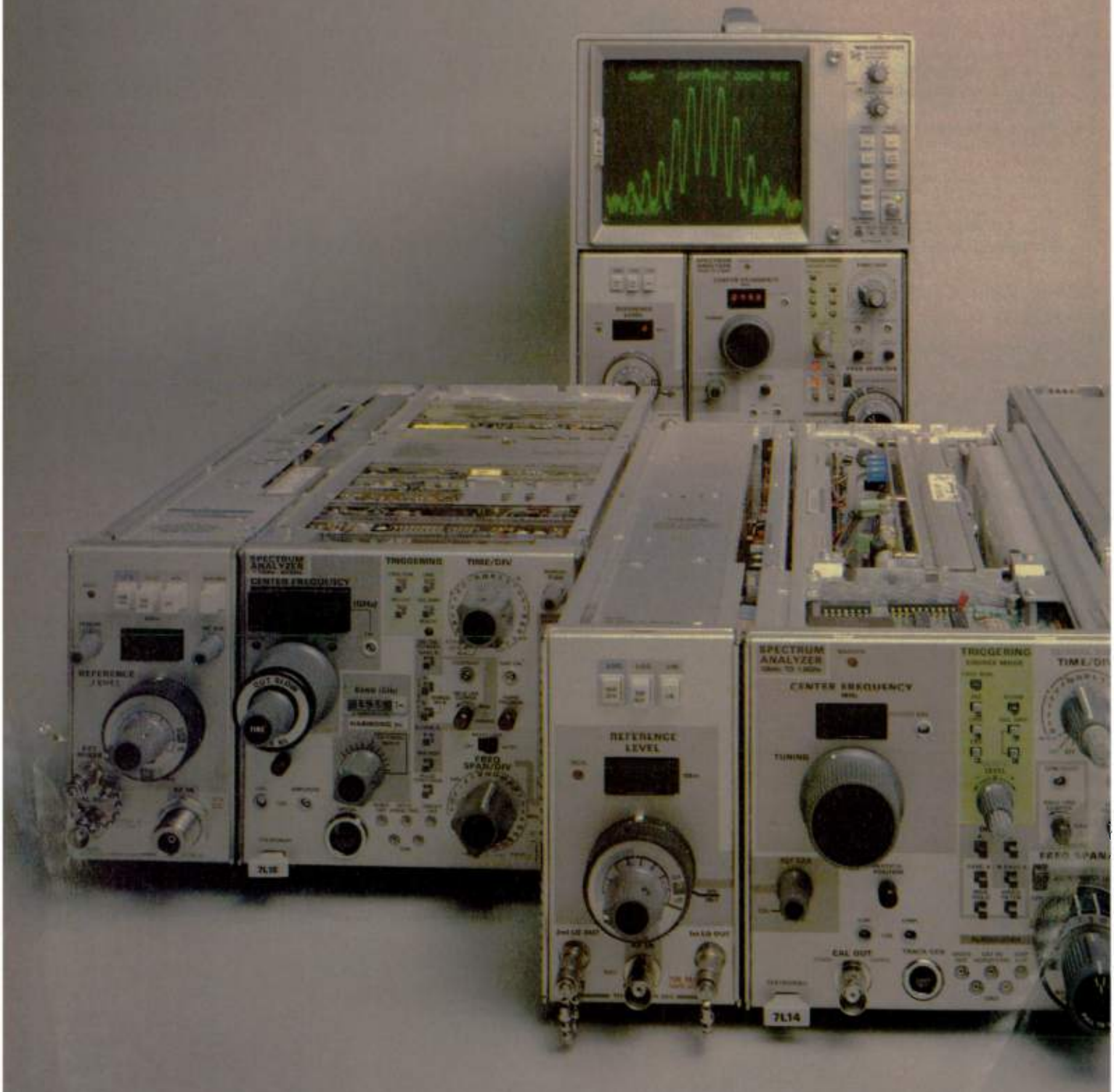
LOG IF AMPLIFIERS FOR 2 GHz BAND



An IF-to-log video amplifier series, ICL-5, cover the 600-2000 MHz frequency range. Log amplifier accuracy is typically less than ± 1 dB deviation from ideal log plot at temperatures to 85 C. Options such as hermetically sealing and power supply protection and regulation are offered. **Varian Associates, Beverly, MA. (617) 922-6000. Circle 211.**

(continued on page 148)

TEK 7000 SERIES SPECTRUM ANALYZERS



Now you can plug in an all digital-storage family of spectrum analyzers.

Three models provide laboratory performance with flexibility and versatility.

With the introduction of the new 7L14, there are now three members of the Tektronix family of digital storage plug-in spectrum analyzers. They provide frequency coverage from 20 Hz to 60 GHz. This plug-in concept brings you high performance, versatility and flexibility unmatched by monolithic instruments. At reasonable prices. They're compatible with any Tektronix 7000 Series oscilloscope mainframe, including the new digitizing GPIB 7854 for programmable solutions to complex measurements.

Family characteristics that make spectrum analysis easier.

All three instruments feature digital storage for flicker-free displays that are easy to interpret. This provides averaging and peak detection; accurate waveform comparisons; stores for long periods to measure amplitude changes and frequency drift.

The 7000 Series plug-in family displays alphanumeric readout for referencing and easy documentation. And each spectrum analyzer is protected from up to one watt input levels to save expensive front end repairs caused by inadvertent overloading.

With a 7000 Series mainframe on your bench, you select the spectrum analyzers that fit your requirements. And they interchange quickly with 30 other Tektronix test and measurement plug-ins. Use the powerful mainframe for logic analyzer, oscilloscope and other measurements.

New 10 KHz to 1.8 GHz 7L14 completes the 20 Hz to 60 GHz digital storage plug-in team.

Here it is. The new 7L14 for digitally-stored close-in, high resolution measurements from 10 KHz to 1.8 GHz. With 10 Hz residual FM, the 7L14 provides stability and jitter-free 30 Hz resolution displays. Its digital storage can be used to eliminate system errors and provide flat swept RF measurement capability. Digital averaging provides noise reduction which gives 70 dB spurious-free dynamic range. You can check broadband RF networks, filter networks, amplifiers, cables. Measure EMI/RFI and FM, navigation, two-way and other communications systems.

At the top of the spectrum you get top performance from the 7L1 Spectrum Analyzer. It provides full amplitude calibration in the 1.5 GHz to 60 GHz range and has 30 Hz resolution to 12 GHz. Displa are sharp, stable and flicker-free. Digital storage and digital signal processing make complex measurements easy with microproces aided controls. An automatic preselector insures spurious-free operation, giving easily interprete displays.

