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GENERAL MICROWAVE

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COMPONENTS & INSTRUMENTS

Salina

Ordering Information

1. Please order by model number, option number (where applicable), and product name.

   Telephone orders for standard catalog products will be accepted and processed immediately. However, shipment cannot be made until a confirming written order is received, either by means of a standard purchase order form or a TWX or FAX containing the following information as a minimum.

   Purchase order number.
   Ship to and bill to addresses.
   Description, model number and unit price.
   Name of authorized representative of purchasing department.
   Method of shipment.
   Amount of insurance on shipment.
   Sales/Use tax status of order.

   An order for special or modified catalog products cannot be processed prior to receipt of written authorization.

2. Address all purchase orders to:

   General Microwave Corporation (GMC)
   5500 New Horizons Blvd.
   Amityville, N.Y. 11701

   or in care of our Engineering-Sales Representative in your area. Determination of prices, terms and conditions of sale, and final acceptance of orders are made only at the GMC factory.

3. Terms of payment for domestic orders are Net 30 days, subject to approval of credit. If credit has not been established, please provide payment in full or authorization to ship C.O.D. All prices are FOB Amityville, New York and include packing to good commerical practice.

   NOTE: Title and risk of loss and damage pass to the purchaser when the shipment is accepted by a common carrier.

4. Our export terms are prepayment or irrevocable sight letter of credit confirmed, engaged and accepted by any prime New York City bank.

5. The right to discontinue any item and to change specifications or prices at any time without notice is reserved.

6. The minimum order is $50, unless prepayment is received.

   The minimum line item charge is $5.

7. Unless specific instructions accompany the order, shipment is made via uninsured UPS or Parcel Post. Air freight shipments will be made FOB origin, freight charges collect.

8. Unless otherwise specified on the face of the order, overseas shipment will be made via air freight using a freight forwarder selected by GMC, with all charges, including forwarder, inland freight, air freight, insurance, consular and banking fees charged to the buyer's account.

9. Units returned for repair must be returned freight prepaid, FOB GMC factory. If warranty repair is applicable, the unit will be repaired and returned freight prepaid, FOB destination. If warranty repair is not applicable, the customer will be advised of the repair charges and his authorization to proceed awaited before any costs are incurred. Non-warranty repairs will be returned FOB Amityville, N.Y.

   Returns from outside the United States must be made free House/Free Domicile. Note that except where prior authorization has been received from the GMC factory, collect shipments will not be accepted by our receiving department.

10. GMC is obligated to process all orders based on their relative Defense Department priorities. Accordingly, all DO or DX ratings should be included on advance and confirming purchase orders.

11. Standard instruments or components returned for credit within 60 days after shipment in a like-new condition will be accepted subject to a restocking charge of $25 plus 12% of selling price in excess of $100.

12. Deliveries quoted are subject to prior sale.

13. Prices quoted are based on inspection at destination. If source inspection is required or desired, add 3% ($150 minimum) to price of inspected material.

14. Each unit will be accompanied by one copy of our standard operating instructions and will be tested in accord with GMC's standard acceptance test procedure for the particular item. Unless specified in the schedule of items or services, no other data or special testing will be provided.

15. Many of the products manufactured by General Microwave require U.S. Government Export Licenses prior to shipment abroad. Therefore, if the products are to be exported from the U.S. by purchaser or purchaser's agent, or if purchaser transfers title to anyone else who will export the products from the U.S., purchaser is hereby advised that a U.S. Government Export License may be required prior to shipment. All sales by General Microwave assume that the proper licenses are obtained by purchaser, purchaser's agent or transferee before the products are exported.

16. The following warranty applies:

EQUIPMENT WARRANTY

General Microwave Corporation warranties all parts of equipment of its manufacture to be free from defects caused by faulty material or poor workmanship. This warranty excludes electronic tubes, batteries, natural rubber and material normally consumed in operation unless such excepted items fail as a result of improper application by General Microwave.

Liability under this warranty is limited to the obligation to repair, or, at General Microwave's sole option, to replace without charge, FOB General Microwave's Plant, any part found to be defective under normal use and service within the time periods shown below, provided:

(1) General Microwave Corporation is promptly notified within the warranty period in writing upon discovery of such defects;

(2) The original parts or equipment are returned to General Microwave Corporation, transportation charges prepaid;

(3) General Microwave Corporation's examination shall disclose to its satisfaction that such defects have not been caused by abuse after delivery; and

(4) Warranties shall not apply to items which have been repaired or altered by others than General Microwave Corporation or its authorized agency.

The period of warranty is one year after delivery of the instrument to the original purchaser.

The warranty period shall not include any period of time the unit or part fails to perform satisfactorily due to such defect, and any unit, part or component repaired or replaced by General Microwave pursuant to this warranty shall itself be guaranteed as specified above.

Contents

Model Number Index

Model Number Index (Con't)

Glossary Of Terms

POWER MEASUREMENT TERMS

Calibration Factor: The ratio of the substitution audio power to the total incident rf power required to produce equal dc output voltages from the tft power head.

Effective Efficiency: The ratio of the substitution audio power to the total absorbed rf power required to produce equal dc output voltages from the tft power head.

ATTENUATION TERMS

Mean Attenuation: At a given control signal condition, the average of the maximum and minimum values of the attenuation over the specified frequency range.

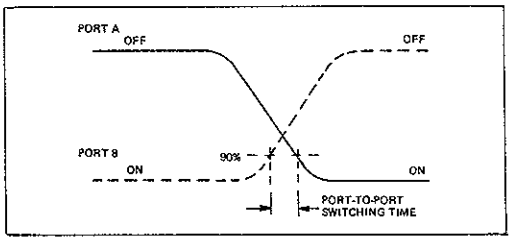
Flatness: The change in attenuation over the specified frequency range, expressed in ± dB about the mean attenuation.

Accuracy of Attenuation: The maximum deviation of the mean attenuation from the selected attenuation, expressed in dB. Accuracy of Attenuation is specified at +23° ±5°C. (The total accuracy of an attenuator is the sum of the Accuracy of Attenuation defined here plus the errors due to Flatness and the variation in attenuation with temperature.)

SWITCHING SPEED TERMS

Switching Time

Port-to-Port Switching: Defined as the time interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, as shown below. For units without integrated drivers, the specifications apply to conditions when it is driven by an appropriately shaped switching waveform.



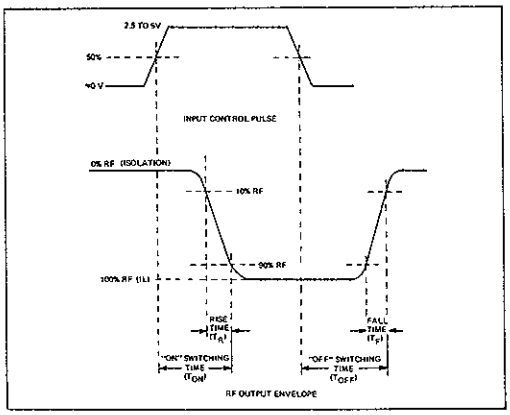
SWITCHING SPEED TERMS (Cont.)

Rise Time: Specified as the transition time between the 10% and 90% points of the square-law detected RF power when the unit is switched from full OFF to full ON, as shown below. For units without integrated drivers, the specifications apply to conditions when it is driven by an appropriately shaped switching waveform.

Fall Time: Specified as the transition time between the 90% and 10% points of the square-law detected RF power when the unit is switched from full ON to full OFF, as shown below. For units without integrated drivers, the specifications apply to conditions when it is driven by an appropriately shaped switching waveform.

ON Time: Specified as the transition time between 50% of the input control signal to the 90% point of the square-law detected RF power when the unit is switched from full OFF to full ON, as shown below. For units without integrated drivers, the specifications apply to conditions when it is driven by an appropriately shaped switching waveform.

OFF Time: Specified as the transition time between 50% of the input control signal to the 10% point of the square-law detected RF power when the unit is switched from full ON to full OFF, as shown below. For units without integrated drivers, the specifications apply to conditions when it is driven by an appropriately shaped switching waveform.



MISCELLANEOUS TERMS

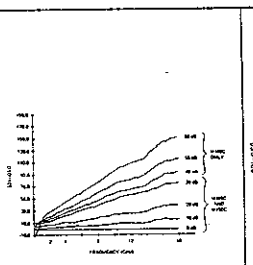
Small Signal Bandwidth: With reference to a modulation frequency of 100 Hz and a modulation depth of ±3 dB at a quiescent level of −6 dB, the frequency at which the modulation depth reduces by 50%.

Large Signal Bandwidth: With reference to a modulation frequency of 100 Hz and a 100% modulation depth at a quiescent level of −6 dB, the frequency at which the modulation depth reduces by 50%.

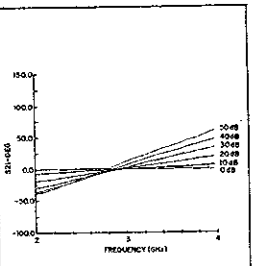
Phase Shift-Attenuators: The difference in phase angle of the exiting rf signal at a given frequency and attenuation level referenced to the exiting signal at the same frequency with the attenuator set at insertion loss. Typical phase shift characteristics of GMC attenuators are shown to the right.

Phase Shift-Phase Shifters: The difference in phase angle of the exiting rf signal at a given frequency and phase shift setting referenced to the exiting signal at the same frequency with the phase shifter set to minimum phase shift.

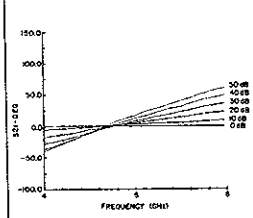
Temperature Coefficient: The average rate of change in attenuation or phase shift over the full operating temperature range of the unit. Expressed in "dB/°C" for attenuators and "degrees/degrees phase shift/°C" for phase shifters.



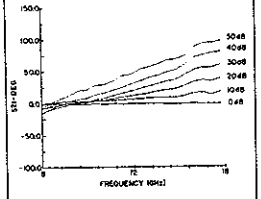
Models M189C and M190C, typical phase vs. attenuation.



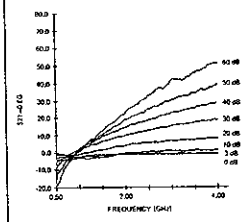
Model D1952, typical phase vs. attenuation.



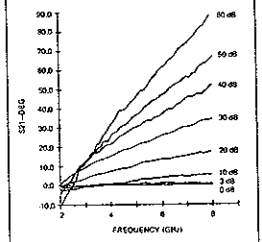
Model D1954, typical phase vs. attenuation.



Model D1958, typical phase vs. attenuation.



Model D1960A, typical phase vs. attenuation.



Model D1962A, typical phase vs. attenuation.

Product Index

Attenuators/Modulators and Phase Shifters

General Microwave (GMC) designs and manufactures a diverse line of high-technology microwave and electronic test equipment and components. This section describes GMC's lines of solid-state absorptive attenuator/modulators, phase shifters and frequency translators.

GMC began the design and manufacture of solid-state control products in 1967. At that time, it introduced the first broadband absorptive attenuator that has since become the basis for its multi-octave M186, M190 and 196 Series of attenuator/modulators. The Company's solid-state control product line has expanded to include an extensive line of phase shifters, PIN diode attenuator/modulators, and PIN diode switches.

Solid-state control components today are essential elements of most modern electronic warfare and countermeasures systems. They also find important applications in navigational systems, telecommunications and fire control systems, and in fact, in almost every aspect of microwave technology. These products are used in primary airborne and shipborne systems, as well as in depot and flightline test equipment required to service these complex equipments.

Selection Guide

BI-PHASE MODULATORS AND PHASE SHIFTERS/FREQUENCY TRANSLATORS

FREQUENCY RANGE (GHz) 2.0 4.0 8.0 12.4 18.0	MODEL	PAGE	COMMENTS
2.6 – 5.2	7722	48	Phase shifter/Frequency translator, digital control
5.0 – 10.0	7724		Phase shifter/Frequency translator, digital control
8 – 18	7728		Phase shifter/Frequency translator, digital control
6 – 18	F1938	51	Bi-phase modulator

ATTENUATORS PHASE SHIFTERS

ATTENUATORS AND MODULATORS

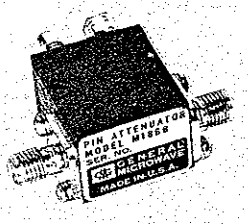
FREQUENCY RANGE (GHz) 0.2 0.5 1.0 2.0 4.0 8.0 12.4 18.0	ATTENUATION RANGE (dB)	MODEL	PAGE	COMMENTS
CONTINUOUSLY VARIABLE, CURRENT CONTROLLED, ABSORPTIVE ATTENUATORS				
0.2 – 18	35	M190C	10	Dual control, low power
	45	M186C		
	65	M189C		
0.2 – 12.4	35	LM190C	10	Dual control, medium power
	40	LM186C		
	65	LM189C		
0.5 – 1	80	1950A	20	Single control
1 – 2	60	1951		
2 – 4	60	1952		
2.6 – 5.2	60	1953		
4 – 8	60	1954		
5 – 10	60	1955		
6 – 12	60	1956		
8 – 18	60	1958		
CONTINUOUSLY VARIABLE, VOLTAGE CONTROLLED, LINEARIZED ABSORPTIVE ATTENUATORS				
0.2 – 18	35	M190C/311	10	Separate driver and rf section, low power
	45	M186C/311		
	65	M189C/311		
0.2 – 12.4	35	LM190C/311	10	Separate driver and rf section, medium power
	40	LM186C/311		
	65	LM189C/311		
0.5 – 4	60	D1960A	27	Integrated driver and rf section
2 – 8	60	D1962A		
0.5 – 1	80	D1950A	24	
1 – 2	60	D1951		
2 – 4	60	D1952		
2.6 – 5.2	60	D1953		
4 – 8	60	D1954		
5 – 10	60	D1955		
6 – 12	60	D1956		
8 – 18	60	D1958		
HIGH SPEED ABSORPTIVE PULSE MODULATORS				
0.2 – 18	35	DM190CH	14	Integrated driver and rf section
	45	DM186CH		
	65	DM189CH		
	80	F192A	17	

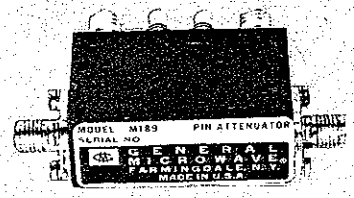
ATTENUATORS AND MODULATORS (cont)

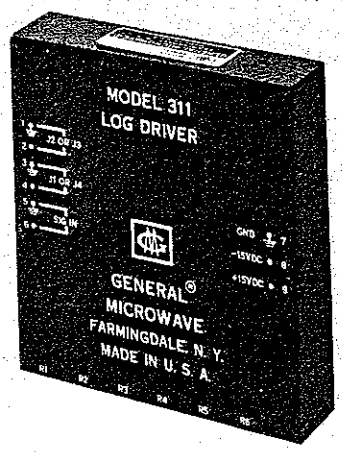
FREQUENCY RANGE (GHz) 0.2 0.5 1.0 2.0 4.0 8.0 12.4 18.0	ATTENUATION RANGE (dB)	MIN STEP SIZE (dB)	MODEL	PAGE	COMMENTS
DIGITALLY PROGRAMMABLE ABSORPTIVE ATTENUATORS, ULTRA-BROADBAND					
0.2 — 18	60	1	3250	30	Integrated driver and rf section
DIGITALLY PROGRAMMABLE ABSORPTIVE ATTENUATORS, MULTI-OCTAVE BAND					
0.5 — 4	60	0.25	3460	45	Integrated driver and rf section
2 — 8	60	0.25	3462		
DIGITALLY PROGRAMMABLE ABSORPTIVE ATTENUATORS, OCTAVE BAND					
0.5 — 1	80	0.05	3290A-80	33	Integrated driver and rf section
	80	0.25	3450	37	
1 — 2	120	0.1	3291-120	33	
	80	0.05	3291-80		
	60	0.25	3451, 3451H	37, 41	
2 — 4	120	0.1	3292-120	33	
	80	0.05	3292-80		
	60	0.25	3452, 3452H	37, 41	
2.6 — 5.2	120	0.1	3293-120	33	
	80	0.05	3293-80		
	60	0.25	3453, 3453H	37, 41	
4 — 8	120	0.1	3294-120	33	
	80	0.05	3294-80		
	60	0.25	3454, 3454H	37, 41	
5 — 10	120	0.1	3295-120	33	
	80	0.05	3295-80		
	60	0.25	3455, 3455H	37, 41	
6 — 12	120	0.1	3296-120	33	
	80	0.05	3296-80		
	60	0.25	3456, 3456H	37, 41	
8 — 18	120	0.1	3298-120	33	
	60	0.05	3298-60		
	60	0.25	3458, 3458H	37, 41	

Models M186C, M189C and M190C Ultra-Broadband PIN Diode Attenuator/Modulators

- Absorptive
- 0.2 to 18 GHz frequency range
- Attenuation range up to 65 dB
- Flatness as low as ±0.5 dB







MODELS M186C, M189C AND M190C

This family of absorptive PIN diode attenuator/modulators operates over the instantaneous frequency range from 0.2 to 18 GHz. Their multi-octave bandwidth makes them highly suitable for wideband ECM and measurement systems.

The rf circuit consists of a T-pad arrangement of shunt and series diodes in a microstrip integrated circuit transmission line, as shown in figures 1 and 2 below, and a resistive low-loss bias line. The arrangement permits operation as a bilaterally-matched device at all attenuation levels by separately controlling the bias currents through the series and shunt diodes.

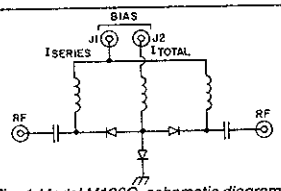


Fig. 1-Model M190C, schematic diagram (Model M189C consists of two such sections)

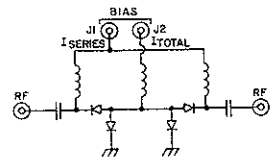


Fig. 2-Model M186C, schematic diagram

Attenuation Levels

The Models M190C and M186C are rated for attenuation levels up to 35 and 45 dB, respectively. The Model M189C, which consists of the equivalent of two independently-controlled M190C attenuators in a single rf assembly, is rated up to 65 dB. Model M189C is also available with digitally-programmable drivers under the Model 3250 designation (see page 30) for full description).

Power Ratings

Although all three models will survive input powers up to 2 watts from −65°C to +25°C, the maximum power levels at which they operate without performance degradation is limited to those shown in figure 5 on page 13. For higher power applications, the narrower band LM186C, LM189C and LM190C models are available.

Models M186C, M189C and M190C Ultra-Broadband PIN Diode Attenuator/Modulators

Drivers

The proper levels of series and shunt diode currents required for operation as a matched attenuator can be provided by either the user's circuitry, or by the GMC Model 311 Driver. (See figure 4 on page 12 for typical Bias Current/Attenuation transfer curves.) The Model 311 provides voltage controlled linear attenuation with a nominal transfer function of 10 dB per volt for the Models M186C and M190C. For the Models M189C or LM189C, two Model 311 drivers are required and the transfer function is 20 dB per volt.

When attenuators are ordered with drivers, the assemblies are adjusted for optimum accuracy at 2 GHz. Optimization at customer-specified frequencies is available on special order.

For Use As Reflective Switches

By reducing the series diode current to zero in the isolations tate, these units can be operated as high-isolation reflective switches for low frequency applications. A typical response curve of the Model M186C operating in this mode is shown in figure 3 on page 12.

Specifications

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz) 0.2 to 8.0	8.0 to 12.4	12.4 to 18.0
M186C	Max Insertion Loss (dB)	1.5	2.2	3.0
	Max VSWR	1.5	1.75	2.0
	Min Attenuation (dB)	45(1)	45	40
M189C	Max Insertion Loss (dB)	2.5	3.0	5.0
	Max VSWR	1.75	2.0	3.0
	Min Attenuation (dB)	65	65	50
M190C	Max Insertion Loss (dB)	1.5	1.8	2.5
	Max VSWR	1.5	1.6	2.0
	Min Attenuation (dB)	35	35	30

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz) 0.2 to 8.0	8.0 to 12.4
LM186C	Max Insertion Loss (dB)	1.5	2.6
	Max VSWR	1.5	1.75
	Min Attenuation (dB)	40(2)	40
LM189C	Max Insertion Loss (dB)	2.5	3.5
	Max VSWR	1.75	2.0
	Min Attenuation (dB)	65	60
LM190C	Max Insertion Loss (dB)	1.5	1.8
	Max VSWR	1.5	1.75
	Min Attenuation (dB)	35	30

ATTEN. (dB)	FLATNESS (±dB) FREQUENCY (GHz) 0.2 to 8.0 M190C	M189C	LM190C	LM189C	0.2 to 12.4 M190C	M189C	LM190C	LM189C	12.4 to 18.0 M190C	M189C
10	0.5	0.5	0.5	0.5	0.7	0.7	0.7	0.7	1.0	1.0
20	0.5	0.5	0.5	0.5	1.0	1.0	1.2	1.2	1.0	1.0
30	0.7	0.7	1.0	1.0	1.5	1.5	2.0	2.0	1.0	1.5
40	—	1.0	—	1.0	—	1.5	—	2.0	—	1.5
50	—	1.0	—	1.5	—	1.5	—	2.0	—	1.5
60	—	1.0	—	2.0	—	1.5	—	2.5	—	1.5

(1) Except 40 dB up to 2 GHz.
(2) Except 35 dB up to 2 GHz.

Models M186C, M189C and M190C Specifications

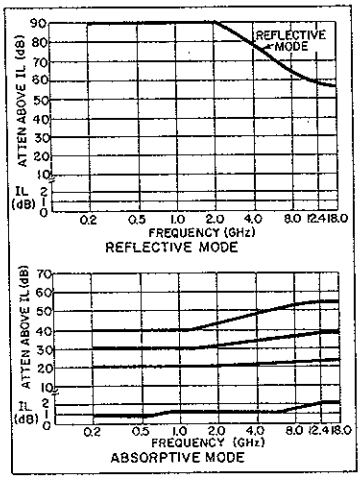


Fig. 3-Typical response curves of Model M186C

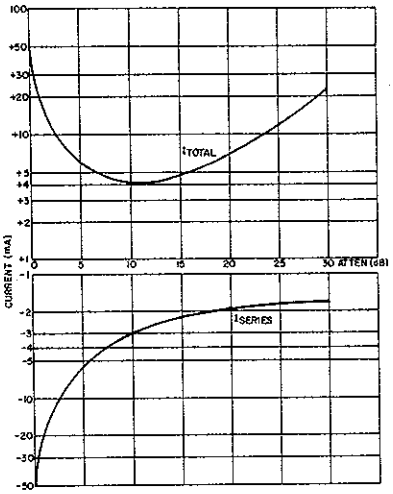


Fig. 4-Typical Models M186C and M190C bias current/attenuation transfer curves

PERFORMANCE CHARACTERISTICS

Power Handling Capability
Without Performance Degradation

M186C, M189C, M190C . . . . . From 0.4 to 100 mW cw or peak (see figure 5 on page 13)

LM186C, LM189C, LM190C . . . . . 100 mW cw or peak

Survival Power (from −65°C to +25°C; see power derating curve, figure 6 on page 13, for higher temperatures)
All units . . . . . 2W average or peak (1μsec max pulse width)

Phase Shift . . . . . See page 5

Typical Small Signal Bandwidth

M186C, M189C, M190C . . . . . 500 kHz

LM186C, LM189C, LM190C . . . . . 50 kHz

Bias Current Requirements (see figure 4 above)
M189C, LM189C . . . . ±100 mA max.
M186C, LM186C, M190C, LM190C . . . . . ±50 mA max.

ENVIRONMENTAL RATINGS (RF UNIT)

Operating Temperature Range . . . −65°C to +85°C

Non-Operating Temperature Range . . . −65°C to +125°C

Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06″double amplitude or 15G, whichever is less)

Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

MODEL 311 CHARACTERISTICS[1]

Nominal Transfer Function . . . . . 10 dB/volt

Accuracy at Calibration Frequency (2 GHz) . . . . . ±1 dB starting from 5 dB above insertion loss

Typical Small Signal Bandwidth When Used With:

M186C, M189C, M190C . . . . . 500 kHz

LM186C, LM189C, LM190C . . . . . 50 kHz

Control Signal Input Voltage Range . . . . . 0 to +5 volts dc

Control Signal Input Impedance . . . . . 3K ohms (nominal)

(1) *Specifications listed are for each Model 311 Driver in use.*

Models M186C, M189C and M190C Specifications

MODEL 311 CHARACTERISTICS[1] (cont)

Switching Time	100 μsec max
Power Supply Requirements	+15V ±0.1%, 125 mA −15V ±0.1%, 125 mA
Operating Temperature Range	−55°C to +75°C
Non-Operating Temperature Range	−55°C to +85°C

AVAILABLE OPTIONS (RF UNIT)

Option No.	Description
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
33	EMI filter solder-type bias terminals
35	High-temperature design (+125°C)

(1) *Specifications listed are for each Model 311 Driver in use.*

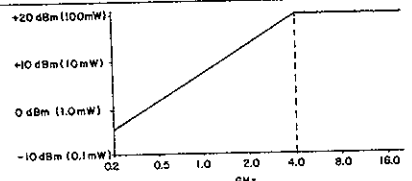


Fig. 5-Models M186C, M190C and M189C, maximum peak and average operating power without performance degradation

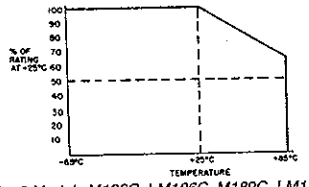
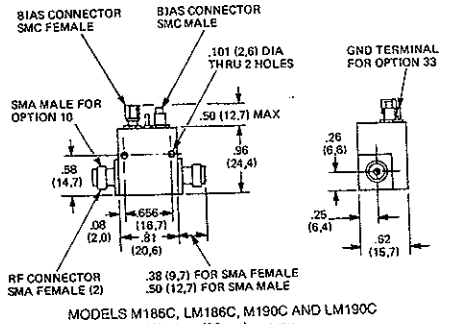
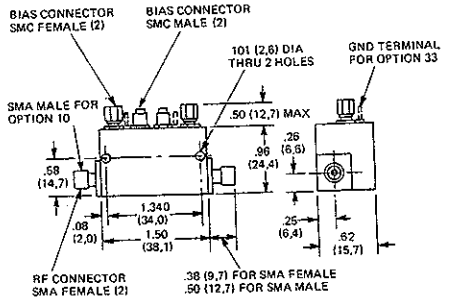


Fig. 6-Models M186C, LM186C, M189C, LM189C, M190C and LM190C, survival power derating factors

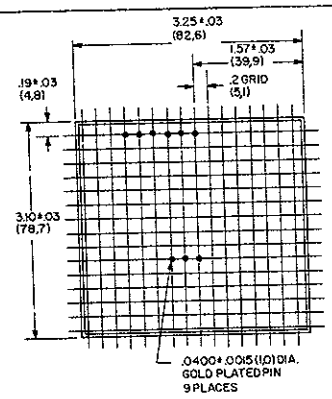
DIMENSIONS AND WEIGHTS

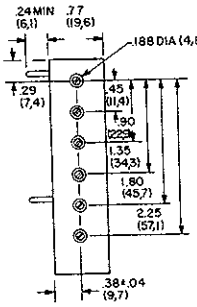


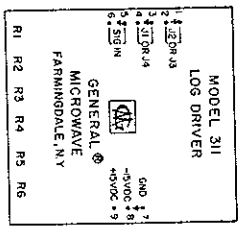
MODELS M186C, LM186C, M190C AND LM190C
Wt. 1 oz (28 gm) approx.



MODELS M189C AND LM189C
Wt. 2 oz. (57 gm) approx.







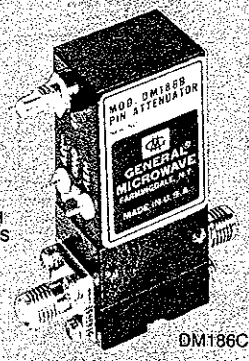
MODEL 311 DRIVER
Wt: 4 oz. (113 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

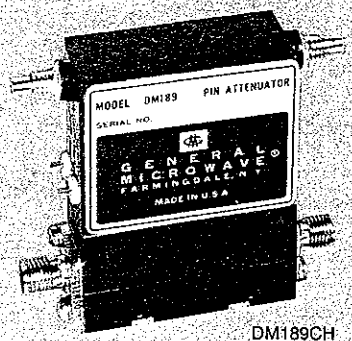
Models DM186CH, DM189CH, and DM190CH Absorptive Ultra-Broadband Pulse Modulators

- Absorptive
- High speed
- 0.2 to 18 GHz frequency range
- Up to 65 dB isolation
- Low VSWR and insertion loss
- Small size, light weight

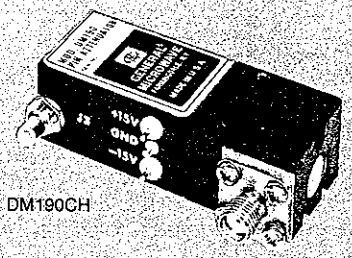
THE THREE UNITS IN THIS SERIES ARE EQUIPPED WITH INTEGRATED DRIVERS



DM186CH



DM189CH



DM190CH

MODELS DM186CH, DM189CH AND DM190CH

Models DM186CH, DM189CH and DM190CH are high-speed ultra-broadband absorptive PIN diode pulse modulators with integrated drivers. Operating over the instantaneous frequency range from 0.2 to 18 GHz, they exhibit nominal isolation characteristics of 40, 60 and 30 dB, respectively. The rf design consists of a T-pad arrangement of shunt and series diodes in a microstrip integrated circuit transmission line (as shown in figures 1 and 2 below) and a resistive low-loss bias line.

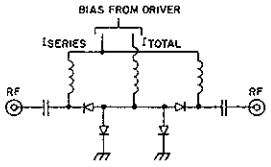


Fig. 1-Model DM186CH, rf schematic diagram

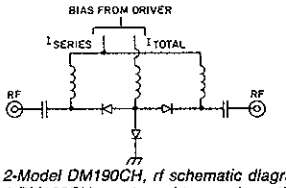


Fig. 2-Model DM190CH, rf schematic diagram (Model DM189CH consists of two such sections)

Switch Control

The currents required to switch the units ON or OFF and to simultaneously maintain a bilateral 50-ohm impedance match at insertion loss and maximum isolation are provided by the integrated drivers, which are controlled by external logic signals.

High-Isolation (Reflective) Models

These units are also available for operation as high-speed high-isolation reflective switches. Designated by Option 31, the reflective switches are intended for low-frequency applications where the isolation provided by the conventional shunt diode switch design (such as that used in the GMC Series M86, 91 and 92) is inadequate. A typical response curve of the Model DM186CH-31 is shown in figure 3 below.

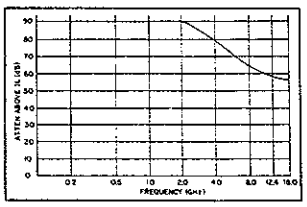


Fig. 3-Typical DM186CH-31 response curve

Models DM186CH, DM189CH, and DM190CH Specifications

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz) 0.2 to 8.0	8.0 to 12.4	12.4 to 18.0
DM186CH	Min Isolation (dB)	45(1)	45	40
	Max Insertion Loss (dB)	2.5	3.0	3.5
	VSWR (ON)	1.75	2.0	2.5
	VSWR (OFF)	1.5	1.5	1.75
DM189CH	Min Isolation (dB)	65	65	50
	Max Insertion Loss (dB)	2.7	4.0	6.0
	VSWR (ON)	1.75	2.0	3.0
	VSWR (OFF)	1.5	1.5	1.75
DM190CH	Min Isolation (dB)	35	30	30
	Max Insertion Loss (dB)	1.5	2.5	3.0
	VSWR (ON)	1.75	2.0	2.5
	VSWR (OFF)	1.5	1.5	1.75

PERFORMANCE CHARACTERISTICS

Rise and Fall Times

Fall time . . . . . 20 nsec. max.
Rise time . . . . . 30 nsec. max.

Power Handling Capability

Without Performance Degradation: From 1 to 30 mW, cw or peak (see figure 5 below)

Survival Power (from −65 °C to +25 °C; see power derating curve, figure 4 below, for higher temperatures): 2W peak or average

Power Supply Requirements

	+15Vdc ±2%	−15Vdc ±5%
DM186CH	30 mA	85 mA
DM189CH	60 mA	170 mA
DM190CH	30 mA	85 mA

Control Characteristics

Control Input Impedance . . . TTL, two-unit load. (A unit load is 1.6 mA sink current and 40μA source current.)

Control Logic . . . . Logic "0" (−0.3 to +0.7 volt) for switch OFF and logic "1" (+2.5 to +5.0 volts) for switch ON.

(1) *Except 40 dB from 0.2 to 2.0 GHz.*

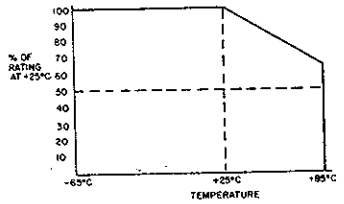


Fig. 4-Models DM186CH, DM189CH and DM190CH, survival power derating factors

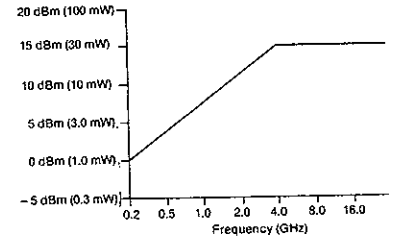


Fig. 5-Models DM186CH, DM189CH and DM190CH, maximum peak and average operating power without performance degradation

Models DM186CH, DM189CH, and DM190CH Specifications

ENVIRONMENTAL RATINGS

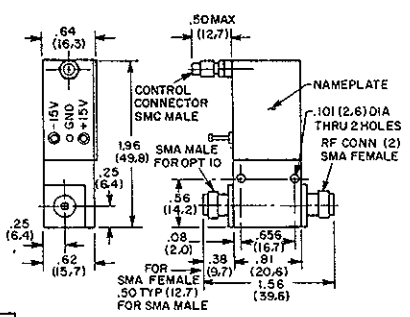
Operating Temperature Range	−65°C to +85°C
Non-Operating Temperature Range	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

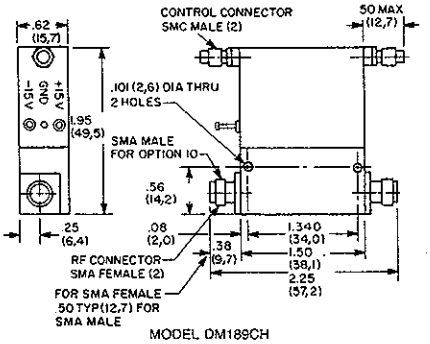
Option No.	Description
3	SMA female control connector(s)
7	Two SMA male rf connectors
9	Inverse control logic; logic 0 for switch ON and logic 1 for switch OFF
10	One SMA male and one SMA female rf connector
20*	Two unit load control input impedance
31	High isolation (reflective) design
33	EMI filter solder-type control terminal(s)
64A	SMB male control connector

*All units are furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.

DIMENSIONS AND WEIGHTS



MODELS DM186CH AND DM190CH
Wt: 2 oz. (56 gm) approx.

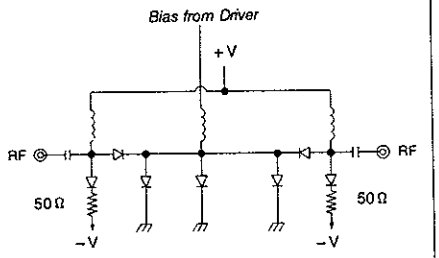


MODEL DM189CH
Wt: 3 oz. (85 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Model F192A Non-Reflective Ultra-Broadband High-Speed Pulse Modulator

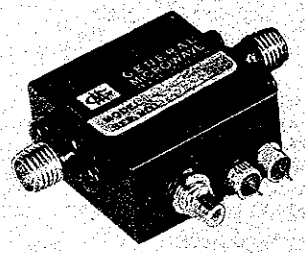
The Model F192A is a high-speed non-reflective PIN diode pulse modulator with integrated driver. Operating over the instantaneous frequency range from 0.2 to 18 GHz, it provides a minimum isolation of 80 dB from 0.5 to 18 GHz, and 70 dB below 0.5 GHz. The rf design consists of an arrangement of shunt and series diodes in a microstrip integrated circuit transmission line as shown in the schematic diagram below.



Model F192A RF Schematic Diagram

The currents required to switch the unit ON or OFF and to simultaneously maintain a bilateral 50-ohm impedance match in both states are provided by the integrated driver, which is controlled by an external logic signal.

- **High speed**
- **0.2 to 18 GHz frequency range**
- **80 dB isolation**
- **Low VSWR and insertion loss**
- **Small size, light weight**



Model F192A
Specifications

CHARACTERISTIC	FREQUENCY (GHz)				
	0.2 to 0.5	0.5 to 2.0	2.0 to 8.0	8.0 to 12.4	12.4 to 18.0
Min Isolation (dB)	70	80	80	80	80
Max Insertion Loss (dB)	2.0	2.0	2.5	3.0	3.5
VSWR (ON and OFF)	1.5	1.5	1.75	2.0	2.0

PERFORMANCE CHARACTERISTICS

Switching Speed

Rise Time (10-90% rf) ..... 10 nsec. max.
Fall Time (90-10% rf) ..... 10 nsec. max.
On Time (50% command to 90% rf) ... 30 nsec. max.
Off Time (50% command to 10% rf) ... 15 nsec. max.

Power Handling Capability

Without Performance Degradation:[1]
500 mW cw or peak
Survival Power (from −65°C to +25°C;
see power derating curve, figure 1 below,
for higher temperatures):
1 W average, 10 W peak (1μ sec max. pulse width)

[1] *Up to Survival Power Limits shown below.*

Power Supply Requirements

+5V ±2%, 90 mA
−12V ±5%, 75 mA

Control Characteristics

Control Input Impedance ..... Schottky TTL, one-unit load. (A unit load is 2 mA sink current and 50μA source current.)

Control Logic .... Logic "0" (−0.3 to +0.5 volt) for switch ON and logic "1" (+2.0 to +5.0 volts) for switch OFF.

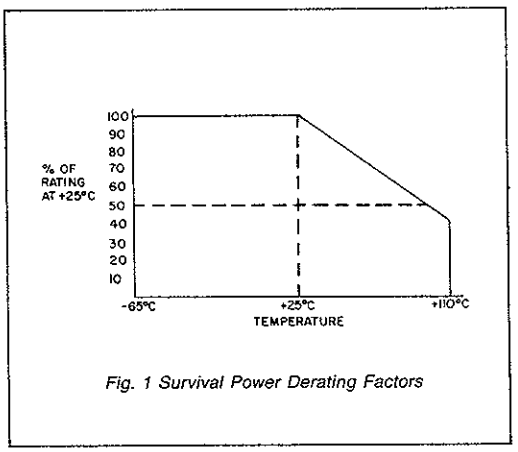


Fig. 1 Survival Power Derating Factors

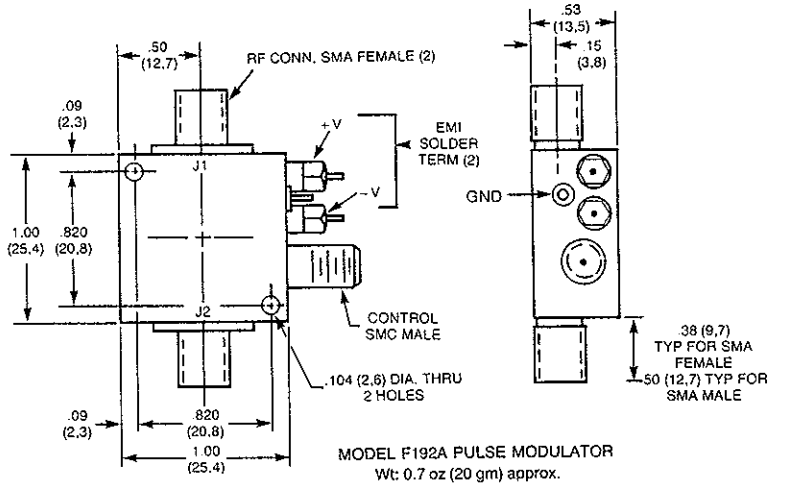
ENVIRONMENTAL RATINGS

Operating Temperature Range	−65°C to +110°C
Non-Operating Temperature Range	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06″ double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female control connector
7	Two SMA male rf connectors
9	Inverse control logic; logic 1 for switch ON and logic 0 for switch OFF
10	One SMA male and one SMA female rf connector
33	EMI filter solder-type control terminal
64A	SMB male control connector

DIMENSIONS AND WEIGHTS

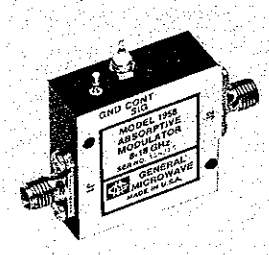


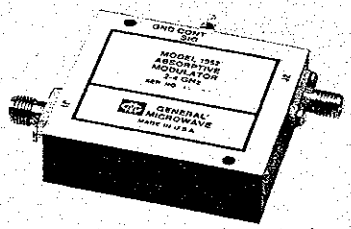
MODEL F192A PULSE MODULATOR
Wt: 0.7 oz (20 gm) approx.

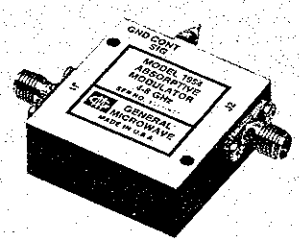
Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005

Series 195 Octave-Band PIN Diode Attenuator/Modulators

- Absorptive
- Current controlled
- 0.5 to 18 GHz frequency range
- High performance MIC quadrature hybrid design
- High speed







SERIES 195

Series 195 current-controlled attenuator/modulators provide small size with greater than octave-bandwidth performance at low cost. All models except the 1950A provide a minimum of 60 dB of attenuation with fall times of 20 nsec max, and rise times ranging from 25 nsec max for the 1951 and 1952 to 100 nsec max for the 1956 and 1958. The 1950A provides a minimum of 80 dB of attenuation with a fall time of 50 nsec max and a rise time of 250 nsec max. These characteristics make this series suitable for a wide range of applications including level setting, complex amplitude modulation, pulse modulation and high-speed switching.

The eight models in the Series 195 encompass a frequency range from 0.5 to 18 GHz. All models except the 1950A are capable of extended bandwidth operation, typically 3:1, with only moderate degradation in performance at the band edges.

As shown in figures 1 and 2 below, the rf circuit employed in all models except the Model 1950A uses two shunt arrays of PIN diodes and two quadrature hybrid couplers. The quadrature hybrids are of a unique GMC microstrip design which are integrated with the diode arrays to yield a minimal package size. The rf circuit employed in the Model 1950A uses one shunt array of PIN diodes with input and output impedance matching circuits.

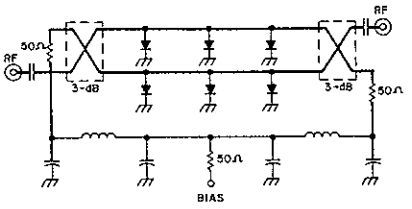


Fig. 1-Models 1951-1958, rf schematic diagram

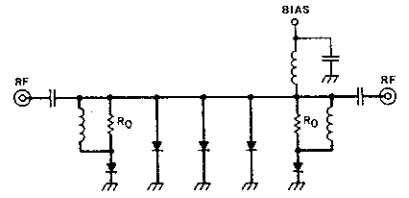


Fig. 2-Model 1950A, rf schematic diagram

MODEL	FREQUENCY RANGE (GHz)	MAX. INSERTION LOSS (dB)	MAX. VSWR	FLATNESS (± dB) AT MEAN ATTENUATION LEVELS UP TO				
				10 dB	20 dB	40 dB	60 dB	80 dB
1950A	0.5 – 1.0	1.2	1.8	0.3	0.8	1.7	2.2	2.5
1951	1.0 – 2.0	1.3	1.5	0.3	0.8	1.5	1.6	
	0.75 – 2.25	1.4	2.0	0.5	1.4	3.0	3.5	
1952	2.0 – 4.0	1.5	1.5	0.3	0.8	1.5	1.6	
	1.5 – 4.5	1.6	2.0	0.5	1.4	3.0	3.5	
1953	2.6 – 5.2	1.7	1.6	0.3	0.8	1.5	1.6	
	1.95 – 5.85	1.8	2.1	0.5	1.4	3.0	3.5	
1954	4.0 – 8.0	2.0	1.7	0.3	0.8	1.5	1.6	
	3.0 – 9.0	2.1	2.2	0.5	1.4	3.0	3.5	
1955	5.0 – 10.0	2.2	1.7	0.5	0.9	1.5	1.6	
	3.75 – 11.25	2.3	2.2	0.7	1.4	3.0	3.5	
1956	6.0 – 12.0	2.3	1.8	0.7	1.0	1.5	1.6	
	4.5 – 13.5	2.4	2.2	0.9	1.5	3.0	3.5	
1958	8.0 – 18.0	2.5(1)	1.8(1)	0.7	1.0	1.5	1.6	
	6.0 – 18.0	2.5(1)	1.8(1)	0.9	1.5	3.0	3.5	

Note: Specifications for the extended frequency ranges are typical.