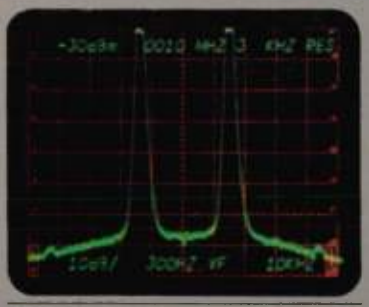
For baseband measurements choose the 7L5 for its precision a convenience in the 20 Hz to 5 MH range with 10 Hz resolution. For a high performance analyzer, it's unusually easy to operate.

This family works together to make an outstanding value.

You get this laboratory performance and measurement flexibility prices that point up the value of th Tektronix plug-in concept.

Call your nearest Tektronix Field Office (listed in major city director for complete details on the 7000 Series lab performance spectrum analyzers. Or call 800-547-1512 fo descriptive literature.

Tektronix, Inc., P.O. Box 1700, Beaverton, OR 97075. In Europe: European Marketing Centre, Postbox 827, 1180 AV Amstelveen, The Netherlands.



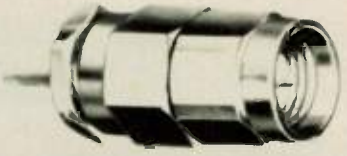
Performance worth the name

Tektronix
COMMITTED TO EXCELLENCE

CIRCLE 191 ON READER SERVICE CARD

(from page 145) PRODUCTS

SMA PLUG FOR BRAIDED COAXIAL CABLE



Designed for use with RG-174/U, -188/U and -316/U, the Model 50-607-3188 plug features clamp-type cable attachment. Unit is designed for interfacing these types of braided coaxial to SMA connectors. Size: .750" L. max.; .312" hex body. Constructed of stainless steel and offered in gold-plated or passivated finish. **RF Components Div., Sealectro Corp., Mamaroneck, NY. (914) 698-5600.** **Circle 184.**

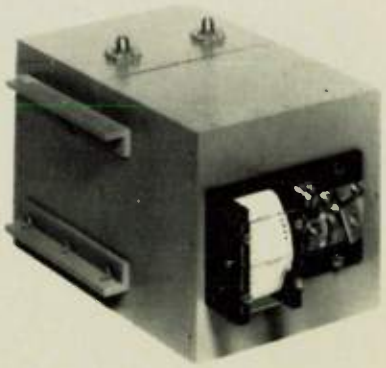
MULTI-CHANNEL AIRBORNE ROTARY JOINT

Model DIC-2319 is a 3-channel rotary joint with separate X-band receive and transmit channels in WR 112 waveguide. Power ratings are 10 W and 3 kW CW, respectively; insertion losses are 0.15 dB and 0.2 dB max. The third channel for Q-band is rated at 500 W CW and 0.15 dB max insertion loss. Other models in C-band, S-band and at 20/40 GHz are available. **Diamond Antenna and Microwave Corporation, Winchester, MA. (617) 729-5500.** **Circle 159.**

5.9 - 6.4 GHz UPCONVERTER

The MC36M is an upconverter for the 5.925 - 6.425 GHz band. With an RF input of 1.1 GHz and local oscillator drive at 4.8 - 5.3 GHz, typical conversion loss of the upconverter is 6.3 dB, maximum is 8 dB. At + 15 dBm LO drive, the third order intercept is at + 18 dBm, typical. MC36P is the SMA connector version of the upconverter. Price: MC36M - $78, MC36P - $110 (100 qty.) **Magnum Microwave Corp., Sunnyvale, CA. David Fealkoff, (415) 738-0600.** **Circle 156.**

FOUR POLE TUNABLE BANDPASS FILTER



A four pole tunable bandpass filter designed for use in the L band (1350-1850 MHz) is offered. The filter has an insertion loss of 1.5 dB maximum at the center frequency ± 1 MHz and rejects all frequencies beyond the center frequency ± 30 MHz by 70 dB minimum. Power handling capability of 40 W. The device has been constructed to operate in a full military environment, temperature range is −62° to +85° C. Calibration is in frequency directly with 1 MHz frequency marks. It may be reset within 100 Hz, a frequency accuracy of 0.008%. Price: $1575, 1-2 qty. Del: 10-12 wks. **K & L Microwave, Inc., Salisbury, MD. Charles Schaub, (301) 749-2424.** **Circle 161.**

VARIABLE POWER HIGH POWER COMBINERS/ DIVIDERS

Five series of variable power combiners/dividers designed for communication satellite earth station applications are offered. Waveguide sizes range from WR-187 to WR-75; power ratings range from 10 kW to 2 kW. In the combiner mode, online HPA's has SWR of 1.15 max. in hot switching; insertion loss for all models is 0.2 dB max; isolation between the two HPA inputs is 30 dB min. Continuously or step-variable models provide a total of 40 dB of power adjustment. In the reverse mode, the devices operate as power dividers permitting two antennas to serve a single up-link. Unit price for the WR-137, $3,200. Del: 60 days. **NEICO Microwave Co., Hopkinton, MA. Robert E. Ranslow, (617) 435-6366.** **Circle 158.**

(continued on page 151)

(from page 148) PRODUCTS

400 - 470 MHz PRESELECTOR

Preselector Model 3779 tunes the 400-470 MHz band with a 3 dB bandwidth of 3 MHz and an insertion loss of 1.5 dB. Selectivity is 30 dB ± 9 MHz from the center frequency. Tuning of the 2-cavity filter is screwdriver controlled, connectors are SMC. Price: $295, (1-9 qty.). Del: 10 days. **Microwave Filter Co. Inc., East Syracuse, NY. Emily Bostick, (315) 437-3953. Circle 157.**

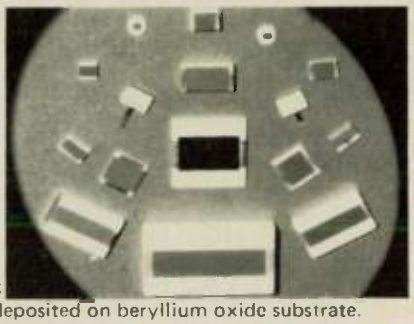
SINGLE CHANNEL CIRCULAR WAVEGUIDE ROTARY JOINT

A single channel circular waveguide rotary joint, Model 21015, operates in the TE_{11} mode at 26.5 to 40 GHz. Power capability is 2 kW CW. **Kevlin Manufacturing, Woburn, MA. Ernest Lattanzi, (617) 935-4800. Circle 153.**

SPDT COAXIAL SWITCH

Model 50S is a single-pole, double-throw coaxial switch for the .5-500 MHz frequency range. Insertion loss is 1.0 dB maximum, SWR is 1.2 maximum and isolation is 60 dB to 50 MHz, 50 dB to 250 MHz and 40 dB to 500 MHz. Standard control voltage is 26 V at 30 mA. Various packages, control voltages, frequency ranges and connectors are offered; BNC connectors are standard. Price: $70, 1-9 qty. Del: 2-4 wks. **JFW Industries, Inc., Beech Grove, IN. Joetta L. Walker, (317) 783-9875. Circle 152.**

POWER CHIP RESISTORS AND TERMINATIONS



A series of power chip resistors and terminations with power handling capabilities from 10 W to 800 W is offered. Resistance ranges from 10-500 ohms; tolerances are 2,5 and 10 percent. Components meet all test requirements of MIL-STD 202, and come in either thick film or thin metal film deposited on beryllium oxide substrate. Size: 100 x 200 mils to 2,000 x 1,8000 mils, depending upon power. Termination, resistor or custom network configurations available. **KDI Pyrofilm Corporation, Whippany, NY. Al Arfin, (201) 887-8100. Circle 160.**

SOLID STATE CLASS A POWER AMPLIFIER

Model 5100L is a solid state Class A power amplifier which covers the 1.5 to 400 MHz frequency range with gain of 50 dB. Linear power output rating is 100 W with more than 200 W available over the 1.5-200 MHz range. Harmonics are −25 dBc at 100 W output, typical 3rd order intermod point is +62 dBm. Model is powered by its own regulated power supply from 115 Vac 50-60 Hz at 22 amperes. Price: $9150, FOB. Del: Stock to 60 days. **Electronic Navigation Industries, Inc., Rochester, NY. L. M. Salmen, (716) 473-6900. Circle 155.**

BROADBAND AMPLIFIER MODULES FOR 10 kHz – 1 GHz BAND

A line of solid state linear broadband amplifier modules, covering the 10 kHz to 1 GHz frequency range, are designed for OEM applications. Modules can be tailored for specific power levels, frequency ranges, AM, FM and pulse modulation. Typically, the modules are supplied in EMI shielded enclosures and attached to appropriate heat sinks. User supplies proper dc voltage and forced air cooling, if needed. Push-pull circuit design is used to enhance linearity; modules provide continuous power adjustment. **AIL-TECH Electronic Instruments, Eaton Corp., Los Angeles, CA. (213) 822-3061. Circle 149.**

(continued on page 152)

(from page 151) PRODUCTS

LOW SWR MIXER FOR TV DOWNCONVERTERS

Model MLP-A97 is a second downconversion mixer for use in 3.7-4.2 GHz downconverters. Mixer has a return loss on the RF port of 15 dB min. over the 750-950 MHz frequency range; LO port return loss is 10 dB min. LO input power range is 0 to +3 dBm; IF frequency range is 0.5-120 MHz; maximum conversion loss is 7.5 dB (5.5 dB typ.); minimum LO/RF isolation is 25 dB and minimum LO/IF isolation is 20 dB. Mixer is supplied with an 8-pin plug-in package. Size: 0.8" x 0.4" x 0.4" plus pins. Price: $15.00 per unit. Avail: From stock. **Engelmann Microwave Company, Montville, NJ. Carl Schraufnagl, (201) 334-5700.**

Circle 151.

K_u-BAND WAVEGUIDE DIPLEXER

Part No. 601175 is a fixed tuned waveguide diplexer for K_u-band. Performance specifications include a transmitter frequency of 14.4-15.2 GHz, receive frequency of 13.6-14.0 GHz and SWR of 1.2:1 maximum. Unit has an insertion loss of 0.5 dB max., transmitter arm and 1.0 dB, max. receiver arm. Rejection-transmit to receive arm is 70 dB min. Waveguide size is WR62. Price: $1150 each. Avail: 6-8 wks. ARO. **Coleman Microwave Co., Edinburg, VA. George Brinkley, (703) 984-8848.** **Circle 154.**

DOUBLE BALANCED MIXER COVERS 0.5-18 GHz BAND

Model MD-166 is a double balanced mixer which spans the 0.5-18 GHz frequency band. Unit exhibits a 8 dB typ., 10 dB maximum conversion loss, an IF bandwidth to 5 GHz, 1 dB conversion loss flatness and isolation better than 20 dB on all ports. Other features include a 3-pin hermetic module for stripline and microstrip integration. SMA connectorized version also can serve as a module test fixture. Mixer can be screened to MIL-STD-883. Price: $550 for module in 1-5 qty; $625 for SMA model. Del: from stock. **Anzac Division, Adams-Russell Co., Inc., Burlington, MA. Mark Rosenzweig, (617) 273-3333.** **Circle 146.**

SINGLE POLE, SINGLE THROW DIODE SWITCHES

Series of single pole, single throw diode switches cover the .1-18 GHz frequency range in bandwidths up to 9:1. Broadband isolations of 45 dB and 70 dB are available with and without drivers in switching speeds of 15 and 350 ns. Size: .69" x .75" x .5" without driver and 7/8" x 1.5" x .5" with driver. Price: From $135. Del: From Stock. **Norsal Industries, Central Islip, NY. Norm Spector, (516) 234-1200.** **Circle 170.**

SILICON MICROWAVE CAPACITORS

MA-4M is a series of metal-nitride-silicon (MNS) chip capacitors designed for microwave circuit applications. Units use a low pressure chemical vapor deposition (LPCVD) technique which results in very dense uniform nitride layer. Typical Q is 20,000. Capacitance values range from 10 to 1000 pF for 100 V. types and from 1 to 600 pf for 200 V ratings. Operating temperature is −55 to +200 C and typical coefficient is 180 ppm/ C. **Microwave Associates, Inc., Burlington, MA. (617) 272-3000.**

Circle 171.