PERFORMANCE CHARACTERISTICS

Mean Attenuation Range
- 1950A . . . . . 80 dB
- All other units . . . . . 60 dB

Monotonicity . . . . . Guaranteed

Phase Shift . . . . . See page 5

Temperature Effects . . . . . See figure 3 on page 22

Power Handling Capability

Without Performance Degradation
- 1950A, 1951 . . . . . 10 mW cw or peak
- All other units . . . . . 100 mW cw or peak

Survival Power (from −65°C to +25°C; see power derating curve, fir gure 4 on page 22, for higher temperatures)
- All units . . . . . 1 W average
  25 W peak (1 μ sec max pulse width)

Rise and Fall Times

Fall Time
- 1950A . . . . . 50 nsec max
- All other units . . . . . 20 nsec max

Rise Time
- 1950A . . . . . 250 nsec max
- All other units . . . . . 125 nsec max

Bias Current for Maximum Attenuation
- 1950A . . . . . From 5 to 35 mA
- All other units . . . . . From 15 to 70 mA

(1) *Except from 16 - 18 GHz where insertion loss is 3.5 dB max and VSWR is 2.0 max.*

Series 195
Specifications

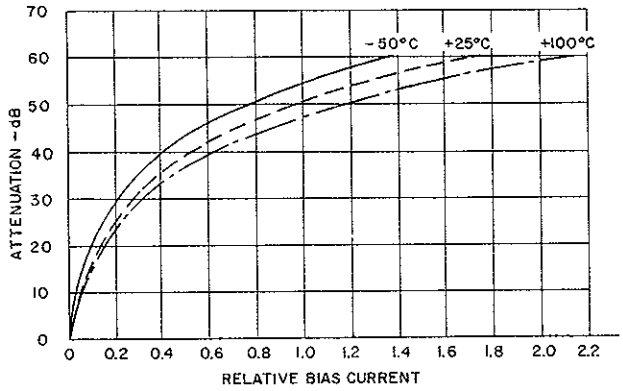


Fig. 3-Series 195, typical effects of temperature on attenuation

ENVIRONMENTAL RATINGS

Operating Temperature Range	–54°C to +125°C
Non-Operating Temperature Range	–65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias connector
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
64	SMC male bias connector
64A	SMB male bias connector

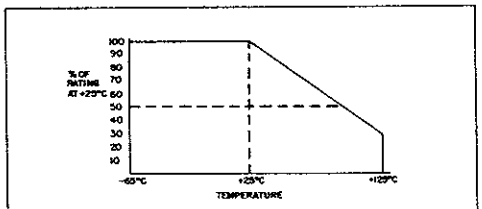
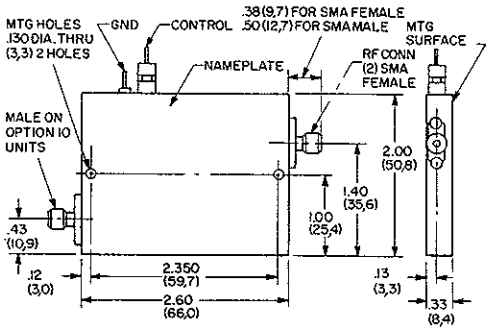
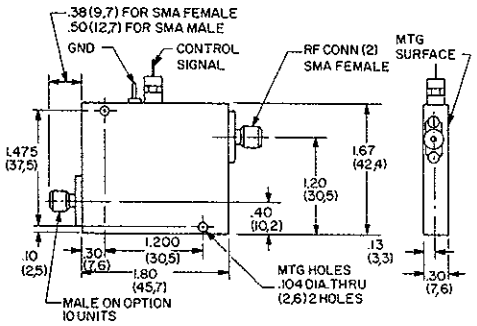


Fig. 4-Series 195, survival power derating factors

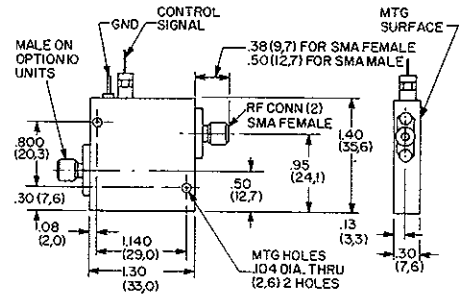
DIMENSIONS AND WEIGHTS



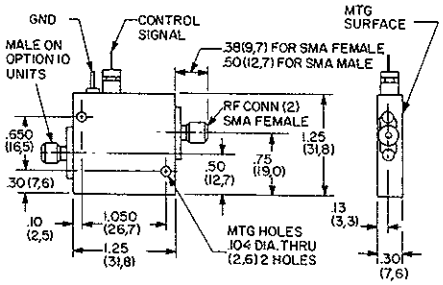
MODELS 1950A AND 1951
Wt: 3 oz. (85 gm) approx.



MODELS 1952 AND 1953
Wt: 2 oz. (57 gm) approx.



MODELS 1954, 1955 AND 1956
Wt: 1 oz. (28 gm) approx.

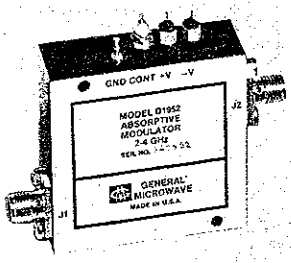


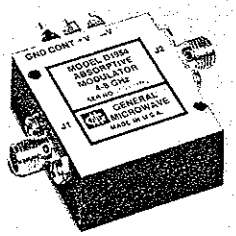
MODEL 1958
Wt: 1 oz. (28 gm) approx.

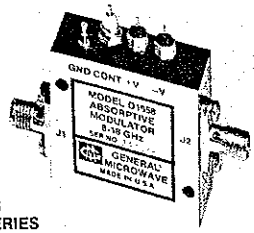
Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series D195 Octave-Band
PIN Diode Attenuator/Modulators
With Integrated Drivers

- **Absorptive**
- **Linearized**
- **Voltage controlled**
- **0.5 to 18 GHz frequency range**
- **High performance MIC quadrature hybrid design**
- **High speed**







ALL UNITS IN THIS SERIES ARE EQUIPPED WITH INTEGRATED DRIVERS

SERIES D195

The Series D195 voltage-controlled linearized attenuator/modulators are integrated assemblies consisting of a Series 195 unit (see page 20) and a hybridized driver circuit which provides a nominal transfer function of 10 dB per volt. (See figure 1 below.)

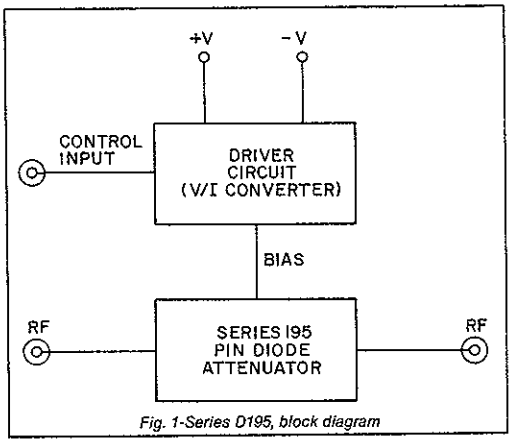


Fig. 1-Series D195, block diagram

All of the Series D195 units except the D1950A exhibit fall times of 20 nsec max and rise times of 1.5 μsec max for attenuation steps of 10 dB or more. For smaller excursions, the fall times can increase to several hundred nsec, while the rise times remain essentially unchanged. In applications where a rapid return to insertion loss from any level of attenuation is required, Option 59 is available. With this option, an external pulse is applied to trigger a high-speed reset circuit, and recovery times of 200 nsec max are obtained. Where use of an external reset pulse as described above is not feasible, an internal reset option (Option 58) is available which will automatically reset the unit to insertion loss within 200 nsec for a step of 50 dB or more.

The fall and rise time specifications for the D1950A are 500 nsec max and 10 μsec max, respectively. Options 58 and 59 are not available for this model.

MODEL	FREQUENCY RANGE (GHz)	MAX. INSERTION LOSS (dB)	MAX. VSWR	FLATNESS (± dB) AT MEAN ATTENUATION LEVELS UP TO				
				10 dB	20 dB	40 dB	60 dB	80 dB
D1950A	0.5 – 1.0	1.2	1.8	0.3	0.8	1.7	2.2	2.5
D1951	1.0 – 2.0	1.6	1.5	0.3	0.8	1.5	1.6	
	0.75–2.25	1.7	2.0	0.5	1.4	3.0	3.5	
D1952	2.0 – 4.0	1.8	1.5	0.3	0.8	1.5	1.6	
	1.5 – 4.5	1.9	2.0	0.5	1.4	3.0	3.5	
D1953	2.6 – 5.2	2.0	1.6	0.3	0.8	1.5	1.6	
	1.95–5.85	2.1	2.1	0.5	1.4	3.0	3.5	
D1954	4.0 – 8.0	2.4	1.7	0.3	0.8	1.5	1.6	
	3.0 – 9.0	2.5	2.2	0.5	1.4	3.0	3.5	
D1955	5.0 – 10.0	2.6	1.7	0.5	0.9	1.5	1.6	
	3.75 –11.25	2.7	2.2	0.7	1.4	3.0	3.5	
D1956	6.0 – 12.0	2.7	1.8	0.7	1.0	1.5	1.6	
	4.5 – 13.5	2.8	2.2	0.9	1.5	3.0	3.5	
D1958	8.0 – 18.0	3.0(1)	1.8(1)	0.7	1.0	1.5	1.6	
	6.0 – 18.0	3.0(1)	1.8(1)	0.9	1.5	3.0	3.5	

Note: Specifications for the extended frequency ranges are typical.

PERFORMANCE CHARACTERISTICS

Mean Attenuation Range
D1950A . . . . . 80 dB
All other units . . . . . 60 dB

Accuracy of Attenuation
0 to 30 dB . . . . . ± 0.5 dB
> 30 to 50 dB . . . . . ± 1.0 dB
> 50 to 60 dB . . . . . ± 1.5 dB
> 60 to 80 dB . . . . . ± 2.0 dB (D1950A only)

Monotonicity . . . . . Guaranteed

Phase Shift . . . . . See page 5

Temperature Coefficient . . . . . ± 0.025 dB/°C

Power Handling Capability
Without Performance Degradation
D1950A, D1951 . . . . . 10 mW cw or peak
All other units . . . . . 100 mW cw or peak
Survival Power (from −65 °C to +25 °C; see power derating curve, figure 2 on page 26, for higher temperatures)
All units . . . . . 1 W average
25 W peak (1 μsec max pulse width)

Rise and Fall Times
Fall Time
D1950A . . . . . 500 nsec max
All other units . . . . . 20 nsec max(2)
Rise Time
D1950A . . . . . 10 μsec max
All other units . . . . . 1.5 μsec max

Nominal Control Voltage Characteristics

Range	Operating	Maximum
D1950A	0 to +8V	±15V
All other units	0 to +6V	±15V

Transfer Function . . . . 10 dB/volt
Input Impedance . . . . 10K ohms(3)
Modulation Bandwidth
Small Signal
D1950A . . . . . 25 kHz
All other units . . . . 500 kHz
Large Signal
D1950A . . . . . 5 kHz
All Other Units . . . 50 kHz

Power Supply Requirements . . . . . +12V ±5%, 100 mA
−12V ±5%, 20 mA

Power Supply Rejection . . . . . Less than 0.1 dB/volt change in either supply

(1) *Except from 16 - 18 GHz where insertion loss is 4.0 dB max and VSWR is 2.0 max.*
(2) *For attenuation steps of 10dB or more.*
(3) *See footnote (3) on page 26 for units equipped with Option 59.*

Series D195 Specifications

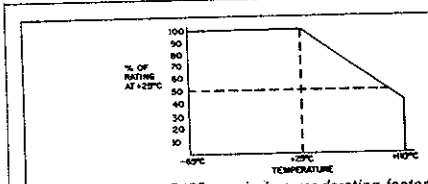


Fig. 2-Series D195, survival power derating factors

ENVIRONMENTAL RATINGS

Operating Temperature Range	−54°C to +110°C
Non-Operating Temperature Range	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

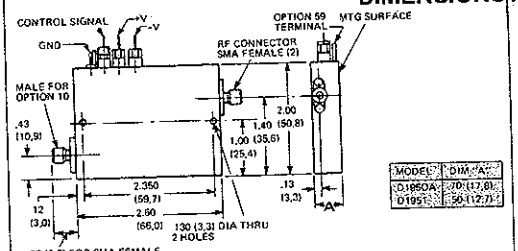
Option No.	Description
3	SMA female control connector
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
58	Internally-generated reset to insertion loss (not available on D1950A)(1)
59	Externally-triggered reset to insertion loss (not available on D1950A)(2)(3)
61	20 dB/volt transfer function with 0 to +3V control signal input (+4V for the D1950A)
62	±15 volts operation
64	SMC male control connector
64A	SMB male control connector

(1) Where use of an Option 59 external reset pulse (see note 2 below) is not feasible, this option is available which will automatically sense the slope and magnitude of the control signal and reset the unit to the insertion loss state within 200 nsec for a step of 50dB or more.

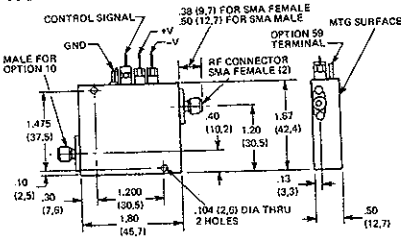
(2) An external terminal is provided for the user to apply a fast (10 nsec max rise time) positive-going 3-volt pulse at least 0.5 μ sec wide to accelerate the return of the attenuator to the insertion loss state with the simultaneous lowering of the control signal to the zero voltage level. This reset can be accomplished within 200 nsec.

(3) The input impedance of units equipped with Option 59 is a circuit equivalent to approximately 50 pF in series with a parallel combination of 100pF and 1000 ohms.

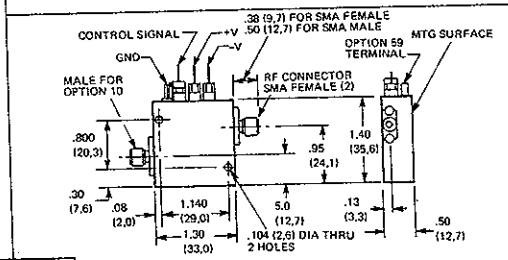
DIMENSIONS AND WEIGHTS



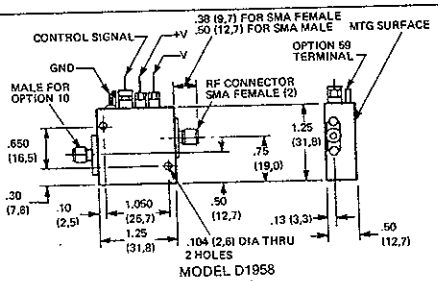
MODELS D1950A AND D1951
Wt: 3 oz. (85 gm) approx.



MODELS D1952 AND D1953
Wt: 2 oz. (57 gm) approx.



MODELS D1954, D1955 AND D1956
Wt: 1 oz. (28 gm) approx.



MODEL D1958
Wt: 1 oz. (28 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series D196 Multi-Octave PIN Diode Attenuator/Modulators

With Integrated Drivers

SERIES D196

The Series D196 voltage-controlled linearized attenuator/modulators provide multi-octave performance in a compact rugged package well-suited to military applications. Frequency coverage from 0.5 to 8 GHz is provided by the two units in the series. Model D1960A covers the 0.5 to 4 GHz band, and Model D1962A covers the 2 to 8 GHz band.

As can be seen from figures 1 and 2 below, the circuit configuration of the Models D1960A and D1962A consists of two T-pad sections in tandem. The proper levels of series and shunt currents required to maintain bilateral match at all attenuation levels are provided by the integrated driver.

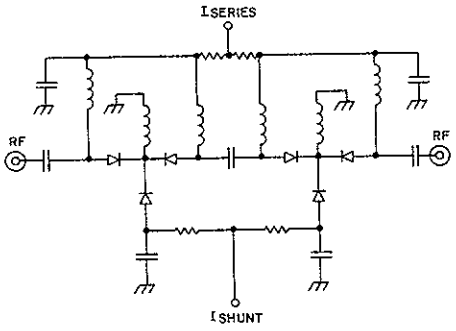


Fig. 1-Series D196, rf schematic diagram

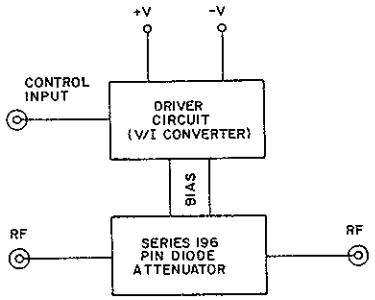
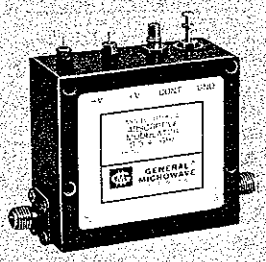


Fig. 2-Series D196, block diagram

- **Absorptive**
- **Linearized**
- **Voltage controlled**
- **Flatness as low as** ±0.5 dB



BOTH UNITS IN THIS SERIES ARE EQUIPPED WITH INTEGRATED DRIVERS

Series D196
Specifications

MODEL	CHARACTERISTIC	FREQUENCY (GHz) 0.5–2	2–4	4–8
D1960A	Insertion loss (max)	2.0 dB	2.5 dB	
	VSWR (max)	1.7		
	Flatness up to 20 dB	±0.5 dB		
	40 dB	±1.0 dB		
	60 dB	±1.5 dB		
D1962A	Insertion loss (max)		2.5 dB	
	VSWR (max)		1.7	
	Flatness up to 20 dB		±0.5 dB	
	40 dB		±1.0 dB	
	60 dB		±1.5 dB	

PERFORMANCE CHARACTERISTICS

Mean Attenuation Range . . . 60 dB

Accuracy of Attenuation

0-20 dB . . . . . ± 1.0 dB
> 20-40 dB . . . . . ± 1.5 dB
> 40-60 dB . . . . . ± 2.0 dB

Monotonicity . . . . . Guaranteed

Temperature Coefficient . . . ± 0.01 dB/°C

Power Handling Capability
Without Performance Degradation

D1960A . . . . . From 0.4 to 100 mW cw or peak (see figure 3 below)

D1962A . . . . . 100 mW cw or peak

Survival Power (from −65°C to +25°C; see power derating curve, figure 4 below, for higher temperatures)

Both units . . . . . 2W average or peak (1 μ sec max pulse width)

Phase Shift . . . . . See page 5

Rise and Fall Times . . . . . 3 μsec

Nominal Control Voltage Characteristics

Range
Operating . . . . . 0 to +6V
Maximum . . . . . ± 15V

Transfer Function . . . . . 10 dB/volt

Input Impedance . . . . . 10K ohms

Modulation Bandwidth
Small Signal . . . . . 20 kHz
Large Signal . . . . . 5 kHz

Power Supply Requirements . . . . . +12V ±5%, 100 mA
−12V ±5%, 25 mA

Power Supply Rejection . . Less than 0.1 dB/volt change in either supply

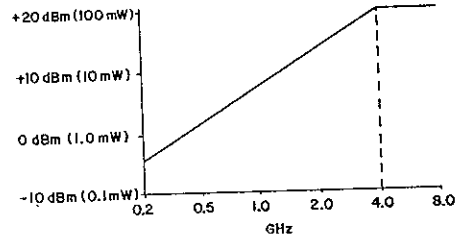


Fig. 3-Model D1960A, maximum peak and average operating power without performance degradation

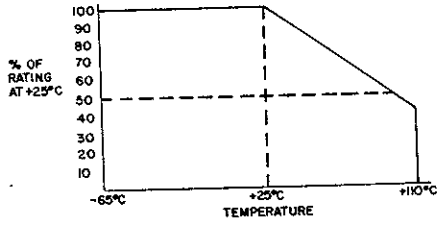


Fig. 4-Models D1960A and D1962A, survival power derating factors

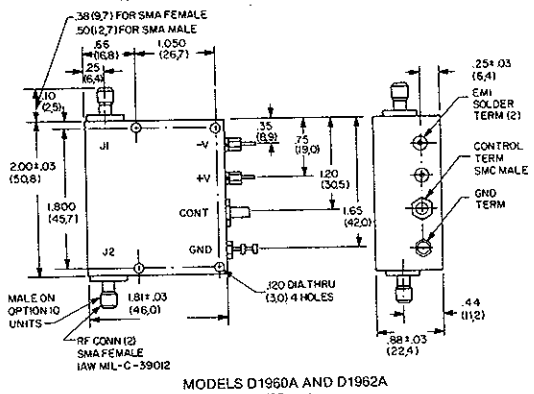
ENVIRONMENTAL RATINGS

Operating Temperature Range	−54°C to +110°C
Non-Operating Temperature Range	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female control connector
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
33	EMI filter solder-type control terminal
61	20 dB/volt transfer function with 0 to +3V control signal input
64A	SMB male control connector

DIMENSIONS AND WEIGHTS

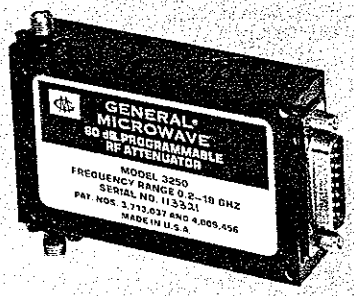


MODELS D1960A AND D1962A
Wt: 3 oz. (85 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Model 3250 Ultra-Broadband Digitally-Programmable PIN Diode Attenuator

- **Frequency range: 0.2 to 18 GHz**
- **Attenuation range: Up to 60 dB**
- **Binary or BCD programming**
- **Absorptive**
- **Guaranteed Monotonicity**



The Model 3250 digitally programmable attenuator provides excellent performance characteristics over the frequency range of 0.2 to 18 GHz. Attenuation levels up to 60 dB are programmable in increments of 1 dB.

The unit is an integrated assembly of a dual T-pad PIN diode attenuator and a driver consisting of a D/A and a V/I Converter. See figures 1 and 2.

The Model 3250 operates as a bilaterally-matched device at all attenuation levels. It is supplied in a compact rugged package well-suited to military applications.

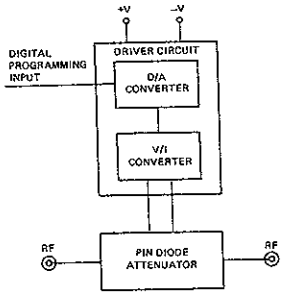


Fig. 1-Model 3250, block diagram

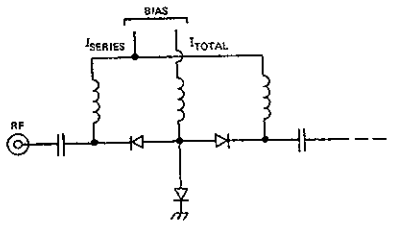


Fig. 2-Model 3250, rf schematic diagram (unit consists of two such sections)

PERFORMANCE CHARACTERISTICS

Frequency Range . . . . . 0.2 to 18 GHz

Mean Attenuation Range
- 0.2 to 12.4 GHz . . . . . 60 dB
- 12.4 to 18 GHz . . . . . 50 dB

Insertion Loss (max.)
- 0.2 to 8 GHz . . . . . 2.5 dB
- 8 to 12.4 GHz . . . . . 3.0 dB
- 12.4 to 18 GHz . . . . . 5.0 dB

VSWR (max.)
- 0.2 to 8 GHz 1.75
- 8 to 12.4 GHz 2.0
- 12.4 to 18 GHz 3.0

Accuracy of Attenuation(1) . ±0.3 dB

Temperature Coefficient . . . 0.02 dB/°C max.

Power Handling Capability
Without Performance Degradation . . . . . From 0.4 to 100 mW cw or peak (see Figure 3 below)

Power Handling Capability (con't)
Survival Power (from −65°C to +25°C; see power derating curve, Figure 4 below, for higher temperatures) . . . . . 2W average or peak (1 µsec max pulse width)

Switching Time . . . . . 20 µsec max.

Programming . . . . . Positive true binary (standard) or BCD (option 1). For complementary code, specify Option 2.

Minimum Attenuation Step . 1.0 dB

Logic Input
- **Logic 0** . . . . . −0.3 to +0.7V
- **Logic 1** . . . . . +2.5 to +5.0V

Power Supply Requirements . . . . . +5V ±5%, 310 mA
+15V ±5%, 100 mA
−15V ±5%, 100 mA

Power Supply Rejection . . . Less than 0.1 dB/volt change in any supply

ATTEN. (dB)	FLATNESS (±dB) Frequency (GHz) 0.2 to 8.0	0.2 to 12.4	12.4 to 18.0
10	0.5	0.7	1.0
20	0.5	1.0	1.0
30	0.7	1.5	1.5
40	1.0	1.5	1.5
50	1.0	1.5	1.5
60	1.0	1.5	1.5

(1) *At calibration frequency. All units are calibrated at 4 GHz. Calibration at other frequencies within the band is available upon request.*

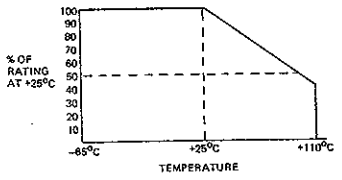


Fig. 3-Model 3250, maximum peak and average operating power without performance degradation.

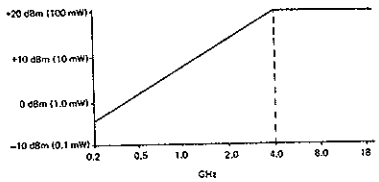


Fig. 4-Model 3250, survival power derating factors.

Model 3250
Specifications

ENVIRONMENTAL RATINGS

Operating Temperature Range ..... −54°C to +110°C
Non-Operating Temperature Range .... −65°C to +125°C
Humidity ..... MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock ..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration ..... MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude ..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling ..... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

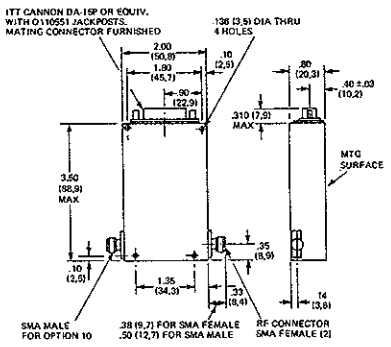
Option No.	Description
1	BCD programming (Binary is standard
2	Complementary programming (positive true is standard)
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector

PIN FUNCTIONS		
PIN NO.	BINARY	BCD (Opt. 1)
1	SPARE	SPARE
2	SPARE	SPARE
3	+5V	+5V
4	DIGITAL & POWER GND	DIGITAL & POWER GND
5	GND	1 dB
6	GND	2 dB
7	1 dB	4 dB
8	2 dB	8 dB
9	4 dB	10 dB
10	8 dB	20 dB
11	16 dB	40 dB
12	32 dB	OPEN (NO CONNECTION)
13	+15V	+15V
14	−15V	−15V
15	SPARE	SPARE

ACCESSORY FURNISHED

Mating power/logic connector

DIMENSIONS AND WEIGHTS



MODEL 3250
Wt: 4 oz. (113 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ±.005

Series 329 Octave-Band Digitally-Programmable PIN Diode Attenuators

SERIES 329

The Series 329 programmable attenuators provide octave-band performance characteristics and wide programming flexibility. Attenuation ranges up to 120 dB are available in attenuation increments as low as 0.05 dB.

Each Series 329 unit is an integrated assembly of Series 195 units, and a driver circuit consisting of a D/A Converter and a precision V/I Converter (see page 20 and figure 1 below). This arrangement preserves the speed, reliability and monotonicity of the PIN diode attenuator and adds an extremely high degree of accuracy and design flexibility that permits selection of a virtually unlimited combination of dynamic range and attenuation interval. The rf characteristics of the Series 329 (e.g. - insertion loss, VSWR and flatness) are similar to the corresponding characteristics of the Series 195 unit employed.

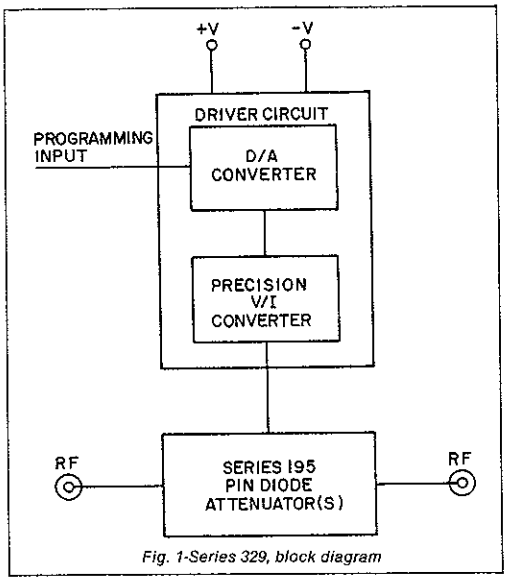
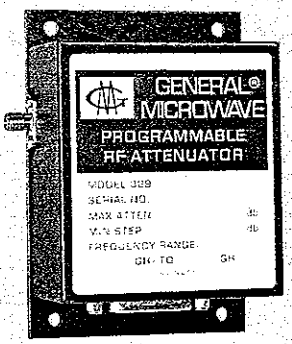


Fig. 1-Series 329, block diagram

- **Absorptive**
- **Binary or BCD programming**
- **Guaranteed Monotonicity**
- **0.5 to 18 GHz frequency range**
- **Attenuation range up to 120 dB**
- **Attenuation interval as low as 0.05 dB**



Series 329
Specifications

60/80 dB Series

MODEL	FREQUENCY RANGE (GHz)	MAX. INSERTION LOSS (dB)	MAX. VSWR	FLATNESS (±dB) AT MEAN ATTENUATION LEVELS UP TO				
				10 dB	20 dB	40 dB	60 dB	80 dB
3290A-80	0.5 – 1.0	1.2	1.8	0.3	0.8	1.7	2.2	2.5
3291-80	1.0 – 2.0	1.6	1.5	0.3	0.8	1.5	1.6	1.7
	0.75 – 2.25	1.7	2.0	0.5	1.4	3.0	3.5	3.6
3292-80	2.0 – 4.0	1.9	1.6	0.3	0.8	1.5	1.6	1.7
	1.5 – 4.5	2.0	2.2	0.5	1.4	3.0	3.5	3.6
3293-80	2.6 – 5.2	2.2	1.7	0.3	0.8	1.5	1.6	1.7
	1.95 – 5.85	2.3	2.3	0.5	1.4	3.0	3.5	3.6
3294-80	4.0 – 8.0	2.7	1.8	0.3	0.8	1.5	1.6	1.7
	3.0 – 9.0	2.8	2.4	0.5	1.4	3.0	3.5	3.6
3295-80	5.0 – 10.0	2.9	1.8	0.5	0.9	1.5	1.6	1.7
	3.75 – 11.25	3.0	2.4	0.7	1.4	3.0	3.5	3.6
3296-80	6.0 – 12.0	3.0	1.9	0.7	1.0	1.5	1.6	1.7
	4.5 – 13.5	3.1	2.4	0.9	1.5	3.0	3.5	3.6
3298-60	8.0 – 18.0	3.3(1)	1.9(1)	0.7	1.0	1.5	1.6	—
	6.0 – 18.0	3.3(1)	1.9(1)	0.9	1.5	3.0	3.5	—

Note: Specifications for the extended frequency ranges are typical.

120 dB Series

MODEL(2)	FREQUENCY RANGE (GHz)	MAX. INSERTION LOSS (dB)	MAX. VSWR	FLATNESS (±dB) AT MEAN ATTENUATION LEVELS UP TO						
				10 dB	20 dB	40 dB	60 dB	80 dB	100 dB	120 dB
3291-120	1.0 – 2.0	3.5	2.0	0.5	0.8	1.6	2.4	3.0	3.1	3.2
	0.75 – 2.25	3.7	2.5	0.7	1.4	3.0	4.5	6.0	6.7	7.0
3292-120	2.0 – 4.0	3.9	2.0	0.5	0.8	1.6	2.4	3.0	3.1	3.2
	1.5 – 4.5	4.1	2.5	0.7	1.4	3.0	4.5	6.0	6.7	7.0
3293-120	2.6 – 5.2	4.3	2.2	0.5	0.8	1.6	2.4	3.0	3.1	3.2
	1.95 – 5.85	4.5	2.6	0.7	1.4	3.0	4.5	6.0	6.7	7.0
3294-120	4.0 – 8.0	5.2	2.3	0.5	0.8	1.7	2.5	3.2	3.3	3.4
	3.0 – 9.0	5.4	2.7	0.7	1.4	3.0	4.6	6.2	6.9	7.2
3295-120	5.0 – 10.0	5.6	2.4	0.7	1.1	1.9	2.7	3.2	3.3	3.4
	3.75 – 11.25	5.8	2.8	1.2	1.7	3.2	4.8	6.3	7.0	7.2
3296-120	6.0 – 12.0	5.9	2.5	0.9	1.4	2.1	2.8	3.3	3.4	3.5
	4.5 – 13.5	6.1	2.9	1.5	2.0	3.5	5.0	6.4	7.0	7.2
3298-120	8.0 – 18.0	6.6(3)	2.5(3)	1.0	1.5	2.2	3.0	3.4	3.5	3.6
	6.0 – 18.0	6.6(3)	2.5(3)	1.5	2.0	3.5	5.0	6.4	7.1	7.4

Note: Specifications for the extended frequency ranges are typical.

(1) Except from 16 - 18 GHz where insertion loss is 4.2 dB max and VSWR is 2.2.

(2) Maximum attenuation in units with BCD option is 119 dB.

(3) Except from 16 - 18 GHz where insertion loss is 8.6 dB max and VSWR is 2.7.

PERFORMANCE CHARACTERISTICS

Mean Attenuation Range. Refer to model number suffix (e.g. - mean attenuation ranges of 3298-60 and 3298-120 are 60 dB and 120 dB, respectively)

Accuracy of Attenuation

60/80 dB units..... ±(0.35 dB + 0.01 dB/dB)

120 dB units..... ±(0.5 dB + 0.02 dB/dB)

Monotonicity ..... Guaranteed

Phase Shift..... See page 5

Temperature Coefficient

60/80 dB units

0 to 10 dB..... ±0.01 dB/°C

>10 to 30 dB..... ±0.025 dB/°C

>30 to max attenuation..... ±0.05 dB/°C

120 dB units

0 to 20 dB..... ±0.02 dB/°C

>20 to 60 dB..... ±0.05 dB/°C

>60 to 120 dB..... ±0.1 dB/°C

Power Handling Capability

Without Performance Degradation

3290A and 3291..... 10 mW cw or peak

All other units..... 100 mW cw or peak

Survival Power (from −25°C to +25°C; see power derating curve, figure 2 at right, for higher temperatures)

All units..... 1 W average
25 W peak
(1μ sec max pulse width)

Switching Time

3298-60 and 3298-120 2μsec max

All other units..... 10μsec max

Programming ..... Positive true binary (standard) or BCD (Option 1). For complementary code, specify Option 2.

Minimum Attenuation Step

	60/80 dB units	120 dB units
Binary Units.....	0.05 dB	0.1 dB
BCD Units.....	0.2 dB	1.0 dB

Logic Input

Logic 0..... −0.3 to +0.7V at −1.0 mA

Logic 1..... +2.5 to +5.0V at +40μA

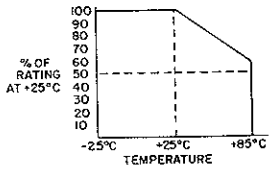


Fig. 2-Series 329, survival power derating factors

Power Supply Requirements

	+15V ±5%	−15V ±5%	+5V ±5%
60/80 dB units	100 mA	50 mA	50 mA
120 dB units	200 mA	100 mA	50 mA

Power Supply Rejection..... Less than 0.1 dB/volt change in any supply

ENVIRONMENTAL RATINGS

Operating Temperature Range..... −25°C to +85°C

Non-Operating Temperature Range.... −54°C to +100°C

Shock..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration..... MIL-STD-202F, Method 204D, Cond. B (.06″ double amplitude or 15G, whichever is less)

Altitude..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling..... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

ACCESSORY FURNISHED

Mating power/logic connector

AVAILABLE OPTIONS

Option No.	Description
1	BCD programming (Binary is standard)
2	Complementary programming (positive true is standard)
7	Two SMA male rf connectors (available only on 3290A-80, 3291-80 and all 120 dB units)
10	One SMA male and SMA female rf connector

Series 329
Specifications

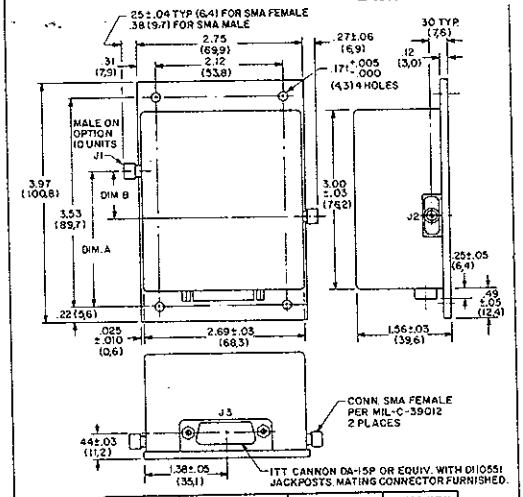
PIN FUNCTIONS—60/80 dB SERIES		
PIN NO.	BINARY[1]	BCD[1]
1	0.1dB	0.2dB
2	0.2dB	0.8dB
3	+5V	+5V
4	GND	GND
5	0.4dB	1dB
6	0.8dB	2dB
7	1.6dB	4dB
8	3.2dB	8dB
9	6.4dB	10dB
10	12.8dB	20dB
11	25.6dB	40dB
12	51.2dB	80dB[1]
13	+15V	+15V
14	−15V	−15V
15	0.05dB	0.4dB

(1) *Model 3298-60 attenuation range is limited to 60 dB. Ground pin 12 in BCD version.*

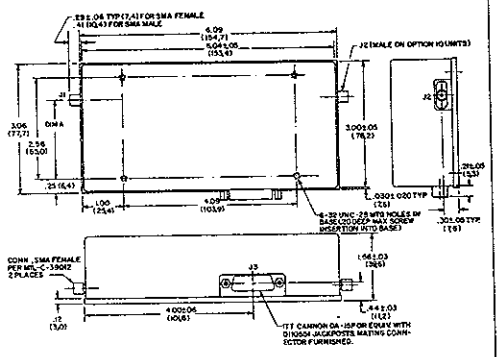
PIN FUNCTIONS—120 dB SERIES		
PIN NO.	BINARY	BCD[2]
1	0.2dB	N/C
2	0.4dB	100dB
3	+5V	+5V
4	GND	GND
5	0.8dB	1dB
6	1.6dB	2dB
7	3.2dB	4dB
8	6.4dB	8dB
9	12.8dB	10dB
10	25.6dB	20dB
11	51.2dB	40dB
12	102.4dB	80dB
13	+15V	+15V
14	−15V	−15V
15	0.1dB	N/C

(2) *Maximum attenuation in units with BCD option is 119 dB.*

DIMENSIONS AND WEIGHTS



MODEL	APPROX. WT.	DIM "A"	DIM "B"
3290A-80	9 oz. (255 gm)	2.43 ± .03	.97
3291-80	9 oz. (255 gm)	2.43 ± .03	.97
3292-80	7 oz. (198 gm)	2.33 ± .03	.80
3293-80	7 oz. (198 gm)	2.33 ± .03	.80
3294-80	6 oz. (170 gm)	2.33 ± .03	.80
3295-80	6 oz. (170 gm)	2.33 ± .03	.80
3296-80	6 oz. (170 gm)	2.33 ± .03	.80
3298-60	6 oz. (170 gm)	2.33 ± .03	.80



MODEL	APPROX. WT.	DIM "A"
3291-120	12 oz. (340 gm)	1.91 ± .06 (48.5)
3292-120	9 oz. (255 gm)	1.84 ± .06 (46.7)
3293-120	9 oz. (255 gm)	1.84 ± .06 (46.7)
3294-120	8 oz. (227 gm)	1.84 ± .06 (46.7)
3295-120	8 oz. (227 gm)	1.84 ± .06 (46.7)
3296-120	8 oz. (227 gm)	1.84 ± .06 (46.7)
3298-120	8 oz. (227 gm)	1.84 ± .06 (46.7)

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series 345 Miniature Octave-Band Digitally-Programmable PIN Diode Attenuators

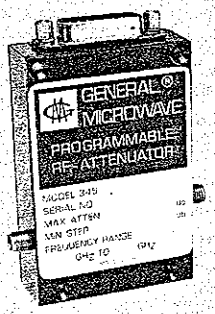
SERIES 345

The Series 345 programmable attenuators provide octave-band performance and wide programming flexibility in compact rugged packages well-suited to military applications. Attenuation ranges up to 60 dB are available (80 dB in the Model 3450) with attenuation increments as low as 0.25 dB.

Each Series 345 unit is an integrated assembly of one Series 195 attenuator, and a driver circuit consisting of an 8-bit D/A Converter and a hybridized V/I Converter (see page 20 and figure 1 below).
This arrangement preserves the speed and reliability of the PIN diode attenuator and guarantees monotonicity and a high degree of accuracy. The rf characteristics of the Series 345 (e.g. - insertion loss, VSWR and flatness) are similar to the corresponding characteristics of the Series 195 attenuator employed.

Although the Series 345 units are intended for use as digitally-programmable attenuators, they can also be used as current-controlled attenuator/modulators. Refer to the Notes following the J3 Pin Function table on page 39.

- **Absorptive**
- **Binary or BCD programming**
- **Guaranteed Monotonicity**
- **0.5 to 18 GHz frequency range**



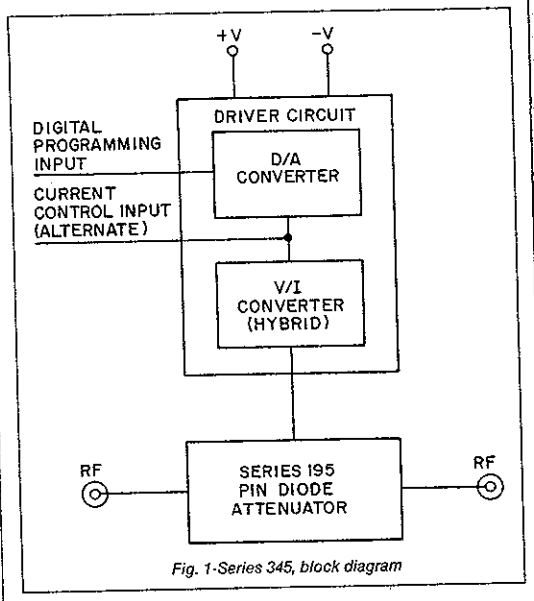


Fig. 1-Series 345, block diagram

Series 345
Specifications

MODEL	FREQUENCY RANGE (GHz)	MAX. INSERTION LOSS (dB)	MAX. VSWR	FLATNESS (±dB) AT MEAN ATTENUATION LEVELS UP TO				
				10 dB	20 dB	40 dB	60 dB	80 dB
3450	0.5 – 1.0	1.2	1.8	0.3	0.8	1.7	2.2	2.5
3451	1.0 – 2.0	1.6	1.5	0.3	0.8	1.5	1.6	
	0.75–2.25	1.7	2.0	0.5	1.4	3.0	3.5	
3452	2.0 – 4.0	1.8	1.5	0.3	0.8	1.5	1.6	
	1.5 – 4.5	1.9	2.0	0.5	1.4	3.0	3.5	
3453	2.6 – 5.2	2.0	1.6	0.3	0.8	1.5	1.6	
	1.95–5.85	2.1	2.1	0.5	1.4	3.0	3.5	
3454	4.0 – 8.0	2.4	1.7	0.3	0.8	1.5	1.6	
	3.0 – 9.0	2.5	2.2	0.5	1.4	3.0	3.5	
3455	5.0 – 10.0	2.6	1.7	0.5	0.9	1.5	1.6	
	3.75–11.25	2.7	2.2	0.7	1.4	3.0	3.5	
3456	6.0 – 12.0	2.7	1.8	0.7	1.0	1.5	1.6	
	4.5 – 13.5	2.8	2.2	0.9	1.5	3.0	3.5	
3458	8.0 – 18.0	3.0(1)	1.8(1)	0.7	1.0	1.5	1.6	
	6.0 – 18.0	3.0(1)	1.8(1)	0.9	1.5	3.0	3.5	

Note: Specifications for the extended frequency ranges are typical.

PERFORMANCE CHARACTERISTICS

Mean Attenuation Range

3450 ..... 80 dB(2)

All other units ..... 60 dB

Accuracy of Attenuation

0-30 dB ..... ±0.5 dB
>30-50 dB..... ±1.0 dB
>50-60 dB..... ±1.5 dB
>60-80 dB..... ±2.0 dB (3450 only)

Monotonicity ..... Guaranteed

Phase Shift..... See page 5

Temperature Coefficient. ±0.03 dB/°C

Power Handling Capability

Without Performance Degradation
3450, 3451 ..... 10 mW cw or peak
All other units ..... 100 mW cw or peak

Survival Power (from −65 °C to +25 °C; see power derating curve, figure 2 at right, for higher temperatures)
All units..... 1 W average
25 W peak (1μ sec max pulse width)

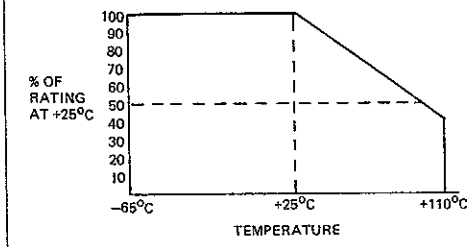


Fig. 2-Series 345, survival power derating factors

(1) *Except from 16 - 18 GHz where insertion loss is 4.0 dB max and VSWR is 2.0 max.*
(2) *Programmable range for 3450 Option 1 BCD units is 79 dB.*

PERFORMANCE CHARACTERISTICS (cont)

Switching Time
- 3450 ..... 10μ sec max
- All other units ..... 2μ max

Programming ..... Positive true binary (standard) or BCD (Option 1). For complementary code, specify Option 2. To interface with CMOS, HTL, NMOS, ECL or HNIL, please contact factory.