MM-WAVE PHASE LOCKED FREQUENCY MULTIPLIER

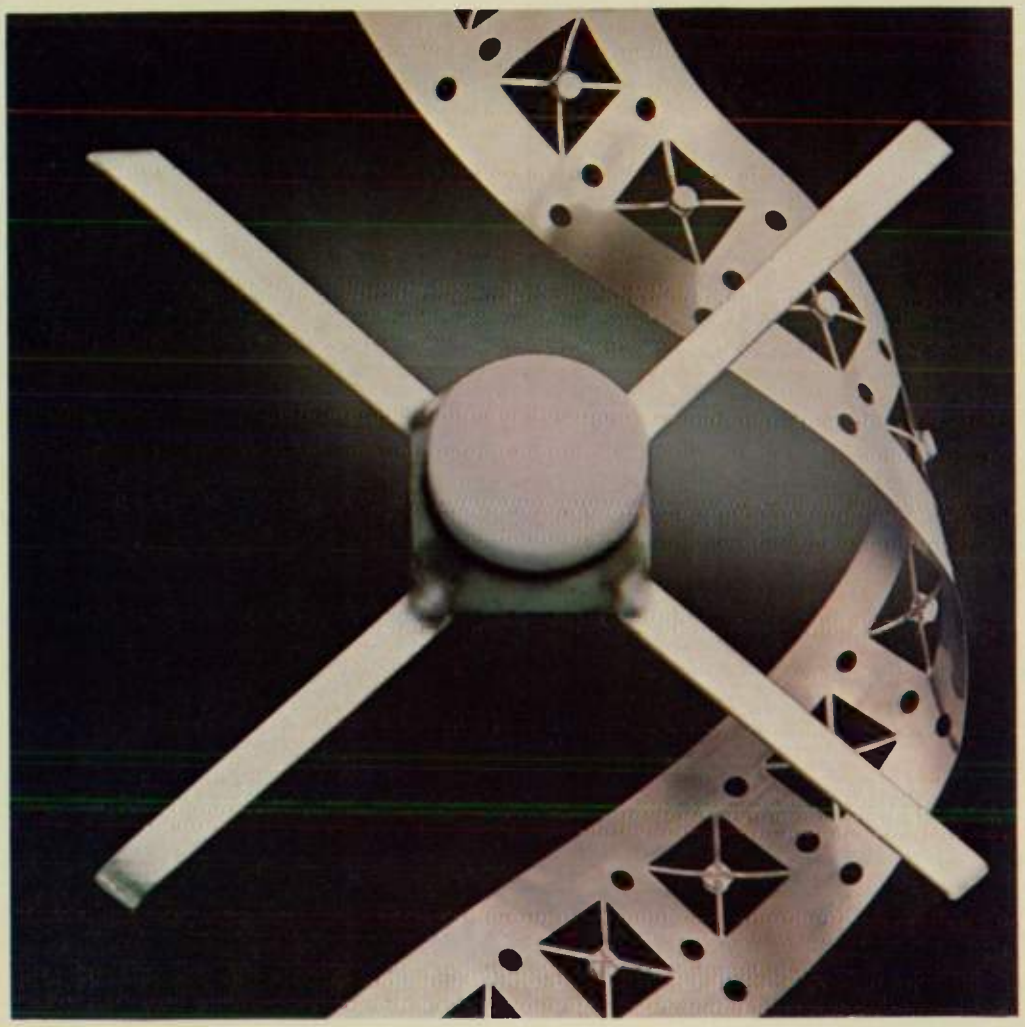
Frequency multiplier Model 34.8X348-1 provides an output of 34.8 GHz at +20 dBm from an input of 100 MHz at +10 dBm. Loop automatically acquires and locks to the input signal. Lock range is ± 300 MHz and output is provided with an isolator. Options include source, lock indicator lights and metering. Price: $8,500. Del: 120 days ARO. **Pacific Research and Development, Montrose, CA. John W. MacConnell, (213) 240-8510. Circle 172.**

FREQUENCY MULTIPLIER TO 7200 MHz

A frequency multiplier which delivers 7200 MHz from a 450 MHz input is offered. Output level is 0 ± 1 dBm with an input of 23 ± 1 dBm. Output SWR is 1.5, max., noise in a 35 Hz BW is −77 dBc, min. and spurious and harmonic outputs are −50 dBc, min. Input and output impedances are 50 Ω. Size: 1.45" x .350" x .200". **KW Engineering, Inc., San Diego, CA. Art Brand, (714) 571-8444.** **Circle 145.**

(continued on page 154)

SURPRISE!



HP has more than enough bipolars to go around.

Consider HP your primary source for economically priced, high performance bipolar transistors. The first devices in HP's new family of low-cost transistors, the HXTR-3101 and HXTR-3102 are suitable for narrow-band and broad-band VHF/UHF applications. The HXTR-3101 features low noise and high gain, while the HXTR-3102 features high linear output.

State-of-the-art self-alignment, ion implantation techniques and titanium/platinum/gold metallization insure excellent reliability and device-to-device uniformity.

Both devices are supplied in HPAC-100X, a rugged metal/ceramic package that is capable of meeting the environmental requirements of MIL-S-19500 and the electrical test conditions of MIL-STD-750.

In 10K quantities, the HXTR-3101 is priced from $4.41* and the HXTR-3102 from $5.34*

For immediate off-the-shelf delivery, call your local HP authorized components distributor. In the U.S., contact Hall-Mark, Hamilton/Avnet, Pioneer Standard, Schweber, Wilshire or the Wyle Distribution Group (Liberty/Elmar). In Canada, call Hamilton/Avnet or Zentronics, Ltd.

HEWLETT PACKARD

05102

*U.S. domestic prices only.

(from page 152) PRODUCTS

PROGRAMMABLE ATTENUATOR WITH 10 BIT BDC INPUT

The PA-5007 is a programmable attenuator designed for 10 bit Bdc input at 12 V and 15 ma per bit. The 10 bit code selects attenuation from 1 to 125 dB at frequencies from dc to 1.3 GHz. Per cell accuracy at 1000 MHz is 0.2 dB and .3 dB or 2% at 1.3 GHz. SWR is 1.3 at 1000 MHz; unit will handle 750 W, 3 s pulse and 0.5 W, average. Provided with Series D male connector for control inputs and SMA female RF connectors. Size: 1 1/32" x 2 13/32" x 5 1/8". Price: $390, 1-9 qty. Del: 8 wks ARO. **Texscan Corp., Indianapolis, IN. Raleigh B. Stelle III, (317) 357-8781.** Circle 174.

HIGH POWER TERMINATIONS HANDLE UP TO 50 WATTS

Broadband, high power coaxial terminations are designed for applications from dc to 8 GHz. Model 1426 has a maximum average power input of 50 W and Model 1427 is rated at 25 W. Peak power rating of 5 kW is offered for both units. SWR is 1.20 to 4 GHz and 1.30 to 8 GHz. Connectors are semi-precision Type N male or female. Both terminations are constructed of a black aluminum body with an array of heat radiating fins. Price: 1426 - $175; 1427 - $100. Avail: Stock to 90 days. **Weinschel Engineering, Gaithersburg, MD. Julian Parker, (301) 948-3434.** Circle 176.

PIN DIODE ATTENUATOR

A 2-8 GHz, 64 dB minimum linearized pin attenuator, Model TG-1131, has SWR of 1.8 maximum, and insertion loss of 3.0 dB maximum. Control voltage is 0-7 V and sensitivity is 10 dB/V. Overall accuracy of the unit, including linearity, frequency flatness, and a -54° C to +85° C temperature range is ± 1.5 dB to 30 dB, ± 2.5 dB to 64 dB. Avail: 8 wks. **Triangle Microwave Inc., East Hanover, NJ. Martin Rabinowitz, (201) 884-1423.** Circle 175.

SMA QUICK-DISCONNECT RACK AND PANEL ADAPTER

An SMA quick-disconnect rack and panel plug adapter to SMA female is offered. The 705535-10 has a spring-loaded float mount and is intended primarily for blind mating rack and panel applications. The plug mates with a standard SMA jack. Connector meets all applicable portions of MIL-C-39012 and has a maximum SWR of 1.25 to 18 GHz. **Cablewave Systems, Inc., North Haven, CT. Steven Raucci, Jr., (203) 239-3311.** Circle 148.

120 K GaAs FET ANTENNA-MOUNTED LNA/DOWNCONVERTER

ACA-4220 is an integrated combination of a 3.7-4.2 GHz, 120 K GaAs FET preamplifier with a block downconverter to the 940-1440 MHz IF range in a case designed for antenna feedpoint mounting. LNA/downconverter features a minimum of 57 dB overall gain with ± 1.0 dB full-band gain flatness, and a +10 dBm typical output intercept point for intermodulation products. Assembly incorporates a dielectrically stabilized, 5140 MHz fundamental local oscillator. It features -45 dBm maximum LO radiation at both the input and output, and 60 dB image suppression (6.1-6.6 GHz). Input is a standard CPR-229 waveguide flange and it is powered from low voltage dc (15-28 Vdc, 250 mA) through the antenna-to-receiver feedline. Price: $2,000 per unit. **Avantek, Inc., Santa Clara, CA. Don Smith, (408) 727-0700.** Circle 147.

WAVEGUIDE FILTER SERIES SPANS 7 GHz TO 12.4 GHz BAND

A new line of waveguide filters spans the 7 GHz to 12.4 GHz frequency spectrum. Filters offer high Q and low loss. Filter designs are available in 3-7 sections. Avail: 30 days, for custom design prototypes and full volume production runs. **Telonic Berkeley, Laguna Beach, CA. Adam Reed, (714) 494-9401.** Circle 173.

(continued on page 155)

Software

CAD TOOL FOR FILTER DESIGN

A new version of the FILSYN software program for computer-aided design of filters is designated 4.6D. FILSYN is a general purpose program adapted for the design of all types of passive, active and digital filters. The latest software revision, 4.6D, incorporates the DELAY program which provides a group delay equalizer network to compensate the delay distortion of filters, a critical feature when flat gain and minimum delay distortion are needed. The 4.6D version also allows for simpler input specifications, thereby reducing programming errors and data input time. Price: One-time license fee, $19,000. Avail: For license on in-house computers. **Compact Engineering, Palo Alto, CA. Jim Lindauer, (415) 858-1200.** **Circle 141.**

Devices

SERIES OF Si SCHOTTKY DIODE QUADS

A series (ND487) of silicon Schottky diode quads are designed for high volume applications. Both low turn-on, N-type Schottky barrier quads and medium-barrier quads are available. Series is available in both interconnected ring and crossover configurations, and in a choice of MICRO-X (hermetically sealed stripline) or DISC-MOLD (plastic molded) packages. **California Eastern Laboratories, Inc., Santa Clara, CA. Neil Corporon, (408) 988-3500.** **Circle 143.**

LOW COST 0.5 W RF TRANSISTOR

The MRF 559 transistor offers 0.5 W minimum output, 8 dB minimum gain and an efficiency of 50% over the 250 MHz to 1.5 GHz band. The 1 dB gain compression point is typically at + 20 dBm. The device is suited for broadband Class A, low noise applications in instrumentation, land-mobile radio and MATV/CATV. Packaging is the Macro-X™ plastic package. Price: $1.80 (100-999). Del.: From factory or distributor stock. **Motorola Inc., Phoenix, AZ. Tom Bishop, (602) 244-6394.** **Circle 166.**

Antennas

ANTENNAS FOR MM-WAVE TECHNOLOGY

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Letters to the Editor

NRL PHASED ARRAY WORKSHOP

I enjoyed your review of NRL phased array workshop in the February 1981 *Microwave Journal*. Has a Proceedings of the Workshop been issued and do you know if it has an NTIS or OOC number – either in the unclassified or unclassifed version? Thank you for your assistance in this.

SAMUEL SENSIPER, Sc.D., P.E.
Culver City, CA

Editor's Note: Proceedings for the 1980 NRL Phased Array Technology Workshop should be ready in June, 1981. Security clearance is required for these classified proceedings and they are available at no cost. Contact: Mr. J. Paul Shelton, Code 5370, Naval Research Laboratory, Washington, DC 20375.

I enjoyed very much reading Dr. J. F. White's excellent summary of the NRL "Phased Array Technology Workshop." There are a few items that are worth commenting on.

First, the PAVE PAWS thinned array does use terminated dummy elements. What was stated is that we now know how to design thinned arrays without the use of potentially expensive dummy elements.[1,2] This can be done with a small loss in gain and little effect on the antenna sidelobes. Future thinned arrays may be built without the dummy elements if the cost saving from leaving them out is greater than the cost accrued in making up for the loss of antenna gain.

Second, the COBRA DANE has 34,768 elements.

Third, the Grumman Aerospace Corp. space based array radar that Dr. James Frazer (DARPA) spoke of was a joint Raytheon/Grumman concept.

1. Beltran, F., "Elimination of the Dummy Elements in Thinned Phased Arrays," Final Report on Contract DASG60-78-C-0124 for BMDATC, Huntsville, AL, 23 August 1979, AD B043885L.
2. Beltran, F. and F. King, "Elimination of the Dummy Elements in Thinned Phased Arrays," to be presented at the 1981 APS Symposium, Los Angeles, CA, June 15-19, 1981.

ELI BROOKNER
Consulting Scientist
Raytheon Co.
Equipment Development Labs
Wayland, MA

ON "WERE YOU ZAPPED"

Your recent article in *Microwave Journal* presented very emphatically the common response to the question of possible biological effects of radiation. I looked briefly at the "Zapping of America" when it frightened one of my research associates. I am in general agreement with your assessment of the quality of the book. However, I was distressed that you did not mention the large body of work which explores the possibility of non-linear effects of microwaves at low intensities where thermal effects are excluded. Frohlich's recent review* suggests that biological systems can "store" the energy from microwaves until it "triggers" events for which the biological system is already prepared. If you can refute this large body of peer-reviewed work, I would be glad to see an article by you. Otherwise, I think you should have acknowledged that the issue isn't quite as simple as you made it seem.