Minimum Attenuation Step
- Binary Units
  - 3450 ..... 0.5 dB
  - 3450 Option 5 ..... 0.25 dB
  - All other binary units ... 0.25 dB
- BCD Units ..... 1.0 dB

Logic Input
- Logic 0 ..... −0.3 to +0.7V
- Logic 1 ..... +2.5 to +5.0V
- Logic Input Current .... 10μ A max

Nominal Control Current Characteristics

Range
- Binary Units
  - Standard 3450 ..... 0 to 1.28 mA
  - All other binary units ... 0 to 2 mA
- BCD Units
  - Standard 3450 ..... 0 to 1.63 mA
  - All other BCD units .... 0 to 1.2 mA

Transfer Function
- Binary Units
  - Standard 3450 ..... 62.5 dB/mA
  - All other binary units ... 30 dB/mA
- BCD Units
  - Standard 3450 ..... 48.5 dB/mA
  - All other BCD units .... 50 dB/mA

Input Impedance
- Binary Units
  - Standard 3450 ..... 6.25K ohms
  - All other binary units ... 3K ohms
- BCD Units
  - Standard 3450 ..... 4.85K ohms
  - All other BCD units .... 5K ohms

Power Supply Requirements ..... + 12V ± 5%, 120 mA
− 12V ± 5%, 35 mA

Power Supply Rejection ..... Less than 0.1 dB/volt change in either supply

J3 PIN FUNCTIONS

PIN NO.	BINARY (Note 5)	BCD
1	GND (Note 2)	GND (Note 2)
2	ANALOG INPUT (Note 3)	ANALOG INPUT (Note 3)
3	NOT USED	NOT USED
4	GND	GND
5	0.25 dB (LSB)	1 dB (LSB)
6	0.5 dB	2 dB
7	1 dB	4 dB
8	2 dB	8 dB
9	4 dB	10 dB
10	8 dB	20 dB
11	16 dB	40 dB (MSB)
12	32 dB (MSB)	(Note 4)
13	+V	+V
14	−V	−V
15	NOT USED	NOT USED

Notes:

1. All unused logic inputs must be grounded.
2. For normal programming control, Pin 1 must be grounded or at Logic 0. Application of Logic 1 to Pin 1 overrides the digital input and sets the unit to insertion loss. For units with complementary programming (Option 2), the application of a Logic 1 to Pin 1 sets the unit to high isolation (60 dB or greater).
3. Pin 2 is available to (a) monitor the D/A converter output, (b) apply a modulation signal from a current source, or (c) apply an independent analog signal for turn-on, turn-off or vernier attenuation levels.
4. For standard Option 1 BCD units, Pin 12 must be open or at Logic 1. For units with complementary BCD programming (Options 1 and 2), Pin 12 must be grounded or at Logic 0.
5. For standard Model 3450, LSB is 0.5 dB and MSB is 64 dB.

Series 345 Specifications

ENVIRONMENTAL RATINGS

Operating Temperature Range	−65°C to +110°C*
Non-Operating Temperature Range	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

ACCESSORY FURNISHED

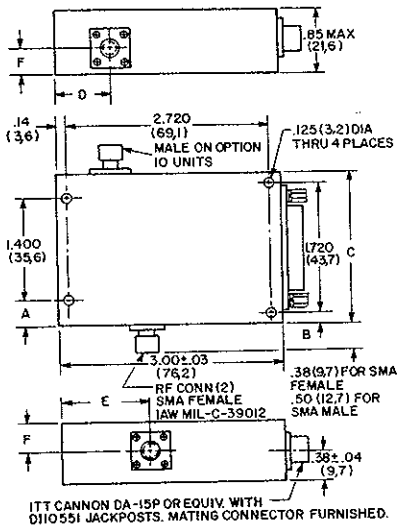
Mating power/logic connector

AVAILABLE OPTIONS

Option No.	Description
1	BCD programming (Binary is standard)*
2	Complementary programming (positive true is standard)
5	3450 with mean attenuation range of 60 dB and minimum attenuation step of 0.25 dB
7	Two SMA male rf connectors (not available on 3458)
10	One SMA male and one SMA female rf connector (not available on 3458)
62	± 15 volts operation

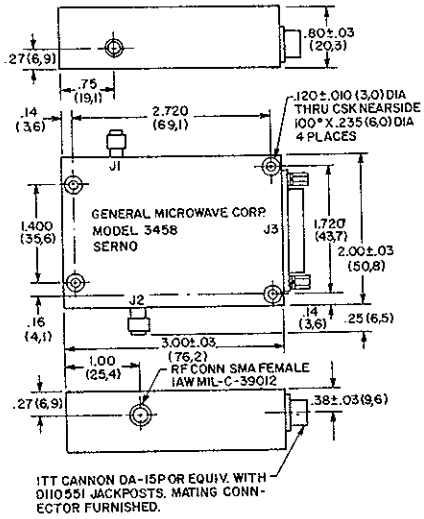
Operating Temperature range of BCD units is limited to 0°C to +70°C.

DIMENSIONS AND WEIGHTS



MODEL	DIM "A"	DIM "B"	DIM "C"	DIM "D"	DIM "E"	DIM "F"
3450	.58 (14,7)	.42 (10,7)	2.56 ±.03 (65,0)	.56 (14,2)	1.53 (38,9)	.31 (7,9)
3451	.58 (14,7)	.42 (10,7)	2.56 ±.03 (65,0)	.56 (14,2)	1.53 (38,8)	.29 (7,4)
3452,53	.30 (7,6)	.14 (3,6)	2.00 ±.03 (50,8)	.50 (12,7)	1.29 (32,8)	.34 (8,6)
3454,55,56	.30 (7,6)	.14 (3,6)	2.00 ±.03 (50,8)	.75 (19,1)	1.19 (30,1)	.34 (8,6)

MODELS 3450 THRU 3456
Wt: 4 oz. (113 gm) approx.



MODEL 3458
Wt: 4 oz. (113 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005

Series 345H Miniature Octave-Band High-Speed Digitally-Programmable PIN Diode Attenuators

SERIES 345H

The Series 345H programmable attenuators provide octave-band performance and wide programming flexibility in compact rugged packages well-suited to military applications. Attenuation ranges up to 60 dB are available with attenuation increments as low as 0.25 dB.

Each Series 345H unit is an integrated assembly of one GMC Series 195 attenuator, and a driver circuit consisting of an 8-bit D/A Converter and a hybridized V/I Converter (see page 20 and figure 1 below). This arrangement preserves the speed and reliability of the PIN diode attenuator and guarantees monotonicity and a high degree of accuracy.

The Series 345H units are similar to the GMC Series 345 attenuators described on pages 37-40. The high-speed performance of the Series 345H units is achieved with some sacrifice of insertion loss. The other rf characteristics of the Series 345H (e.g.-VSWR and flatness) are similar to the corresponding characteristics of the Series 195 attenuator employed.

Although the Series 345H units are intended for use as digitally-programmable attenuators, they can also be used as current-controlled attenuator/modulators. Refer to the Notes following the J3 Pin Function table on page 43.

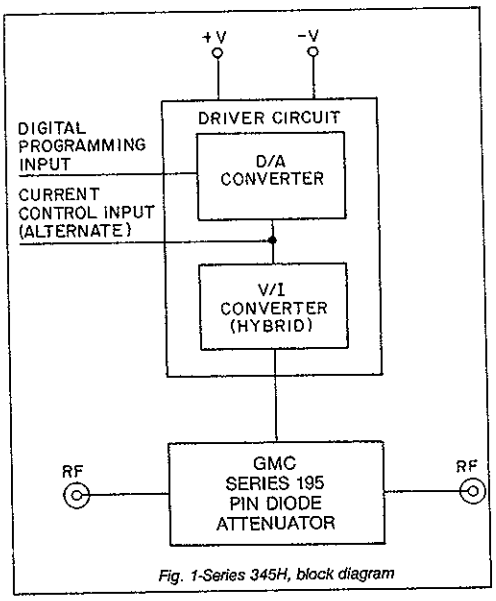
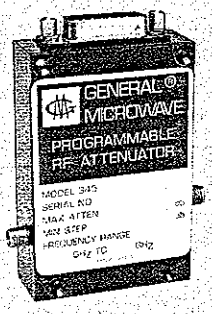


Fig. 1-Series 345H, block diagram

- **High Speed**
- **Absorptive**
- **Binary or BCD programming**
- **Monotonicity guaranteed**
- **1 to 18 GHz frequency range**



Series 345H Specifications

MODEL	FREQUENCY RANGE (GHz)	MAX. INSERTION LOSS (dB)	MAX. VSWR	FLATNESS (±dB) AT MEAN ATTENUATION LEVELS UP TO			
				10 dB	20 dB	40 dB	60 dB
3451H	1.0 – 2.0	2.6	1.5	0.3	0.8	1.5	1.6
	0.75–2.25	2.7	2.0	0.5	1.4	3.0	3.5
3452H	2.0 – 4.0	2.8	1.5	0.3	0.8	1.5	1.6
	1.5 – 4.5	2.9	2.0	0.5	1.4	3.0	3.5
3453H	2.6 – 5.2	3.0	1.6	0.3	0.8	1.5	1.6
	1.95–5.85	3.1	2.1	0.5	1.4	3.0	3.5
3454H	4.0 – 8.0	3.4	1.7	0.3	0.8	1.5	1.6
	3.0 – 9.0	3.5	2.2	0.5	1.4	3.0	3.5
3455H	5.0 – 10.0	3.6	1.7	0.5	0.9	1.5	1.6
	3.75–11.25	3.7	2.2	0.7	1.4	3.0	3.5
3456H	6.0 – 12.0	3.7	1.8	0.7	1.0	1.5	1.6
	4.5 – 13.5	3.8	2.2	0.9	1.5	3.0	3.5
3458H	8.0 – 18.0	4.0(1)	1.8(1)	0.7	1.0	1.5	1.6
	6.0 – 18.0	4.0(1)	1.8(1)	0.9	1.5	3.0	3.5

Note: Specifications for the extended frequency ranges are typical.

PERFORMANCE CHARACTERISTICS

Mean Attenuation Range 60dB

Accuracy of Attenuation

0-10 dB	±0.75 dB
>10-30 dB	±0.5 dB
>30-50 dB	±1.0 dB
>50-60 dB	±1.5 dB

Monotonicity . . . . . Guaranteed

Phase Shift . . . . . See page 5

Temperature Coefficient . ±0.03 dB/°C

Power Handling Capability

Without Performance Degradation

3451H . . . . . 10 mW cw or peak

All other units . . . . . 100 mW cw or peak

Survival Power (from −65°C to +25°C; see power derating curve, figure 2 at right, for higher temperatures)

All units . . . . . 1 W average
25 W peak (1μ sec max pulse width)

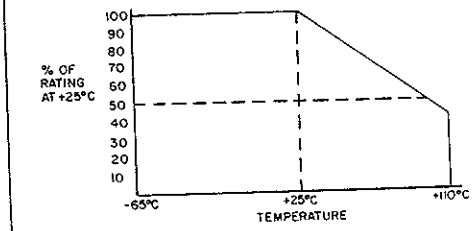


Fig. 2-Series 345H, survival power derating factors

(1) Except from 16 - 18 GHz where insertion loss is 5.0 dB max and VSWR is 2.0 max.

PERFORMANCE CHARACTERISTICS (cont)

Switching Time . . . . . 500 nsec max.

Programming . . . . . Positive true binary (standard) or BCD (Option 1). For complementary code, specify Option 2. To interface with CMOS, HTL, NMOS, ECL or HNIL, please contact factory.

Minimum Attenuation Step

Binary Units . . . . . 0.25 dB

BCD Units . . . . . 1.0 dB

Logic Input

Logic 0 . . . . . −0.3 to +0.7V

Logic 1 . . . . . +2.5 to +5.0V

Logic Input Current . . 10 μA max

Nominal Control Current Characteristics

Range

Binary Units . . . . . 0 to 4mA

BCD Units . . . . . 0 to 1.2 mA

Transfer Function

Binary Units . . . . . 15 dB/mA

BCD Units . . . . . 50 dB/mA

Input Impedance

Binary Units . . . . . 1.5K ohms

BCD Units . . . . . 5K ohms

Power Supply Requirements . . . . . +12V ± 5%, 120 mA
−12V ± 5%, 35 mA

Power Supply Rejection . . . . . Less than 0.1 dB/volt change in either supply

J3 PIN FUNCTIONS

PIN NO	BINARY	BCD
1	GND (Note 2)	GND (Note 2)
2	ANALOG INPUT (Note 3)	ANALOG INPUT (Note 3)
3	NOT USED	NOT USED
4	GND	GND
5	0.25 dB (LSB)	1 dB (LSB)
6	0.5 dB	2 dB
7	1 dB	4 dB
8	2 dB	8 dB
9	4 dB	10 dB
10	8 dB	20 dB
11	16 dB	40 dB (MSB)
12	32 dB (MSB)	(Note 4)
13	+V	+V
14	−V	−V
15	NOT USED	NOT USED

Notes:

1. All unused logic inputs must be grounded.
2. For normal programming control, Pin 1 must be grounded or at Logic 0. Application of Logic 1 to Pin 1 overrides the digital input and sets the unit to insertion loss. For units with complementary programming (Option 2), the application of a Logic 1 to Pin 1 sets the unit to high isolation (60 dB or greater).
3. Pin 2 is available to (a) monitor the D/A converter output, (b) apply a modulation signal from a current source, or (c) apply an independent analog signal for turn-on, turn-off or vernier attenuation levels.
4. For standard Option 1 BCD units, Pin 12 must be open or at Logic 1. For units with complementary BCD programming (Options 1 and 2), Pin 12 must be grounded or at Logic 0.

Series 345H Specifications

ENVIRONMENTAL RATINGS

Operating Temperature Range ..... −65°C to +110°C

Non-Operating Temperature Range ..... −65°C to +125°C

Humidity ..... MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock ..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration ..... MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

Altitude ..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling ..... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

ACCESSORY FURNISHED

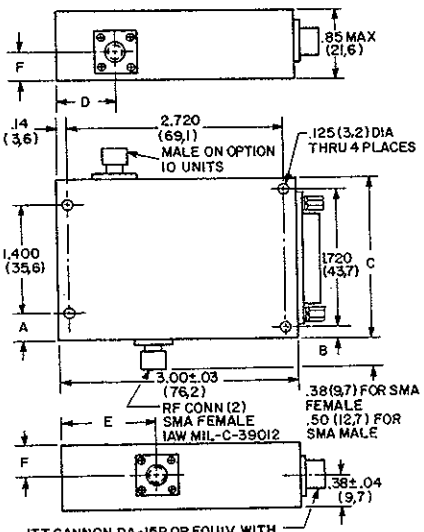
Mating power/logic connector

AVAILABLE OPTIONS

Option No.	Description
1	BCD programming (Binary is standard)*
2	Complementary programming (positive true is standard)
7	Two SMA male rf connectors (not available on 3458H)
10	One SMA male and one SMA female rf connector (not available on 3458H)
62	± 15 volts operation

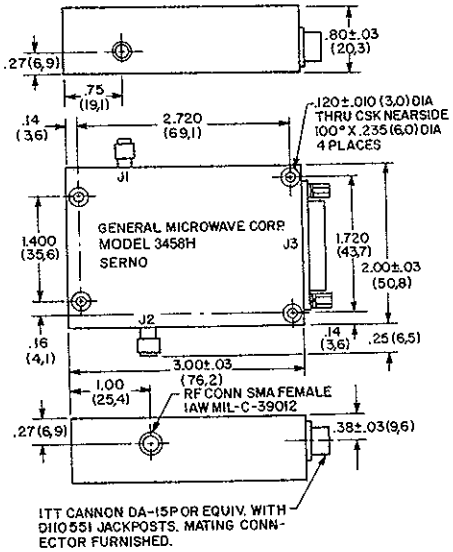
**Operating Temperature range of BCD units is limited to 0°C to +70°C.*

DIMENSIONS AND WEIGHTS



MODELS 3451H THRU 3456H
Wt: 4 oz. (113 gm) approx.

MODEL	DIM "A"	DIM "B"	DIM "C"	DIM "D"	DIM "E"	DIM "F"
3451H	.58 (14,7)	.42 (10,7)	2.56 ±.03 (65,0)	.56 (14,2)	1.53 (38,8)	.29 (7,4)
3452H,53H	.30 (7,6)	.14 (3,6)	2.00 ±.03 (50,8)	.50 (12,7)	1.29 (32,8)	.34 (8,6)
3454H,55H,56H	.30 (7,6)	.14 (3,6)	2.00 ±.03 (50,8)	.75 (19,1)	1.19 (30,1)	.34 (8,6)



MODEL 3458H
Wt: 4 oz. (113 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series 346 Multi-Octave Digitally-Programmable PIN Diode Attenuators

SERIES 346

The Series 346 programmable attenuators provide high multi-octave band performance and wide programming flexibility in a compact rugged package well-suited to military applications. An attenuation range of up to 60 dB is programmable in attenuation increments as low as 0.25 dB. Frequency coverage from 0.5 to 8.0 GHz is provided by the two units in the series. Model 3460 covers the 0.5 to 4 GHz band, and Model 3462 covers the 2 to 8 GHz band.

The Series 346 units are integrated assemblies of GMC Series 196 Attenuators, and a driver circuit consisting of a D/A Converter and a hybridized V/I Converter (see page 27 and figure 1 below). This arrangement preserves the speed and reliability of the PIN diode attenuator and guarantees monotonicity over a multi-octave frequency range at any programmed attenuation level. The rf characteristics of the Models 3460 and 3462 (e.g. - insertion loss, VSWR and flatness) are similar to the corresponding characteristics of the Models D1960A and D1962A as detailed on page 28.

Although the Series 346 units are intended for use as digitally-programmable attenuators, they can also be used as current-controlled attenuator/modulators. Refer to the Notes following the J3 Pin Function table on page 47.

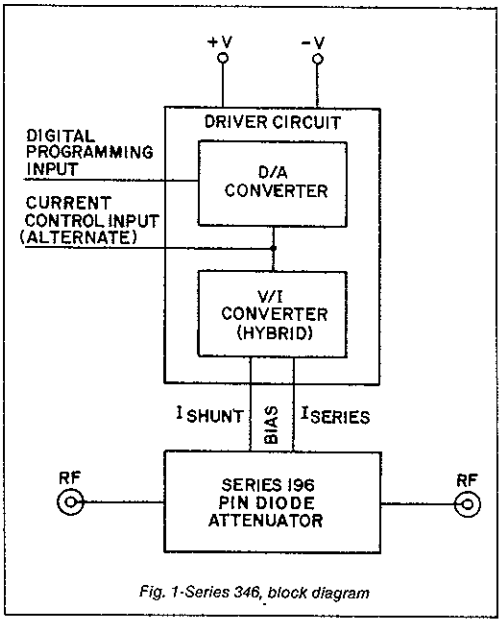
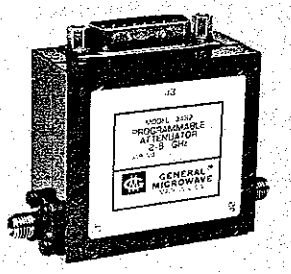


Fig. 1-Series 346, block diagram

- **Absorptive**
- **Binary or BCD programming**
- **Guaranteed monotonicity**
- **Flatness as low as ±0.5 dB**



Series 346
Specifications

CHARACTERISTIC	MODEL 3460	MODEL 3462
Frequency Range	0.5–4.0 GHz	2.0–8.0 GHz
Mean Attenuation Range	60 dB	60 dB
Insertion Loss (max)	2.0 dB[1]	2.5 dB
VSWR (max)	1.7	1.7
Flatness up to 20 dB	±0.5 dB	±0.5 dB
40 dB	±1.0 dB	±1.0 dB
60 dB	±1.5 dB	±1.5 dB

PERFORMANCE CHARACTERISTICS

Accuracy of Attenuation
0-20 dB . . . . . ±1.0 dB
> 20-40 dB . . . . . ±1.5 dB
> 40-60 dB . . . . . ±2.0 dB

Monotonicity . . . . . Guaranteed

Temperature Coefficient . ±0.02 dB/°C

Power Handling Capability
Without Performance Degradation
3460 . . . . . From 0.4 to 100 mW cw or peak (see figure 2 below)
3462 . . . . . 100 mW cw or peak
Survival Power (from −65 °C to +25 °C; see power derating curve, figure 3 below, for higher temperatures)
Both units . . . . . 2W average or peak (1 μsec max pulse width)

Rise and Fall Times . . . 3 μsec

Programming . . . . . Positive true binary (standard) or BCD (Option 1). For complementary code, specify Option 2. To interface with CMOS, HTL, NMOS, ECL or HNIL, please contact factory

Phase Shift . . . . . See page 5

Minimum Attenuation Step
Binary Units . . . . . 0.25 dB
BCD Units . . . . . 1.0 dB

Logic Input
Logic 0 . . . . . −0.3 to +0.7V
Logic 1 . . . . . +2.5 to +5.0V
Logic Input Current . . 10 μA max

Nominal Control Current Characteristics
Range
Binary Units . . . . . 0 to 2 mA
BCD Units . . . . . 0 to 1.2 mA
Transfer Function
Binary Units . . . . . 30 dB/mA
BCD Units . . . . . 50 dB/mA
Input Impedance
Binary Units . . . . . 3K ohms
BCD Units . . . . . 5K ohms

Power Supply Requirements . . . . . +12V ±5%, 120 mA
−12V ±5%, 35 mA

Power Supply Rejection . . Less than 0.1 dB/volt change in either supply

[1]except from 2-4 GHz where insertion loss may rise to 2.5 dB

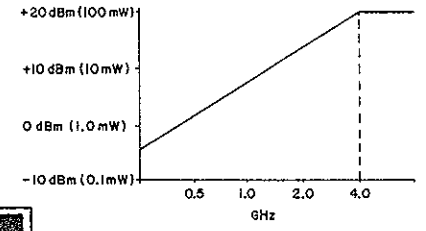


Fig. 2-Model 3460, maximum peak and average operating power without performance degradation

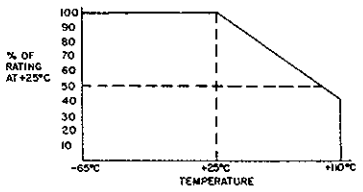


Fig. 3-Models 3460 and 3462, survival power derating factors

ENVIRONMENTAL RATINGS

Operating Temperature Range ..... −54°C to +110°C
Non-Operating Temperature Range .... −65°C to +125°C
Humidity ..... MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock ..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration ..... MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude ..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling ..... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

ACCESSORY FURNISHED

Mating power/logic connector

AVAILABLE OPTIONS

Option No.	Description
1	BCD programming (Binary is standard)*
2	Complementary programming (positive true is standard)
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
62	±15 volts operation

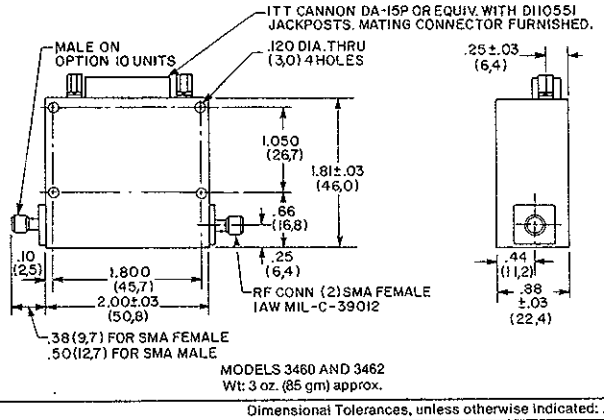
**Operating temperature range of BCD units is limited to 0°C to +70°C.*

J3 PIN FUNCTIONS		
PIN NO.	BINARY	BCD
1	GND (Note 2)	GND (Note 2)
2	ANALOG INPUT (Note 3)	ANALOG INPUT (Note 3)
3	NOT USED	NOT USED
4	GND	GND
5	0.25 dB (LSB)	1 dB (LSB)
6	0.5 dB	2 dB
7	1 dB	4 dB
8	2 dB	8 dB
9	4 dB	10 dB
10	8 dB	20 dB
11	16 dB	40 dB (MSB)
12	32 dB (MSB)	(Note 4)
13	+V	+V
14	−V	−V
15	NOT USED	NOT USED

Notes:

1. All unused logic inputs must be grounded.
2. For normal programming control, Pin 1 must be grounded or at Logic 0. Application of Logic 1 to Pin 1 overrides the digital input and sets the unit to insertion loss. For units with complementary programming (Option 2), the application of a Logic 1 to Pin 1 sets the unit to high isolation (60 dB or greater).
3. Pin 2 is available to (a) monitor the D/A converter output, (b) apply a modulation signal from a current source, or (c) apply an independent analog signal for turn-on, turn-off or vernier attenuation levels.
4. For standard Option 1 BCD units, Pin 12 must be open or at Logic 1. For units with complementary BCD programming (Options 1 and 2), Pin 12 must be grounded or at Logic 0.

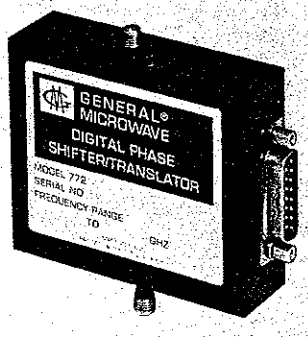
DIMENSIONS AND WEIGHTS



Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series 77
360° Phase Shifters/Frequency Translators

- 2 to 18 GHz in three bands
- 360° range
- High speed
- 3-to-1 band
- Digitally programmable (8 bits)
- Guaranteed Monotonicity



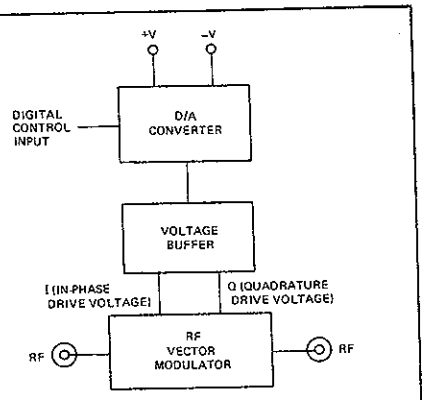


Figure 1. Series 77, Block Diagram

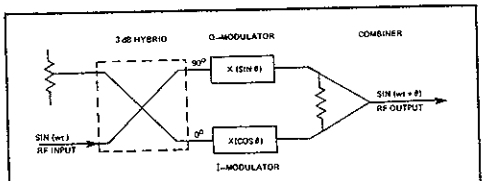


Figure 2. Rf Vector Modulator

The Series 77 comprises a family of three solid-state PIN diode phase shifters covering the frequency range from 2 to 18 GHz in three bands. Model 7722 operates from 2 to 6 GHz, Model 7724 from 4 to 12 GHz and Model 7728 from 6 to 18 GHz.

Each provides a full 360° range of variable phase shift, and can also be used to perform frequency translation.

Each Series 77 unit is an integrated assembly of an rf vector modulator and a driver circuit consisting of an 8-bit D/A converter and a voltage buffer. See Figure 1.

Phase shifting is achieved utilizing the rf vector modulator approach shown in Figure 2. The 3-dB hybrid coupler divides the rf signal into two quadrature components which are then modulated in proportion to the sine and cosine of the desired phase shift. The signals are then combined in-phase to yield the phase-shifted output.

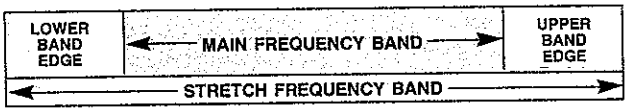
Improved phase accuracy and PM/AM performance are achieved by using doubly-balanced bi-phase linear amplitude modulators. In their main operating bands, phase accuracy is better than ±10° up to 10 GHz and ±12° to 18 GHz. Equal phase accuracy performance can be achieved in the band edges by using a built-in frequency correction circuit.

Switching speed is better than 500 nsec.

FREQUENCY TRANSLATION (SERRODYNING)

Special attention in the design of the Series 77 units has been paid to those characteristics which affect their performance as frequency translators. These include minimizing PM-to-AM conversion, use of high slew rate drivers, and optimizing phase shift linearity with applied signal. As a result, carrier and sideband suppression levels of over 25 and 20 dB, respectively, are obtained in the main bands. The same carrier and sideband performance can be realized over the full stretch band when the internal frequency correction circuit is employed.

On special order, frequency translators can be provided for operation over reduced bandwidths with suppression levels of up to 40dB. Consult the factory for individual requirements.



FREQUENCY BAND DESIGNATIONS

PERFORMANCE CHARACTERISTIC		7722	7724		7728	
General	Frequency Range (GHz) Main Band	2.6-5.2	5-10		8-18	
	Stretch Band	2-6	4-11	11-12	6-16	16-18
	Insertion Loss (Max.) dB	10	10.5	12	11	12
	VSWR (Max.)	1.6	1.8		2.0	

For Use As Phase Shifter	Phase Shift	360° in 256 Steps (8 Bit)		
	Phase Accuracy Vs. Frequency (Max.) Main Band	±10°	±10°	±12°
	Band Edges[1]	±15°	±15°	±15°
	Amplitude Variation with Phase Shift (Max.) Main Band	±1.1dB	±1.1dB	±1.1dB
	Band Edges[1]	±1.5dB	±2.0dB	±2.0dB
	Switching Speed (50% TTL to within 10° of Final Phase Value)	500 nsec Max.		

For Use As Frequency Translator	Translation Rate (Min.) Using 5 Bits	0 to 500 kHz		
	Using 8 Bits	0 to 60 kHz		
	Carrier Suppression (Min.) Main Band	25dB	25dB	25dB
	Band Edges[1]	18dB	18dB	18dB
	Sideband Suppression (Min.) Main Band	20dB	20dB	20dB
	Band Edges[1]	15dB	15dB	15dB
	Insertion Loss Variation (Max.) With Translation Rate: 0 to 200kHz	1dB	1dB	1dB
	200 to 500kHz	3dB	3dB	3dB

(1) *Main band specifications apply if 1 bit TTL logic signal is provided indicating whether input rf signal is in main-band or band-edge.*

Series 77
Specifications

PERFORMANCE CHARACTERISTICS

Control . . . . . 8 bit TTL
Power Supply . . . . . +5V at 250 mA
+12 to +15V at 50 mA
−12 to −15V at 35 mA
Power Handling Capability
Without performance degradation . . . . . +20 dBm
Survival . . . . . +30 dBm
Harmonics Below Carrier (Min.) . . . . . −30 dB

ENVIRONMENTAL RATINGS

Operating Temperature Range . . . . . −54°C to +100°C
Non-Operating Temperature Range . . . . −65°C to +125°C
Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

ACCESSORY FURNISHED

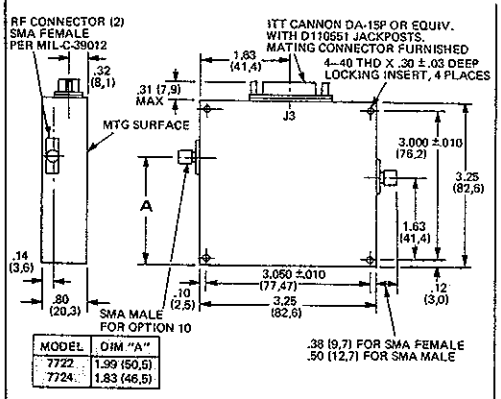
Mating power/control connector

J3 PIN FUNCTIONS	
PIN NO.	FUNCTION
1	−12V
2	+12V
3	INTERNAL FREQUENCY CORRECTION CIRCUIT SELECT
4	1.4°
5	5.6°
6	45.0°
7	180.0°
8	90.0°
9	GROUND
10	NOT USED
11	22.5°
12	2.8°
13	11.3°
14	NOT USED
15	+5V

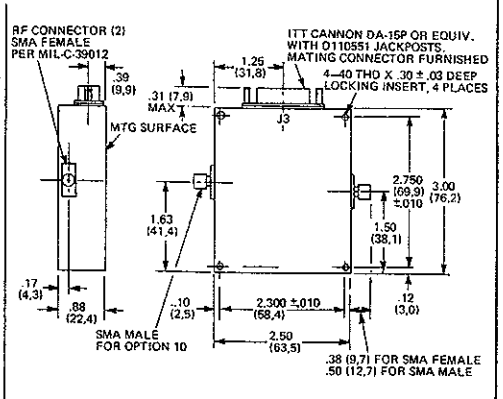
AVAILABLE OPTIONS

Option No.	Description
7	Two SMA male rf connectors
10	One SMA male, and one SMA female rf connector

DIMENSIONS AND WEIGHTS



MODELS 7722 AND 7724
Wt: 6 oz. (170 gm) approx.



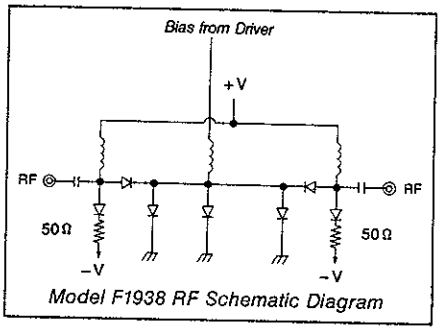
MODEL 7728
Wt: 4 oz. (113 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005

Model F1938
Bi-Phase Modulator
With Integrated Driver

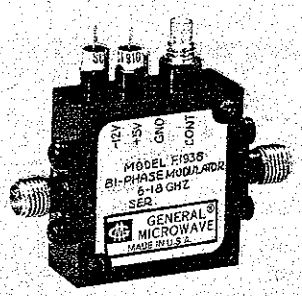
The Model F1938 is a high-speed 0° or 180° phase shifter that operates over the 6 to 18 GHz frequency range. It features a double-balanced design that provides excellent phase accuracy over its entire frequency range.

The rf design is shown below. The currents required to switch the unit between states are provided by the integrated driver, which is controlled by an external logic signal.



Model F1938 RF Schematic Diagram

- **6-18 GHz frequency range**
- **Differential phase shift: 180° ± 10°**
- **High speed: 5 nsec (10-90% rf)**
- **Low VSWR and insertion loss**
- **Small size, light weight**



Model F1938
Specifications

CHARACTERISTIC	FREQUENCY (GHz)		
	2.0 to 8.0	8.0 to 12.4	12.4 to 18.0
Min Isolation (dB)	80	80	80
Max Insertion Loss (dB)	2.5	3.0	4.0
VSWR (ON)	1.75	2.0	2.0
VSWR (OFF)	1.5	1.5	1.75

PERFORMANCE CHARACTERISTICS

Frequency Range .....6 to 18 GHz
Differential Phase Shift ..... 180° ± 10°
Switching Speed [1]
50% TTL to 10% or 90% rf .....20 nsec. max.
10% to 90% rf ..... 5 nsec. max.
Insertion Loss ..... 3.0 dB max.
VSWR ..... 2.0 max.
Change of Insertion Loss With Phase Shift ..... 1.0 dB max.
Carrier Suppression ..... 20 dB min.
Modulation Rate ..... 10 MHz max.
Power Handling Capability[2] .....1W cw, 5W peak[3]

Power Supply Requirements. +5V ± 2%, 65 mA
−12V ± 5%, 20 mA

Control Characteristics

Control Input Impedance ..... Schottky TTL, two-unit load. (A unit load is 2 mA sink current and 50μA source current.)

Control Logic ..... Alternate application of logic "0" (−0.3 to +0.5 volt) and logic "1" (+2.0 to +5.0 volts) switches phase by 180°.

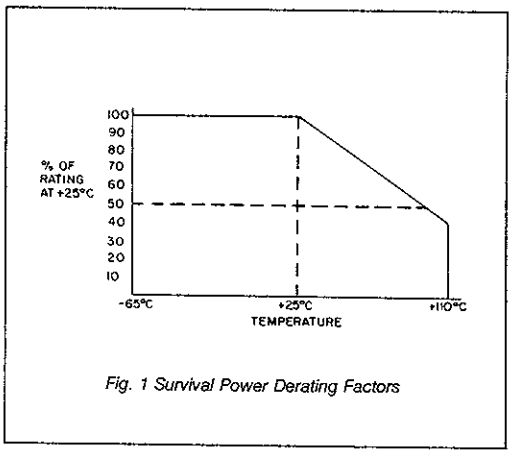


Fig. 1 Survival Power Derating Factors

[1] *As measured with a phase bridge*
[2] *Without performance degradation*
[3] *1 μsec max. pulse width*

ENVIRONMENTAL RATINGS

Operating Temperature Range ..... −65° to +110°C

Non-Operating Temperature Range ..... −65° to +125°C

Humidity ..... MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock ..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration ..... MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

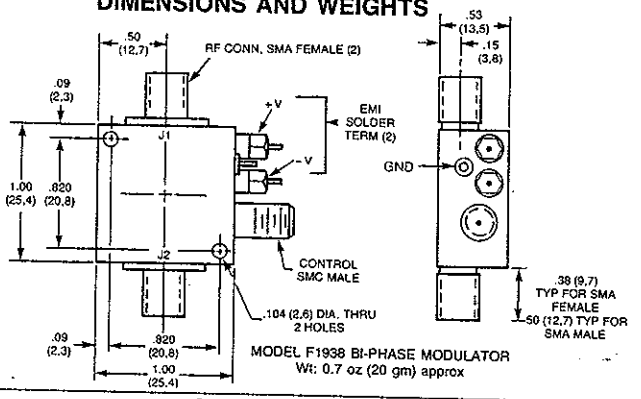
Altitude ..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling ... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female control connector
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
33	EMI filter solder-type control terminal
64A	SMB male control connector

DIMENSIONS AND WEIGHTS



MODEL F1938 BI-PHASE MODULATOR
Wt: 0.7 oz (20 gm) approx

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Switches

This section describes GMC's lines of PIN diode switches.

The PIN diode is a semiconductor device consisting of an intrinsic (high resistivity) layer sandwiched between highly doped *p* and *n* layers. The resistance of the diode is a function of the charge density present in the intrinsic region, which is in turn determined by the forward bias current applied to the diode. The usefulness of the PIN diode derives from its behavior as a linear resistor for all rf signal frequencies that are substantially higher than a low frequency limit, f_ω, which is primarily a function of the minority carrier lifetime of the intrinsic material.

Thus, the PIN diode can be described as an ideal current-variable microwave resistive element over broad frequency ranges when properly mounted in an rf transmission line and when the required dc bias is applied to the PIN diode without either disturbing the rf transmission line's characteristic impedance or contributing significant loss of its own. This element can then be placed in series, shunt, or series-shunt configurations to provide a variety of switching functions.

SWITCHES WITH INTEGRATED DRIVERS

FREQUENCY RANGE (GHz) 0.1 0.2 0.5 1 2 4 8 12.4 18	MODEL OR SERIES	PAGE	COMMENTS
REFLECTIVE SPST SWITCHES			
0.1–18	DM86, FM86	57	Ultra-broadband, low insertion loss
	DM86H, FM86H		Ultra-broadband, high-speed
1–18	F91	60	Miniature broadband
0.2–4	F9214		
NON-REFLECTIVE SPST SWITCHES			
0.2–18	DM190CH, DM186CH, DM189CH, F192A	63	Ultra-broadband, high-speed
REFLECTIVE SP2T SWITCHES			
0.2–18	DM870	69	Ultra-broadband
1–18	F91, G91	72	Miniature broadband
	F91H		Miniature broadband, high-speed
0.2–4	F92, G92		Miniature broadband
1.5–4.5	F892	77	Octave-band, high-speed
3–9			
6–18			
NON-REFLECTIVE SP2T AND TRANSFER SWITCHES			
1–18	F91T, F91W, G91T, G91W	72	Miniature broadband
	F91HT		Miniature broadband, high-speed
0.2–4	F92T, G92T		Miniature broadband
0.5–18	F940H	79	Broadband transfer switch
REFLECTIVE SP3T SWITCHES			
1–18	F91, G91	82	Miniature broadband
	F91H		Miniature broadband, high-speed
0.2–4	F92, G92		Miniature broadband
NON-REFLECTIVE SP3T SWITCHES			
1–18	F91T, F91W, G91T, G92W	82	Miniature broadband
	F91HT		Miniature broadband, high-speed
0.2–4	F92T, G92T		Miniature broadband
REFLECTIVE SP4T SWITCHES			
0.2–18	DM871	90	Ultra-broadband
1–18	F91, G91	86	Miniature broadband
	F91H		Miniature broadband, high-speed
0.2–4	F92, G92		Miniature broadband
NON-REFLECTIVE SP4T SWITCHES			
1–18	F91T, F91W, G91T, G91W	86	Miniature broadband
	F91HT		Miniature broadband, high-speed
0.2–4	F92T, G92T		Miniature broadband
REFLECTIVE SP5T SWITCHES			
1–18	F91, G91	92	Miniature broadband
0.2–4	F92, G92		
NON-REFLECTIVE SP5T SWITCHES			
1–18	F91T, F91W, G91T, G91W	92	Miniature broadband
0.2–4	F92T, G92T		
REFLECTIVE SP6T SWITCHES			
1–18	F91, G91	95	Miniature broadband
0.2–4	F92, G92		
NON-REFLECTIVE SP6T SWITCHES			
1–18	F91T, F91W, G91T, G91W	95	Miniature broadband
0.2–4	F92T, G92T		
REFLECTIVE SP7T SWITCHES			
1–18	F91, G91	98	Miniature broadband
0.2–4	F92, G92		
NON-REFLECTIVE SP7T SWITCHES			
1–18	F91T, F91W, G91T, G91W	98	Miniature broadband
0.2–4	F92T, G92T		

Selection Guide (Cont.)

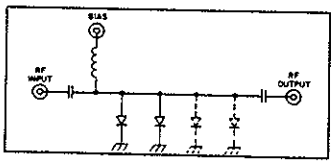
SWITCHES WITHOUT INTEGRATED DRIVERS

FREQUENCY RANGE (GHz) 0.1 0.2 0.5 1 2 4 8 12.4 18	MODEL OR SERIES	PAGE	COMMENTS
REFLECTIVE SPST SWITCHES			
0.1 — 18	M86	57	Ultra-broadband, low insertion loss
	M86H		Ultra-broadband, high-speed
1 — 18	91	60	Miniature broadband
0.2 — 4	9214		
REFLECTIVE SP2T SWITCHES			
0.2 — 18	M870	69	Ultra-broadband
1 — 18	91	72	Miniature broadband
	91H		Miniature broadband, high-speed
0.2 — 4	92		Miniature broadband
NON-REFLECTIVE SP2T SWITCHES			
1 — 18	91T, 91W	72	Miniature broadband
	91HT		Miniature broadband, high-speed
0.2 — 4	92T		Miniature broadband
REFLECTIVE SP3T SWITCHES			
1 — 18	91	82	Miniature broadband
	91H		Miniature broadband, high-speed
0.2 — 4	92		Miniature broadband
NON-REFLECTIVE SP3T SWITCHES			
1 — 18	91T, 91W	82	Miniature broadband
	91HT		Miniature broadband, high-speed
0.2 — 4	92T		Miniature broadband
REFLECTIVE SP4T SWITCHES			
0.2 — 18	M871	90	Ultra-broadband
1 — 18	91	86	Miniature broadband
	91H		Miniature broadband, high-speed
0.2 — 4	92		Miniature broadband
NON-REFLECTIVE SP4T SWITCHES			
1 — 18	91T, 91W	86	Miniature broadband
	91HT		Miniature broadband, high-speed
0.2 — 4	92T		Miniature broadband
REFLECTIVE SP5T SWITCHES			
1 — 18	91	92	Miniature broadband
0.2 — 4	92		
NON-REFLECTIVE SP5T SWITCHES			
1 — 18	91T, 91W	92	Miniature broadband
0.2 — 4	92T		
REFLECTIVE SP6T SWITCHES			
1 — 18	91	95	Miniature broadband
0.2 — 4	92		
NON-REFLECTIVE SP6T SWITCHES			
1 — 18	91T, 91W	95	Miniature broadband
0.2 — 4	92T		
REFLECTIVE SP7T SWITCHES			
1 — 18	91	98	Miniature broadband
0.2 — 4	92		
NON-REFLECTIVE SP7T SWITCHES			
1 — 18	91T, 91W	98	Miniature broadband
0.2 — 4	92T		

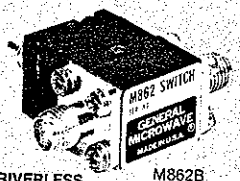
Series 86
Ultra-Broadband SPST Switches

SERIES M86

The Series M86 is a diverse group of high performance broadband SPST switches. Included are two low insertion loss models and four high speed models, all of which operate up to 18 GHz. Each model features an integrated circuit assembly of up to four PIN diodes mounted in a microstrip transmission line as well as a resistive bias line that contributes to the broadband low-loss performance. The circuit configuration is shown below. By applying positive current to the bias terminal, the diodes are biased to low resistances and the switch is OFF. With zero or negative voltage at the bias terminal, the diodes are biased to high resistances and the switch is ON.

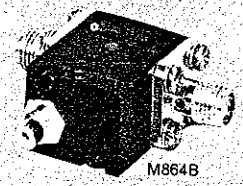


- 0.1 to 18 GHz frequency range
- Low VSWR and insertion loss
- Up to 80 dB isolation
- As fast as 10 nsec rise and fall times
- Small size, light weight

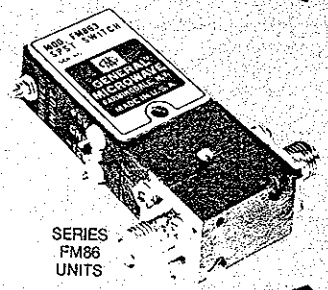


DRIVERLESS UNITS

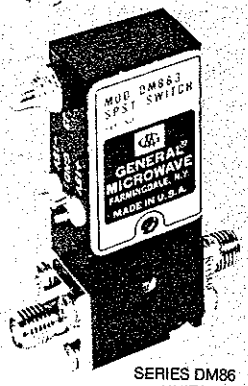
M862B



M864B



SERIES FM86 UNITS



UNITS WITH INTEGRATED DRIVERS

SERIES DM86 UNITS

Low Insertion Loss Models

Models M862B and M864B operate over the frequency range from 0.1 to 18 GHz. They exhibit nominal isolation characteristics of 40 and 80 dB, respectively, with maximum rise and fall times of 50 nanoseconds.

High Speed Models

For higher speed requirements, Models M862BH and M864BH are available. These operate from 0.5 to 18 GHz and feature maximum rise and fall times of 10 nanoseconds. Optional Models M862BH-25 and M864BH-25 operate from 0.1 to 18 GHz with maximum rise and fall times of 20 nanoseconds.

SERIES DM86 AND FM86

The Series DM86 and FM86 switches are the same as the corresponding Series M86 models except the units are equipped with integrated drivers. DM86 switches are powered by ±15 volt supplies; FM86 units are powered by +5 and −12 to −15 volt supplies. The proper current required to switch the unit ON or OFF is provided by the driver, which is controlled by an external logic signal.

Series 86
Specifications

MODEL NO. (3)		CHARACTERISTIC	ISOLATION, INSERTION LOSS, VSWR (shown for various frequencies) FREQUENCY (GHz) 0.1 to 1.0	1.0 to 2.0	2.0 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0	MAX. RISE AND FALL TIME (nsec) (2)
LOW INSERTION LOSS MODELS	M862B DM862B FM862B	Min. Isolation (dB) Max. Insertion Loss (dB) Max. VSWR (ON position)	33 1.0 1.3	36 1.0 1.3	40 1.0 1.3	45 1.0 1.6	45 1.5 1.75	45 2.0 1.75	50
	M864B DM864B FM864B	Min. Isolation (dB) Max. Insertion Loss (dB) Max. VSWR (ON position)	48 1.0 1.4	60 1.0 1.4	74 1.0 1.4	80 1.3 1.7	80 1.8 1.75	80 2.5 2.2	50
HIGH SPEED MODELS (1)	M862BH DM862BH FM862BH	Min. Isolation (dB) Max. Insertion Loss (dB) Max. VSWR (ON position)	33 1.0 1.3	36 1.0 1.3	40 1.0 1.5	45 1.0 1.7	45 1.5 2.0	45 2.3 2.2	10
	M864BH DM864BH FM864BH	Min. Isolation (dB) Max. Insertion Loss (dB) Max. VSWR (ON position)	48 1.0 1.4	60 1.0 1.4	74 1.0 1.5	80 1.3 1.7	80 1.8 2.0	80 2.8 2.2	10

PERFORMANCE CHARACTERISTICS (6)

Power Handling Capability

Without Performance Degradation
- Low insertion loss units
  - Without integrated drivers: 2W cw or peak(4)
  - With integrated drivers: 1W cw or peak
- High speed units
  - Without integrated drivers
    - All units without Option 25: 2W cw or peak
    - All units with Option 25: 1W cw or peak(5)
  - With integrated drivers
    - All units without Option 25: 1W cw or peak
    - All units with Option 25: 0.3W cw or peak

Power Handling Capability (cont)

Survival Power (from −65°C to +25°C; see power derating curves, figure 1 below, for higher temperatures)
- Low insertion loss units: 5W average, 75W peak (1μ sec max. pulse width)
- High speed units: 2W average, 10W peak (1μ sec max. pulse width)

(1) *Models shown operate from 0.5 to 18 GHz. The addition of Option 25 to these models permits operation from 0.1 to 18 GHz, with max. rise and fall times of 20 nanoseconds.*
(2) *Defined as the time interval between 10% and 90% of the output rf power level, and is rated for units driven by shaped current pulses. For Series DM86 and FM86 units, the pulses are provided by the integrated driver. For Series M86 units, the pulses must be provided by the user.*
(3) *Models prefixed with "DM" or "FM" are equipped with integrated TTL-compatible drivers; models prefixed with "M" only are current-controlled units and are furnished without drivers.*
(4) *5W cw or peak with — 20V back bias.*
(5) *2W cw or peak with — 20V back bias.*
(6) *Into 50 ohm system.*

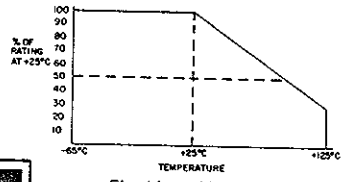


Fig. 1A. — M86 units

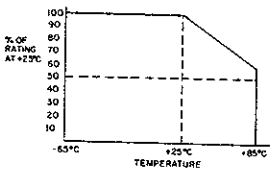


Fig. 1B. — DM86 units

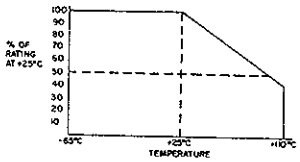


Fig. 1C. — FM86 units

SURVIVAL POWER DERATING FACTORS

Power Supply Requirements

Driverless Units

For rated isolation: +35mA
For rated insertion loss: −10V

Units With Integrated Drivers

All DM86 Units: +15 VDC ±2%, 70 mA
−15 VDC ±5%, 20 mA
All FM86 Units: +5 VDC ±2%, 65 mA
−12 to −15 VDC, 20 mA

Control Characteristics

Units With Integrated Drivers

Control Input Impedance . . . . . TTL, two-unit load. (A unit load is 1.6 mA sink current and 40 μA source current.)

Control Logic
Series DM86 . . . . . Logic "0" (−0.3 to +0.7 volt) for switch OFF and logic "1" (+2.5 to +5.0 volts) for switch ON.
Series FM86 . . . . . Logic "0" (−0.3 to +0.7 volt) for switch ON and logic "1" (+2.5 to +5.0 volts) for switch OFF.

ENVIRONMENTAL RATINGS

Operating Temperature Range:
Series M86 . . . . . −65°C to +125°C
Series DM86 . . . . . −65°C to +85°C
Series FM86 . . . . . −65°C to +110°C
Non-Operating Temperature Range: . . . . . −65°C to +125°C

ENVIRONMENTAL RATINGS (Con't)

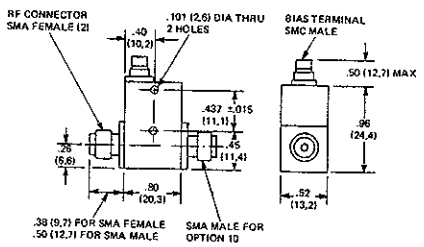
Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

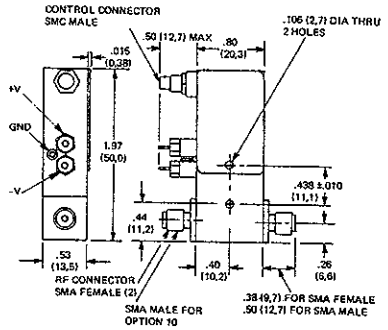
Option No.	Description
3	SMA female bias/control connector
7	Two SMA male rf connectors
9	Inverse control logic (Series DM86 and FM86 only)
10	One SMA male and one SMA female rf connector
20*	Two unit load control input impedance
25	0.1 to 18 GHz range, 20 nsec rise and fall times (available only on high-speed models)
33	EMI filter solder-type bias/control terminal
64A	SMB male bias/control connector

*Not applicable to Series M86; standard in Series FM86 (need not be specified when ordering); all Series DM86 units are furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.

DIMENSIONS AND WEIGHTS



SERIES M86 SWITCHES
Wt: 1 oz. (28 gm) approx.



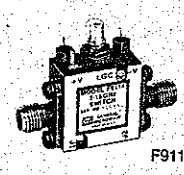
SERIES DM86 AND FM86 SWITCHES
Wt: 2 oz. (56 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005

SWITCHES

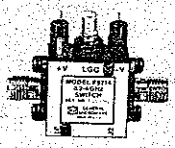
Series 91 and 92
Miniature Broadband SPST Switches

- 1 to 18 GHz frequency range (Series 91)
- 0.2 to 4 GHz frequency range (Series 92)
- Low VSWR and insertion loss
- Up to 80 dB isolation
- Less than 10 nsec rise and fall times
- Miniature size, light weight

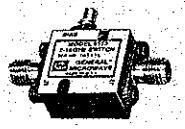


F9114

UNITS WITH INTEGRATED DRIVERS

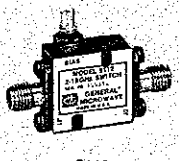


F9214



9113

DRIVERLESS UNITS

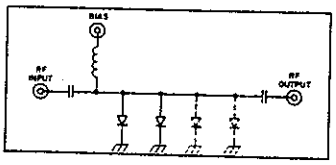


9112

SERIES 91 AND 92

Series 91 and 92 switches provide high performance characteristics over a multi-octave range. Series 91 models cover the frequency range of 1 to 18 GHz, while Series 92 models cover the range from 0.2 to 4.0 GHz. These miniature switches measure only 0.75 × 0.69 × 0.38 inches.

Both series use an integrated circuit assembly of up to four PIN diodes mounted in a microstrip transmission line. The circuit configuration is shown below.



Application of a positive current to the bias terminal switches the unit OFF since the diodes are biased to a low resistance value. With zero or negative voltage at the bias terminal, the diodes are biased to high resistances and the unit is switched ON. Maximum rise and fall times are less than 10 nsec.

SERIES F91 AND F92

The Series F91 and F92 switches are the same as the corresponding Series 91 and 92 models except the units are equipped with integrated drivers, and the dimensions of the units are 0.75 × 0.75 × 0.38 inches. The proper current required to switch the unit ON or OFF is provided by the integral driver which requires +5 and −12 to −15 volt power supplies and is controlled by an external logic signal.

MODEL NO. (1)	CHARACTERISTIC	FREQUENCY (GHz) 0.2 to 0.5	0.5 to 1.0	1.0 to 2.0	2.0 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
9112, F9112	Min Isolation (dB)	—	—	36	40	45	45	45
	Max Insertion Loss (dB)	—	—	0.8	0.8	0.9	1.1	1.8
	Max VSWR (ON position)	—	—	1.3	1.3	1.6	1.75	1.75
9113, F9113	Min Isolation (dB)	—	—	50	50	63	63	63
	Max Insertion Loss (dB)	—	—	0.8	0.8	1.1	1.4	2.2
	Max VSWR (ON position)	—	—	1.4	1.4	1.75	1.75	1.85
9114, F9114	Min Isolation (dB)	—	—	60	74	80	80	80
	Max Insertion Loss (dB)	—	—	1.0	1.0	1.3	1.6	2.5
	Max VSWR (ON position)	—	—	1.4	1.4	1.75	1.75	2.2
9214, F9214	Min Isolation (dB)	40	45	50	50	—	—	—
	Max Insertion Loss (dB)	1.0	1.0	1.0	1.0	—	—	—
	Max VSWR (ON position)	1.5	1.5	1.5	1.5	—	—	—

PERFORMANCE CHARACTERISTICS[4]

Rise and Fall Times . . .10 nanoseconds[2]

Power Handling Capability

Without Performance Degradation[5]
- Without integrated drivers
  - Series 91: 2W cw or peak
  - Series 92: 1W cw or peak[3]
- With integrated drivers
  - Series F91: 1W cw or peak
  - Series F92: 0.3 W cw or peak

Survival Power (from −65°C to +25°C; see power derating curves, figure 1 below, for higher temperatures) (all units): . . . . . 2W average, 10W peak (1μ sec max. pulse width)

Power Supply Requirements

Driverless Units
For rated isolation: +35mA
For rated insertion loss: −10V

Units With Integrated Drivers
+5V ±2%, 65 mA
−12V to −15V, 20 mA

(1) *Models prefixed with "F" are equipped with integrated TTL-compatible drivers; models without the "F" prefix are current-controlled units and are furnished without drivers.*
(2) *Defined as the time interval between 10% and 90% of the output rf power level, and is rated for units driven by shaped current pulses. For Series F91 and F92 units, the pulses are provided by the integrated driver. For Series 91 and 92 units, the pulses must be provided by the user.*
(3) *2W cw or peak with — 20V back bias.*
(4) *Into 50 ohm system.*
(5) *Up to Survival Power limits shown below.*

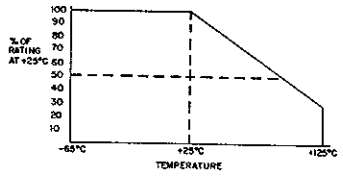


Fig. 1A. — 91/92 units

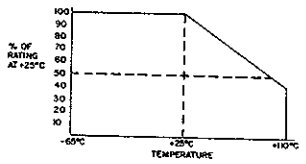


Fig. 1B. — F91/F92 units

SURVIVAL POWER DERATING FACTORS

Series 91 and 92 SPST Switches Specifications

Control Characteristics

Control Input Impedance . . . . . TTL, two-unit load. (A unit load is 1.6 mA sink current and 40 μ A source current.)

Control Logic . . . . . Logic "0" (−0.3 to +0.7 volt) for switch ON and logic "1" (+2.5 to +5.0 volts) for switch OFF.

ENVIRONMENTAL RATINGS

Operating Temperature Range:

Series 91 and 92 . . . . −65°C to +125°C

Series F91 and F92 . . −65°C to +110°C

Non-Operating Temperature Range . . . . . −65°C to +125°C

Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

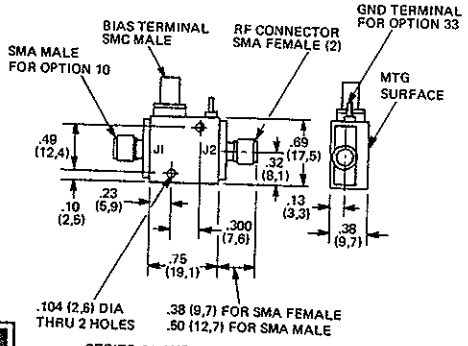
Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

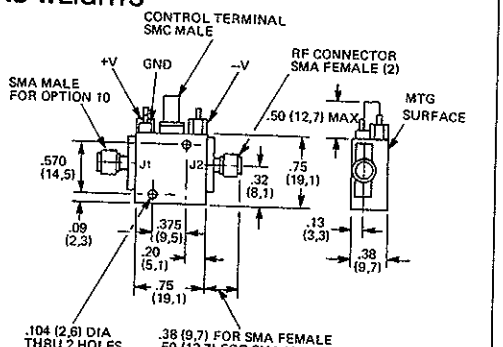
AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias/control connector
7	Two SMA male rf connectors
9	Inverse control logic (Series F91 and F92 only)
10	One SMA male (J1) and one SMA female (J2) rf connector
33	EMI filter solder-type bias/control terminal
64A	SMB male bias/control connector

DIMENSIONS AND WEIGHTS



SERIES 91 AND 92 SPST SWITCHES
Wt: .39 oz. (11 gm) approx.



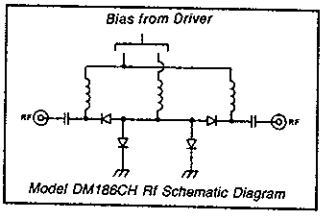
SERIES F91 AND F92 SPST SWITCHES
Wt: .43 oz. (12 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

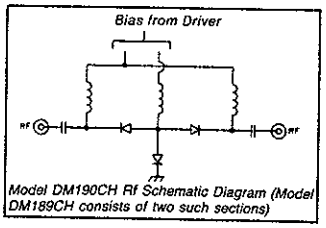
Models DM186CH, DM189CH and DM190CH Non-Reflective Ultra-Broadband SPST Switches

MODELS DM186CH, DM189CH AND DM190CH

Models DM186CH, DM189CH and DM190CH are high speed broadband non-reflective SPST PIN diode switches with integrated drivers. Operating over the instantaneous frequency range 0.2 to 18 GHz, they exhibit nominal isolation characteristics of 40, 60 and 30 dB, respectively. The rf design consists of a T-pad arrangement of shunt and series diodes in a microstrip integrated circuit transmission line (as shown in the schematic diagrams below) and a resistive low-loss bias line.



Model DM186CH Rf Schematic Diagram



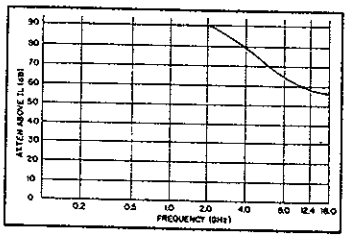
Model DM190CH Rf Schematic Diagram (Model DM189CH consists of two such sections)

Switch Control

The currents required to switch the units ON or OFF and to simultaneously maintain a bilateral 50-ohm impedance match at insertion loss and maximum isolation are provided by the integrated drivers, which are controlled by external logic signals.

High-Isolation (Reflective) Models

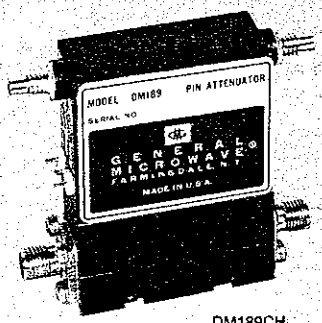
These units are also available for operation as high-speed high-isolation reflective switches. Designated by Option 31, the reflective switches are intended for low-frequency applications where the isolation provided by the conventional shunt diode switch design (such as that used in the GMC Series M86, 91 and 92) is inadequate. A typical response curve of the Model DM186CH-31 is shown below.



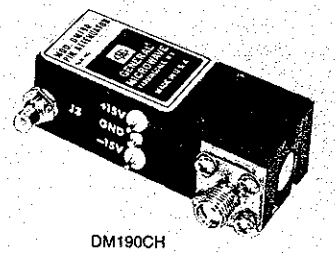
- **High speed**
- **0.2 to 18 GHz frequency range**
- **Up to 65 dB isolation**
- **Low VSWR and insertion loss**
- **Small size, light weight**

THE THREE UNITS IN THIS SERIES ARE EQUIPPED WITH INTEGRATED DRIVERS

DM186CH



DM189CH



DM190CH

Models DM186CH, DM189CH and DM190CH Specifications

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz) 0.2 to 8.0	8.0 to 12.4	12.4 to 18.0
DM186CH	Min Isolation (dB)	45(1)	45	40
	Max Insertion Loss (dB)	2.5	3.0	3.5
	VSWR (ON)	1.75	2.0	2.5
	VSWR (OFF)	1.5	1.5	1.75
DM189CH	Min Isolation (dB)	65	65	50
	Max Insertion Loss (dB)	2.7	4.0	6.0
	VSWR (ON)	1.75	2.0	3.0
	VSWR (OFF)	1.5	1.5	1.75
DM190CH	Min Isolation (dB)	35	30	30
	Max Insertion Loss (dB)	1.5	2.5	3.0
	VSWR (ON)	1.75	2.0	2.5
	VSWR (OFF)	1.5	1.5	1.75

PERFORMANCE CHARACTERISTICS

Rise and Fall Times (Time interval between 10% and 90% of the output rf power level)

Fall time . . . . . 20 nsec. max.
Rise time . . . . . 30 nsec. max.

Power Handling Capability

Without Performance Degradation: From 1 to 30 mW, peak or cw (see figure 2 below)

Survival Power (from −65°C to +25°C; see power derating curve, figure 1 below, for higher temperatures): . . . . . 2W peak or average

Power Supply Requirements

Model	+15Vdc ±2%	−15Vdc ±5%
DM186CH	30 mA	85 mA
DM189CH	60 mA	170 mA
DM190CH	30 mA	85 mA

Control Characteristics

Control Input Impedance . . . . . TTL, two-unit load. (A unit load is 1.6 mA sink current and 40μA source current.)

Control Logic . . . . . Logic "0" (−0.3 to +0.7 volt) for switch OFF and logic "1" (+2.5 to +5.0 volts) for switch ON.

(1) *Except 40 dB from 0.2 to 2.0 GHz.*

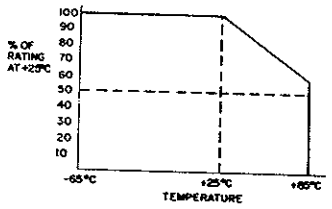


Fig. 1 — Survival power derating factors

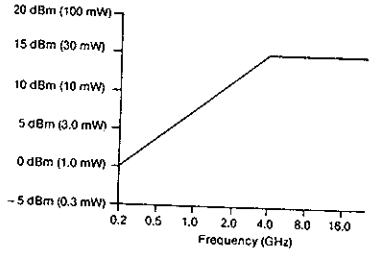


Fig. 2 — Maximum peak and average operating power without performance degradation.

ENVIRONMENTAL RATINGS

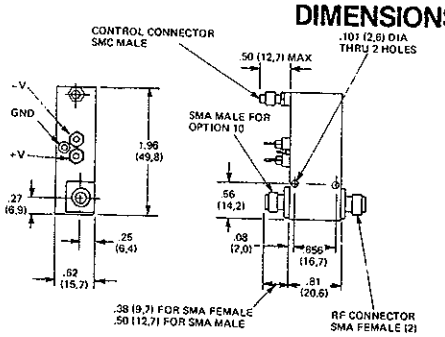
Operating Temperature Range . . . . . −65°C to +85°C
Non-Operating Temperature Range . . . . . −65°C to +125°C
Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

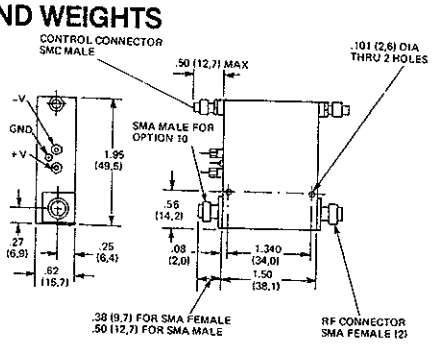
Option No.	Description
3	SMA female control connector
7	Two SMA male rf connectors
9	Inverse control logic; logic 0 for switch ON and logic 1 for switch OFF
10	One SMA male and one SMA female rf connector
20*	Two unit load control input impedance
31	High isolation (reflective) design
33	EMI filter solder-type control terminal(s)
64A	SMB male control connector

*All units are furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.

DIMENSIONS AND WEIGHTS



MODELS DM186CH AND DM190CH
Wt: 2 oz. (56 gm) approx.

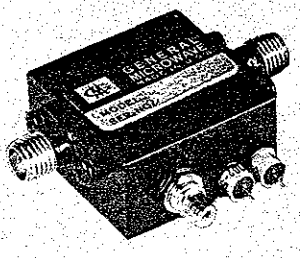


MODEL DM189CH
Wt: 3 oz. (85 gm) approx.

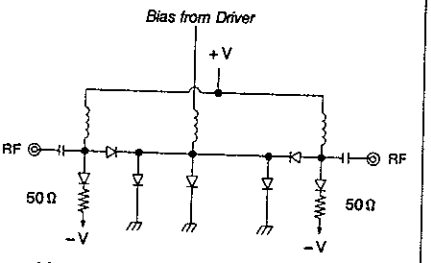
Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Model F192A Non-Reflective Ultra-Broadband High-Speed SPST Switch

- **High speed**
- **0.2 to 18 GHz frequency range**
- **80 dB isolation**
- **Low VSWR and insertion loss**
- **Small size, light weight**



The Model F192A is a high-speed non-reflective SPST PIN diode switch with integrated driver. Operating over the instantaneous frequency range from 0.2 to 18 GHz, it provides a minimum isolation of 80 dB from 0.5 to 18 GHz, and 70 dB below 0.5 GHz. The rf design consists of an arrangement of shunt and series diodes in a microstrip integrated circuit transmission line as shown in the schematic diagram below.



Model F192A RF Schematic Diagram

The currents required to switch the unit ON or OFF and to simultaneously maintain a bilateral 50-ohm impedance match in both states are provided by the integrated driver, which is controlled by an external logic signal.

CHARACTERISTIC	FREQUENCY (GHz)				
	0.2 to 0.5	0.5 to 2.0	2.0 to 8.0	8.0 to 12.4	12.4 to 18.0
Min Isolation (dB)	70	80	80	80	
Max Insertion Loss (dB)	2.0	2.0	2.5	3.0	3.5
VSWR (ON and OFF)	1.5	1.5	1.75	2.0	2.0

PERFORMANCE CHARACTERISTICS

Switching Speed

Rise Time (10-90% rf) ..... 10 nsec. max.
Fall Time (90-10% rf) ..... 10 nsec. max.
On Time (50% command to 90% rf) . 30 nsec. max.
Off Time (50% command to 10% rf) . 15 nsec. max.

Power Handling Capability

Without Performance Degradation[1] .. 500 mW cw or peak

Survival Power (from −65°C to +25°C; see power derating curve, figure 1 below, for higher temperatures): .... 1 W average, 10 W peak (1 sec max. pulse width)

[1] Up to Survival Power Limits shown below.

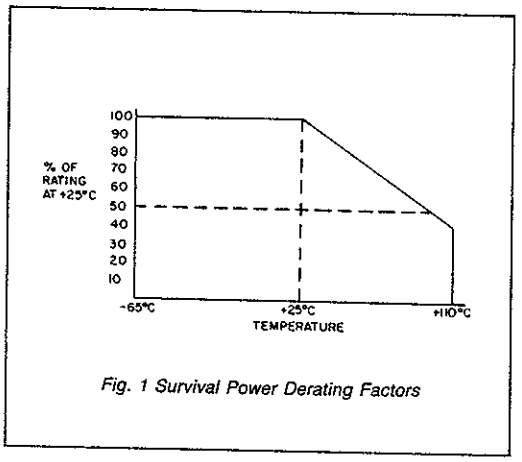


Fig. 1 Survival Power Derating Factors

Power Supply Requirements

+5V ±2%, 90 mA
−12V ±5%, 75 mA

Control Characteristics

Control Input Impedance .... Schottky TTL, one-unit load. (A unit load is 2 mA sink current and 50 μA source current.)

Control Logic .... Logic "0" (−0.3 to +0.5 volt) for switch ON and logic "1" (+2.0 to +5.0 volts) for switch OFF.

Model F192A Specifications

ENVIRONMENTAL RATINGS

Operating Temperature Range . . . . . −65°C to +110°C

Non-Operating Temperature Range . . . . . −65°C to +125°C

Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

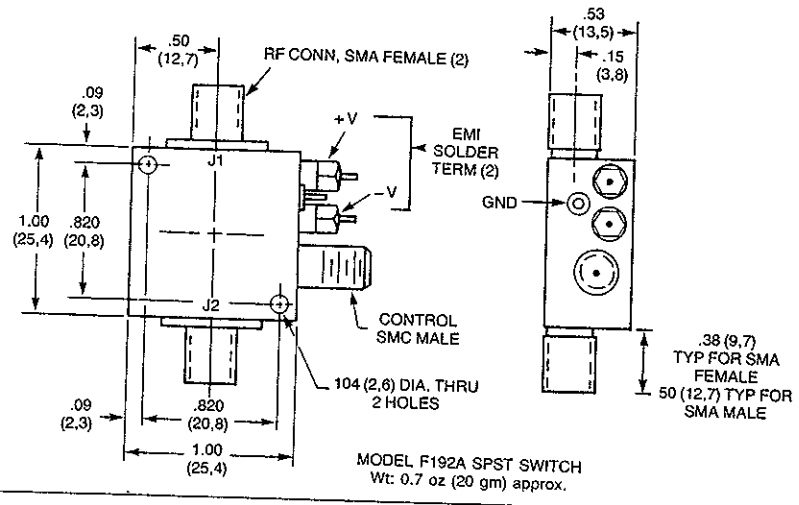
Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female control connector
7	Two SMA male rf connectors
9	Inverse control logic; logic 1 for switch ON and logic 0 for switch OFF
10	One SMA male and one SMA female rf connector
33	EMI filter solder-type control terminal
64A	SMB male control connector

DIMENSIONS AND WEIGHTS



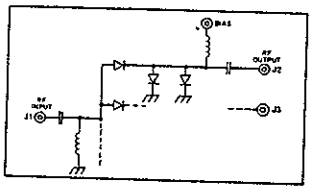
MODEL F192A SPST SWITCH
Wt: 0.7 oz (20 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Models M870 and DM870
Ultra-Broadband SP2T Switches

MODEL M870

Model M870 is a high-performance broadband single-pole two-throw switch that operates over the full instantaneous bandwidth of 0.2 to 18 GHz. Design features include an integrated circuit assembly of PIN diodes mounted in a microstrip transmission line as well as a resistive bias line that contributes to the broadband low-loss performance. The circuit configuration of the Model M870 is shown below.

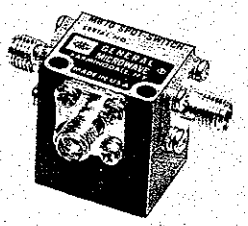


By applying positive current to a bias terminal, the associated port is OFF since the corresponding shunt diodes are biased to a low resistance and the series diode to a high resistance. With negative current at the bias terminal, the converse conditions are established and the port is ON. Since bias terminals are individually available for both ports, the user has the option of operating with either or both ports ON or OFF.

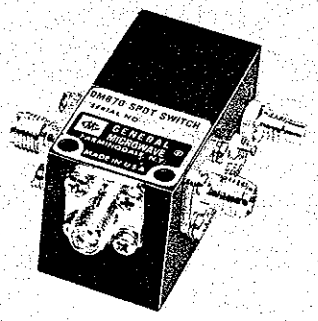
MODEL DM870

The Model DM870 is the same as the Model M870 except it is equipped with an integrated driver that is powered by +15 and −12 to −15 volt supplies. The proper currents required to switch the ports ON or OFF are provided by the driver, which is controlled by external logic signals. Standard units are wired so that one port is biased ON and the other OFF at all times. See AVAILABLE OPTIONS for independent port control.

- **0.2 to 18 GHz frequency range**
- **Low VSWR and insertion loss**
- **Up to 60 dB isolation**
- **Small size, light weight**



M870 (DRIVERLESS)



DM870
(WITH INTEGRATED
DRIVER)

Models M870 and DM870 Specifications

MODEL NO. (2)	CHARACTERISTIC	FREQUENCY (GHz)			
		0.2 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
M870 DM870	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	55 1.75 1.75	55 2.2 2.0

PERFORMANCE CHARACTERISTICS[4]

Switching Speed (port to port) . . . . . 2 μsec max.[1]

Power Handling Capability

Without Performance Degradation[5]. . . . . 1W cw or peak

Survival Power (from −65°C to +25°C; see power derating curves, figure 1, for higher temperatures): . . . . . 1W average, 75W peak (1 μsec max. pulse width)

Power Supply Requirements

MODEL M870

Bias current required at each port for rated isolation and insertion loss[3]

Port OFF . . . . . +30 mA

Port ON . . . . . −30 mA

MODEL DM870 (For one port ON)

+15 Vdc ±2%, 65 mA

−12 to −15 Vdc, 65 mA

Control Characteristics

MODEL DM870

Control Input Impedance . . . . . TTL, low power Schottky, two unit load. (A unit load is 0.8 mA sink current and 40 μA source current.)

Control Logic . . . . . One port ON and one port OFF. Logic "0" (−0.3 to +0.8 volt) connects J1 to J3. Logic "1" (+2.0 to +5.0 volts) connects J1 to J2. For independent port control, see AVAILABLE OPTIONS on page 71.

(1) *Switching speed, defined as the interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, is rated for ports driven by shaped current pulses. For the Model DM870, the pulses are provided by the integrated driver. For the Model M870, the pulses must be provided by the user.*

(2) *DM870 is equipped with an integrated TTL compatible driver; M870 is a current-controlled unit that is furnished without a driver.*

(3) *For operation of Models M870 with more than one port ON, total negative current must be limited to −40mA. Do not apply more than 75 mA to any OFF port or more than −40 mA to any ON port.*

(4) *Into 50 ohm system.*

(5) *Up to Survival Power limits shown below.*

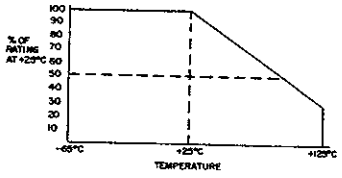


Fig. 1A — Model M870

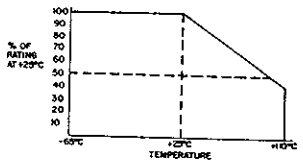


Fig. 1B — Model DM870

SURVIVAL POWER DERATING FACTORS

ENVIRONMENTAL RATINGS

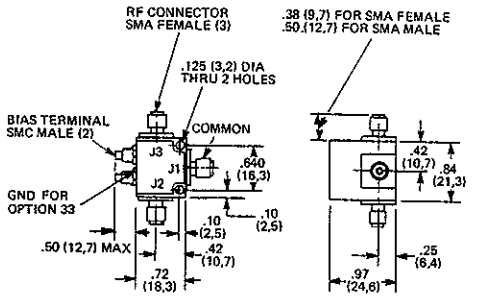
Operating Temperature Range	
Model M870	−65°C to +125°C
Model DM870	−65°C to +110°C
Non-Operating Temperature Range	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

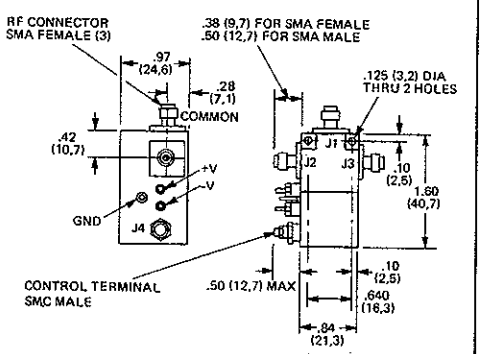
Option No.	Description
7	J1, J2 and J3 SMA male
7A	J1 SMA male; J2 and J3 SMA female
7B	J1 SMA female; J2 and J3 SMA male
9	Inverse control logic; logic 0 for port ON and logic 1 for port OFF (available only in conjunction with Option 22)
20(1)	Two unit load control input impedance
22	Individual port control (DM 870 only — 1 unit load); logic 0 for port OFF and logic 1 for port ON. Also available with logic 0 for port ON and logic 1 for port OFF (Specify Option 9)
33	EMI Filter solder-type bias/control terminal.
64A	SMB male bias/control connector

(1) *Not applicable to Model M870. All Models DM870 are furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.*

DIMENSIONS AND WEIGHTS



MODEL M870
Wt: 1.5 oz. (42 gm) approx.

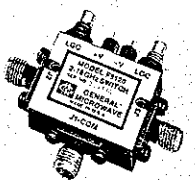


MODEL DM870
Wt: 2.5 oz (70 gm) approx.

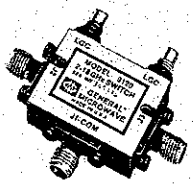
Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series 91 and 92
Miniature Broadband SP2T Switches

- 1 to 18 GHz frequency range (Series 91)
- 0.2 to 4 GHz frequency range (Series 92)
- Rise and fall times as fast as 10 nsec
- Reflective and non-reflective models
- Low VSWR and insertion loss
- Up to 60 dB isolation
- Miniature size, light weight



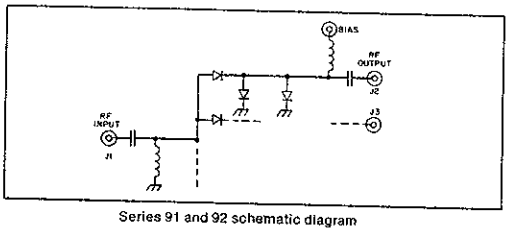
F9120
(WITH INTEGRATED
DRIVER)



9120-500
(DRIVERLESS)

MODELS 9120-500 AND 9220-500

These switches provide high-performance characteristics over a multi-octave frequency range. Model 9120-500 covers the frequency range of 1 to 18 GHz; Model 9220-500 covers the frequency range of 0.2 to 4 GHz. Both models use an integrated circuit assembly of a series-shunt configuration of PIN diodes mounted in a microstrip transmission line as shown below.



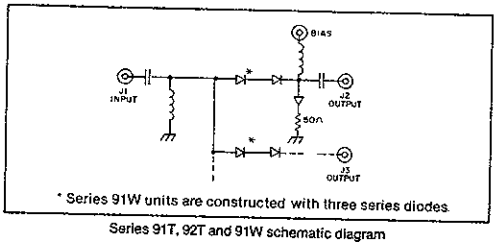
Series 91 and 92 schematic diagram

Port Control

By applying positive current to a bias terminal, the associated port is OFF since the corresponding shunt diodes are biased to a low resistance and the series diode to a high resistance. With negative current at the bias terminal, the converse conditions are established and the port is ON. Since bias terminals are individually available for both ports, the user has the option of any combination of ports ON or OFF.

MODELS 9120T-500, 9120W-500 AND 9220T-500

These switches are non-reflective versions of the switches described above. They are constructed in the configuration shown below.



* Series 91W units are constructed with three series diodes.

Series 91T, 92T and 91W schematic diagram

When positive current is applied, the port is OFF since the associated series diodes are back-biased to a high resistance. At the same time, the corresponding shunt diode is biased to a low resistance, and the impedance at the port is then effectively that of the 50 ohm resistor in series with the shunt diode.

When negative current is sinked, the converse conditions are established and the port is ON.

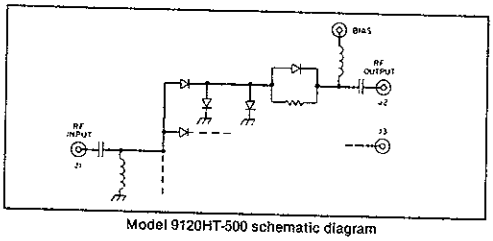
Note that when all output ports are OFF, a high VSWR will be present at the common port.

MODEL 9120H-500

This switch has the same circuit topology as the 9120-500 except it is equipped with high-speed diodes to achieve rise and fall times of 10 nsec.

MODEL 9120HT-500

This switch is similar to the 9120H-500 except it includes a terminating network as shown below.



Model 9120HT-500 schematic diagram

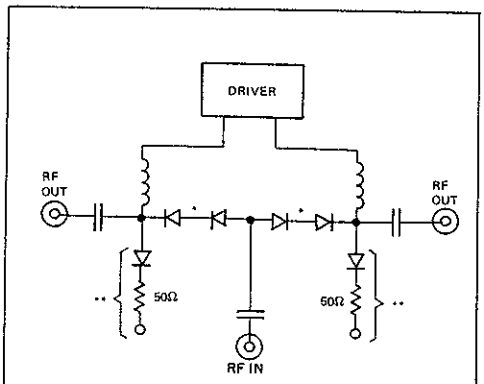
SERIES F91/F92

The Series F91/F92 units are the same as the Series 91/92 units except they are equipped with integrated drivers that are powered by +5 and −12 to −15 volt supplies. The proper currents required to switch the ports ON or OFF are provided by the drivers, which are controlled by external control signals. Standard units are wired so that a port is ON with the application of a Logic 0 control signal.

Series G91 and G92
Miniature Broadband SP2T Switches

SERIES G91 and G92

Operating from +5 and +15V power supplies only, the G-series switches provide high performance characteristics at relatively high speeds over multi-octave frequency ranges. The series includes low insertion loss and high isolation models in both reflective and non-reflective configurations. Series G91 units cover the frequency range of 1 to 18 GHz; Series G92 units cover the frequency range of 0.2 to 4 GHz. The design is based on an integrated circuit assembly of PIN diodes mounted in a microstrip transmission transmission line as shown below. The currents required to switch the ports ON or OFF are provided by the integrated driver, which is controlled by external TTL logic signals.



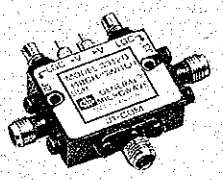
Model G9120( ), rf schematic diagram

*SERIES G91W UNITS ARE CONSTRUCTED WITH THREE SERIES DIODES
**DELETE FOR UNITS WITHOUT "T" OR "W" SUFFIX

SERIES G91T/G92T and G91W

These switches are non-reflective versions of the switches described above. Note that when all output ports are OFF, a high VSWR will be present at the common port.

- **1 to 18 GHz frequency frange (Series G91)**
- **0.2 to 4 GHz frequency range (Series G92)**
- **Rise times as fast as 75 nsec**
- **Reflective and non-reflective models**
- **Low VSWR and insertion loss**
- **Up to 60 dB Isolation**
- **Positive dc supply only**
- **Miniature size, light weight**



MODEL G9120

Series 91 and 92 SP2T Switches Specifications

MODEL NO.[1]	CHARACTERISTIC	FREQUENCY (GHz)					
		0.2-1	1-2	2-4	4-8	8-12.4	12.4-18
9120-500 F9120 F9121[2]	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.75	60 1.5 1.75	55 1.5 1.75	55 1.75 1.75	55 2.2 2.0
9220-500 F9220, G9220 F9221[2]	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	60 1.5 1.5	60 1.5 1.5	— — —	— — —	— — —
9120T-500 F9120T F9121T[2]	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	50 1.2 1.5	50 1.2 1.5	50 1.5 1.5	45 1.5 1.5	40 2.2 2.0
9220T-500 F9220T, G9220T F9221T[2]	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	60 1.2 1.5	60 1.2 1.5	50 1.2 1.5	— — —	— — —	— — —
9120W-500 F9120W F9121W[2]	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	60 1.8 1.5	60 1.8 1.5	60 1.8 1.5	60 2.2 1.5	55 2.5 2.0
9120H-500 F9120H F9121H[2]	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.8 1.75	60 1.8 1.75	60 2.1 1.85	60 2.3 1.9	50 2.7 2.0
9120HT-500 F9120HT F9121HT[2]	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR: Port ON Max Output VSWR: Port OFF	— — — —	60 2.1 1.75 1.75	60 2.1 1.75 1.75	60 2.4 1.9 2.0	60 2.6 2.0 2.2	50 3.0 2.2 2.3
G9120	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON)	— — —	60 1.5 1.5	60 1.5 1.5	60 1.5 1.5	60 1.7 1.5	50 2.2 1.8
G1920T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	— — —	60 1.2 1.5	50 1.2 1.5	50 1.3 1.5	45 1.5 1.5	40 2.0 1.8
G9120W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	— — —	60 1.5 1.5	60 1.5 1.5	60 1.6 1.5	60 1.8 1.5	55 2.5 1.8

PERFORMANCE CHARACTERISTICS[3]

Power Handling Capability

Without Performance Degradation[4]
- Units without "T" or "W" suffix: 1W cw or peak
- Units with "T" or "W" suffix
  - Input to any "OFF" port: 100 mW cw or peak
  - Input to any "ON" port: 1W cw or peak
  - Input to common port: 1W cw or peak

Survival Power
- Units without "T" or "W" suffix: 1W average, 75W peak (1μsec max. pulse width)
- Units with "T" or "W" suffix
  - Input to any "OFF" port[5]: 1W average, 10W peak (1μsec max. pulse width)
  - Input to any "ON" port: 1W average, 75W peak (1μsec max. pulse width)
  - Input to common port: 1W average, 75W peak (1μsec max. pulse width)

(1) *Models prefixed with "F" or "G" are equipped with integrated TTL-compatible drivers; models without the "F" or "G" prefix are current-controlled units and are furnished without drivers; models suffixed with "T" or "W" are non-reflective except a high VSWR will be present at the common port if all other ports are OFF; models suffixed with "H" are high-speed units; models without a "T", "W" or "H" suffix are reflective units with maximum switching speeds of 500 nsec.*

(2) *Special order only.*

(3) *Into 50 ohm system.*

(4) *Up to Survival Power limits shown on page 75.*

(5) *From −65°C to +25°C; see power derating curves, figure 1 on page 75, for higher temperatures.*

Series 91 and 92 SP2T Switches Specifications

Switching Speed

SERIES G91/G92

		SINGLE PORT SWITCHING		COMMUTATION MODE SWITCHING	
		Units Without "T" or "W" Suffix	Units With "T" or "W" Suffix	Units Without "T" or "W" Suffix	Units With "T" or "W" Suffix
Rise Time (10% rf to 90% rf)	Series G91	75 nsec.	100 nsec.	100 nsec.	150 nsec.
	Series G92	100 nsec.	125 nsec.		
Fall Time (90% rf to 10% rf)	Series G91	125 nsec.	125 nsec.	100 nsec.	100 nsec.
	Series G92	150 nsec.	150 nsec.		
ON Time (50% TTL to 90% rf)	Series G91	100 nsec.	150 nsec.	200 nsec.	200 nsec.
	Series G92	125 nsec.	150 nsec.		
OFF Time (50% TTL to 10% rf)	Series G91	150 nsec.	150 nsec.	150 nsec.	150 nsec.
	Series G92	200 nsec.	200 nsec.		