* The Biological Effects of Microwaves and Related Questions. H. Frohlich, Adv. Electronics and Electron Physics *53*, 85-152 (1980).

GARETH R. EATON, Professor
U. of Denver
University Park
Denver, CO

Editor's Note: Yes, there have been some non-thermal effects described, one of which was cited in, "Were You Zapped," the Frey effect by which some people can "hear" pulsed radar signals; however, to our knowledge none of these appears to be any more dangerous than, for example, exposure to artificial light, coffee drinking, etc.

Your editorial on zapping was timely and quite interesting. However, I was somewhat disappointed that it seemed to espouse the conservative doctrine which has been valiantly but unsuccessfully defended by John Osepchuk and others. Although much Russian and East European work in this area is suspect, there is now considerable evidence that there are significant effects which are neither ionizing nor thermal. In fact, COMAR is in the process of reducing the 10 mw/cm^2.

Reprints from the London ONR publication concern the recent URSI session on biological effects. Some other indications can be found in the journal, *Bioelectromagnetics*, which initiated publication in 1980. For example, in Volume 1, Number 1, Page 35, some people from the EPA Health Defects Research Lab report on an interesting non-linear power density window which affects calcium ion efflux from brain tissue at levels much below 10. Another paper in the same issue from the Naval Medical Research Institute, on Page 89, discusses rat modified response scores for power densities as low as .25. The situation is confused by the fact that all these effects seem to be non-linear in power and there may be frequency resonances as well. Nonetheless, there is now a large accumulation of reputable data showing that there can be significant long-term effects at power densities below 1 mw/cm^2. On the other hand, I have no doubt that microwave ovens are completely safe and that most people are not exposed to any significant hazard.

ROBERT C. HANSEN
Consulting Engineer
Tarzana, CA

There is an invitation in your editorial to act as spokespeople in cocktail parties to disseminate sound information about potential microwave hazards among the general public. This I have been doing for years, not at cocktail parties, which I do not attend very frequently, but through my personal contacts, technical meetings, meetings with workers' organizations, meetings with the population involved with the installation of a new radar, contacts with the local administrations, local health offices, magistrates, military people, local newspapers and university lessons.

My contribution to the solution of the problem is this: with a little discernment and no additional cost it is possible to comply with even the most restrictive standards existing in the world, thus reducing the drama problem to an easily manageable level. In other words: through the problem of understanding the biological mechanisms of interaction of RF with living bodies certainly exists, the emotion on the subject of the risks of exposure can be reduced to practically nothing by showing that *levels above the most restrictive safety values are practically never found.*

The above statement is based on the results of several surveys which I was requested to perform with my collaborators on various potentially RF-polluted ambients. This usually occurred in connection with cases of public fear. In each case a written report was issued. The Introduction and Conclusions of each report were worded such that could be read by non-technical persons, while the body was in a form suited to an expert in the field. The surveys include:

a) a TACAN transponder
b) an ATC high-power radar
c) a short-wave dielectric-heating machine for the furniture industry

d), e), f), g) others, as above
n) a medium-wave induction heating machine
) two AM broadcast transmitters on the roof of an elementary school
) a high-power AM broadcast transmitter (100 kW carrier + 50 kW peak modulation)
m) short-wave and microwave diathermy appliances in a room
n) an anti-aircraft missile site with 5 radars.

PROF. L. MILLANTA
IROE-National Research Council
Firenze, Italy

Your article in the *Microwave Journal*, January 1981, is an excellent summary of the phony microwave radiation scare which has been promoted in recent years.

In answer to your question: "Was I zapped?" – No! Despite being exposed along with a few other technical people in 1944 and 1945 to power levels which were orders of magnitude higher than the milliwatt levels which have been feared in recent years.

For more than a year I worked with a group of MIT Radiation Laboratory which was responsible for upgrading transmission line components at S, X and K Bands to prevent high power breakdown. The procedure was to establish an arc, determine its location and redesign for higher power handling. We used high power equipment, 125 kW peak power at K Band, 250 kW peak at X Band and 1 megawatt at S Band, with a .001 duty cycle. The component to be tested was placed in a bell jar and terminated by a horn antenna so that we could see the arc when it occurred and determine its exact location. Generally, we set the power as noted above and decreased pressure until the arc occurred, while one member of the team looked into the horn and observed the position of the arc. The viewer moved away from the horn when his face became too hot to bear. The results of several hundred tests are presented in Radiation Laboratory Report No. 1071, dated November 1945, entitled "Summary of High Power Breakdown Tests on Microwave Components," by H. F. Clarke, G. L. Rogan, Richard M. Walker and Ina Mansur. I am not aware of any health problems caused by this work 35 years ago.

The waveguide horns used were of the order of 4 x 6 inches = 24 in^2 or 150 cm^2. Therefore, the peak power density was 830 watts/cm^2 at K Band 1670 watts/cm^2 at X Band and 6700 watts/cm^2 at S Band. The average power levels were .83, 1.67 and 6.70 watts/cm^2 at the horn face.

This information may be of interes to *Microwave Journal* readers.

RICHARD M. WALKER
Founder Director
M/A-COM, Inc. Companie
Microwave Associates, Inc
Burlington, MA

ERRATA

Monolithic GaAs IC development work was incorrectly attributed to Marconi Research Laboratories in the Special Report, "The European Microwave Industry," *Microwave Journal*, January 1981. This work is being done at the General Electric Company Ltd. Hirst Research Centre.

Mon. M. Claude Chekroun is an employee of the Société d'Etude du Radant in Orsay, France and not a member of the staff of Radant Systems, Inc. in Stowe, Mass. as printed in the February, 1981 issue of *Microwave Journal*, page 45.

Honeywell's MMW radar design and analysis team is looking for a good shortstop.

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Rick Anton, Engineering Manager, MN 11-1020, (D1), Honeywell Inc., Defense Systems Division, 600 Second Street N.E., Hopkins, Minnesota 55343

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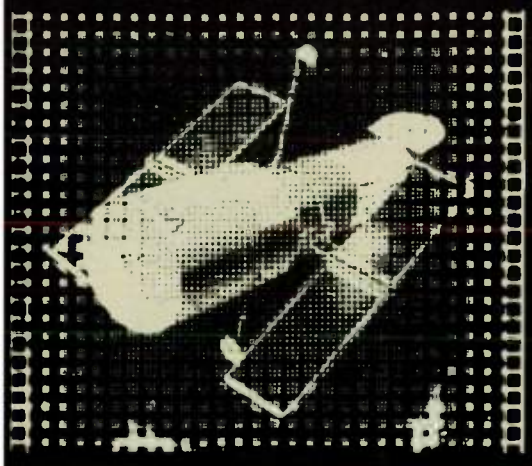

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New Literature

PRIMER ON SATELLITE EARTH STATION FREQUENCY COORDINATION

A 4-page primer defines frequency coordination for satellite earth stations and explains the need for interference analysis. Also includes a map showing the 4 GHz terrestrial microwave routes throughout the US. **Comsearch, Inc., Falls Church, VA. Jerry Schulman, (703) 356-9470.**

Circle 134.