Switching Speed

SERIES 91/92/F91/F92

Units without "H" suffix
(port-to-port) . . . . . 500 nsec max.(1)

Units with "H" suffix(2)
Rise time . . . . . 10 nsec (10-90% rf)
Fall time . . . . . 10 nsec (90-10% rf)
ON time . . . . . 35 nsec(3) (50% TTL to 90% rf)
OFF time . . . . . 35 nsec (50% TTL to 10% rf)

Power Supply Requirements

SERIES 91/92/F91/F92

Driverless Units

Bias current required at each port for rated isolation and insertion loss
Port OFF . . . . . +30 mA
Port ON . . . . . −50 mA

Units With Integrated Drivers

(For one port ON)

	+5V ±2%	−12V to −15V
Units Without "H" Suffix	65 mA	65 mA
Units With "H" Suffix	90 mA	50 mA

SERIES G91/G92

(For one port ON)
+5V ±5%, 100 mA
+15V ±5%, 30 mA

Control Characteristics

SERIES 91/92/F91/F92

Units With Integrated Drivers

Control Input Impedance
Units without "H" suffix . . TTL, low power Schottky, one unit load. (A unit load is 0.8 mA sink current and 40μA source current.)
Units with "H" suffix . . . . Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50μA source current.)

Control Logic . . . . . Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

SERIES G91/G92

Control Input Impedance . . Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 μA source current.)

Control Logic . . . . . Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

(1) *Defined as the time interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, and is rated for ports driven by shaped current pulses. For units with drivers, the pulses are provided by the integrated driver. For driverless units, the pulses must be provided by the user.*
(2) *Max repetition rate is 3 MHz.*
(3) *50 nsec if preceding OFF period is less than 800 nsec.*

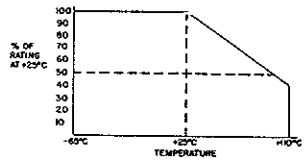


Fig. 1A — Units with integrated drivers

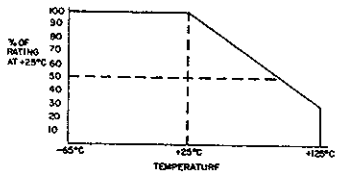


Fig. 1B — Driverless units

"OFF" PORT SURVIVAL POWER DERATING FACTORS

SWITCHES

Series 91 and 92 SP2T Switches Specifications

ENVIRONMENTAL RATINGS

Temperature Range
Units With Integrated Drivers
Operating . . . . . −65°C to +110°C
Non-Operating . . . . . −65°C to +125°C
Driverless Units
Operating and Non-Operating . . . . . −65°C to +125°C

Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

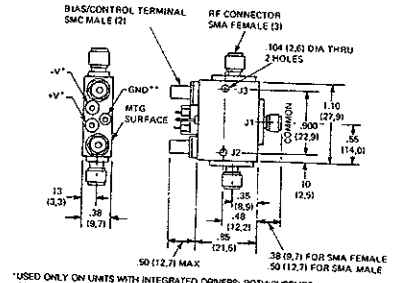
Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

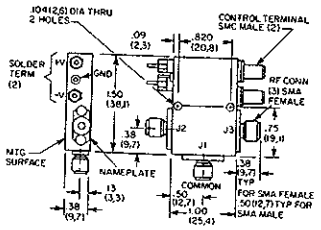
Option No.	Description
3	SMA female bias/control connectors
7	J1, J2 and J3 SMA male
7A	J1 SMA male; J2 and J3 SMA female
7B	J1 SMA female; J2 and J3 SMA male
9	Inverse logic (integrated units only); logic 0 for port OFF and logic 1 for port ON
27	Single-port toggle control (integrated units only); logic 0 connects J1 to J2
33	EMI filter solder-type bias/control terminals
64A	SMB male bias/control connectors

DIMENSIONS AND WEIGHTS



*USED ONLY ON UNITS WITH INTEGRATED DRIVERS; BOTH SUPPLIES POSITIVE FOR G91/G92 SERIES.
**NOT USED ON DRIVERLESS UNITS EXCEPT WITH OPTION 33

SERIES 91/92/F91/F92/G91/G92 SWITCHES
Wt: .75 oz. (21 gm) approx.



MODELS F9121 AND F9221
Wt: 1 oz. (28 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series F892
High-Speed Octave-Band SP2T Switches

SERIES F892

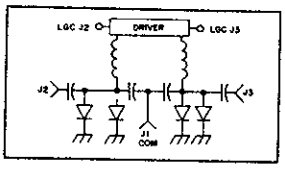
Series F892 high speed switches with integrated drivers are low-cost units that have been engineered to meet the need of microwave system designers for fast switching devices in small packages.

2 To 18 GHz Frequency Range

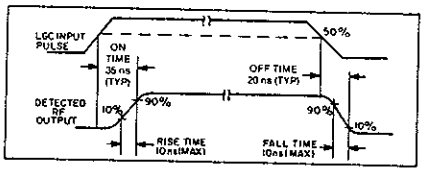
Frequency coverage from 2 to 18 GHz is provided by the three models in the Series: Model F8922 (2-4 GHz), Model F8924 (4-8) GHz) and Model F8928 (8-18 GHz). Each model is capable of extended bandwidth operation, typically 3:1, with only moderate degradation in performance at the band edges, as shown in the specifications on page 78.

Fast Switching Shunt Design

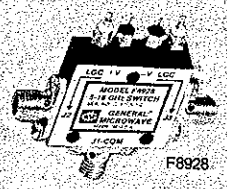
All models are optimally designed, with respect to their size, for low VSWR and insertion loss. As shown in the schematic below, a pure shunt design is used for the most practical realization of fast switching action. Although the use of a pure shunt mode imposes certain bandwidth limitations, frequency coverage in excess of octave bands has been maintained.

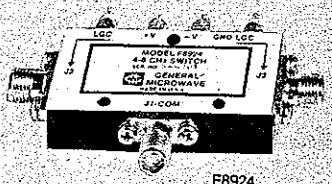


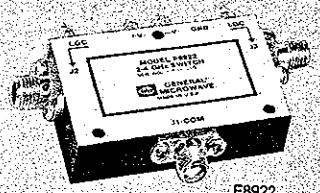
The proper currents required to switch ports ON or OFF are provided by the integrated drivers which are controlled by external logic signals. The switches are TTL-compatible. Switching characteristics are shown below.



- Low Cost
- S, C and X-U band models
- 10 nsec rise and fall times
- Up to 60 dB isolation
- As low as 1.0 dB insertion loss


F8928


F8924


F8922

THE THREE UNITS IN THIS SERIES ARE EQUIPPED WITH INTEGRATED DRIVERS

SWITCHES

Series F892
Specifications

MODEL NO.	FREQUENCY RANGE (GHz)	INSERTION LOSS, MAX. (dB)	ISOLATION, MIN. (dB)	VSWR MAX. (ON position)
F8922	2-4	1.0	60	1.5
	1.5-4.5	2.0	55	2.0
F8924	4-8	1.4	50	1.5
	3-9	2.3	45	2.2
F8928	8-18	2.3	45	2.2
	6-18	2.5	45	2.5

PERFORMANCE CHARACTERISTICS

Rise and Fall Times . . . . . 10 nsec max. (see figure on page 77)

Power Handling Capability
Without Performance Degradation[3] . . 2W cw or peak[1]

Survival Power (from −65°C to +25°C; see power derating curve, figure 1, for higher temperatures) . . . . 2W average, 10W peak (1 μsec max pulse width)

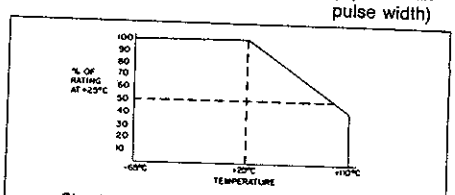


Fig. 1 — Survival power derating factors

Control Characteristics

Control Input Impedance . . . . . Schottky TTL, one-unit load. (A unit load is 2.0 mA sink current and 50 μA source current.)

Control Logic . . . . . −0.3 to +0.8 volt (Logic "0") for port ON and +2.0 to +5.0 volts (Logic "1") for port OFF

Power Supply Requirements

+5V ±2%, 65 mA
−12V to −15V[1], 2 mA

ENVIRONMENTAL RATINGS

Operating Temperature Range . . . . . −65°C to +110°C

Non-Operating Temperature Range . . . . . −65°C to +125°C

Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

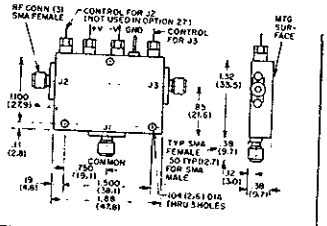
Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

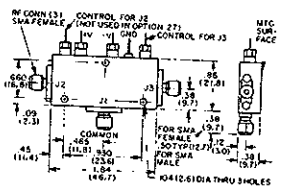
Option No.	Description
3	SMA female control connectors
7	J1, J2 and J3 SMA male
7A	J1 SMA male; J2 and J3 SMA female
7B	J1 SMA female; J2 and J3 SMA male
9	Inverse logic; logic 0 for port OFF and logic 1 for port ON
27	Single-port toggle control; logic 0 connects J1 to J2
62	±15 volts operation
64	SMC male control connectors
64A	SMB male control connectors
65	±12 volts operation

(1) *Units can be operated at higher input power levels with some increase in switching time when −30V power supply is used.*
(2) *Into 50 ohm system.*
(3) *Up to Survival Power limits shown in figure 1.*

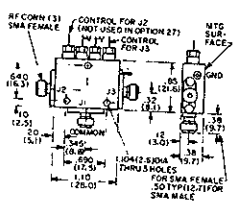
DIMENSIONS AND WEIGHTS



MODEL F8922
Wt: 1.5 oz. (43 gm) approx.



MODEL F8924
Wt: 1 oz. (28 gm) approx.



MODEL F8928
Wt: 1 oz. (28 gm) approx.

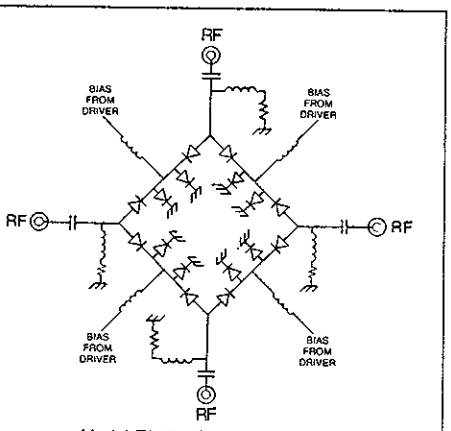
Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Model F940H
Broadband Transfer Switch

With Integrated Driver

MODEL F940H

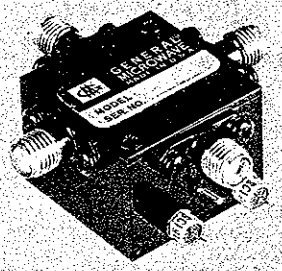
Model F940H is a high-performance broadband transfer switch that operates over the full instantaneous bandwidth of 0.5 to 18 GHz with ON and OFF times of 30 nsec. Design features include an integrated circuit assembly of PIN diodes mounted in a microstrip transmission line as well as a resistive bias line that contributes to the broadband low-loss performance. The circuit configuration of the Model F940H is shown below.



Model F940H Schematic Diagram

The Model F940H is equipped with an integrated driver that is powered by +5 and −12 volt supplies. The proper currents required to switch the ports ON or OFF are provided by the driver, which is controlled by external logic signals.

- **0.5 to 18 GHz frequency range**
- **Low VSWR and insertion loss**
- **Up to 60 dB isolation**
- **Small size, light weight**



Model F940H
Specifications

CHARACTERISTIC	FREQUENCY (GHz)		
	0.5 to 8.0	8.0 to 12.4	12.4 to 18.0
Min Isolation (dB)	60	55	50
Max Insertion Loss (dB)	2.0	2.5	3.0
Max VSWR	1.75	1.75	2.0

PERFORMANCE CHARACTERISTICS[2]

ON and OFF Times[1] ..... 30 nsec max

Power Handling Capability

Without Performance Degradation[3] .. 500 mW cw or peak

Survival Power (from −65°C to +25°C; see power derating curve, figure 1, for higher temperatures) .... 1W average, 75W peak (1 μsec max pulse width)

Power Supply Requirements

+5 V ±2%, 100 mA
−12 V ±5%, 60 mA

Control Characteristics

Control Input Impedance ..... Schottky TTL, two unit loads. (A unit load is 2 mA sink current and 50 μA source current.)

Control Logic ..... Logic "0" (−0.3 to +0.8 V) connects J1 to J2 and J3 to J4. Logic "1" (+2.0 to +5.0 V) connects J1 to J4 and J2 to J3. See AVAILABLE OPTIONS for inverse logic.

(1) ON time is specified as the transition time between 50% of the input control signal to the 90% point of the square-law detected RF power when the port is switched from OFF to ON. OFF time is specified as the transition time between 50% of the input control signal to the 10% point of the square-law detected RF power when the port is switched from ON to OFF.

(2) Into 50 ohm system.

(3) Up to Survival Power limits shown below.

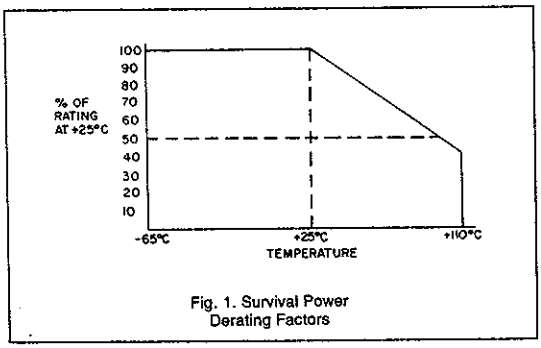


Fig. 1. Survival Power Derating Factors

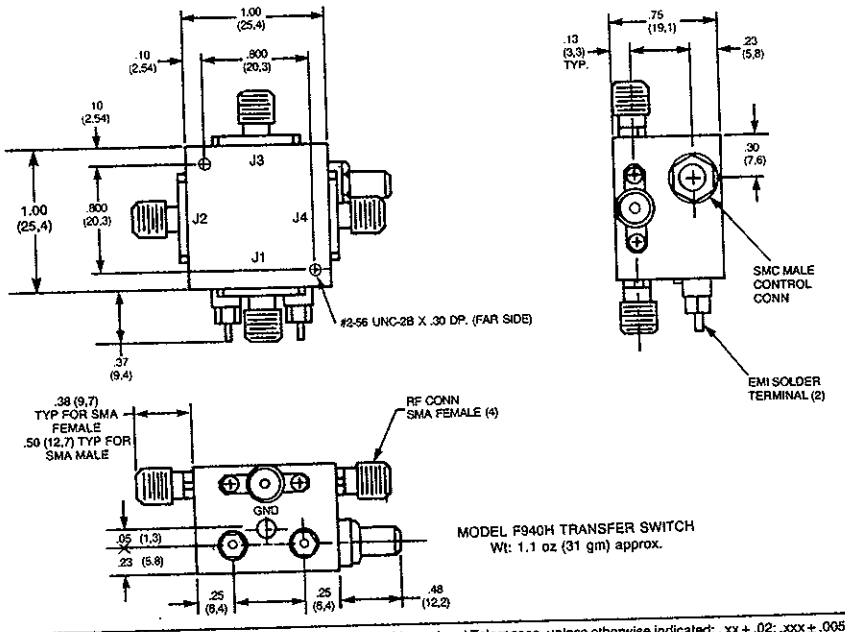
ENVIRONMENTAL RATINGS

Operating Temperature Range	−65°C to +110°C
Non-Operating Temperature Range	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
7	SMA male rf connectors
9	Inverse control logic; logic "0" connects J1 to J4 and J2 to J3, and logic "1" connects J1 to J2 and J3 to J4
33	EMI filter solder-type control terminal
64A	SMB male control connector

DIMENSIONS AND WEIGHTS

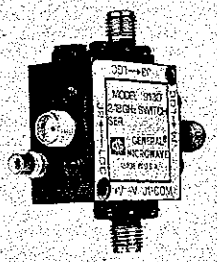


MODEL F940H TRANSFER SWITCH
Wt: 1.1 oz (31 gm) approx.

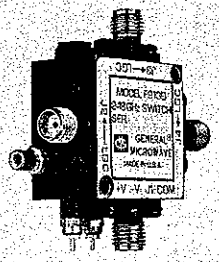
Dimensional Tolerances, unless otherwise indicated: .xx ± .02; .xxx ± .005

Series 91 and 92
Miniature Broadband SP3T Switches

- 1 to 18 GHz frequency range (Series 91)
- 0.2 to 4 GHz frequency range (Series 92)
- Rise and fall times as fast as 10 nsec
- Reflective and non-reflective models
- Low VSWR and insertion loss
- Up to 60 dB isolation
- Miniature size, light weight



9130-500 (DRIVERLESS)



F9130
(WITH INTEGRATED
DRIVER)

MODELS 9130-500 AND 9230-500

These switches provide high-performance characteristics over a multi-octave frequency range. The Model 9130-500 covers the 1 to 18 GHz frequency range while the Model 9230-500 covers the 0.2 to 4 GHz range. Their description and operation are the same as that for the Models 9120-500 and 9220-500 SP2T switches as appear on page 72.

MODELS 9130T-500, 9130W-500 AND 9230T-500

These switches are non-reflective versions of the switches described above. See page 72 for description.

MODELS 9130H-500 AND 9130HT-500

These switches are the same as the 9120H-500 and 9120HT-500 except for the number of ports. See page 72 for description.

SERIES F91 AND F92

The Series F91 and F92 switches are the same as the corresponding Series 91 and 92 models, except the units are equipped with integrated drivers. See page 72 for description.

SERIES G91 AND G92

These switches are the same as the SP2T versions described on page 73 except for the number of ports.

MODEL NO.(1)	CHARACTERISTIC	FREQUENCY (GHz) 0.2-1	1-2	2-4	4-8	8-12.4	12.4-18
9130-500 F9130	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.75	60 1.5 1.75	55 1.5 1.75	50 1.75 1.75	50 2.5 2.0
9230-500 F9230 G9230	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	60 1.5 1.5	60 1.5 1.5	— — —	— — —	— — —
9130T-500 F9130T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	50 1.4 1.5	50 1.4 1.5	45 1.6 1.5	40 1.8 1.75	40 2.5 2.0
9230T-500 F9230T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	60 1.2 1.5	60 1.2 1.5	50 1.4 1.5	— — —	— — —	— — —
9130W-500 F9130W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	60 1.8 1.5	60 1.8 1.5	60 2.0 1.7	60 2.5 1.7	55 2.8 2.0
9130H-500 F9130H	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.8 1.75	60 1.8 1.75	60 2.2 1.85	60 2.6 1.9	50 3.1 2.0
9130HT-500 F9130HT	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR: Port ON Max Output VSWR: Port OFF	— — — —	60 2.2 1.75 1.75	60 2.2 1.75 1.75	60 2.5 1.9 2.0	60 2.9 2.0 2.2	50 3.4 2.2 2.3
G9130	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON)	— — —	60 1.5 1.5	60 1.5 1.5	60 1.6 1.5	60 1.9 1.5	50 2.4 1.8
G9130T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	— — —	60 1.3 1.5	50 1.3 1.5	50 1.4 1.5	45 1.7 1.5	40 2.2 1.8
G9130W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	— — —	60 1.5 1.5	60 1.6 1.5	60 1.7 1.5	60 2.0 1.5	55 2.5 1.8
G9230T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	60 1.2 1.5	60 1.2 1.5	50 1.2 1.5	— — —	— — —	— — —

PERFORMANCE CHARACTERISTICS [2]

Power Handling Capability

Without Performance Degradation
- Units without "T" or "W" suffix: 1W cw or peak
- Units with "T" or "W" suffix
  - Input to any "OFF" port: 100 mW cw or peak
  - Input to any "ON" port: 1W cw or peak
  - Input to common port: 1W cw or peak

Survival Power
- Units without "T" or "W" suffix: 1W average, 75W peak (1μ sec max. pulse width)
- Units with "T" or "W" suffix
  - Input to any "OFF" port[4]: 1W average, 10W peak (1μsec max. pulse width)
  - Input to any "ON" port: 1W average, 75W peak (1μ sec max. pulse width)
  - Input to common port: 1W average, 75W peak (1μ sec max. pulse width)

(1) *Models prefixed with "F" or "G" are equipped with integrated TTL-compatible drivers; models without the "F" or "G" prefix are current-controlled units and are furnished without drivers; models suffixed with "T" or "W" are non-reflective except a high VSWR will be present at the common port if all other ports are OFF; models suffixed with "H" are high-speed units; models without a "T", "W" or "H" suffix are reflective units with maximum switching speeds of 500 nsec.*

(2) *Into 50 ohm system.*

(3) *Up to Survival Power limits shown on page 84.*

(4) *From −65°C to +25°C; see power derating curves, figure 1 page 84, for higher temperatures.*

Series 91 and 92 SP3T Switches Specifications

Switching Speed

SERIES G91/G92

		SINGLE PORT SWITCHING		COMMUTATION MODE SWITCHING	
		Units Without "T" or "W" Suffix	Units With "T" or "W" Suffix	Units Without "T" or "W" Suffix	Units With "T" or "W" Suffix
Rise Time (10% rf to 90% rf)	Series G91	75 nsec.	100 nsec.	100 nsec.	150 nsec.
	Series G92	100 nsec.	125 nsec.		
Fall Time (90% rf to 10% rf)	Series G91	125 nsec.	125 nsec.	100 nsec.	100 nsec.
	Series G92	150 nsec.	150 nsec.		
ON Time (50% TTL to 90% rf)	Series G91	100 nsec.	150 nsec.	200 nsec.	200 nsec.
	Series G92	125 nsec.	150 nsec.		
OFF Time (50% TTL to 10% rf)	Series G91	150 nsec.	150 nsec.	150 nsec.	150 nsec.
	Series G92	200 nsec.	200 nsec.		

Switching Speed

SERIES 91/92/F91/F92

Units without "H" suffix
(port-to-port) . . . . . 500 nsec max.[1]

Units with "H" suffix[2]
Rise time . . . . . 10 nsec (10-90% rf)
Fall time . . . . . 10 nsec (90-10% rf)
ON time . . . . . 35 nsec[3] (50% TTL to 90% rf)
OFF time . . . . . 35 nsec (50% TTL to 10% rf)

Power Supply Requirements

SERIES 91/92/F91/F92

Driverless Units
Bias current required at each port for rated isolation and insertion loss
Port OFF
Units without "H" suffix . . . . . + 50 mA
Units with "H" suffix . . . . . + 30 mA
Port ON
Units without "H" suffix . . . . . − 50 mA
Units with "H" suffix . . . . . − 35 mA

For operation with more than one port ON, total negative current must be limited to − 100 mA.

Units With Integrated Drivers
(For one port ON)

	+ 5V ± 2%	− 12V to − 15V
Units Without "H" Suffix	130 mA	60 mA
Units With "H" Suffix	175 mA	50 mA

SERIES G91/G92
(For one port ON)
+ 5V ± 5%, 100 mA
+ 15V ± 5%, 40 mA

Control Characteristics

SERIES 91/92/F91/F92

Units With Integrated Drivers

Control Input Impedance
Units without "H" suffix . . . TTL, low power Schottky, one unit load. (A unit load is 0.8 mA sink current and 40 μA source current.)
Units with "H" suffix . . . . . Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 μA source current.)

Control Logic . . . . . Logic "0" (− 0.3 to + 0.8 volts) for port ON and logic "1" (+ 2.0 to + 5.0 volts) for port OFF.

SERIES G91/G92

Control Input Impedance . . Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 μA source current.)

Control Logic . . . . . Logic "0" (− 0.3 to + 0.8 volts) for port ON and logic "1" (+ 2.0 to + 5.0 volts) for port OFF.

(1) Detined as the time interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value. and is rated for ports driven by shaped current pulses. For units with drivers, the pulses are provided by the integrated driver. For driverless units, the pulses must be provided by the user.
(2) Max repitition rate is 3 MHz.
(3) 50 nsec if preceding OFF period is less than 800 nsec.

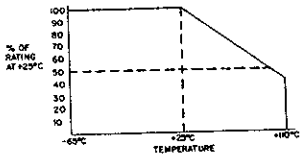


Fig. 1A — Integrated units

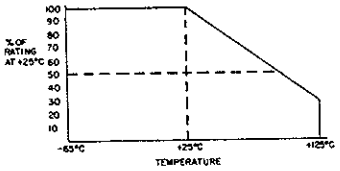


Fig. 1B — Driverless units

"OFF" PORT SURVIVAL POWER DERATING FACTORS

ENVIRONMENTAL RATINGS

Temperature Range

Units With Integrated Drivers

Operating	−65°C to +110°C
Non-Operating	−65°C to +125°C

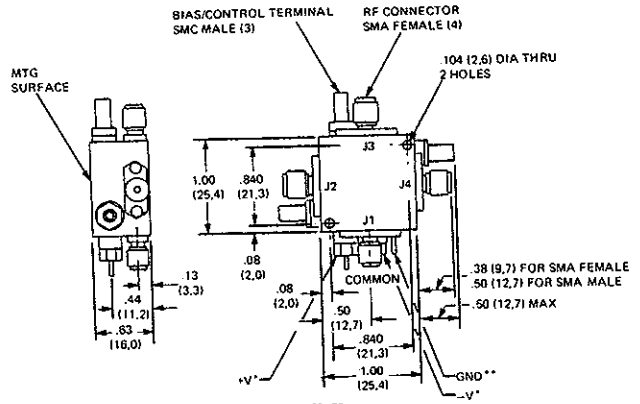
Driverless Units

Operating and Non-Operating	−65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias/control connectors
7	SMA male rf connectors
9	Inverse logic (integrated units only); logic 0 for port OFF and logic 1 for port ON
33	EMI filter solder-type bias/control terminals
64A	SMB male bias/control connectors

DIMENSIONS AND WEIGHTS



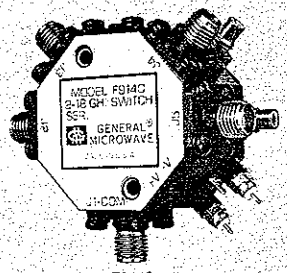
*USED ONLY ON UNITS WITH INTEGRATED DRIVERS; BOTH SUPPLIES POSITIVE FOR G91/G92 SERIES.
**NOT USED ON DRIVERLESS UNITS EXCEPT WITH OPTION 33

MODELS 91/92/F91/F92/G91/G92 SP3T SWITCHES
Wt: 1.1 oz. (31 gm) approx.

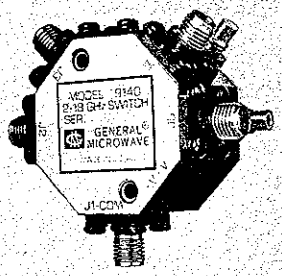
Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series 91 and 92
Miniature Broadband SP4T Switches

- 1 to 18 GHz frequency range (Series 91)
- 0.2 to 4 GHz frequency range (Series 92)
- Rise and fall times as fast as 10 nsec
- Reflective and non-reflective models
- Low VSWR and insertion loss
- Up to 60 dB isolation
- Miniature size, light weight



F9140
(WITH INTEGRATED DRIVER)



9140-500
(DRIVERLESS)

MODELS 9140-500 AND 9240-500

These switches provide high-performance characteristics over a multi-octave frequency range. Model 9140-500 covers the 1 to 18 GHz frequency range while the Model 9240–500 covers the 0.2 to 4 GHz range. Their description and operation are the same as that for the Models 9120-500 and 9220-500 SP2T switches as appear on page 72.

MODELS 9140T-500, 9140W-500 AND 9240T-500

These switches are non-reflective versions of the switches described above. See page 72 for description.

MODELS 9140H-500 AND 9140HT-500

These switches are the same as the 9120H-500 and 9120HT-500 except for the number of ports. See page 72 for description.

SERIES F91 AND F92

The Series F91 and F92 switches are the same as the corresponding Series 91 and 92 models except the units are equipped with integrated drivers. See page 72 for description.

SERIES G91 AND G92

These switches are the same as the SP2T versions described on page 73 except for the number of ports.

Series 91 and 92 SP4T Switches Specifications

MODEL NO.[1]	CHARACTERISTIC	FREQUENCY (GHz)					
		0.2-1	1-2	2-4	4-8	8-12.4	12.4-18
9140-500 F9140	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.5	60 1.5 1.5	55 1.5 1.75	50 2.0 1.75	50 2.5 2.0
9240-500 F9240	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.6	60 1.5 1.6	60 1.5 1.6	— — —	— — —	— — —
9140T-500 F9140T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	50 1.5 1.5	50 1.5 1.5	45 1.7 1.5	40 2.0 1.75	40 2.5 2.0
9240T-500 F9240T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	60 1.3 1.5	60 1.3 1.5	50 1.5 1.5	— — —	— — —	— — —
9140W-500 F9140W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	60 2.0 1.5	60 2.0 1.5	60 2.2 1.7	60 2.7 1.7	55 3.0 2.0
9140H-500 F9140H	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.9 1.75	60 1.9 1.75	60 2.4 2.0	60 2.8 2.0	50 3.5 2.1
9140HT-500 F9140HT	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR: Port ON Max Output VSWR: Port OFF	— — — —	60 2.3 1.75 1.75	60 2.3 1.75 1.75	60 2.7 2.0 2.0	60 3.1 2.1 2.2	50 3.9 2.3 2.3
G9140	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON)	— — —	60 1.5 1.5	60 1.5 1.5	60 1.8 1.5	60 2.1 1.5	50 2.6 1.8
G9140T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	— — —	60 1.3 1.5	50 1.4 1.5	50 1.6 1.5	45 1.9 1.5	40 2.4 1.8
G9140W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	— — —	60 1.6 1.5	60 1.7 1.5	60 1.9 1.5	60 2.2 1.5	55 2.7 1.8
G9240	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON)	60 1.5 1.5	60 1.5 1.5	60 1.5 1.5	— — —	— — —	— — —
G9240T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON or OFF)	60 1.2 1.5	60 1.2 1.5	50 1.2 1.5	—	—	—

PERFORMANCE CHARACTERISTICS[2]

Power Handling Capability

Without Performance Degradation[3]

Units without "T" or "W" suffix: 1W cw or peak
Units with "T" or "W" suffix
Input to any "OFF" port: 100 mW cw or peak
Input to any "ON" port: 1W cw or peak
Input to common port: 1W cw or peak

Survival Power

Units without "T" or "W" suffix: 1W average, 75W peak (1μsec max. pulse width)
Units with "T" or "W" suffix
Input to any "OFF" port[4]: 1W average, 10W peak (1μsec max. pulse width)
Input to any "ON" port: 1W average, 75W peak (1μsec max. pulse width)
Input to common port: 1W average, 75W peak (1μsec max. pulse width)

(1) Models prefixed with "F" or "G" are equipped with integrated TTL-compatible drivers; models without the "F" or "G" prefix are current-controlled units and are furnished without drivers; models suffixed with "T" or "W" are non-reflective except a high VSWR will be present at the common port if all other ports are OFF; models suffixed with "H" are high-speed units; models without a "T", "W" or "H" suffix are reflective units with maximum switching speeds of 500 nsec.

(2) Into 50 ohm system.

(3) Up to Survival Power limits shown on page 88.

(4) From −65°C to +25°C; see power derating curves, figure 1 on page 88, for higher temperatures.

Series 91 and 92 SP4T Switches Specifications

Switching Speed

SERIES G91/G92

		SINGLE PORT SWITCHING		COMMUTATION MODE SWITCHING	
		Units Without "T" or "W" Suffix	Units With "T" or "W" Suffix	Units Without "T" or "W" Suffix	Units With "T" or "W" Suffix
Rise Time (10% rf to 90% rf)	Series G91	75 nsec.	100 nsec.	100 nsec.	150 nsec.
	Series G92	100 nsec.	125 nsec.		
Fall Time (90% rf to 10% rf)	Series G91	125 nsec.	125 nsec.	100 nsec.	100 nsec.
	Series G92	150 nsec.	150 nsec.		
ON Time (50% TTL to 90% rf)	Series G91	100 nsec.	150 nsec.	200 nsec.	200 nsec.
	Series G92	125 nsec.	150 nsec.		
OFF Time (50% TTL to 10% rf)	Series G91	150 nsec.	150 nsec.	150 nsec.	150 nsec.
	Series G92	200 nsec.	200 nsec.		

Switching Speed

SERIES 91/92/F91/F92

Units without "H" suffix
(port-to-port) . . . . . 500 nsec max.(1)

Units with "H" suffix(2)
Rise time . . . . . 10 nsec (10-90% rf)
Fall time . . . . . 10 nsec (90-10% rf)
ON time . . . . . 35 nsec(3) (50% TTL to 90% rf)
OFF time . . . . . 35 nsec (50% TTL to 10% rf)

Power Supply Requirements

SERIES 91/92/F91/F92

Driverless Units

Bias current required at each port for rated isolation and insertion loss
Port OFF
Units without "H" suffix . . . . . +50 mA
Units with "H" suffix . . . . . +30 mA
Port ON
Units without "H" suffix . . . . . −50 mA
Units with "H" suffix . . . . . −35 mA

For operation with more than one port ON, total negative current must be limited to −100 mA.

Units With Integrated Drivers

(For one port ON)

	+5V ±2%	−12V to −15V
Units Without "H" Suffix	190 mA	60 mA
Units With "H" Suffix	215 mA	50 mA

SERIES G91/G92

(For one port ON)
+5V ±5%, 150 mA
+15V ±5%, 50 mA

Control Characteristics

SERIES 91/92/F91/F92

Units With Integrated Drivers

Control Input Impedance
Units without "H" suffix . . TTL, low power Schottky, one unit load. (A unit load is 0.8 mA sink current and 40 μA source current.)
Units with "H" suffix . . . . Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 μA source current.)

Control Logic . . . . . Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

SERIES G91/G92

Control Input Impedance . . Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 μA source current.)

Control Logic . . . . . Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

(1) Defined as the time interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, and is rated for ports driven by shaped current pulses. For units with drivers, the pulses are provided by the integrated driver. For driverless units, the pulses must be provided by the user.
(2) Max repitition rate is 3 MHz.
(3) 50 nsec if preceding OFF period is less than 800 nsec.

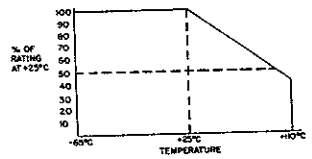


Fig. 1A — Integrated units

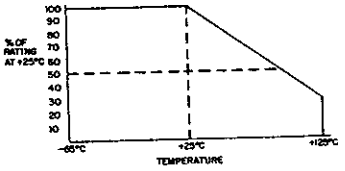


Fig. 1B — Driverless units

"OFF" PORT SURVIVAL POWER DERATING FACTORS

SWITCHES

ENVIRONMENTAL RATINGS

Temperature Range
Units With Integrated Drivers
Operating ..... −65°C to +110°C
Non-Operating ..... −65°C to +125°C

Driverless Units
Operating and Non-Operating ..... −65°C to +125°C

Humidity ..... MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock ..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration ..... MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

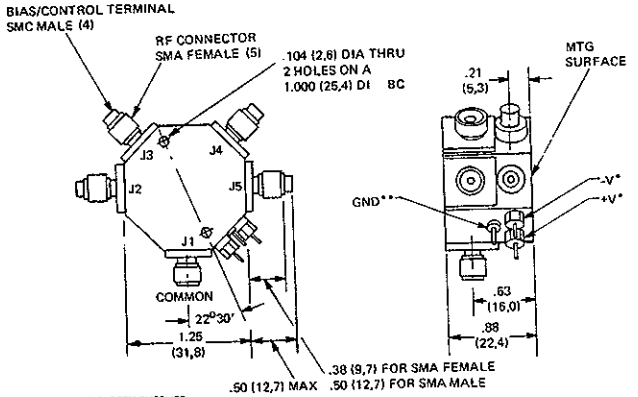
Altitude ..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling ..... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias/control connectors
7	SMA male rf connectors
9	Inverse logic (integrated units only); logic 0 for port OFF and logic 1 for port ON
33	EMI filter solder-type bias/control terminals
64A	SMB male bias/control connectors

DIMENSIONS AND WEIGHTS



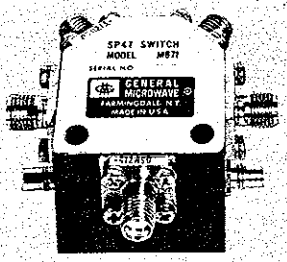
*USED ONLY ON UNITS WITH INTEGRATED DRIVERS; BOTH SUPPLIES POSITIVE FOR G91/G92 SERIES.
**NOT USED ON DRIVERLESS UNITS EXCEPT WITH OPTION 33.

MODELS 91/92/F91/F92/G91/G92 SP4T SWITCHES
Wt: 2 oz. (56 gm) approx.

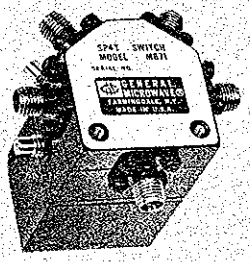
Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005

Models M871A and DM871A Ultra-Broadband SP4T Switches

- 0.2 to 18 GHz frequency range
- Low VSWR and insertion loss
- Up to 60 dB isolation
- Small size, light weight



M871A (DRIVERLESS)



DM871A (WITH INTEGRATED DRIVER)

MODEL M871A

Model M871A is a high-performance broadband single-pole four-throw switch that operates over the full instantaneous bandwidth of 0.2 to 18 GHz. Its description and operation is the same as that for the Model M870 as appears on page 69.

MODEL DM871A

The Model DM871A is the same as the Model M871A except it is equipped with an integrated driver. See page 69 for description.

SPECIFICATIONS

CHARACTERISTIC	FREQUENCY (GHz) 0.2 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
Min Isolation (dB)	60	55	50	50
Max Insertion Loss (dB)	1.5	1.5	2.0	2.5
Max VSWR (ON position)	1.5	1.75	1.75	2.0

PERFORMANCE CHARACTERISTICS[2]

Switching Speed (port-to-port) . . . . . 2 μsec max.[1]

Power Handling Capability
Without Performance Degradation[3] : 1W cw or peak
Survival Power (from −65°C to +25°C; see power derating curve, figure 1 below, for higher temperatures): 1W average, 75W peak (1μ sec max. pulse width)

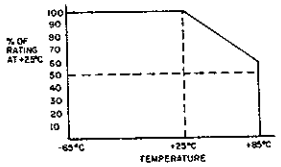


Fig. 1 — Survival power derating factors

(1) Defined as the interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, and is rated for ports driven by shaped current pulses. For the Model DM871A, the pulses are provided by the integrated driver. For the Model M871A, the pulses must be provided by the user.

(2) *Into 50 ohm system.*

(3) *Up to Survival Power limits shown in figure 1.*

Models M871A and DM871A SP4T Switches Specifications

Control Characteristics

MODEL DM871A

Control Input Impedance . . . TTL, low power Schottky, one unit load. (A unit load is 0.8 mA sink current and 40μA source current.)

Control Logic . . . . . Logic "0" (−0.3 to +0.8 volts) for port OFF and logic "1" (+2.0 to +5.0 volts) for port ON.

Power Supply Requirements

MODEL M871A

Bias current required at each port for rated isolation and insertion loss[1]

Port OFF . . . . . +50 mA
Port ON . . . . . −50 mA

MODEL DM871A

(For one port ON)
+15 V ±5%, 190 mA
−12V to −15V, 60 mA

ENVIRONMENTAL RATINGS

Operating Temperature Range . . . . . −65°C to +85°C

Non-Operating Temperature Range . . . . . −65°C to +125°C

Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

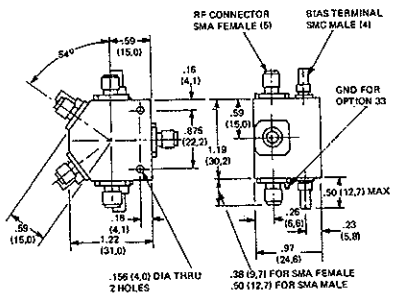
AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias/control connectors
7	SMA male rf connectors
9	Inverse control logic; logic "0" for port ON and logic "1" for port OFF (DM871A only)
20*	One unit load control input impedance
33	EMI filter solder type bias/control terminals.
64A	SMB male bias/control connector

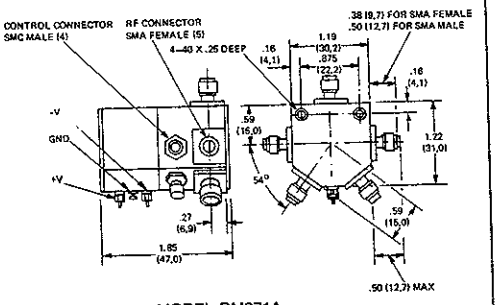
**Not applicable to Model M871A. Model DM871A is furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.*

(1) *For operation of Models M871A with more than one port ON, total negative current must be limited to − 150 mA. Do not apply more than 75 mA to any OFF port or more than − 75 mA to any ON port.*

DIMENSIONS AND WEIGHTS



MODEL M871A
Wt: 2.5 oz. (70 gm) approx.

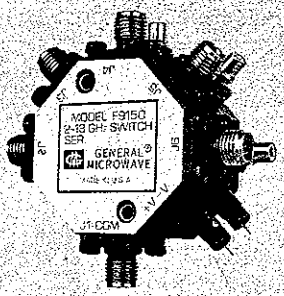


MODEL DM871A
Wt: 4.5 oz. (127 gm) approx.

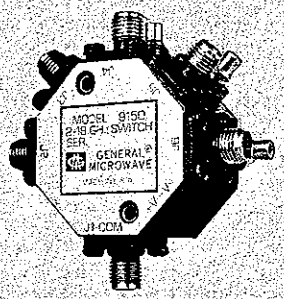
Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

Series 91 and 92
Miniature Broadband SP5T Switches

- 1 to 18 GHz frequency range (Series 91)
- 0.2 to 4 GHz frequency range (Series 92)
- Reflective and non-reflective models
- Low VSWR and insertion loss
- Up to 60 dB isolation
- Miniature size, light weight



F9150
(WITH INTEGRATED DRIVER)



9150-500 (DRIVERLESS)

MODELS 9150-500 AND 9250-500

These switches provide high-performance characteristics over a multi-octave frequency range. Model 9150-500 covers the 1 to 18 GHz frequency range while the Model 9250-500 covers the 0.2 to 4 GHz range. Their description and operation are the same as that for the Models 9120-500 and 9220-500 SP2T switches as appear on page 72.

MODELS 9150T-500, 9150W-500 AND 9250T-500

These switches are non-reflective versions of the switches described above. See page 72 for description.

SERIES F91 AND F92

The Series F91 and F92 switches are the same as the corresponding Series 91 and 92 models, except the units are equipped with integrated drivers. See page 72 for description.

SERIES G91 AND G92

These switches are the same as the SP2T versions described on page 73 except for the number of ports.

MODEL NO.[1]	CHARACTERISTIC	FREQUENCY (GHz) 0.2-1	1-2	2-4	4-8	8-12.4	12.4-18
9150-500 F9150 G9150	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.5	60 1.5 1.5	55 1.5 1.75	50 2.0 1.75	50 3.0 2.0
9250-500 F9250 G9250	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.6	60 1.5 1.6	60 1.5 1.6	— — —	— — —	— — —
9150T-500 F9150T G9150T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	50 1.5 1.5	50 1.5 1.5	45 2.0 1.7	40 2.5 2.0	40 3.0 2.2
9250T-500 F9250T G9250T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	60 1.4 1.5	60 1.4 1.5	50 1.5 1.5	— — —	— — —	— — —
9150W-500 F9150W G9150W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	60 2.2 1.5	60 2.2 1.5	60 2.4 1.8	60 3.0 2.0	55 3.3 2.2

PERFORMANCE CHARACTERISTICS[3]

Power Handling Capability

Without Performance Degradation[4]
Units without "T" or "W" suffix: 1W cw or peak
Units with "T" or "W" suffix
Input to any "OFF" port: 100 mW cw or peak
Input to any "ON" port: 1W cw or peak
Input to common port: 1W cw or peak

Survival Power
Units without "T" or "W" suffix: 1W average, 75W peak (1μ sec max. pulse width)
Units with "T" or "W" suffix
Input to any "OFF" port[5]: 1W average, 10W peak (1μ sec max. pulse width)
Input to any "ON" port: 1W average, 75W peak (1μ sec max. pulse width)
Input to common port: 1W average, 75W peak (1μ sec max. pulse width)

Switching Speed

SERIES 91/92/F91/F92 (port-to-port) . . . . . 500 nsec max.[2]

SERIES G91/G92		SINGLE PORT SWITCHING: Units Without "T" or "W" Suffix	SINGLE PORT SWITCHING: Units With "T" or "W" Suffix	COMMUTATION MODE SWITCHING: Units Without "T" or "W" Suffix	COMMUTATION MODE SWITCHING: Units With "T" or "W" Suffix
Rise Time (10% rf to 90% rf)	Series G91	75 nsec.	100 nsec.	100 nsec.	150 nsec.
	Series G92	100 nsec.	125 nsec.		
Fall Time (90% rf to 10% rf)	Series G91	125 nsec.	125 nsec.	100 nsec.	100 nsec.
	Series G92	150 nsec.	150 nsec.		
ON Time (50% TTL to 90% rf)	Series G91	100 nsec.	150 nsec.	200 nsec.	200 nsec.
	Series G92	125 nsec.	150 nsec.		
OFF Time (50% TTL to 10% rf)	Series G91	150 nsec.	150 nsec.	150 nsec.	150 nsec.
	Series G92	200 nsec.	200 nsec.		

(1) *Models prefixed with "F" or "G" are equipped with integrated TTL-compatible drivers; models without the "F" or "G" prefix are current-controlled units and are furnished without drivers; models suffixed with "T" or "W" are non-reflective except a high VSWR will be present at the common port if all other ports are OFF; models without a "T" or "W" suffix are reflective units.*

(2) *Defined as the time interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, and is rated for ports driven by shaped current pulses. For units with drivers, the pulses are provided by the integrated driver. For driverless units, the pulses must be provided by the user.*

(3) *Into 50 ohm system.*

(4) *Up to Survival Power limits shown below.*

(5) *From −65°C to +25°C; see power derating curves, figure 1 below, for higher temperatures.*

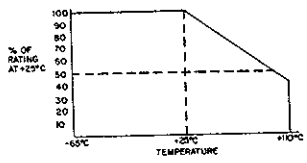


Fig. 1A — Integrated units

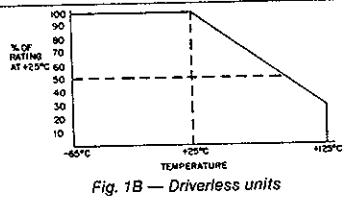


Fig. 1B — Driverless units

"OFF" PORT SURVIVAL POWER DERATING FACTORS

Series 91 and 92 SP5T Switches Specifications

Power Supply Requirements

SERIES 91/92/F91/F92
Driverless Units
Bias current required at each port for rated isolation and insertion loss
Port OFF . . . . . +50 mA
Port ON . . . . . −50 mA
For operation with more than one port ON, total negative current must be limited to −100 mA.
Units With Integrated Drivers
(For one port ON)
+5V ±2%, 250 mA
−12V to −15V, 60 mA
SERIES G91/G92
(For one port ON)
+5V ±5%, 150 mA
+15V ±5%, 60 mA

Control Characteristics

SERIES 91/92/F91/F92
Units With Integrated Drivers
Control Input Impedance . . TTL, low power Schottky, one unit load. (A unit load is 0.8 mA sink current and 40 µA source current.)
Control Logic . . . . . Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

SERIES G91/G92
Control Input Impedance . . Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 µA source current.)
Control Logic . . . . . Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

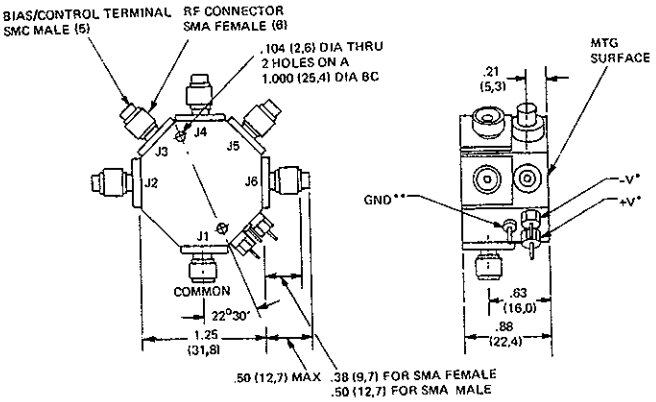
ENVIRONMENTAL RATINGS

Temperature Range
Units With Integrated Drivers
Operating . . . . . −65°C to +110°C
Non-Operating . . . . . −65°C to +125°C
Driverless Units
Operating and Non-Operating . . . . . −65°C to +125°C
Humidity . . . . . MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)
Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias/control connectors
7	SMA male rf connectors
9	Inverse logic (integrated units only); logic 0 for port OFF and logic 1 for port ON
33	EMI filter solder-type bias/control terminals
64A	SMB male bias/control connector

DIMENSIONS AND WEIGHTS



*USED ONLY ON UNITS WITH INTEGRATED DRIVERS, BOTH SUPPLIES POSITIVE FOR G91/G92 SERIES.
**NOT USED ON DRIVERLESS UNITS EXCEPT WITH OPTION 33

MODELS 91/92/F91/G91/G92 SP5T SWITCHES
Wt: 2 oz. (56 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005

Series 91 and 92
Miniature Broadband SP6T Switches

MODELS 9160-500 AND 9260-500

These switches provide high-performance characteristics over a multi-octave frequency range. Model 9160-500 covers the 1 to 18 GHz frequency range while the Model 9260-500 covers the 0.2 to 4 GHz range. Their description and operation are the same as that for the Models 9120-500 and 9220-500 SP2T switches as appear on page 72.

MODELS 9160T-500, 9160W-500 AND 9260T-500

These switches are non-reflective versions of the switches described above. See page 72 for description.

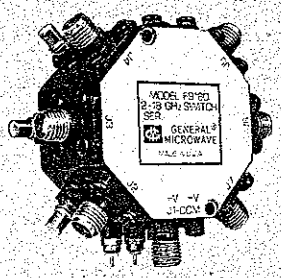
SERIES F91 AND F92

The Series F91 and F92 switches are the same as the corresponding Series 91 and 92 models, except the units are equipped with integrated drivers. See page 72 for description.

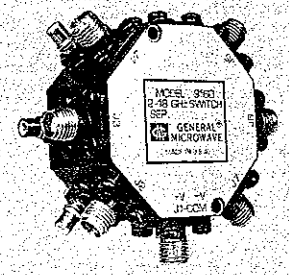
SERIES G91 AND G92

These switches are the same as the SP2T versions described on page 73 except for the number of ports.

- **1 to 18 GHz frequency range (Series 91)**
- **0.2 to 4 GHz frequency range (Series 92)**
- **Reflective and non-reflective models**
- **Low VSWR and insertion loss**
- **Up to 60 dB isolation**
- **Miniature size, light weight**



F9160
(WITH INTEGRATED DRIVER)



9160-500 (DRIVERLESS)

Series 91 and 92 SP6T Switches Specifications

MODEL NO.(1)	CHARACTERISTIC	FREQUENCY (GHz) 0.2-1	1-2	2-4	4-8	8-12.4	12.4-18
9160-500 F9160 G9160	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.6 1.6	60 1.6 1.6	55 1.8 1.9	50 2.2 2.0	50 3.4 2.2
9260-500 F9260 G9260	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.6	60 1.5 1.6	60 1.5 1.6	— — —	— — —	— — —
9160T-500 F9160T G9160T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	50 1.5 1.6	50 1.5 1.6	45 2.2 1.8	40 2.7 2.0	40 3.2 2.2
9260T-500 F9260T G9260T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	60 1.5 1.5	60 1.5 1.5	50 1.5 1.6	— — —	— — —	— — —
9160W-500 F9160W G9160W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	60 2.2 1.6	60 2.2 1.6	60 2.6 2.0	60 3.2 2.2	55 3.5 2.3

PERFORMANCE CHARACTERISTICS(3)

Power Handling Capability

Without Performance Degradation(4)

Units without "T" or "W" suffix: 1W cw or peak

Units with "T" or "W" suffix

Input to any "OFF" port: 100 mW cw or peak

Input to any "ON" port: 1W cw or peak

Input to common port: 1W cw or peak

Survival Power

Units without "T" or "W" suffix: 1W average, 75W peak (1 μsec max. pulse width)

Units with "T" or "W" suffix

Input to any "OFF" port(5): 1W average, 10W peak (1 μsec max. pulse width)

Input to any "ON" port: 1W average, 75W peak (1 μsec max. pulse width)

Input to common port: 1W average, 75W peak (1 μsec max. pulse width)

Switching Speed

SERIES 91/92/F91/F92 (port-to-port) . . . . . 500 nsec max.(2)

SERIES G91/G92		SINGLE PORT SWITCHING: Units Without "T" or "W" Suffix	SINGLE PORT SWITCHING: Units With "T" or "W" Suffix	COMMUTATION MODE SWITCHING: Units Without "T" or "W" Suffix	COMMUTATION MODE SWITCHING: Units With "T" or "W" Suffix
Rise Time (10% rf to 90% rf)	Series G91	75 nsec.	100 nsec.	100 nsec.	150 nsec.
	Series G92	100 nsec.	125 nsec.		
Fall Time (90% rf to 10% rf)	Series G91	125 nsec.	125 nsec.	100 nsec.	100 nsec.
	Series G92	150 nsec.	150 nsec.		
ON Time (50% TTL to 90% rf)	Series G91	100 nsec.	150 nsec.	200 nsec.	200 nsec.
	Series G92	125 nsec.	150 nsec.		
OFF Time (50% TTL to 10% rf)	Series G91	150 nsec.	150 nsec.	150 nsec.	150 nsec.
	Series G92	200 nsec.	200 nsec.		

(1) *Models prefixed with "F" or "G" are equipped with integrated TTL-compatible drivers; models without the "F" or "G" prefix are current-controlled units and are furnished without drivers; models suffixed with "T" or "W" are non-reflective except a high VSWR will be present at the common port if all other ports are OFF; models without a "T" or "W" suffix are reflective units.*

(2) *Defined as the time interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, and is rated for ports driven by shaped current pulses. For units with drivers, the pulses are provided by the integrated driver. For driverless units, the pulses must be provided by the user.*

(3) *Into 50 ohm system.*

(4) *Up to Survival Power limits shown below.*

(5) *From −65°C to +25°C; see power derating curves, figure 1 below, for higher temperatures.*

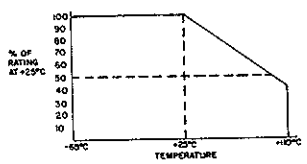


Fig. 1A — Integrated units

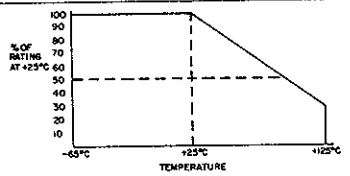


Fig. 1B — Driverless units

"OFF" PORT SURVIVAL POWER DERATING FACTORS

Series 91 and 92 SP6T Switches Specifications

Power Supply Requirements

SERIES 91/92/F91/F92

Driverless Units

Bias current required at each port for rated isolation and insertion loss

Port OFF ..... +50 mA
Port ON ..... −50 mA

For operation with more than one port ON, total negative current must be limited to −100 mA.

Units With Integrated Drivers

(For one port ON)

+5V ±2%, 315 mA
−12V to −15V, 60 mA

SERIES G91/G92

(For one port on)

+5V ±5%, 150mA
+15V ±5%, 70mA

Control Characteristics

SERIES 91/92/F91/F92

Units With Integrated Drivers

Control Input Impedance .. TTL, low power Schottky, one unit load. (A unit load is 0.8 mA sink current and 40 µA source current.)

Control Logic ..... Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

SERIES G91/G92

Control Input Impedance .. Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 µA source current.)

Control Logic ..... Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

ENVIRONMENTAL RATINGS

Temperature Range

Units With Integrated Drivers

Operating ..... −65°C to +110°C
Non-Operating ..... −65°C to +125°C

Driverless Units

Operating and Non-Operating ..... −65°C to +125°C

Humidity ..... MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock ..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration ..... MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

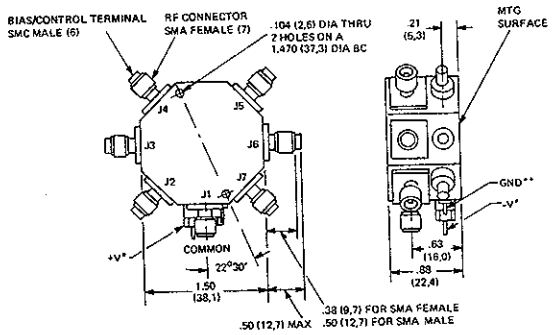
Altitude ..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling ..... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias/control connectors
7	SMA male rf connectors
9	Inverse logic (integrated units only); logic 0 for port OFF and logic 1 for port ON
33	EMI filter solder-type bias/control terminals
64A	SMB male bias/control connector

DIMENSIONS AND WEIGHTS



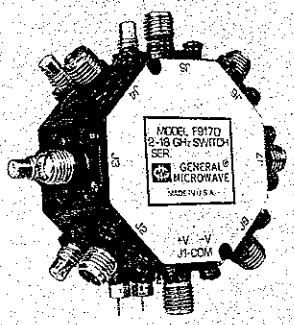
*USED ONLY ON UNITS WITH INTEGRATED DRIVERS; BOTH SUPPLIES POSITIVE FOR G91/G92 SERIES.
**NOT USED ON DRIVERLESS UNITS EXCEPT WITH OPTION 33

MODELS 91/92/F91/F92/G91/G92 SP6T SWITCHES
Wt: 2.9 oz. (81 gm) approx.

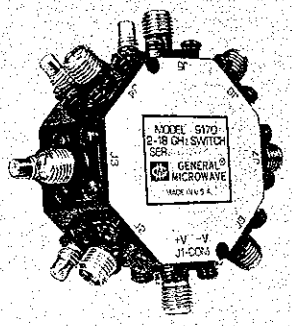
Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005

Series 91 and 92
Miniature Broadband SP7T Switches

- 1 to 18 GHz frequency range (Series 91)
- 0.2 to 4 GHz frequency range (Series 92)
- Reflective and non-reflective models
- Low VSWR and insertion loss
- Up to 60 dB isolation
- Miniature size, light weight



F9170
(WITH INTEGRATED
DRIVER)



9170-500 (DRIVERLESS)

MODELS 9170-500 AND 9270-500

These switches provide high-performance characteristics over a multi-octave frequency range. Model 9170-500 covers the 1 to 18 GHz frequency range while the Model 9270-500 covers the 0.2 to 4 GHz range. Their description and operation are the same as that for the Models 9120-500 and 9220-500 SP2T switches as appear on page 72.

MODELS 9170T-500, 9170W-500 AND 9270T-500

These switches are non-reflective versions of the switches described above. See page 72 for description.

SERIES F91 AND F92

The Series F91 and F92 switches are the same as the corresponding Series 91 and 92 models, except the units are equipped with integrated drivers. See page 72 for description.

SERIES G91 AND G92

These switches are the same as the SP2T versions described on page 73 except for the number of ports.

MODEL NO.[1]	CHARACTERISTIC	FREQUENCY (GHz) 0.2-1	1-2	2-4	4-8	8-12.4	12.4-18
9170-500 F9170 G9170	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.75 1.75	60 1.75 1.75	55 2.0 2.0	50 2.6 2.2	50 3.8 2.4
9270-500 F9270 G9270	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.6	60 1.5 1.6	60 1.5 1.6	— — —	— — —	— — —
9170T-500 F9170T G9170T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	50 1.5 1.7	50 1.5 1.7	45 2.4 2.0	40 3.0 2.2	40 3.5 2.4
9270T-500 F9270T G9270T	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port On or OFF)	60 1.5 1.5	60 1.5 1.5	50 1.5 1.7	— — —	— — —	— — —
9170W-500 F9170W G9170W	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (Port ON or OFF)	— — —	60 2.2 1.7	60 2.2 1.7	60 2.8 2.2	60 3.5 2.2	55 3.8 2.4

PERFORMANCE CHARACTERISTICS[3]

Power Handling Capability

Without Performance Degradation[3]
- Units without "T" or "W" suffix: 1W cw or peak
- Units with "T" or "W" suffix
  - Input to any "OFF" port: 100 mW cw or peak
  - Input to any "ON" port: 1W cw or peak
  - Input to common port: 1W cw or peak

Survival Power
- Units without "T" or "W" suffix: 1W average, 75W peak (1 μsec max. pulse width)
- Units with "T" or "W" suffix
  - Input to any "OFF" port[5]: 1W average, 10W peak (1 μsec max. pulse width)
  - Input to any "ON" port: 1W average, 75W peak (1 μsec max. pulse width)
  - Input to common port: 1W average, 75W peak (1 μsec max. pulse width)

Switching Speed

SERIES 91/92/F91/F92 (port-to-port) . . . . . 500 nsec max.[2]

SERIES G91/G92		SINGLE PORT SWITCHING: Units Without "T" or "W" Suffix	SINGLE PORT SWITCHING: Units With "T" or "W" Suffix	COMMUTATION MODE SWITCHING: Units Without "T" or "W" Suffix	COMMUTATION MODE SWITCHING: Units With "T" or "W" Suffix
Rise Time (10% rf to 90% rf)	Series G91	75 nsec.	100 nsec.	100 nsec.	150 nsec.
	Series G92	100 nsec.	125 nsec.		
Fall Time (90% rf to 10% rf)	Series G91	125 nsec.	125 nsec.	100 nsec.	100 nsec.
	Series G92	150 nsec.	150 nsec.		
ON Time (50% TTL to 90% rf)	Series G91	100 nsec.	150 nsec.	200 nsec.	200 nsec.
	Series G92	125 nsec.	150 nsec.		
OFF Time (50% TTL to 10% rf)	Series G91	150 nsec.	150 nsec.	150 nsec.	150 nsec.
	Series G92	200 nsec.	200 nsec.		

(1) *Models prefixed with "F" or "G" are equipped with integrated TTL-compatible drivers; models without the "F" or "G" prefix are current-controlled units and are furnished without drivers; models suffixed with "T" or "W" are non-reflective except a high VSWR will be present at the common port if all other ports are OFF; models without a "T" or "W" suffix are reflective units.*

(2) *Defined as the time interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value, and is rated for ports driven by shaped current pulses. For units with drivers, the pulses are provided by the integrated driver. For driverless units, the pulses must be provided by the user.*

(3) *Into 50 ohm system.*

(4) *Up to Survival Power limits shown below.*

(5) *From −65°C to +25°C; see power derating curves, figure 1 below, for higher temperatures.*

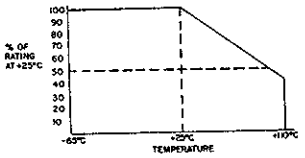


Fig. 1A — Integrated units

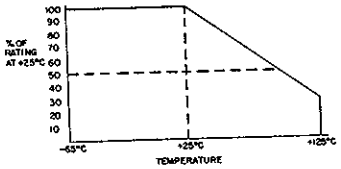


Fig. 1B — Driverless units

"OFF" PORT SURVIVAL POWER DERATING FACTORS

Series 91 and 92 SP7T Switches Specifications

Power Supply Requirements

SERIES 91/92/F91/F92

Driverless Units

Bias current required at each port for rated isolation and insertion loss

Port OFF ..... +50 mA
Port ON ..... −50 mA

For operation with more than one port ON, total negative current must be limited to −100 mA.

Units With Integrated Drivers

(For one port ON)

+5V ±2%, 375 mA
−12 to −15V, 60 mA

SERIES G91/G92

(For one port ON)

+5V ±5%, 190 mA
+15V ±5%, 70 mA

Control Characteristics

SERIES 91/92/F91/F92

Units With Integrated Drivers

Control Input Impedance .. TTL, low power Schottky, one unit load. (A unit load is 0.8 mA sink current and 40 µA source current.)

Control Logic ..... Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

SERIES G91/G92

Control Input Impedance .. Schottky TTL, one unit load. (A unit load is 2.0 mA sink current and 50 µA source current.)

Control Logic ..... Logic "0" (−0.3 to +0.8 volts) for port ON and logic "1" (+2.0 to +5.0 volts) for port OFF.

ENVIRONMENTAL RATINGS

Temperature Range

Units With Integrated Drivers

Operating ..... −65°C to +110°C
Non-Operating ..... −65°C to +125°C

Driverless Units

Operating and Non-Operating ..... −65°C to +125°C

Humidity ..... MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)

Shock ..... MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration ..... MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

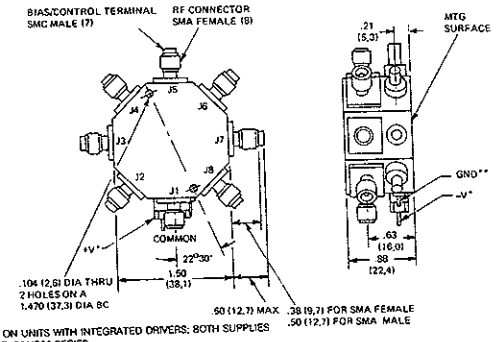
Altitude ..... MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling ..... MIL-STD-202F, Method 107D, Cond. A, 5 cycles

AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias/control connectors
7	SMA male rf connectors
9	Inverse logic (integrated units only); logic 0 for port OFF and logic 1 for port ON
33	EMI filter solder-type bias/control terminals
64A	SMB male bias/control connector

DIMENSIONS AND WEIGHTS



*USED ONLY ON UNITS WITH INTEGRATED DRIVERS; BOTH SUPPLIES POSITIVE FOR G91/G92 SERIES
**NOT USED ON DRIVERLESS UNITS EXCEPT WITH OPTION 33

MODELS 91/92/F91/F92/G91/G92 SP7T SWITCHES
Wt: 2.9 oz. (81 gm) approx.

Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

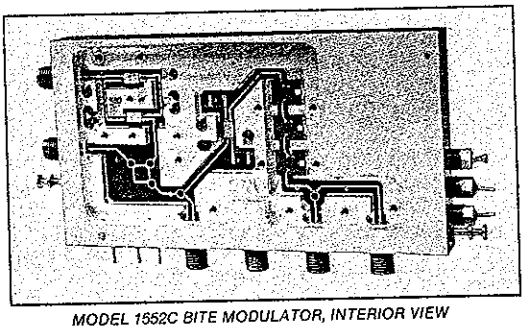
Custom Products: MIC Assemblies

Drawing upon its extensive experience in the design of broadband active and passive components, GMC is now very active in the design and manufacture of custom MIC assemblies for military and space-borne applications. Descriptions of some of these appear below and serve as examples of the Company's capabilities.

MILITARIZED BITE MODULATOR MIC ASSEMBLY

This hermetically-sealed Ku-Band MIC assembly is used as a BITE component in a missile-borne environment and consists of:

- One 10 nsec 40dB digitally-controlled attenuator
- Five power dividers
- One balanced mixer
- Three isolators
- Size: 2.12″ × 4.0″ × 0.5″

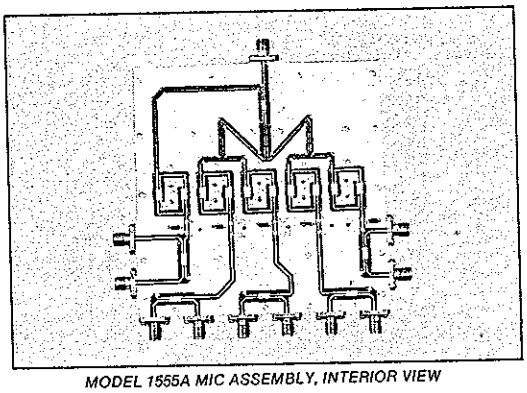


MODEL 1552C BITE MODULATOR, INTERIOR VIEW

MILITARIZED MULTI-CHANNEL MIC ASSEMBLY

This X/Ku-Band MIC assembly serves as a signal conditioner in an airborne ECM application. It has five inputs and six outputs, and contains:

- Five signal samplers
- Five high-speed switches
- Five 40dB digitally-controlled attenuators
- One signal combiner
- Size: 4″ × 4″ × 1.25″



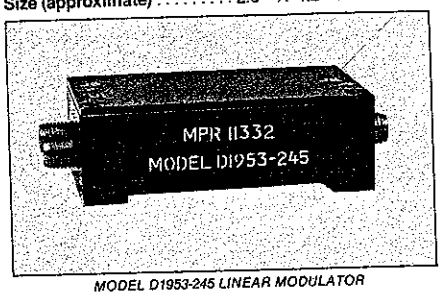
MODEL 1555A MIC ASSEMBLY, INTERIOR VIEW

GMC has designed and manufactured a large number of special and modified components for dedicated customer applications. Salient specifications of some of them are described on these pages and pages 104 and 105.

MILITARIZED HERMETICALLY-SEALED LINEAR MODULATORS

These hermetically-sealed S- and C-Band voltage-controlled linear modulators incorporate a passive driver with very wide modulation bandwidth. They are used in an airborne ECM application.

	S-Band Unit	C-Band Unit
Minimum Attenuation Range (dB)	55	55
Maximum Insertion Loss (dB)	2.2	3.5
Maximum Input VSWR	1.5	1.55
Small Signal Bandwidth (MHz)	5	5
Size (approximate)	2.0″ × 1.2″ × 0.7″	

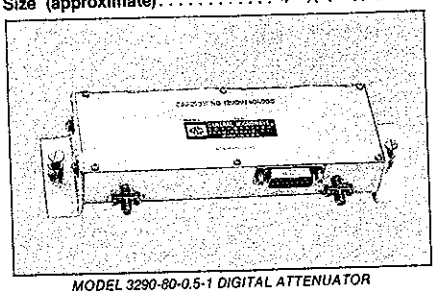


MODEL D1953-245 LINEAR MODULATOR

TEMPERATURE-STABILIZED DIGITAL ATTENUATOR

This digitally-controlled attenuator was specially designed for a TACAN application and incorporates a fast settling temperature-stabilizing circuit to maintain accuracy over a wide operating temperature range.

Frequency Range ..... 1040 - 1150 MHz
Attenuation Range ..... 80dB min
Minimum Step Size 0.125dB
Accuracy (at 23°C, including flatness)
0 - 64dB ..... ±0.7dB max
64 - 80dB ..... ±1.0dB max
Attenuation Stability (over −40 to +65°C range) .... ±0.7dB max
Insertion Loss ..... 2dB max
VSWR ..... 1.5 max
Size (approximate) ..... 4″ × 7″ × 1″

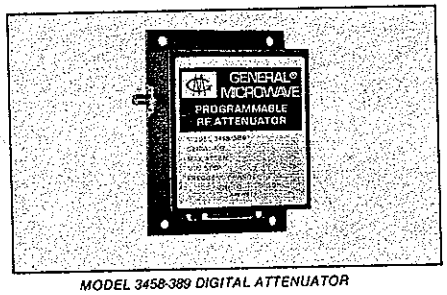


MODEL 3290-80-0.5-1 DIGITAL ATTENUATOR

MILITARIZED HERMETICALLY-SEALED DIGITAL ATTENUATOR

This DCA is used in a guided missile test equipment application.

Frequency Range ..... 6 - 18 GHz
Attenuation Range ..... 60dB min
Minimum Step Size 0.25dB
Maximum Insertion Loss
6 - 16 GHz 3dB
16 - 18 GHz 4dB
Maximum VSWR
6 - 16 GHz 1.8
16 - 18 GHz 2.0
Size (approximate) ..... 3.75″ × 2.0″ × 0.8″

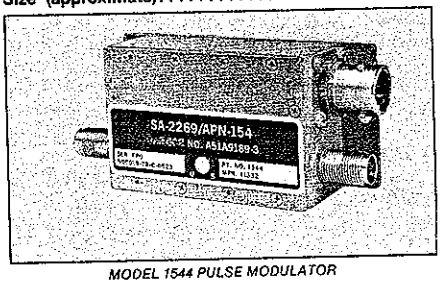


MODEL 3458-389 DIGITAL ATTENUATOR

MILITARIZED MONOSTABLE PULSE MODULATOR

This X-Band pulse modulator is used aboard a high-performance fighter aircraft.

Isolation ..... 65dB min
Dwell Time (period during which unit will remain in isolation mode regardless of state of control signal) ..... 600 nsec nom
Switching Speed (over full dynamic range) ..... 35 nsec max
Insertion Loss ..... 1.5dB max
VSWR ..... 1.75 max
Size (approximate) ..... 3.0″ × 2.0″ × 1.3″

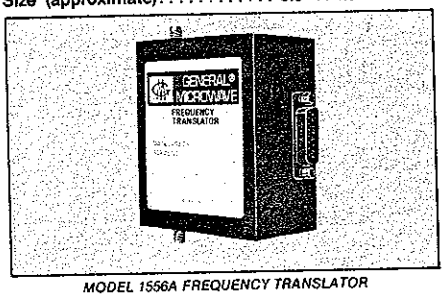


MODEL 1544 PULSE MODULATOR

MILITARIZED HERMETICALLY-SEALED FREQUENCY TRANSLATOR

This X/Ku-Band phase shifter is used in an airborne serrodyne application.

Frequency Translation Range ... DC to 300kHz
Carrier and Spurious Suppression ..... – 20dBc min
Insertion Loss ..... 20dB max
Size (approximate) ..... 3.5″ × 4.0″ × 1.6″

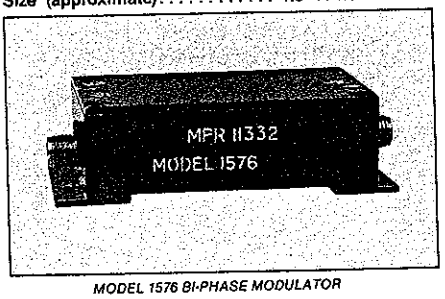


MODEL 1556A FREQUENCY TRANSLATOR

MILITARIZED HIGH-SPEED BI-PHASE MODULATOR

This high-speed X/Ku-Band bi-phase modulator is used in an airborne ECM application.

Differential Phase Shift ..... 180° ± 15°
Switching Speed ..... 10 nsec max
Insertion Loss ..... 2.3dB max
VSWR ..... 2.0 max
Size (approximate) ..... 1.5″ × 1.0″ × 0.62″

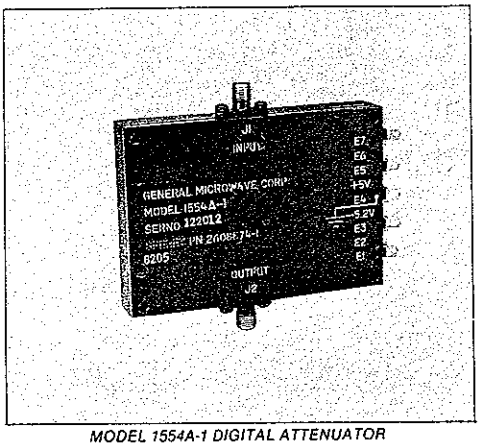


MODEL 1576 BI-PHASE MODULATOR

MILITARIZED HIGH-SPEED DIGITAL ATTENUATORS

These very high-speed programmable attenuators are used in both ground and airborne military applications, and feature nanosecond switching times from any attenuation level to another.

	Low-Band Unit	Mid-Band Unit	High-Band Unit
Frequency Range (GHz)	0.5-8.4	8-13.5	13-19.5
Minimum Attenuation Range (dB)	70	70	70
Minimum Step Size (dB)	0.55	0.55	0.55
Maximum Switching Speed (nsec) (to 1dB of final value)	100	100	100
Maximum Insertion Loss (dB)	12	12	14
Maximum Input VSWR	2.0	2.0	2.0
Size (approximate)	2.25″ × 3.25″ × 0.55″	2.25″ × 3.25″ × 0.55″	2.5″ × 3.7″ × 0.55″

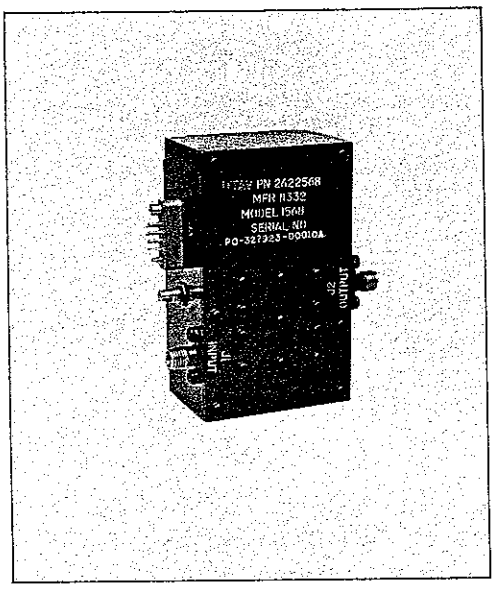


MODEL 1554A-1 DIGITAL ATTENUATOR

MILITARIZED HIGH-SPEED TEMPERATURE-STABILIZED AMPLITUDE MODULATOR

This high-speed linear modulator utilizes a fast settling temperature-stabilizing network to maintain its accuracy over a wide-temperature range. It operates in an airborne (uninhabited) environment.

Frequency Range ..... 8 - 18 GHz
Attenuation Range ..... 60 dB min
Accuracy (including frequency and temperature effects)
At insertion loss ..... ±0.8dB max
At maximum attenuation .... ±1.6dB max
Switching Speed (for increasing attenuation) (within 2dB of final value) ..... 100 nsec max
Transfer Function ..... 10dB/volt nominal
Insertion Loss ..... 4.0dB max
VSWR ..... 2.0 max
Temperature Range ..... −54°C to +85°C
Size (approximate) ..... 3.0″ x 1.8″ x 1.25″



MODEL 1568 MODULATOR

Modified Components (Cont.)

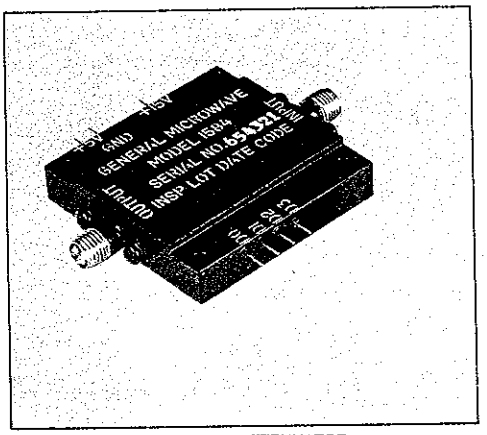
Two new digital attenuators, custom-designed for high-reliability military applications, are shown below.

The 5-bit 62 dB hermetically-sealed model shown to the left is used in an airborne system. It has a removable rf connector feature that enables the unit to be used as a "drop-in module". The 53 dB version shown to the right is used in a target simulation test set and features 0.5 dB resolution. Small size, temperature-stabile performance and fast switching speed are design features of both.

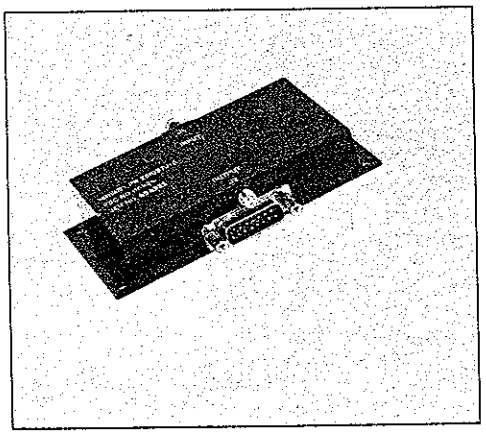
Requirements for custom units for other applications are invited.

Frequency Range	0.5 to 2 GHz
Attenuation Range	62 dB
Minimum Step Size	2 dB (5 bits)
Accuracy (at 25°C, including flatness)	±1 dB
Switching Speed	1μ sec max.
Monotonicity	Guaranteed
Insertion Loss	4 dB
RF Input Power	+15 dBm (without performance degradation)
Size	1.6″L × 1.6″W × 0.34″H

Frequency Range	0.8 to 8.45 GHz
Attenuation Range	53 dB min.
Minimum Step Size	0.5 dB (7 bits)
Accuracy (at 25°C, including flatness)	±0.5 dB or ±4%, whichever is greater
Switching Speed	100 nsec max.
Monotonicity	Guaranteed for steps of 1 dB or greater
Insertion Loss	6 dB
RF Input Power	+15 dBm (without performance degradation)
Size	4.75″L × 2.30″W × 0.88″H including mounting flange



MODEL 1584 ATTENUATOR



MODEL 1588 ATTENUATOR

CUSTOM PRODUCTS

Power Measuring Equipment

In 1964, General Microwave achieved a breakthrough in the field of power measuring equipment when it developed the thermoelectric technique of rf and microwave power measurement. This technique employs tft® (thin-film thermoelectric) power heads, which produce dc output voltages directly proportional to the absorbed power.

Since then, power measuring products designed and produced by General Microwave have become the standard of performance, user convenience and best-buy value — service-proved in a wide range of military, industrial and commercial applications.

Product	Description	Page No.
PEAK POWER METER, AUTOMATIC Model 478A	Automatically measures and displays Pulse Peak Power, Instantaneous Power, CW Power, Pulse Rise and Fall Times, Pulse Width and Pulse Period. Frequency range to 26.5 GHz, power range to +15 dBm, self-contained CRT, IEEE-488 GPIB Programmable, optional CIIL compatibility for MATE and ATLAS programming.	108
AVERAGE POWER METER, DIGITAL Model 475B	Single range operation over a 50 dB dynamic range. Digital readout in dBm, internal calibrator, automatic zero set and scale indication, power head overload indicator, built-in calibration factor compensator. Optional IEEE 488 bus, BCD output, remotely programmable zero.	113
AVERAGE POWER METER, ANALOG Model 476	55 dB dynamic range. Analog readout, internal calibrator, automatic zero set, built-in calibration factor compensator, DVM/recorder output.	116
POWER HEADS Series 4200 for use with Models 475B and 476 Power Meters	Up to 3 W. Waveguide, coaxial and miniature coaxial types (with SMA or N input connectors).	118
CALIBRATOR Model 308	For rapid precision calibration of Models 475B and 476 Power Meters.	129
POWER METER AMPLIFIER Model 468	40 dB dynamic range. Chopper-stabilized dc amplifier (no readout meter) for systems applications.	120
POWER HEADS Series 44 and 420 for use with Model 468 Power Meter Amplifier	Up to 3 W. Waveguide, coaxial and miniature coaxial types (with SMA or N input connectors). Includes efficiency compensator.	122
POWER MONITORS Models N445A, N446A, N425B, N426B, N427B	Up to 100 mW. Includes tilt power sensor and dc amplifier in single compact package, for local or remote power monitoring. 30 dB dynamic range.	124
HIGH SENSITIVITY POWER MONITOR Model N447	−50 dBm to −20 dBm. Includes temperature-compensated Schottky power sensor and dc amplifier in single compact package, for local or remote power monitoring.	127
ACCESSORIES	Tool kit, rack adapter, special cables, battery pack.	130

Model 478A
Automatic Peak Power Meter

- Measures and Digitally Displays
  Pulse Peak Power
  Instantaneous Power
  CW Power
  Pulse Rise and Fall Times
  Pulse Width
  Pulse Period
- Frequency Range: 0.75 to 26.5 GHz
- Power Range: −30 to +15 dBm
- Accuracy: To ±0.3 dB
- Pulse Width: 15 nsec to CW
- Automatic or Manual Operation
- Self-Contained CRT
- Automatic Frequency and Amplitude Compensation
- IEEE-488 GPIB Programmable
- Optional CIIL
  Compatibility for MATE
  and ATLAS Programming.

INTRODUCTION

The Model 478A Automatic Peak Power Meter, with its associated Model N436A or M438A Power Head, is a powerful and flexible new instrument designed to measure and display the characteristics of pulsed microwave signals. In addition to offering significant improvements in accuracy, sensitivity and video bandwidth, the instrument offers full programmability via an IEEE-488 GPIB data bus for use with computer based automatic test systems.

POWER METER

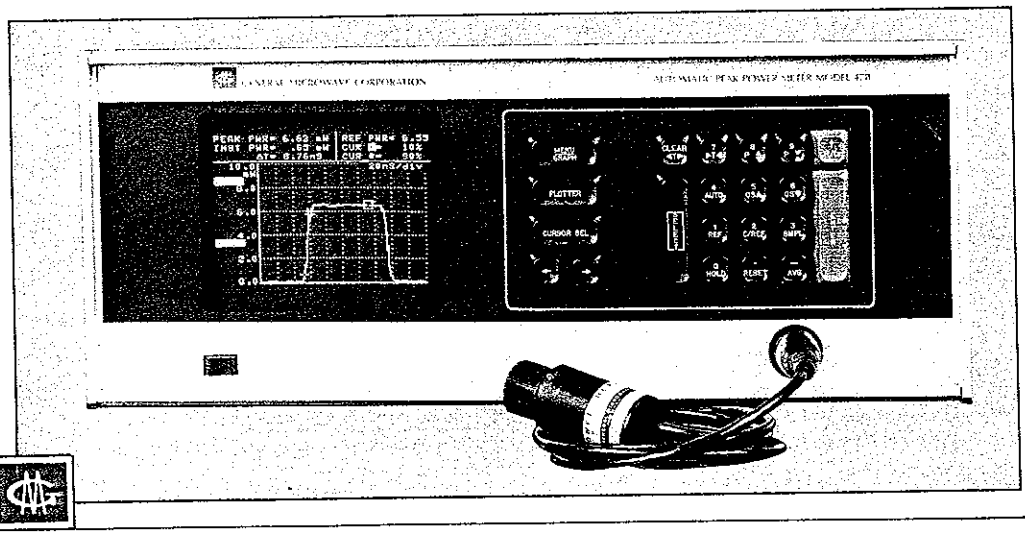
Operating with a microprocessor-based sampled data system, the power meter digitizes the detected input signal and creates a composite representation of that signal. All operations may be controlled locally through a front panel keyboard with measurement parameters selected from an initiating menu, or remotely via the GPIB interface. In the Automatic mode of operation, the input is displayed on a calibrated graph with machine-selected time base and power scales.

The Model 478A is designed to be easily calibrated and maintained in the field. RF calibration can be verified using CW standards. An internal test routine is included to facilitate test and circuit calibration, and the time base is automatically calibrated against a crystal-controlled clock each time the power meter is turned on.

POWER HEAD

The Models N436A and M438A are temperature-compensated power heads that employ low-barrier Schottky diode detectors mounted on a thin-film substrate. A matching circuit optimizes both the VSWR and frequency sensitivity. The standard power head is furnished with a five foot cable. Other lengths are available on special order.

Each power head is supplied with a customized ROM to be installed in the Model 478A which then compensates for the individual power head square-law deviation and frequency response characteristics.



Model 478A
Automatic Peak Power Meter

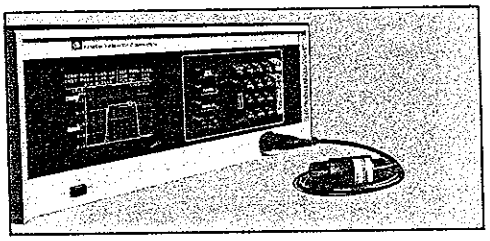
APPLICATIONS

In addition to the absolute measurement in linear (watts) or logarithmic (dB) units of peak power, referred to the input of the power head, the Model 478A can be used in the following measurement procedures:

- **Relative power measurements (in dB mode):** To make gain or loss measurements with respect to an arbitrary reference.
- **Measurement of transient and steady state VSWR:** To characterize system performance under "hot switching" as well as "dwell" intervals.
- **Measurement of a selected pulse in a repetitive burst:** Trigger delay can be preset to select any pulse among a pulse train for display with optimum resolution.
- **Measurement through directional couplers or other lossy devices:** By using the Relative Offset feature, the de-coupling factor is added to the measured levels to provide a correctly scaled power indication.
- **Measurement of power versus frequency:** The unit can be configured in conjunction with suitable external test equipment to display the frequency response characteristics of pulsed or CW signals.

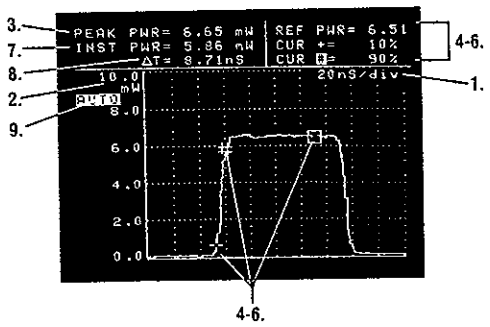
FEATURES

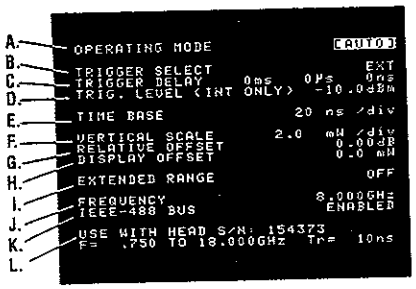
- **Automatic Operation:** The time base and power scale are automatically selected to fully characterize and obtain the best presentation of the pulse being measured.
- **Manual Operation:** The keyboard control permits selection of the desired time base and power scale.
- **Built-in Display:** A 7" CRT presents a calibrated display of the detected signal as well as an alpha-numeric readout of amplitude and time. Peak power and instantaneous power values are digitally displayed at up to three different selectable times in either linear or logarithmic units by the use of a novel three-cursor system. Pulse rise and fall times, pulse width and pulse period are also digitally displayed via a time interval measurement between selectable pulse power levels.
- **Menu Mode:** A prompted menu permits selection of Automatic or Manual operation, trigger source, Trigger Delay, internal trigger level, time base, power scale, Relative Offset, Display Offset, Normal or Extended Range, local or remote IEEE-488 GPIB operation, and operating frequency for optimum accuracy compensation.
- **Frequency and Amplitude Compensation:** The Model 478A automatically corrects for square-law deviation and frequency response characteristics of the power head at the operating frequency.