CATALOG ON CONHEX RF CONNECTORS

Catalog CX-9 describes a complete line of ConheX RF connectors which incorporate the provision for lockwire captivation. Lockwire holes are offered in the coupling nut, locknut, body or mounting flange. **Sealectro Corp., Mamaroneck, NY. (914) 698-5600.** **Circle 138.**

BOOKLET ON SOLID STATE MICROWAVE SOURCES

A 17-page booklet describes a line of solid state microwave sources. Mechanical, varactor-tuned, and YIG-tuned models are listed. Application information, outline drawings and performance comparisons are included. **Varian Solid State Microwave Division, Santa Clara, CA. (408) 988-1331.**

Circle 139.

HIGH POWER COAXIAL TERMINATIONS BROCHURE

Data sheet 1426/1427 describes high power coaxial terminations covering the dc to 8 GHz frequency range. Information covers models for 25 W and 50 W max. average power, 5 kW peak power applications. Mechanical dimensions are also detailed. **Weinschel Engineering, Gaithersburg, MD. (301) 948-3434.** **Circle 140.**

UPDATED SPECIFICATION ON WAVEGUIDE FLANGES

Publication 154-2, Pt. 2 is an updated version of specifications for flanges for rectangular waveguides. This edition contains specifications for: rim dimensions for PDR 14 to PDR 180 flanges; alignment hole location and circular tolerancing dimensions for E Type flanges; tolerances of flanges in the PDR 14 to PDR 180 range and UDR 120 to UDR 180 range; attachment hole location and circular tolerancing dimensions for E Type flanges and permitted deviations of attachment hole diameters for D Type flanges. Price: S. fr. 70. **International Electrotechnical Commission, Geneva, Switzerland. 34 01 50.** **Circle 181.**

FILTER SERIES CATALOG

A line of lowpass, highpass, band reject and bandpass filters are featured in a 32-page catalog describing filters in waveguide and coax line for the .300 to 22.0 GHz band. Diplexers, wavemeters and filters that are fixed tuned, tunable and programmable are also described with complete performance specifications, photographs and line drawings. **Coleman Microwave Company, Edinburgh, VA. George Brinkley, (703) 984-8848.** **Circle 133.**

BROCHURE ON SPECTRUM ANALYZER SERIES

A series of spectrum analyzers (6008) covering 100 kHz through 40 GHz are described in a 16-page brochure. Full performance specifications, scan characteristics, digital memory and optional accessories are covered for each unit. A Data Interface Adapter and Cassette Recorder suitable for use with any of the spectrum analyzers are also discussed. **Polarad Electronics, Inc., Lake Success, NY. (516) 328-1100.**

Circle 136.

PULSE POWER TEST SET PAMPHLET

A two-color leaflet (PPTS-101) describes the PPTS-101 (US Navy AN/UPM-114), an instrument which provides pulse-modulated high level RF (up to 4 kW peak) power for testing and calibrating TACAN, DME and IFF ground support equipment. Features, performance capabilities, specifications and construction details for the instrument are provided. **Republic Electronic Industries Corp., Melville, NY. (516) 249-1414.**

Circle 137.

1980 ANNUAL REPORT FROM NBS

A 40-page report (SP 600) reviews the recent science and engineering research advances at the National Bureau of Standards. The overall role of NBS as a central US reference library for the physical and engineering sciences is described. Program plans in the fields of electronics, automation, chemical processing and materials research are discussed. Over 40 different projects are detailed as well as recent accomplishments within NBS' National Measurement Lab, National Engineering Lab, Institute for Computer Sciences and Technology. The report summarizes NBS services to industry, other government agencies and the public and provides information on cooperative research programs. Price: $2.50; Stock No. 003-003-02300-1. **National Bureau of Standards, c/o Superintendent of Documents, Government Printing Office, Washington, DC.** **Circle 135.**

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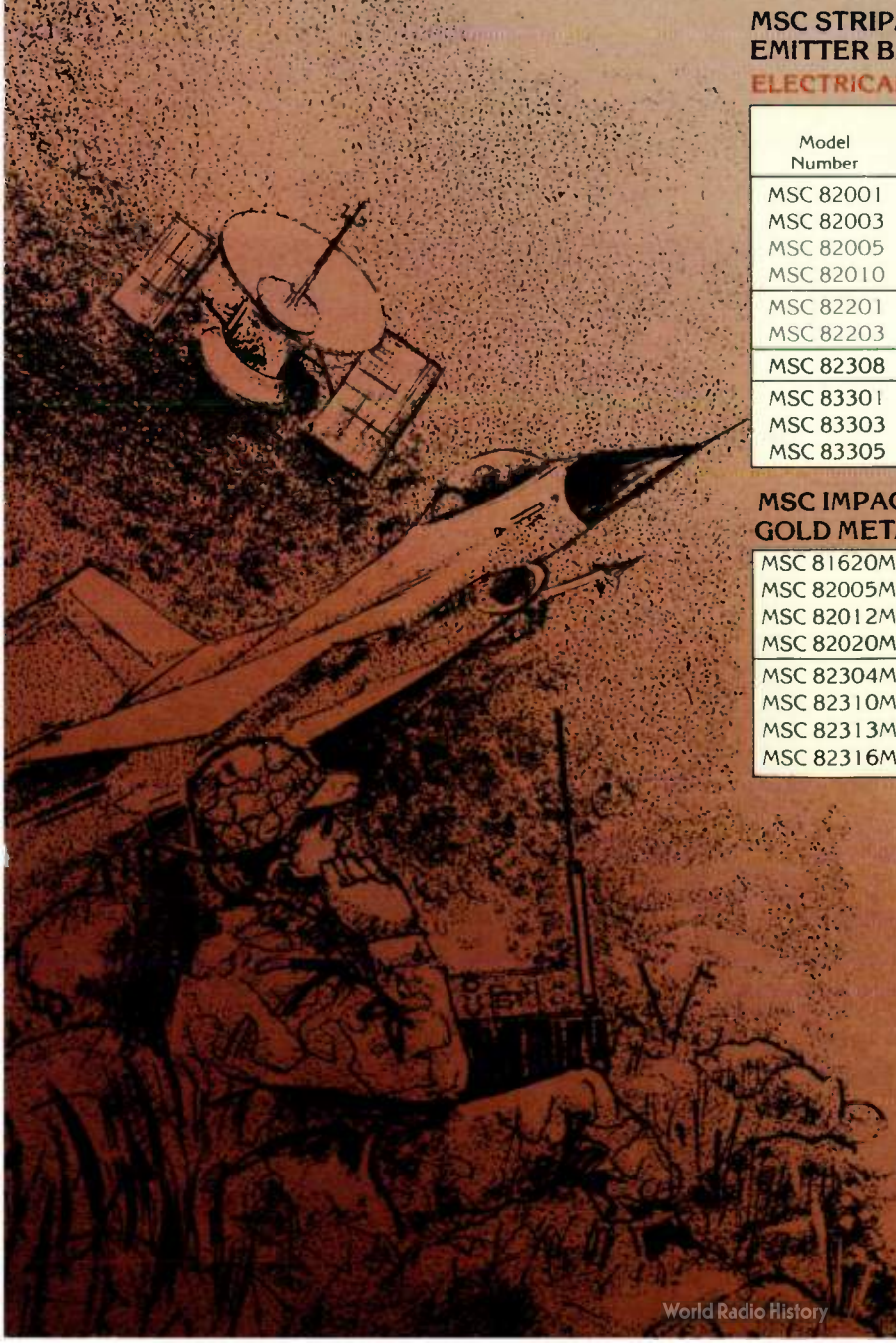