- **Short-Sweep Cycle:** The number of sample points per sweep can be selected from 1 to 201. Reducing the number of the sample points results in more rapid updating of the display, thereby enabling higher-speed system operation.
- **Digital Averaging:** Enhances low level signal-to-noise ratio by a factor of up to 10:1.
- **Relative Offset:** Automatically scales display to compensate for external gain or loss.
- **Display Offset:** Permits a vertical shifting of the display for more detailed examination of the measured pulse.
- **Trigger Select:** Gives choice of internal or external triggers or CW operation in both Automatic and Manual modes.
- **Trigger Delay:** Delayed trigger capability provides pulse sampling flexibility.
- **Hold Mode:** Retains display for further analysis after signal input has been removed.
- **Video Output:** Provides real time buffered output of the detected waveform via rear BNC connector.
- **X-Y Recorder Output:** Provides horizontal and vertical outputs and pen lift command; associated switch compensates for a variety of recorder characteristics.
- **IEEE-488 GPIB Programmability:** Permits use of unit as part of an IEEE-488 GPIB system to receive commands from a controller and transmit measured data to other instruments on the bus.
- **Overload Indication:** Automatically indicates that input to power head has exceeded +15 dBm
- **Option 09: CIIL Compatibility for MATE and ATLAS Programming:** Option 09 enables the Model 478A to recognize commands written in the Control Interface Intermediate Language (CIIL).

Model 478A
Automatic Peak Power Meter





1. Time base. A ten-division graph with ranges from 10 nsec/division to 100 msec/division.
2. Power scale. A five-division graph with ranges from 0.1 to 20 dBm (or dB)/division or 1 μW to 2 MW/division.
3. The pulse peak power level.

4-6. Three independently adjustable cursors: Cursor □ establishes the reference power level; cursors + and # are set to any desired power level with respect to the reference power level (i.e.—10%, 50%, 90%, etc.). These cursors are used to make time and instantaneous power measurements.

7. The instantaneous power level at the selected cursor (+ or #).
8. The time difference between the + and # cursors.
9. AUTO: Indicates that both the time base and power scale have been optimally selected for the measured pulse.

The following annunciators are not shown above but are illuminated under the appropriate operating conditions:

REM: Indicates unit is being controlled by the IEEE-GPIB system.

REMLLO: Local lockout when on IEEE-GPIB system.

AVG: Indicates Digital Averaging is employed. This feature is particularly useful on noisy signals.

REL OS: Indicates use of Relative Offset.

Range from −99.99 to +99.99 dB.

HOLD: Indicates that further sampling of incoming signals has ceased and that waveform has been "frozen" for further analysis.

EXD RG: Indicates unit is in the Extended Range. Additional dynamic range is provided with some sacrifice in video bandwidth.

PLOTR: Indicates X-Y recorder output is activated.

NO TRIG: Indicates a loss of adequate trigger level.

OVERLOAD: Indicates when input to power head exceeds +15 dBm.

LOCAL: Indicates that GPIB is disabled.

A. Select Automatic or Manual mode of operation.

B. Select Internal or External Trigger, Triggered CW, or CW operation.

C. Enter Trigger Delay.

D. Select Internal Trigger Level.

E. Select time base.

F. Select power scale.

G. Select Relative Offset.

H. Select Display Offset.

I. Select Extended Range.

J. Enter operating frequency from 0.75 to 26.5 GHz for automatic compensation of power head square-law deviation and frequency response characteristics.

K. Select local operation or use of IEEE-488 GPIB for remote operation.

L. A field replaceable ROM in the Model 478A automatically compensates for square-law deviation and frequency response characteristics of the power head with this serial number. "F" indicates the frequency range and "Tr" indicates the inherent rise time of the power head.

SPECIFICATIONS

Power Range
Normal Range: −20 to +15 dBm with N436A
−14 to +15 dBm with M438A
Extended Range: −30 to +15 dBm with N436A
−24 to +15 dBm with M438A

Pulse Width
Normal Range: 15 nsec to 1 sec and CW
Extended Range: 1.5 μsec to 1 sec and CW

Video Bandwidth and Rise/Fall Times (10-90%/90-10%)[1]
Normal Range: 35 MHz, 10 nsec
Extended Range: 500 kHz, 700 nsec

Frequency Range[1]**:** 0.75 to 18 GHz with N436A
0.75 to 26.5 GHz with M438A

Accuracy: See Figure 1 to the right

Maximum Safe Input Power: +20 dBm CW, +30 dBm peak
(1 μsec max pulse width, 1% duty cycle)

Frequency Response
Compensated: ±0.1 dB to 18 GHz
±0.3 dB to 26.5 GHz (M438A only)
Uncompensated: ±0.3 dB to 8 GHz
±0.5 dB to 18 GHz
±1.0 dB to 26.5 GHz (M438A only)

Input Impedance: 50 ohms nominal

N436A VSWR: 1.2:1 to 8 GHz
1.4:1 to 18 GHz

M438A VSWR: 1.2:1 to 8 GHz
1.35:1 to 18 GHz
1.7:1 to 26.5 GHz

Power Scale
Range: From 0.1 to 20 dBm (or dB)/division or 1μW to 2 MW/division in a 1-2-5 sequence

Relative Offset
Range: From −99.99 to +99.99 dB

Time Base Range: From 10 nsec/division to 100 msec/division in a 1-2-5 sequence

Trigger Delay
Range: From 1 nsec to 1 sec with resolution of 1 nsec

External Trigger Requirements: +1.5V to +5V pulse into 50 ohms

Trigger Delay Uncertainty
For delays up to 1 μsec: 2 nsec max
For delays above 1 μsec: 10 nsec max

Nominal Measurement Time: 2 seconds[2]

Internal Trigger Level Range
Normal Range: −15 to +15 dBm with N436A
−10 to +15 dBm with M438A
Extended Range: −25 to +15 dBm with N436A
−20 to +15 dBm with M438A

Self Contained Display: Built-in 7" CRT. Graph area is 201 horizontal by 151 vertical cells, which are organized into 10 horizontal and 5 vertical major divisions

Display Offset
Range: Up to 2 MW or 0 to +100 dBm (or dB).

Samples: Selectable up to 201 per sweep.

IEEE-488 GPIB
Programmability: Unit is fully programmable via an IEEE-488 GPIB data bus to receive commands from a controller and transmit measured data to other instruments on the bus.
Function Subsets: SRI, SHI, AHI, T6, TEO, L4, LEO, RLI, PPO, DCI and DTI are implemented.

Video Output: Real time buffered output; nominal 375 mV full scale into 50 ohms.

X-Y Recorder Output: Horizontal and vertical outputs of +10V full scale and pen lift command via contact closure.

Operating Temperature Range: +15 to +35°C

Power Requirements: 100, 120, 220 or 240 VAC, +5%, −10%; 48 to 63 Hz; 150 watts

Power Head Connector
N436A: Type N, male
M438A: Type APC 3.5 mm, male

Figure 1A — Model 478A/N436A Accuracy

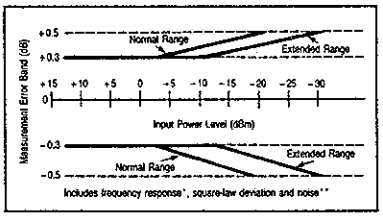
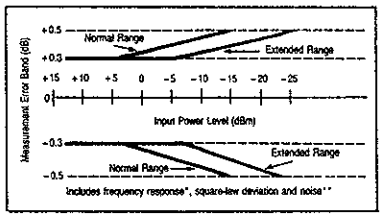


Figure 1B — Model 478A/M438A Accuracy***



*Assumes that operating frequency has been entered into instrument.
**In digital averaging mode.
***To 18 GHz; above 18 GHz, add ±0.2 dB.

(1) *See Power Head Options on page 112.*

(2) *At 201 samples per sweep in Manual mode; faster at lower number of samples; slower in Automatic mode or with wide or low repetition rate pulses.*

Model 478A
Specifications

Nominal Dimensions

Model 478A: 7.0″ (177.8mm) H × 17.0 (431.8mm) W × 18.0″ (457.2 mm) L excluding projections

Model N436A: 1.27″ (32.3 mm) diameter × 3.01″ (76.5 mm) length (including rf connector), plus 5-foot umbilical cable assembly

Model M438A: 1.27″ (32.3 mm) diameter × 2.40″ (61 mm) length (including rf connector), plus 5-foot umbilical cable assembly.

Weight

Model 478A: 39.5 lbs. (17.9 kg)
Model N436A: 9.0 oz. (255 gm)
Model M438A: 8.7 oz. (246 gm)

POWER METER OPTIONS

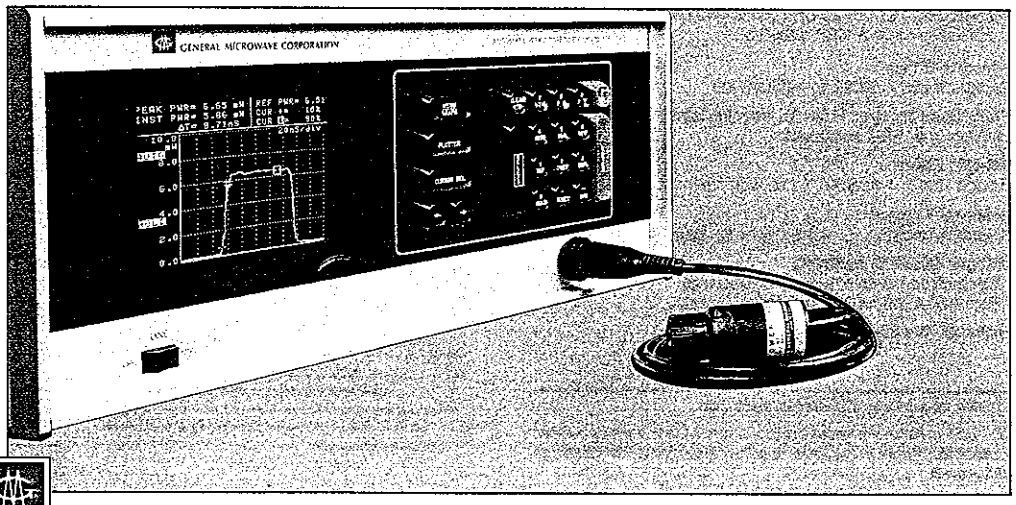
Model 478AR: 19″ Rack Mount Configuration

Option 01: Rear Panel Power Head Input

Option 09: CIIL Compatibility for MATE and ATLAS Programming

POWER HEAD OPTIONS

OPTION	FREQUENCY RANGE		VIDEO BANDWIDTH	RISE/FALL TIMES
	N436A	M438A		
02	100 MHz - 18 GHz	100 MHz - 26.5 GHz	4.7 MHz	75 nsec
03	500 MHz - 18 GHz	500 MHz - 26.5 GHz	23 MHz	15 nsec
13	5 MHz - 18 GHz	5 MHz - 26.5 GHz	250 kHz	4 μsec
15	70 MHz - 18 GHz	70 MHz - 26.5 GHz	3.3 MHz	107 nsec



Model 475B
Digital Thermoelectric Power Meter
With Optional IEEE–488 Bus

The Model 475B is a third-generation equipment employing the service-proved thermoelectric technique of rf and microwave power measurement pioneered by General Microwave more than a decade ago.

FEATURES

This model incorporates a number of features that enhance accuracy, dynamic range and convenience of operation.

Self-Calibrating

Prominent among these is a self-calibration capability employing a highly stable 10 kHz oscillator which assures that the gain of the power meter is matched to the sensitivity of the tft power head in use. Calibration of the power meter-power head assemblage is conveniently checked and adjusted at the Model 475B front panel without disconnecting the power head from the rf system under measurement. This is particularly useful in applications where the power head is remote from the power meter or in systems where access to the power head is inconvenient.

Automatic Zero Set, Scale Indication And Overload Indicator

Another feature of the Model 475B is automatic zero set which is activated by means of a front panel push-button. In addition, the unit provides automatic scale indication when changing from a power head of one dynamic range to another, and an indicator to warn of power head overload.

Single Range Operation

The Model 475B employs a logarithmic amplifier with a 100 dB (50 dB square law) dynamic range to convert the linear amplified output of the power head to a logarithmic signal for presentation on the self-contained 3¾ digit display.

Configuration

The Model 475B is packaged in the third-rack configuration convenient for bench use or rack mounting.

- 0.01 to 40 GHz frequency range
- Direct reading from − 39.9 to + 35 dBm
- Accuracy: to ± 0.05 dB
- Resolution: 0.01 dB
- Low noise and drift
- Internal calibrator
- Automatic zero set
- Built-in calibration factor compensator
- Auxiliary tuning meter
- Automatic scale indication
- Power head overload indicator
- IEEE-488 Bus option
- BCD output option
- Programmable zero option

Model 475B
Digital Thermoelectric Power Meter

OPTIONS AVAILABLE

IEEE 488 Bus

An interface to the IEEE-488 Bus can be provided. This bus interface allows the Model 475B to communicate with a controller or other instruments on the bus. Using this option, the Model 475B can be remotely zeroed, put into a "Hold" mode (which "freezes" the display), or have its data placed on the bus to be read by other devices.

BCD Output

This option provides a standard 1 - 2 - 4 - 8 parallel BCD output. There are three full decades plus one half decade, brought out on 14 lines. The logic is positive true with a fanout capability of two standard TTL loads. Additional lines include polarity information, data ready, out of range signal and a data "Hold" function.

Programmable Zero

This option provides a means of remotely zeroing the Model 475B using a TTL control line brought in through the BCD connector.

tft® POWER HEADS

The Model 475B is designed to operate with the Series 4200 coaxial and waveguide power heads. The power range of the Model 475B is dependent on the power head used, as follows:

POWER HEAD	Model 475B Power Range (dBm)	
	FROM	TO
M4240A, N4240A (coaxial) X4240C, U4240C, K4240C, A4240C (waveguide)	−39.9	+10
M4241A, N4241A (coaxial)	−30	+20
N4243 (coaxial)	−10	+35

For a complete description of these power heads, see pages 118 and 119.

POWER HEAD IN USE	INPUT POWER LEVEL (dBm) FROM	TO	ACCURACY (dB) 15-35°C	0-50°C	NOISE & DRIFT[1]
( )4240( )	+5	+10	±0.1	±0.2	0.01μW P-P
	−30	+5	±0.05	±0.2	
	−39.9	−30	±0.1	±0.3	
( )4241A	+15	+20	±0.1	±0.2	0.1μW P-P
	−20	+15	±0.05	±0.2	
	−30	−20	±0.1	±0.3	
N4243	0	+35	±0.05	±0.2	10μW P-P
	−10	0	±0.1	±0.3	

Instrument Type	Digital thermoelectric power meter, for use with Series 4200 coaxial and waveguide power heads.
Dynamic Range	From −39.9 to +35 dBm.
Resolution	0.01 dB[2]
Self Calibration	Self contained 10 kHz oscillator is operated by front-panel switch. (Accuracy ±0.3% at +25°C.)
Zero Set	Automatic, operated by front-panel button.
Rf Disable	Provides ground closure at rear connector in auto-zero and calibration modes.
Scale Selection	Automatic indicator corresponding to power head in use.
Power Head Calibration Factor Compensator	Continuously variable front-panel control; range is 86 to 100%.
Power Head Overload Indicator	Automatic, blinks when maximum rating of power head is exceeded.
Display	Digital, direct reading in dBm.
Relative Power Meter	Front-panel analog meter.
Response Time (to 0.1 dB)	3 sec. (approx.)
Recorder Output	Rear mounted connector provides output proportional to indicated power. Scaling factor is 1V/10 dB (+1 V = +10 dBm); minimum load resistance of 1000 ohms.
Input Power	115/230 V ±10%, 50-1000 Hz, 20 watts
Input Connector	Front panel mounted. (Optional rear panel location.)
Dimensions (max.)	6.15″ (156 mm) H × 5.22″ (133 mm) W × 14.81″ (376 mm) D (excluding projections)
Approximate Weight	11 lbs (5 kg)

(1) Equivalent input power variation.
(2) 0.1 dB for lowest 10 dB.

OPTIONS AVAILABLE

Option 01. Input connector re-positioned to the rear.

Option 02. Standard 1-2-4-8 parallel or serial BCD output made available from rear-mounted Amphenol 57-40240 (or equal) connector (fanout 2 TTL loads).

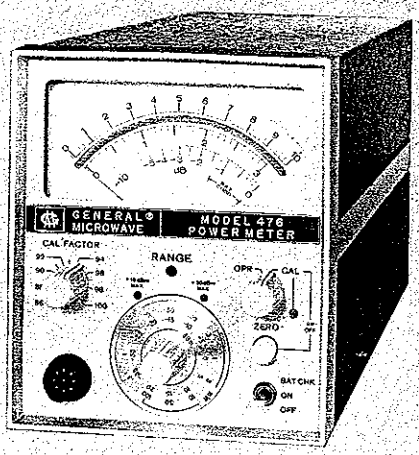
Option 03. IEEE-488 Standard (connector is AMP 552840-1 or equal). This option cannot be ordered in conjunction with Option 02 or 04.

Option 04. Programmable zero set input (uses BCD connector—See Option 02 above). This option can be ordered by itself or in conjunction with Option 02.

ACCESSORIES AVAILABLE: See pages 129 and 130.

Model 476
Thermoelectric Power Meter

- 0.01 to 40 GHz frequency range
- 30 nanowatts to 3 W power range
- ±1% of full scale accuracy
- <1.5% noise and drift
- Internal calibrator
- Automatic zero set
- Built-in calibration factor compensator
- Optional rechargeable battery pack



The Model 476 is a third-generation equipment, employing the service-proved thermoelectric technique of rf and microwave power measurement pioneered by General Microwave more than a decade ago.

FEATURES

This model incorporates a number of features that enhance accuracy, dynamic range and convenience of operation.

Self-Calibrating

Prominent among these is a self-calibration capability employing a highly stable 10 kHz oscillator which assures that the gain of the power meter is matched to the sensitivity of the power head in use. Calibration of the power meter-power head assemblage is conveniently checked and adjusted at the power meter's front panel without disconnecting the power head from the rf system under measurement. This is particularly useful in applications where the power head is remote from the power meter, or in systems where access to the power head is inconvenient.

Automatic Zero Set and Scale Indication

Another feature of the Model 476 is automatic zero set which can be activated on any range by means of a front panel push-button. In addition, the unit provides automatic scale indication when changing from power heads of one dynamic range to another.

Configuration

The Model 476 is packaged in the third-rack configuration convenient for bench use or rack mounting. For portable and field applications, an optional rechargeable battery pack is available.

Model 476
Thermoelectric Power Meter

tft® POWER HEADS

The Model 476 is designed to operate with the Series 4200 coaxial and waveguide power heads. The power range of the Model 476 is dependent on the power head used, as indicated in chart at right.

For a complete description of these power heads, see pages 118 and 119.

Power Head	Power Range FROM	TO
M4240A, N4240A (coaxial) X4240C, U4240C, K4240C, A4240C (waveguide)	30 nW (−45 dBm)	10 mW (+10 dBm)
M4241A, N4241A (coaxial)	300 nW (−35 dBm)	100 mW (+20 dBm)
N4243 (coaxial)	30 μW (−15 dBm)	3 W (+35 dBm)*

Specifications

Instrument Type	Thermoelectric power meter, for use with Series 4200 coaxial and waveguide power heads.
Power Range	From 30 nW to 100 mW (−45 dBm to +20 dBm). Twelve full-scale readings: 0.3, 1, 3, 10, 30 and 100 μW; 0.3, 1, 3, 10, 30 and 100 mW.
Accuracy	±1% of full scale on all ranges, from 0° C to +55° C.
Noise and Drift	Less than 1.5% peak on most sensitive range; proportionately less on less sensitive ranges.
Self Calibration	Self contained 10 kHz oscillator is operated by front-panel switch. (Accuracy ±0.3% at 25°C.)
Zero Set	Automatic on all ranges, operated by front-panel button.
Rf Disable	Provides ground closure at rear connector in auto-zero and calibration modes.
Scale Selection	Automatic indicator corresponding to power head in use.
Power Head Calibration Factor Compensator	Continuously variable front-panel control; range is 86 to 100%.
Response Time (Time Constant)	Less than 0.5 seconds for eight upper ranges; less than 1.7 seconds for two most sensitive ranges.
DVM/Recorder Output	Rear mounted connector provides output proportional to indicated power with −1.0 volt corresponding to full scale on "10" scales and −0.3 volt on "3" scales; minimum load resistance of 1000 ohms.
Input Power	115/230 V ±10%, 50-1000 Hz, 5 watts.
Input Connector	Front panel mounted. (Optional rear panel location.)
Meter	4½", mirror scales, taut-band suspension.
Dimensions (max.)	6.15" (156 mm) H × 5.18" (132 mm) W × 11.31" (287 mm) D excluding projections.
Approximate Weight	7 lbs. (3.2 kg.)

OPTION AVAILABLE

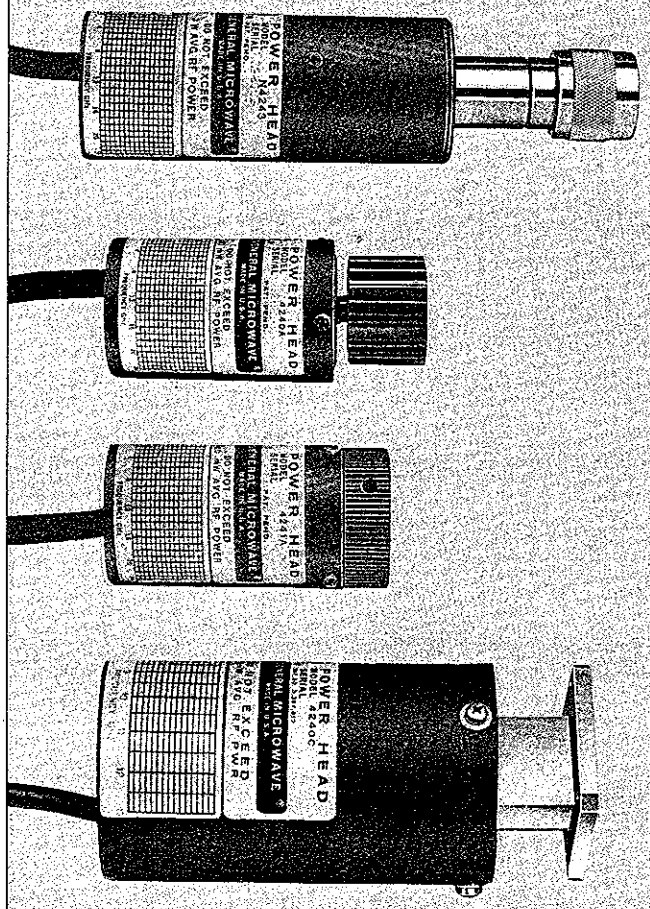
Option 01 . . . . . Input connector repositioned to the rear.

ACCESSORIES AVAILABLE . . . . . See pages 129 and 130, and footnote below.

*When used with the Model N4243, it is necessary to manually correct the Model 476 indication by multiplying μW and mW readings by 100, or adding 20 to dBm readings. Alternately, the need for manual correction of the indication can be eliminated by replacing the Model 476 RANGE dial. Order a P/N 7907-5 dial.

Series 4200 tft® Power Heads, Coaxial, Miniature Coaxial and Waveguide

- **0.01 to 40 GHz frequency range**
- **30 nanowatts to 3 watts power range**
- **Field-replaceable elements**
- **Up to 300% overload protection**
- **Type SMA or N coaxial connectors**
- **Individually calibrated against NBS-certified standards**
- **Can be operated at distances up to several hundred feet from the power meter**



Series 4200 for use with Models 475B and 476 Power Meters.

Series 4200 tft Power Heads employ the well-established thermoelectric technique of rf and microwave power measurement pioneered by General Microwave more than a decade ago. Designed for use with the Models 475B and 476 Power Meters, the Series 4200 includes four waveguide models with a power range of 10 mW (+10 dBm) full scale, plus five coaxial units in power ranges of 10 mW, 100 mW and 3 W (+10, +20 and +35 dBm). The 10 and 100 mW coaxial units are available with type SMA or N input connectors.

The power head design uses thin-film metallic loads to absorb incident rf power. By constructing the rf load as a bi-metallic element, vacuum-deposited on a thin dielectric substrate, pairs of thermoelectric junctions are created. Half of the junctions are thermally "sinked" to the transmission line conductors, while the others are located within the air space between. These latter junctions constitute almost the entire calorimetric mass, enabling high sensitivity and fast response time.

The absorption of rf power by the load creates a temperature difference between the hot and cold junctions that gives rise to a thermoelectric emf. By keeping this temperature differential small, the load acts as a true square-law (rms) device, producing a dc output voltage directly proportional to the absorbed power.

Measures CW and Modulated Signals
The element within the power head responds only to the rms value of the input power and it is completely insensitive to waveshape. Pulsed, amplitude-modulated and CW signals are measured with equal accuracy.

Power Overload
Overload input levels up to 300% of the maximum rated power are safely handled. Long term stability is insured by stringent inspection and aging procedures.

Field Repairable
In the event that replacement of the element becomes necessary, it can be readily performed at the user's facilities.

Series 4200 tft® Power Heads, Coaxial, Miniature Coaxial and Waveguide

Individually Calibrated
All units are individually calibrated against NBS-certified standards for calibration factor vs. frequency. (The calibration factor data for the Model N4243 include the errors associated with the built-in attenuator.) Compensation for calibration factor is accomplished by means of a calibrated control located on the front panel of the Models 475B and 476 Power Meters.

Remote Monitoring
The power heads are normally supplied with a five-foot umbilical cable. Special length cables or extension cables (see page 130) can be provided where greater separation between the power head and power meter is required. The power head and meter will operate satisfactorily even when separated from each other by hundreds of feet.

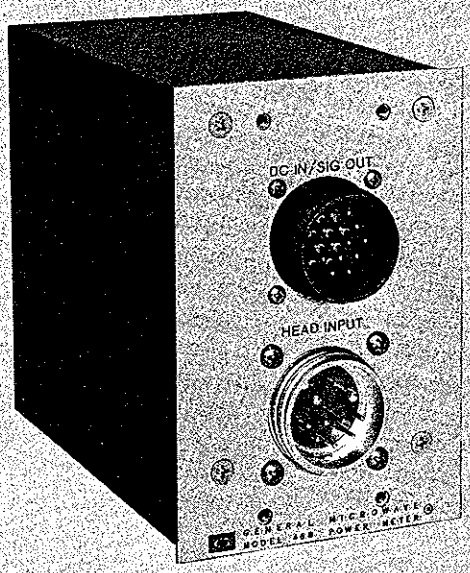
Specifications

	COAXIAL TYPES					WAVEGUIDE TYPES			
MODEL NO.	**M4240A**	**N4240A**	**M4241A**	**N4241A**	**N4243[9]**	**X4240C**	**U4240C**	**K4240C**	**A4240C**
Input Connector Type	SMA-Male	N-Male	SMA-Male	N-Male	N-Male	UG-39/U	UG-419/U	UG-595/U	UG-599/U
Transmission Line	Coaxial					RG-52/U	RG-91/U	RG-53/U	RG-96/U
Frequency Range (GHz)	0.01 to 18					8.2 to 12.4	12.4 to 18	18 to 26.5	26.5 to 40
Maximum Average Power	10 mW (+10 dBm)		100 mW (+20 dBm)		3 W (+35dBm)	10 mW (+10 dBm)			
CW Overload Rating[1]	300%		200%			300%			
Max. Pulse Energy at +25°C (W-μsec)	5		30		3000	10		5	
Max. Pulse Power at +25°C (W)	1		15		1000	2		1	
Max. Pulse Duration[5] at +25°C (μsec)	5		2		3	5			
Max. dc Voltage (volts)	10		30			N/A			
Field-Replaceable Elements	TL-4A		TL-5			TL-XO-A	TL-UO-A	TL-KO-A	TL-AO-A
Temperature Range[10] Storage	−54°C to +85°C					−54°C to +125°C			
Operating	−54°C to +85°C[6]		−54°C to +85°C[7]		−54°C to +85°C[8]	−54°C to +85°C[8]			
Element Temperature Sensitivity	0.1%/°C								
Max. VSWR	1.35[2] to 10 GHz; 1.6 from 10 GHz to 18 GHz				1.35	1.5			1.65
Diameter (nominal)	1.28″ (33 mm)				1.34″ (34 mm)	2.12″ (54 mm)			
Length	2.66″[4] (68 mm)	2.95″[4] (75 mm)	2.66″[4] (68 mm)	2.95″[4] (75 mm)	5.00″[4] (127 mm)	3.73″[3] (95 mm)			
Weight (approx.)	6.3 oz. (179 gm)				9 oz. (255 gm)	32 oz. (907 gm)			

(1) While the power heads will take overloads for short periods of time, extended periods of operation at overload levels may result in permanent change in the element characteristics or even burnout. Maximum care should be exercised to avoid such an occurence.
(2) Except in the range from 0.010 to 0.015 GHz where VSWR may rise to 1.5.
(3) Maximum, excluding rf connector, cable, multi-pin connector.
(4) Maximum, including rf connector, but excluding cable, and multi-pin connector.
(5) At maximum pulse power.
(6) Derate at 0.2 mW/°C from +60°C to +85°C.
(7) Derate at 1.4 mW/°C from +50°C to +85°C.
(8) Derate at 50 mW/°C from +65°C to +85°C.
(9) See Footnote on page 118.
(10) Other Environmental Ratings are the same as those on page 126.

Model 468
Power Meter Amplifier

- ±0.5% of full scale accuracy
- −40 dBm to +35 dBm power range
- < ±1% peak-to-peak noise and drift
- 0.01 to 40 GHz frequency range
- Fully-militarized versions available



The Model 468 is a chopper-stabilized dc amplifier with high gain stability, specially designed for use in rf systems requiring high-quality, drift-free power measurements. This unit enables the systems designer to construct his own power meter in modular form without losing any of the performance normally found only in complete laboratory instruments.

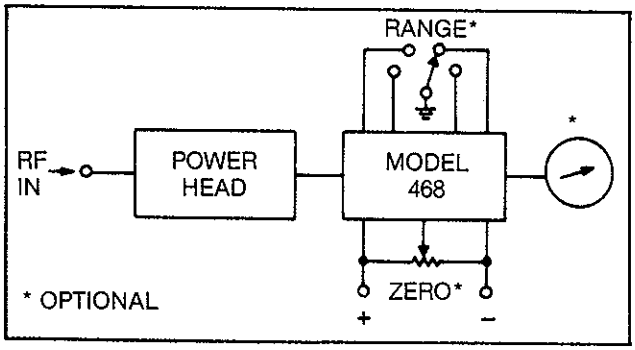
On the instrument's most sensitive range, −30 dBm full scale, noise and drift is less than ±1% peak-to-peak of full scale, and is correspondingly less on the higher ranges. In applications where measurements are limited to power levels above −25 dBm, noise and drift are essentially negligible, thereby eliminating zero setting.

Thus, the Model 468 is ideally suited for systems requiring accurate unattended power measuring equipment with long-term stability.

The Model 468 is compatible with all Series 420 and 44 power heads. (See tabulation on page 121 for detailed information regarding power ranges when used with various power heads.)

For any power head selected, the Model 468 provides a choice of four power ranges yielding a dynamic range of 40 dB. Range selection is accomplished by contact closures to ground of the appropriate connector pins, as shown below in the typical setup for measuring rf power.

TYPICAL SET-UP FOR OPERATION



Model 468
Power Meter Amplifier

The Model 468 can also be used with systems requiring multi-point measurements since individual amplifiers can be located at each measurement location.

The Model 468 requires only a low voltage dc supply for operation. The use of a recorder, panel meter, range switch and zero-set control is optional.

Special versions of the Model 468 are available which feature automatic zero setting and fully automatic range selection. Both the standard and special versions can be supplied to meet military specifications.

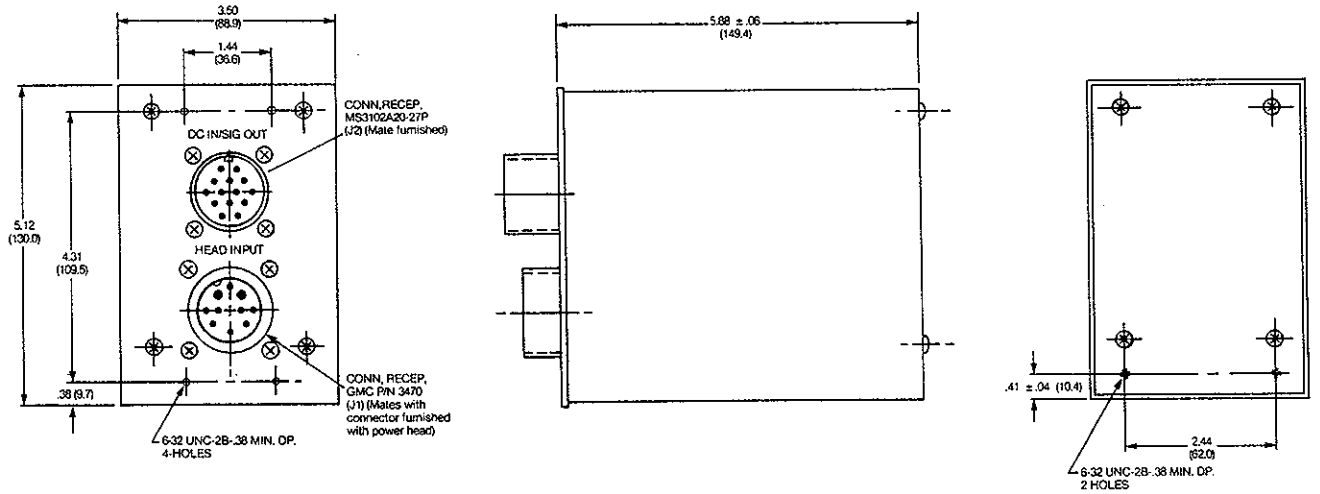
A full line of thin-film thermoelectric waveguide and coaxial power heads is available for operation with the Model 468 Power Meter Amplifier. The average power range of the amplifier is dependent on the specific power head used, as indicated in chart below.

POWER HEAD MODEL	MODEL 468 POWER RANGE	
	FROM	TO
N422C (coaxial)	0.1 μW (−40 dBm)	1 mW (0 dBm)
N420C, M440A, N440A (coaxial) X420C, U420C, K420C, A420C (waveguide)	1 μW (−30 dBm)	10 mW (+10 dBm)
N421D, M441A, N441A (coaxial)	10 μW (−20 dBm)	100 mW (+20 dBm)
N443 (coaxial)	1 mW (0 dBm)	3 W (+35 dBm)

For complete description of these power heads, see pages 122 and 123.

Specifications

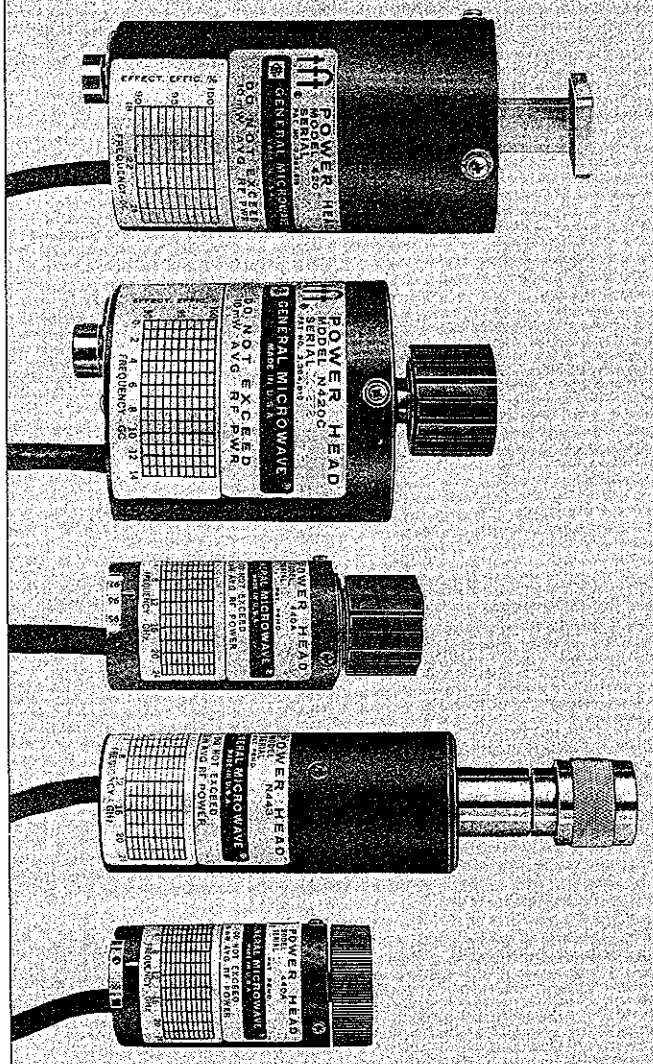
Frequency Range	0.01 to 40 GHz, with appropriate power heads.
Power Range	From 0.1 μW to 3 W (−40 to +35 dBm). Eight different ranges in four overlapping power scales, with full-scale readings of 1, 10 and 100 μW, 1, 10 and 100 mW, 1 and 3 W.
Accuracy	±0.5% full scale.
Temperature Range	0 to 55°C.
Input Power	±12 to ±15 VDC, 100 mA (+) and 50 mA (−), 0.1% regulation.
Response Time (10-90%)	1.5 seconds (max.)
Noise and Drift	< ±0.3% peak-to-peak of full scale on most sensitive range; correspondingly less on the higher ranges.
Zero Carryover	Single electrical zeroing on most sensitive range carries over from range to range.
Dimensions (max.)	See outline drawing
Approximate Weight	2.5 lbs. (1.13 kg.)
Connectors: Head Input	Mates with multipin connector on power head.
DC IN/SIG OUT	Mates with furnished MS3106A20-27S connector.



OUTLINE DIMENSIONS

Series 44 and 420 tft® Power Heads, Coaxial, Miniature Coaxial and Waveguide

- 0.01 to 40 GHz frequency range
- 10 nanowatts to 3 watts power range
- Field-replaceable elements
- Up to 300% overload protection
- Self-contained efficiency compensators
- Type SMA or N coaxial connectors
- Individually calibrated against NBS-certified standards
- Can be operated at distances up to several hundred feet from the power meter



Series 44 and 420 for use with Model 468 Power Meter Amplifier.

These two series of power heads utilize the same proven power measuring techniques discussed in the Series 4200 description on page 118. Available in waveguide or coaxial models, they are designed for use with the Model 468 Power Meter Amplifier and earlier Series 460, 467 and 471 Power Meters. Measurements of power levels as low as 0.1μ W(– 40 dBm) can be made with the Models N422C and 468. Direct-reading power measurements up to 3 watts (+ 35 dBm) can be made with the Model N443. Other models provide intermediate power ranges.

Each power head is factory-calibrated for effective efficiency at various fixed frequencies over its band and tested on a swept-frequency basis. The data are stamped on a graph mounted on the power head enclosure. A calibrated control is provided on each power head to correct for its effective efficiency. When this control is set to the measured or interpolated value, the power meter or amplifier will automatically correct for and eliminate this error. (The efficiency data for the Model N443 include the errors associated with the built-in attenuator.)

These power heads can be operated at distances up to several hundred feet from the power meter or amplifier. Standard units are provided with a five-foot umbilical cable. Special length cables or extension cables (see page 130) can be provided where greater separation between the power head and instrument is required.

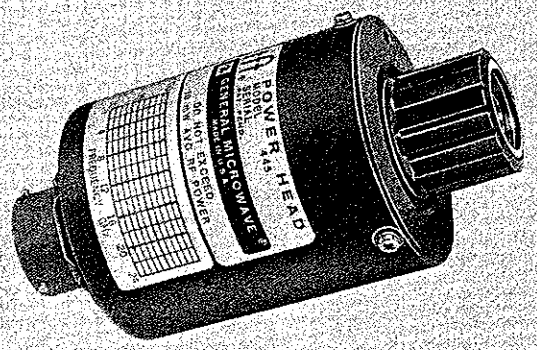
Series 44 and 420 Specifications

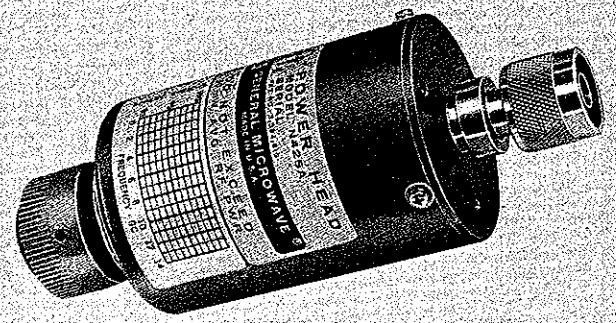
MODEL NO.	COAXIAL TYPES, SERIES 420			COAXIAL TYPES, SERIES 44					WAVEGUIDE TYPES, SERIES 420			
	N420C	N421D	N422C	M440A	N440A	M441A	N441A	N443	X420C	U420C	K420C	A420C
Frequency Range (GHz)	0.01 to 12.4			0.01 to 18					8.2 to 12.4	12.4 to 18	18 to 26.5	26.5 to 40
Transmission Line	Coaxial			Coaxial					RG-52/U	RG-91/U	RG-53/U	RG-96/U
Input Connector Type	N-Male			SMA-Male	N-Male	SMA-Male	N-Male	N-Male	UG-39/U	UG-419/U	UG-595/U	UG-599/U
Max. Average Power	10 mW (+10 dBm)	100 mW (+20 dBm)	1 mW (0 dBm)	10 mW (+10 dBm)		100 mW (+20 dBm)		3 W (+35 dBm)	10 mW (+10 dBm)			
CW Overload Rating[1]	300%			300%		200%			300%			
Max. Pulse Energy at +25°C (W·μsec)	15	150	1.5	5		30		3000	10		5	
Max. Pulse Power at +25°C (W)	3	30	0.3	1		15		1000	2		1	
Max. Pulse Duration[6] at +25°C (μsec)	5			5		2		3	5			
Max. dc Voltage (volts)	10	30	3	10		30			N/A			
Max. VSWR	1.5[2]			1.35[3] to 10 GHz; 1.6 from 10 GHz to 18 GHz				1.35	1.5			1.65
Temperature Range[11] Storage	−54°C to +85°C			−54°C to +85°C					−54°C to +125°C			
Operating	−54°C to +85°C[7]	−54°C to +85°C[8]	−54°C to +85°C[10]	−54°C to +85°C[7]		−54°C to +85°C[8]		−54°C to +85°C[9]	−54°C to +85°C[7]			
Element Temperature Sensitivity	0.1%/°C			0.1%/°C					0.1%/°C			
Field-Replaceable Elements	TL-0A	TL-1A	TL-2A	TL-4A		TL-5			TL-XO-A	TL-UO-A	TL-KO-A	TL-AO-A
Diameter (nominal)	2.12″ (54 mm)			1.28″ (33 mm)				1.25″ (32 mm)	2.12″ (54 mm)			
Length	2.50″[4] (63 mm)			2.66″[5] (68 mm)	2.95″[5] (75 mm)	2.66″[5] (68 mm)	2.95″[5] (75 mm)	5.16″[5] (131mm)	3.74″[4] (95 mm)			
Weight (approx.)	16 oz. (453 gm)			6.3 oz. (179 gm)				9 oz. (255gm)	32 oz. (907 gm)			

(1) While the power heads will take overloads for short periods of time, extended periods of operation at overload levels may result in permanent change in the element characteristics or even burnout. Maximum care should be exercised to avoid such an occurrence.
(2) Except in the range from 0.010 to 0.015 GHz where VSWR may rise to 1.75.
(3) Except in the range from 0.010 to 0.015 GHz where VSWR may rise to 1.5.
(4) Maximum, excluding rf connector, cable, multi-pin connector and efficiency control.
(5) Maximum, including rf connector, but excluding cable and multi-pin connector.
(6) At maximum pulse power.
(7) Derate at 0.2 mW/°C from +60°C to +85°C.
(8) Derate at 1.4 mW/°C from +50°C to +85°C.
(9) Derate at 50 mW/°C from +65°C to +85°C.
(10) Derate at 0.02 mW/°C from +60°C to +85°C
(11) Other Environmental Ratings are the same as those on page 126.

Models N445A, N446A, N425B, N426B, N427B Integrated Thermoelectric Power Monitors

- **Amplifier and power sensor in a single, compact package**
- **0.01 to 18 GHz frequency range**
- **30 dB dynamic power range**
- **±1% accuracy**
- **−55°C to +85°C temperature range**
- **0.02% F.S. (p-p) noise**
- **0.02% F.S./°C drift**





Model N445A, N446A: 0.01 to 18 GHz
Models N425B, N426B, N427B: 0.01 to 12.4 GHz

These power monitors are compact, integrated assemblies of thermoelectric power sensors and dc amplifiers specially designed for system power monitoring at local or remote locations. Small size and light weight make them ideal for difficult systems packaging requirements, and choice of readout type and location is flexible — all this is accomplished without sacrificing high accuracy, excellent stability or economy.