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MSC 82203	2000	3.00	0.50	35	28	15.0
MSC 82308	2300	8.00	0.80	38	22	8.0
MSC 83301	3000	1.00	0.20	35	28	25.0
MSC 83303	3000	2.50	0.79	30	28	15.0
MSC 83305	3000	4.50	1.59	30	28	8.5

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MSC 81620M	1600	20.0	4.00	43	24	3.0
MSC 82005M	2000	5.0	0.75	40	28	15.0
MSC 82012M	2000	12.0	2.00	40	28	6.0
MSC 82020M	2000	20.0	4.00	40	28	3.0
MSC 82304M	2300	4.0	0.75	38	24	15.0
MSC 82310M	2300	10.0	2.00	38	24	6.0
MSC 82313M	2300	13.0	3.00	38	24	4.3
MSC 82316M	2300	16.0	4.00	38	24	3.0

NOTE These transistors are available in either the STRIPAC* package or the flangeless MIC-PAC™ package.

STRIPAC* U.S. Patent No. 3,651,434, March 21, 1972
* U.S. Trademark No. 417,158, April 24, 1973, U.S. Patent No. 3,651,434, March 21, 1972

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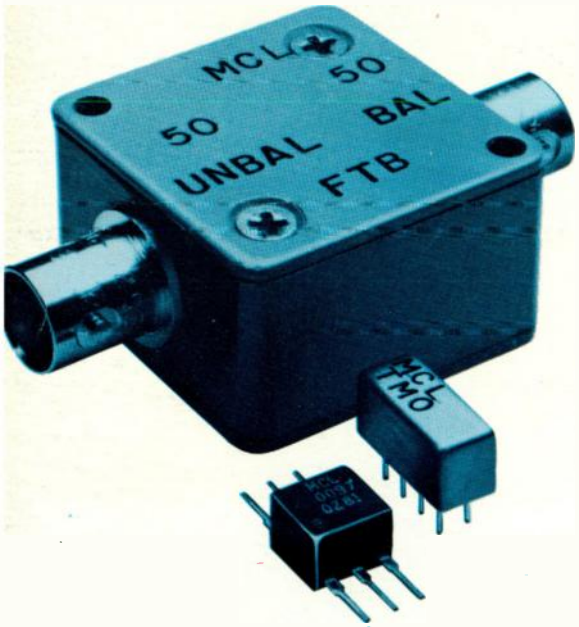

Select from the economical, microminiature T-series (plastic case) or TMO series (hermetically-sealed metal case) covering 10 KHz to 800 MHz. These models operate from 12.5 to 800 ohms with insertion loss typically less than 0.5 dB.

For large dynamic range applications, specify the T-H series which can handle up to 100 mA primary current without saturation or distortion.

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DC ISOLATED PRIMARY & SECONDARY

Model No.	T1-1 TMO1-1	T1-1H	T1.5-1 TMO1.5-1	T2.5-6 TMO2.5-6	T4-6 TMO4-6	T9-1 TMO9-1	T9-1H	T16-1 TMO16-1	T16-1H
Imped. Ratio	1	1	1.5	2.5	4	9	9	16	16
Freq. (MHz)	.15-400	8-300	.1-300	.01-100	.02-200	.15-200	2-90	.3-120	7-85
T Model (10-49)	$2.95	$4.95	$3.95	$3.95	$3.95	$3.45	$5.45	$3.95	$5.95
TMO model (10-49)	$4.95		$6.75	$6.45	$6.45	$6.45		$6.45	

CENTER-TAPPED DC ISOLATED PRIMARY & SECONDARY

Model No.	T1-1T TMO1-1T	T2-1T TMO2-1T	T2.5-6T TMO2.5-6T	T3-1T TMO3-1T	T4-1 TMO4-1	T4-1H	T5-1T TMO5-1T	T13-1T TMO13-1T
Imped. Ratio	1	2	2.5	3	4	4	5	13
Freq. (MHz)	.05-200	.07-200	.01-100	.05-250	.2-350	8-350	.3-300	.3-120
T Model (10-49)	$3.95	$4.25	$4.25	$3.95	$2.95	$4.95	$4.25	$4.25
TMO model (10-49)	$6.45	$6.75	$6.75	$6.45	$4.95		$6.75	$6.75

UNBALANCED PRIMARY & SECONDARY

Model No.	T2-1 TMO2-1	T3-1 TMO3-1	T4-2 TMO4-2	T8-1 TMO8-1	T14-1 TMO14-1
Imped. Ratio	2	3	4	8	14
Freq. (MHz)	.025-600	.5-800	.2-600	.15-250	.2-150
T model (10-49)	$3.45	$4.25	$3.45	$3.45	$4.25
TMO Model (10-49)	$5.95	$6.95	$5.95	$5.95	$6.75

FT FTB

Model No.	FT1.5-1	FTB1-1	FTB1-6	FTB1-1-75
Imped. Ratio	1.5	1	1	1
Freq. (MHz) (1-4)	.1-400	.2-500	.01-200	.5-500
	$29.95	$29.95	$29.95	$29.95

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