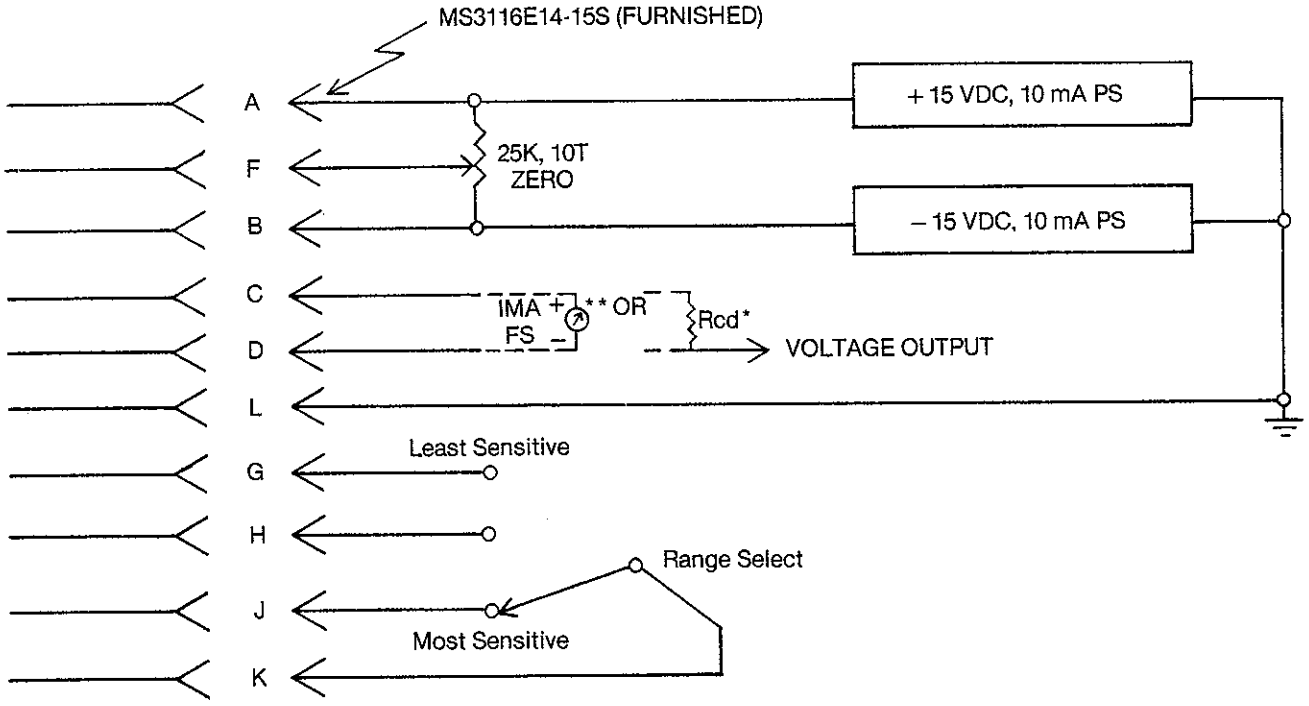
Modulated, pulsed, or cw signals from 0.01 to 18 GHz are measured over a 30 dB dynamic range covered in three convenient decade steps. Power levels as low as −30 dBm (1μW) and as high as +20 dBm (100 mW) can be measured. Provisions for remote range selection and zero setting are included.

The monitor output is a dc analog signal which may be connected to readouts in either a constant current or constant voltage mode, directly scaleable in milliwatts. The constant current output is 1 milliampere full scale, and the constant voltage output is adjustable up to −10 volts full scale. For remote readout distances up to many hundreds of feet, the constant current connection provides a stable reading free from errors caused by long line wire resistance values. Where the readout device is a voltmeter, or for such applications as sweep generator levelling, the constant voltage mode of operation is available.

The carefully designed amplifier section, when combined with the excellent stability of the thermoelectric power sensor, assures exceptionally low noise and drift. A wide operating temperature range of −55 °C to +85 °C is also featured.

The Type N rf connector conforms to MIL-C-39012, and the dc and signal output connector mates with a furnished MS3116E plug connector. Rugged construction is featured throughout.

Models N445A, N446A, N425B, N426B, N427B
Integrated Thermoelectric Power Monitors



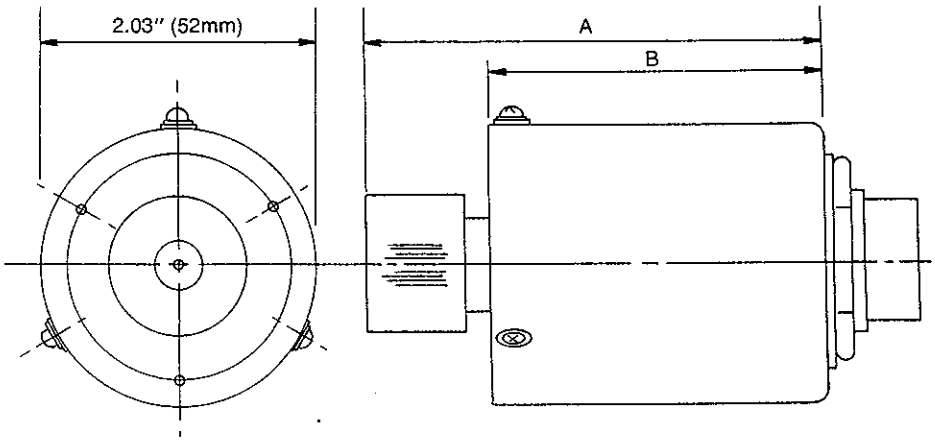
PIN	N445A,N425B	N446A,N426B	N427B
G	+ 10 dBm	+ 20 dBm	0 dBm
H	0 dBm	+ 10 dBm	– 10 dBm
J	– 10 dBm	0 dBm	– 20 dBm

* When voltage output is used, connect resistor (Rcd) between pins C and D. Output between pins D and L will be – 1 Volt per 1000 ohms of resistance of Rcd with a maximum value of – 10V (i.e. – 10,000 ohms). Simultaneous use of voltage and current modes is also possible.

** Any number of 1 mA meters may be connected in series provided total pins C-D loop resistance does not exceed 10,000 ohms.

TYPICAL SET-UP FOR OPERATION

OUTLINE DIMENSIONS



Unit	Dimensions	
	A	B
N445A, N446A	3.60" (92mm)	2.60" (66mm)
N425B, N426B, N427B	4.34" (111mm)	3.10" (79mm)

Models N445A, N446A, N425B, N426B, N427B Specifications

MODEL	N445A		N446A		N425B		N426B		N427B	
Frequency Range	0.01 to 18 GHz				0.01 to 12.4 GHz					
Full Scale Ranges:	dBm	mW	dBm	mW	dBm	mW	dBm	mW	dBm	mW
Range 1	+10	10	+20	100	+10	10	+20	100	0	1
Range 2	0	1	+10	10	0	1	+10	10	−10	0.1
Range 3	−10	0.1	0	1	−10	0.1	0	1	−20	0.01
Input Impedance	50 ohms									
Max. VSWR	1.35[1] to 10 GHz; 1.6 from 10 GHz to 18 GHz				1.5[2]					
Accuracy[3]	± 1% of full scale									
Operating Temperature Range	−54°C to +85°C[8]		−54°C to +85°C[9]		−54°C to +85°C[8]		−54°C to +85°C[9]		−54°C to +85°C[10]	
Zero Drift[4][5]	0.02% F.S./°C								0.035% F.S./°C	
Noise[4]	0.02% F.S. (p-p)								0.035% F.S. (p-p)	
Element Temperature Sensitivity	0.1%/°C									
Field-Replaceable Elements	TL-4A		TL-5		TL-0A		TL-1A		TL-2A	
CW Overload Rating[7]	300%		200%		300%					
Max. Pulse Energy at +25°C (Wμ-sec)	5		30		15		150		1.5	
Max. Pulse Power at +25°C (W)	1		15		3		30		0.3	
Max. Pulse Duration at +25°C (μ sec)[6]	5		2		5					
Max. dc Voltage (volts)	10		30		10		30		3	
Output: Current Mode	1 mA full scale, each range									
Voltage Mode	−10 volts full scale (maximum), each range									
Power Supply Requirements	±6V to ±18V, 10 mA, 0.1% regulation									
Weight	8 oz. (227 gm.)									

ENVIRONMENTAL RATINGS

Shock . . . . . MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)

Vibration . . . . . MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)

Altitude . . . . . MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)

Temp. Cycling . . . . . MIL-STD-202F, Method 107D, Cond. A, 5 cycles

(1) Except in the range from 0.010 to 0.015 GHz, where VSWR may rise to 1.5.
(2) Except in the range from 0.010 to 0.015 GHz, where VSWR may rise to 1.75.
(3) Excluding RF calibration error.
(4) On least sensitive range. Proportionately more on lower power ranges.
(5) Over temperature range from −25°C to +85°C.
Over full temperature range:
Models N445A, N446A, N425B and N426B: 0.03% F.S./°C.
Model N427B: 0.05% F.S./°C.
(6) At maximum pulse power.
(7) While the units will take overloads for short periods of time, extended periods of operation at overload levels may result in permanent change in the element characteristics or even burnout. Maximum care should be exercised to avoid such an occurrence.
(8) Derate at 0.2 mW/°C from +60°C to +85°C.
(9) Derate at 1.4 mW/°C from +50°C to +85°C.
(10) Derate at 0.02 mW/°C from +60°C to +85°C

Model N447
High-Sensitivity Crystal Power Monitor
−50 to −20 dBm

The Model N447 Power Monitor is a compact, integrated assembly of a temperature-compensated low-barrier Schottky power sensor and a dc amplifier specially designed for system power monitoring at local or remote locations. Small size and light weight make it ideal for difficult systems packaging requirements, and choice of readout type and location is flexible—all this is accomplished without sacrificing high accuracy, excellent stability or economy.

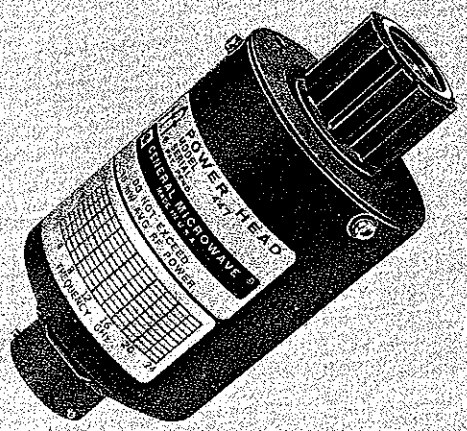
Modulated, pulsed, or cw signals from 0.01 to 18 GHz are measured over a 30 dB dynamic range covered in three convenient decade steps. Power levels as low as −50 dBm (10 nW) can be measured. Provisions for remote range selection and zero setting are included.

The monitor output is a dc analog signal which may be connected to readouts in either a constant current or constant voltage mode, directly scaleable in milliwatts. The constant current output is 1 milliampere full scale, and the constant voltage output is adjustable up to −10 volts full scale. For remote readout distances up to many hundreds of feet, the constant current connection provides a stable reading free from errors caused by long line wire resistance values. Where the readout device is a voltmeter, or for such applications as sweep generator leveling, the constant voltage mode of operation is available.

The carefully designed amplifier section, when combined with the power sensor, assures exceptionally low noise and drift. A wide operating temperature range of −20°C to +85°C is also featured.

The Type N rf connector conforms to MIL-C-39012, and the dc and signal output connector mates with a furnished MS3116E plug connector. Rugged construction is featured throughout.

- **Amplifier and power sensor in a single, compact package**
- **0.01 to 18 GHz frequency range**
- **30 dB dynamic power range**
- **±1% accuracy**
- **−20°C to +85°C temperature range**
- **0.02% F.S. (p-p) noise**
- **0.035% F.S./°C drift**

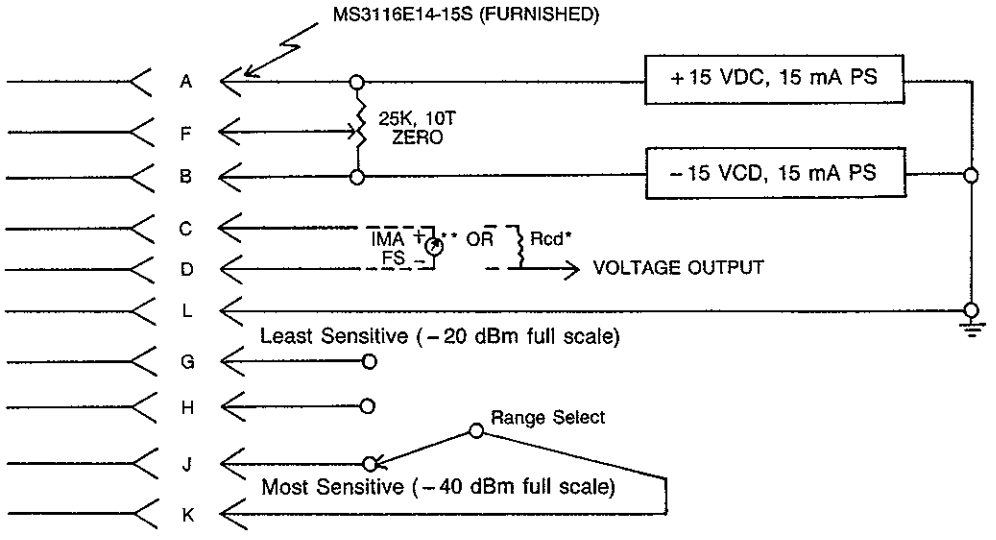


Model N447
Specifications

Frequency Range	0.01 to 18 GHz	
Full Scale Ranges:	dBm	uW
Range 1	−20	10
Range 2	−30	1
Range 3	−40	0.1
Input Impedance	50 ohms	
Max. VSWR	1.2:1 to 8 GHz 1.4:1 to 18 GHz	
Accuracy(1)	±1% of full scale	
Operating Temperature Range	−20°C to +85°C	
Zero Drift(2)	0.035% F.S./°C	
Noise(2)	0.02% F.S. (P-P)	
Temperature Sensitivity	0.2%/°C	
CW Overload Rating(4)	100 mW	
Max. Pulse Energy at +25°C (W μ sec)	1	
Max. Pulse Power at +25°C (W)	1	
Max. Pulse Duration at +25°C (μ sec)(3)	1	
Max. dc Voltage (volts)	10	
Output: Current Mode Voltage Mode	 1 mA full scale, each range −10 volts full scale (maximum), each range	
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6msec)	
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)	
Altitude	MIL-STD-202F, Method 105C, Cond. B (50,000 ft.)	
Temp. Cycling	MIL-STD-202F, Method 107D, Cond. A, 5 cycles	
Power Supply Requirements	±6V to ±18V, 15 mA, .01% regulation	
Weight	8 oz. (227 gm.)	

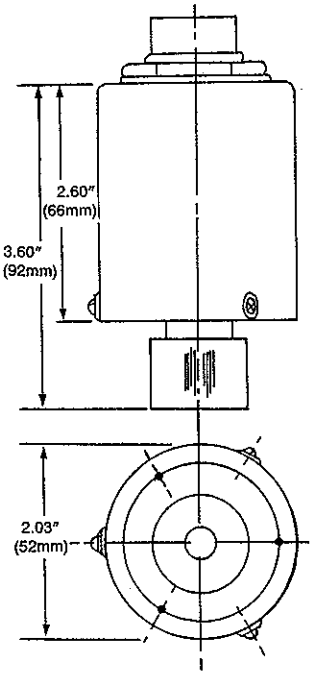
(1) *Excluding RF calibration error.*
(2) *On least sensitive range. Proportionately more on lower power ranges.*
(3) *At maximum pulse power.*
(4) *While the unit will take overloads for short periods of time, extended periods of operation at overload levels may result in permanent change in characteristics or even burnout. Maximum care should be exercised to avoid such an occurrence.*

TYPICAL SET-UP FOR OPERATION



*When voltage output is used, connect resistor (Rcd) between pins C and D. Output between pins D and L will be −1 Volt per 1000 ohms of resistance of Rcd with a maximum value of −10V (i.e. −10,000 ohms). Simultaneous use of voltage and current modes is also possible.
**Any number of 1 mA meters may be connected in series provided total pins C-D loop resistance does not exceed 10,000 ohms.

OUTLINE DIMENSIONS



Model 308 Calibrator

The Model 308 Calibrator is designed to facilitate the rapid calibration of Models 475B and 476 Power Meters. Using self-contained long-life mercury batteries in conjunction with a highly stable voltage reference, the Model 308 establishes a standard voltage level which is scaled by a precision divider to the ten discrete values required to calibrate the power meters.

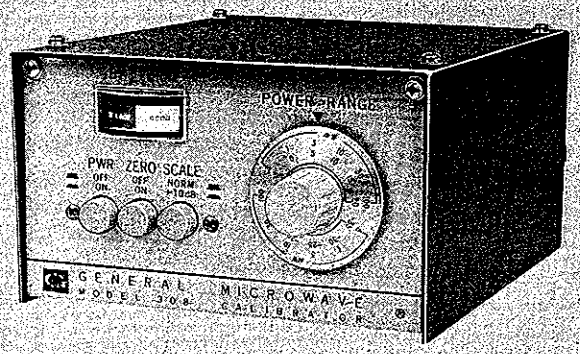
The Model 308 is a compact, lightweight unit, requiring only standard voltmeters for the calibration process. The condition of the internal batteries is quickly checked by means of the front panel meter provided for that purpose. There are no other checks or adjustments necessary to prepare the calibrator for use.

A two-position push-button switch is provided to check the operation of the scale indicator circuitry of the power meter under test.

A ten-position rotary switch is employed to provide the voltages required to calibrate all of the power ranges of the power meter under test.

For added convenience, the Model 308 comes equipped with an output cable which connects directly to the input of the power meter under test.

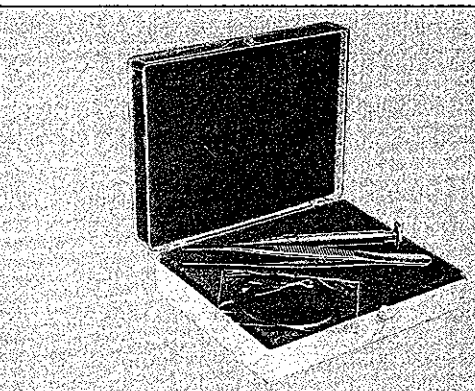
- **Rapid precision calibration of Models 475B and 476 Power Meters**
- **Battery operated with built-in battery check meter**
- **Ten-position voltage selector**
- **Push-button sensitivity selector**



Specifications

Instrument Type	Calibrator for use with Models 475B and 476 Power Meters
Input Power	Supplied by two self-contained mercury batteries Battery life: 250 operating hours Battery check meter included
Accuracy at 25°C ± 5°C:	
Ranges 0.3 to 10 mW	± 0.05%
Ranges 3 to 100 μW	± 0.075%
Ranges 0.3 to 1 μW	± 0.1%
Temperature Coefficient	± 0.0065%/°C
Long Term Stability Error	< 0.005%/year
Output Cable	6 ft. (183 cm.) long with tft power head connector.
Dimensions	3.83" (97 mm.) H x 6.02" (153 mm.) W x 7.71" (196 mm.) D
Weight	3 lb. (1.36 kg)

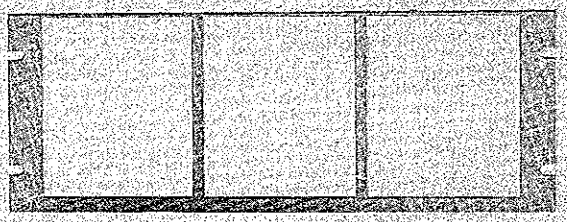
Accessories



Model TK-1

Tool Kit

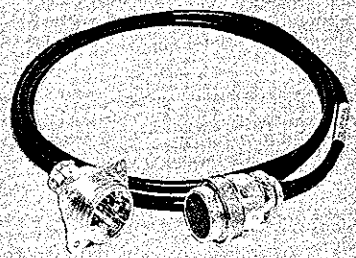
The Model TK-1 contains all the special tools necessary for field replacement of tft elements in any Series 420 coaxial power head. Other tft power heads require no special tools for element replacement.



Model 983-4A

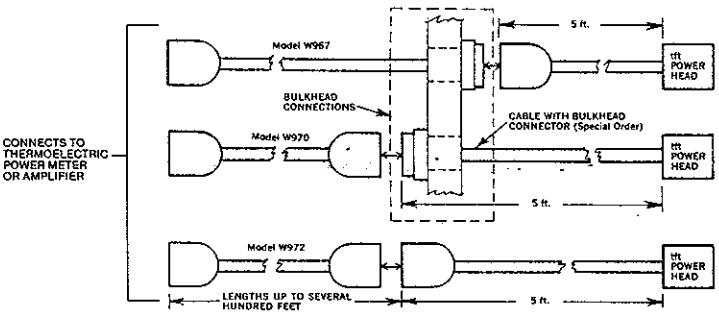
Rack Adapter

The Model 983-4A provides a convenient means of rack-mounting up to three Models 475B or 476 Power Meters.

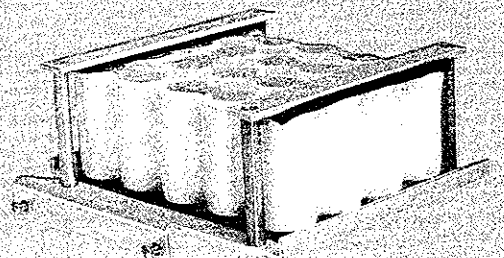


Special Cables

An assortment of special extension cables in various lengths is available to enable power measurements at distances up to several hundred feet from a power meter or amplifier as shown below.



For use with Model 475B or 476, add suffix –4 to cable model number.



Model 981-1

Rechargeable Battery Pack

The Model 981-1 permits the Model 476 Power Meter to be used for portable or field applications. Includes one 24-volt battery and can power a Model 476 approximately 12 hours.

RAHAM Radiation Hazard Meters

General Microwave RAHAM Radiation Hazard Meters detect and measure potentially hazardous electromagnetic energy radiating from RF and microwave sources. They are designed to monitor a wide variety of systems — military, industrial and commercial — which may expose personnel to such conditions. Typical of these are microwave ovens, medical equipment, radar installations, microwave heaters and dryers, communication systems, and electronic warfare systems.

All General Microwave RAHAMs consist of a power density meter, one or more probes, an extension cable, and a carrying case, and all are portable and battery operated.

The probe output is applied to a battery powered, high gain, low noise, solid-state amplifier. The amplifier is packaged in an instrument case with a self-contained meter which is calibrated to read power density directly.

In normal operation, the user has the option of mounting the probe directly on the power density meter or interconnecting the probe and meter with the extension cable. While the directly connected probe offers convenient one-hand operation, the extension cable allows the operator greater flexibility in probing for radiation fields in awkward or less accessible locations. It also permits him to more readily shield himself in potentially hazardous radiation fields.

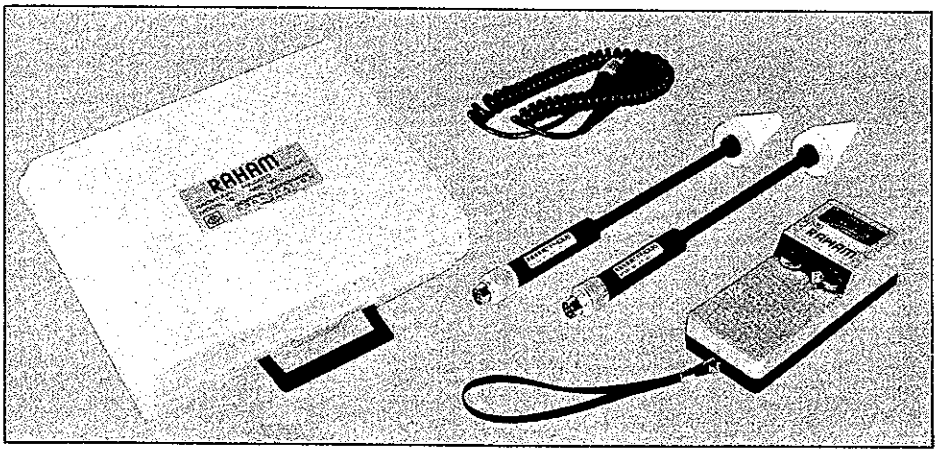
Selection Guide

RAHAM Model	Frequency Range (GHz)	Power Range	Description
1	0.3 to 18	0.2 mW/cm² to 200 mW/cm²	High frequency anisotropic unit using a single probe to cover frequency and power ranges. Probe employs two thin-film thermocouple arrays.
2	0.01 to 3	0.2 mW/cm² to 200 mW/cm²	Low cost low frequency anisotropic unit using a single probe to cover frequency and power ranges. Probe employs two short crossed dipoles each feeding a Schottky barrier diode.
3	0.3 to 18	0.2 mW/cm² to 200 mW/cm²	High frequency isotropic unit using a single probe to cover frequency and power ranges. Probe employs three thin-film thermocouple arrays.
4A	0.0002 to 26	1μW/cm² to 20 mW/cm²	Ultra-broadband isotropic unit using a single probe to cover frequency and power ranges. Probe employs three thin-film circuits.
12	0.01 to 18	0.2 mW/cm² to 200 mW/cm²	Broadband anisotropic unit using two probes to cover frequency range. Both cover power range. See Models 1 and 2 descriptions above.

CALIBRATION

Each General Microwave RAHAM is calibrated at 2.45 GHz plus a number of additional frequencies over its operating frequency range. The resultant data are furnished with the unit.

General Microwave's RAHAMs meet the requirements specified for test equipment in the "IMPI Performance Standard on Leakage from Industrial Microwave Systems dated August 1973 (International Microwave Power Institute)", and measure power density levels in accord with the standards established by OSHA and the Department of Defense, present and proposed.



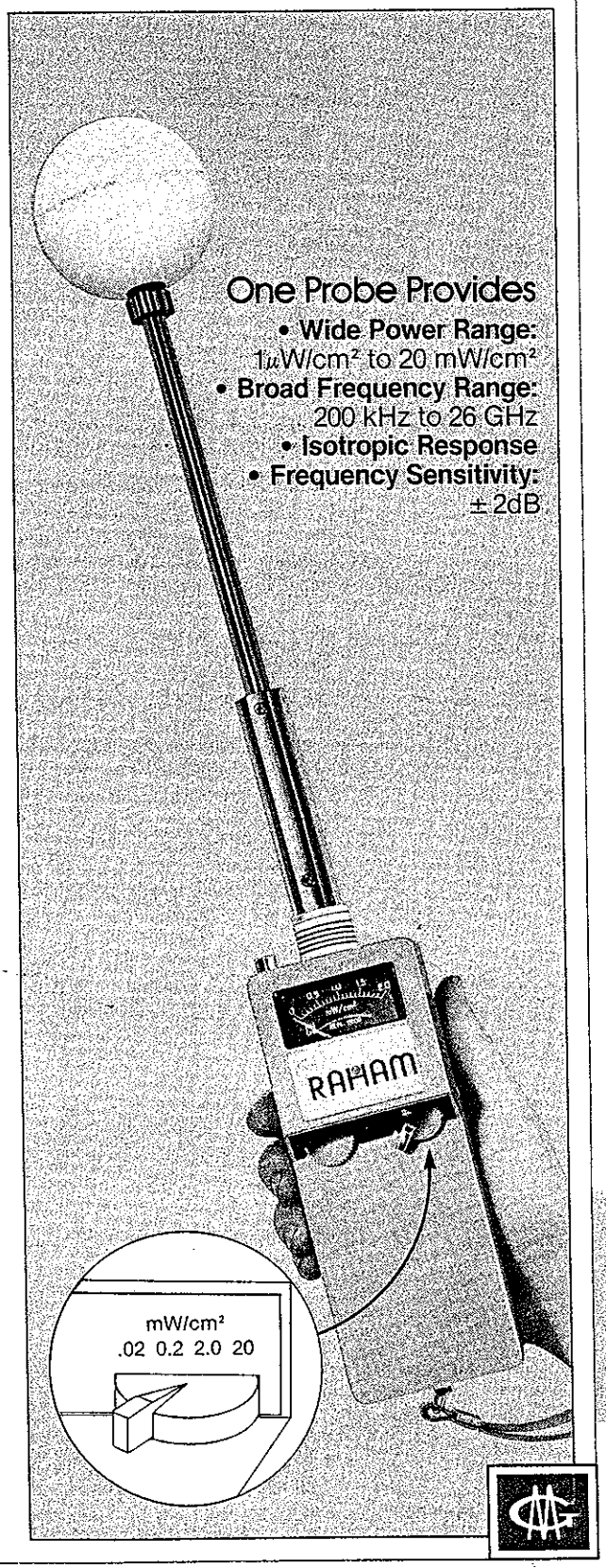
Model 12 RAHAM

Model 4A

200 kHz to 26 GHz, 1μW/cm² to 20 mW/cm² Isotropic RAHAM

The Model 4A[1], which consists of a Model 484 Power Density Meter, Model 84B Probe, extension cable, and carrying case, features operation over the frequency range from 200 kHz to 26 GHz and four power density ranges with full scale readings of 0.02 mW/cm², 0.2 mW/cm², 2 mW/cm² and 20 mW/cm².

The probe employs three orthogonally-mounted thin-film circuits which provide isotropic response. Accurate near and far field power density measurements result from the novel design which provides an almost constant effective aperture to radiation fields ranging from 200 kHz to 26 GHz. Frequency sensitivity over the operating band is held to within ±2 dB.



Frequency Range	200 kHz to 26 GHz
Power Density Ranges	43 dB dynamic range. Four ranges with full scale readings of 0.02 mW/cm², 0.2 mW/cm², 2 mW/cm², and 20 mW/cm². Sensitivity on lowest range extends from 1μW/cm².
Frequency Sensitivity	±2 dB
Calibration Accuracy[2]	±0.5 dB
Average Power Overload	0.5 W/cm² (at 25°C)
Peak Power Overload	30 W/cm² (at 25°C)
Pulse Energy Density Overload	150 W-μsec/cm² (at 25°C)
Isotropy	Response varies ±0.5 dB (max.) for energy incident from any direction except from/through handle.
Noise	Less than 3% peak-to-peak on most sensitive range
Response Time	1.5 seconds (approx.)
Battery Operation	900 hours (expendable)
Recorder Output	0.124 volt full scale into a nominal resistance of 100K ohms.
Operating Temp. Range	0°C to +50°C
Size:	
Power Density Meter	2.50″ x 1.63″ x 6.38″ (64 x 41 x 162 mm)
Probe	13.25″ long x 2.75″ max. dia. (336 x 70 mm)
Cable Assembly	4′ long (1.22 m)
Carrying Case	15.5″ x 12.25″ x 4.75″ (394 x 311 x 120 mm)
Weight	3.25 lbs. (1.47 kg.)

(1) *At this printing, new exposure standards are under active consideration by NIOSH, OSHA, and other concerned groups. The Model 4A has been designed to measure radiation below the lowest of the power levels and frequencies of the standards under consideration that are known to General Microwave.*

(2) *Each unit is aligned at 2.45 GHz, and calibrated at a number of additional frequencies over its operating frequency range. The resultant data are furnished with the unit.*

RAHAM Radiation Hazard Meters

Model 1
0.3 to 18 GHz, 0.2 to 200 mW/cm² RAHAM

The Model 1, which consists of a Model 481B Power Density Meter, Model 81A Probe, extension cable, and carrying case, features operation over the frequency range of 0.3 to 18 GHz and three power density ranges with full-scale readings of 2 mW/cm², 20 mW/cm² and 200 mW/cm².

Foremost among the unique design concepts of the Model 1 is its broadband probe which employs two orthogonally-mounted thin-film thermocouple arrays. These arrays, which contain a large number of series connected thermal junctions, are mounted between a pair of special high thermal conductivity, low loss dielectric wafers which serve to simultaneously enhance sensitivity and reduce drift. When the probe is irradiated, alternate junctions located within the RF field rise in temperature relative to the thermally "sinked" junctions. By keeping the temperature differential small, the probe acts as a true square-law (RMS) detector, producing a DC output voltage directly proportional to the absorbed radiation.

Wideband frequency performance and accurate near and far field power density measurements result from the design of the thermocouple array, which is equivalent to a thin-film resistive screen whose surface resistivity is high relative to free space impedance. This provides an almost-constant effective aperture to radiation fields ranging from UHF to K-band wavelengths.

Offering maximum flexibility and economy, the Model 481B Power Density Meter furnished with the Model 1 can also be used with a Model 82 Probe (see **Model 2** below) to extend the Model 1 frequency range to 10 MHz, or with a Model 83A Probe (see **Model 3** on page 136) to convert the Model 1 for isotropic operation over the 0.3 to 18 GHz frequency range.

Model 2
0.01 to 3 GHz, 0.2 to 200 mW/cm² RAHAM

The Model 2, which consists of a Model 481B Power Density Meter, Model 82 Probe, extension cable, and carrying case, features operation over the frequency range of 0.01 to 3 GHz and three power density ranges with full-scale readings of 2 mW/cm², 20 mW/cm² and 200 mW/cm².
The operating frequency range and power handling characteristics of the Model 2 are primarily a function of the Model 82 probe design. The design empioys two short crossed dipoles each feeding a Schottky barrier diode. The diode impedance, in the frequency range of operation, is largely characterized by its barrier capacity. This capacitance is in series with that of the short dipole whose coupling action to free space is also essentially represented by an equivalent capacitance. For as long as the total circuit reactance is large relative to free space impedance, a condition which sets the upper frequency limit, the induced voltage for constant power density remains constant with frequency. As a consequence of the capacitive divider network, the induced voltage across the diode is a constant and the probe's output is flat with frequency. The lower frequency limit is reached when the barrier capacitive reactance becomes comparable to the barrier resistance. For the Model 82, that condition is reached below 0.01 GHz. Considerable care is taken in the construction of the Model 2 to realize the circuit model.

Offering maximum flexibility and economy, the Model 481B Power Density Meter furnished with the Model 2 can also be used with a Model 81A Probe (see **Model 1** above) to extend the Model 2 frequency range to 18 GHz, or with a Model 83A Probe (see **Model 3** on page 136) to convert the Model 2 for isotropic operation over the 0.3 to 18 GHz frequency range.

Model 12
0.01 to 18 GHz, 0.2 to 200 mW/cm² RAHAM

The Model 12 consists of a Model 481B Power Density Meter, a Model 81A High Frequency Probe, a Model 82 Low Frequency Probe, extension cable and carrying case.
It is a combination unit providing all Model 1 and 2 features. Refer to those models above for more complete information.

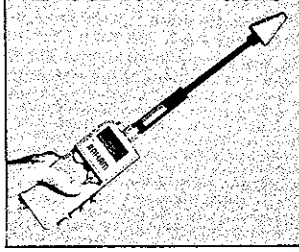
RAHAM Radiation Hazard Meters

	MODEL 1	MODEL 2	MODEL 12
Frequency Range	0.3 to 18 GHz	0.01 to 3 GHz	0.01 to 18 GHz
Power Density Ranges	30 dB dynamic range. Three 10 dB ranges with full scale readings of 2 mW/cm², 20 mW/cm² and 200 mW/cm².		
Frequency Sensitivity	± 1.5 dB from 1 to 18 GHz – 1.0 to – 6.0 dB from 0.3 to 1 GHz	± 1.0 dB from 0.01 to 3 GHz	± 1.0 dB from 0.01 to 3 GHz (Model 82 Probe) ± 1.5 dB from 3 to 18 GHz (Model 81A Probe)
Calibration Accuracy (1)	± 0.5 dB		
Average Power Overload (2)	0.5 W/cm²	1 W/cm²	0.5 W/cm² (Model 81A Probe) 1W/cm² (Model 82 Probe)
Peak Power Overload (2)	30 W/cm² (max)		
Pulse Energy Density Overload (2)	150 W-μsec/cm² (max)		
Polarization	Elliptical, measures linear and circularly polarized signals		
Ellipticity	± 0.5 dB (max.) change in sensitivity due to rotation about an axis through the handle.		
Noise	Less than 1% peak-to-peak on most sensitive range		
Response Time	1.5 seconds (approx.)		
Battery Operation	500 hours (expendable)		
Recorder Output	0.124 volt full scale into a minimum resistance of 100K ohms		
Operating Temperature Range	0°C to + 55°C		
Size:			
Power Density Meter	2.50″ x 1.63″ x 6.38″ (64 x 41 x 162 mm)		
Each Probe	12.75″ long x 1.50″ max. dia. (324 x 38 mm)		
Cable Assembly	4′ long (1.22m)		
Carrying Case	15.5″ x 12.25″ x 4.75″ (394 x 311 x 120 mm)		
Weight	3.25 lbs. (1.47 kg.)		

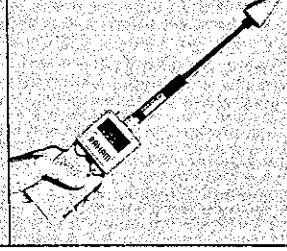
(1) *Each unit is aligned at 2.45 GHz, and calibrated at a number of additional frequencies over its operating frequency range. The resultant data are furnished with the unit.*

(2) *at 25°C*

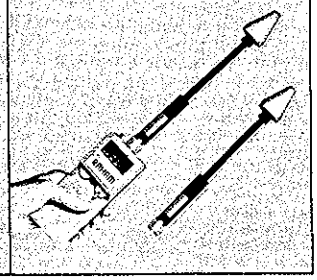
- **Frequency Range:** 0.3 to 18 GHz
- **Power Range:** 0.2 to 200 mW/cm²
- **Frequency Sensitivity:** ± 1.5 dB from 1 to 18 GHz



- **Frequency Range:** 0.01 to 3 GHz
- **Power Range:** 0.2 to 200 mW/cm²
- **Frequency Sensitivity:** ± 1 dB

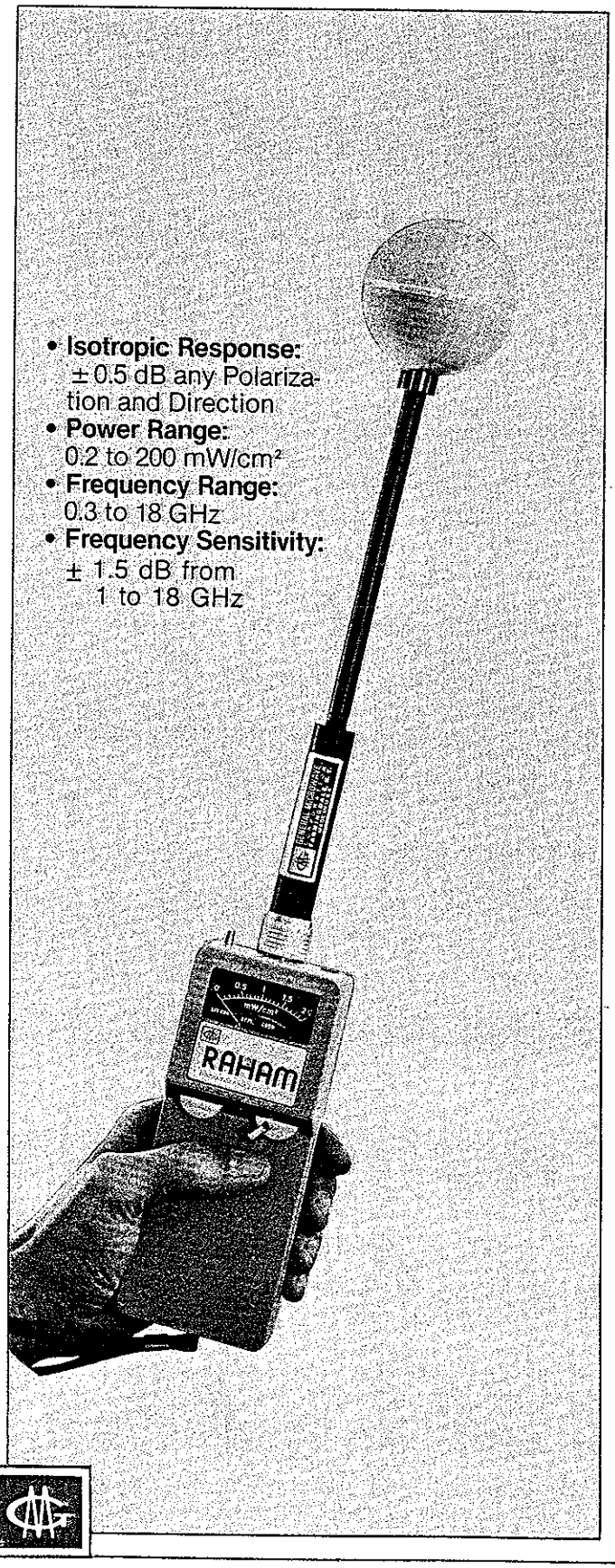


- **Frequency Range:** 0.01 to 18 GHz
- **Power Range:** 0.2 to 200 mW/cm²



Model 3

0.3 to 18 GHz, 0.2 to 200 mW/cm² Isotropic RAHAM



- **Isotropic Response:** ± 0.5 dB any Polarization and Direction
- **Power Range:** 0.2 to 200 mW/cm²
- **Frequency Range:** 0.3 to 18 GHz
- **Frequency Sensitivity:** ± 1.5 dB from 1 to 18 GHz

The Model 3, which consists of a Model 481B Power Density Meter, Model 83A Probe, extension cable, and carrying case, features operation over the frequency range from 0.3 to 18 GHz and three power density ranges with full scale readings of 2 mW/cm², 20 mW/cm² and 200 mW/cm².

The isotropic probe employs three orthogonally-mounted thin-film thermocouple arrays. When the probe is irradiated, alternate junctions located within the rf field rise in temperature relative to adjacent thermally "sinked" junctions. By keeping the temperature differential small, the probe acts as a true square law (rms) detector producing a dc output voltage directly proportional to the absorbed radiation.

Wideband frequency performance and accurate near and far field power density measurements result from the design of the thermocouple array, which is equivalent to a thin-film resistive screen whose surface resistivity is high relative to free space impedance. This provides an almost constant effective aperture to radiation fields ranging from UHF to K-Band wavelengths such that frequency sensitivity over the operating band is held to within ± 1 dB.

Offering maximum flexibility and economy, the Model 481B Power Density Meter furnished with the Model 3 can also be used with a model 82 Probe (see **Model 2** on page 134) to convert the Model 3 for anisotropic operation over the 0.01 to 3 GHz frequency range, or with a Model 81A Probe (see **Model 1** on page 134) to convert the Model 3 for anisotropic operation over the 0.3 to 18 GHz frequency range.

Frequency Range	0.3 to 18 GHz
Power Density Ranges	30 dB dynamic range. Three 10 dB ranges with full scale readings of 2 mW/cm², 20 mW/cm² and 200 mW/cm²
Frequency Sensitivity	+0, −3 dB from 0.3 to 1 GHz; ± 1.5 dB from 1 to 18 GHz
Calibration Accuracy(1)	± 0.5 dB
Average Power Overload	0.5 W/cm² (at 25 °C)
Peak Power Overload	30 W/cm² (max.) (at 25 °C)
Pulse Energy Density Overload	150 W-μsec/cm² (max.) (at 25 °C)
Isotropy	Response varies ± 0.5 dB (max.) for energy incident from any direction except from/through handle.
Noise	Less than 1% peak-to-peak on most sensitive range
Response Time	1.5 seconds (approx)
Battery Operation	500 hours (expendable)
Recorder Output	0.124 volt full scale into a nominal resistance of 100K ohms.
Operating Temp. Range	0°C to +50°C
Size:	
Power Density Meter	2.50" x 1.63" x 6.38" (64 x 41 x 162 mm)
Probe	13.25" long x 2.75" max. dia. (336 x 70 mm)
Cable Assembly	4' long (1.22 m)
Carrying Case	15.5" x 12.25" x 4.75" (394 x 311 x 120 mm)
Weight	3.25 lbs. (1.47 kg.)

(1) *Each unit is aligned at 2.45 GHz, and calibrated at a number of additional frequencies over its operating frequency range. The resultant data are furnished with the unit.*

The U.S Department of Labor's Occupational Safety and Health Administration (OSHA) has established occupational safety and health standards for the protection of personnel exposed to electromagnetic radiation.

The following are the applicable paragraphs of those standards, extracted from the Federal Register Volume 39, Number 125, June 27, 1974:

§ 1910.97 NONIONIZING RADIATION

(1) Electromagnetic Radiation—Definitions

(i) The term *"electromagnetic radiation"* is restricted to that portion of the spectrum commonly defined as the radio frequency region, which for the purpose of this specification shall include the microwave frequency region.

(ii) *Partial body irradiation.* Pertains to the case in which part of the body is exposed to the incident electromagnetic energy.

(iii) *Radiation protection guide.*Radiation level which should not be exceeded without careful consideration of the reasons for doing so.

(iv) *Whole body irradiation.* Pertains to the case in which the entire body is exposed to the incident electromagnetic energy or in which the cross section of the body is smaller than the cross section of the incident radiation beam.

(2)Radiation Protection Guide

(i) For normal environmental conditions and for incident electromagnetic energy of frequencies from 10 MHz to 100 GHz, the radiation protection guide is 10 mW/cm² (milliwatt per square centimeter) as averaged over any possible 0.1-hour period. This means the following:

Power density: 10 mW/cm² for periods of 0.1-hour or more.

Energy density: 1 mW-hr/cm² (milliwatt hour per square centimeter) during any 0.1-hour period.

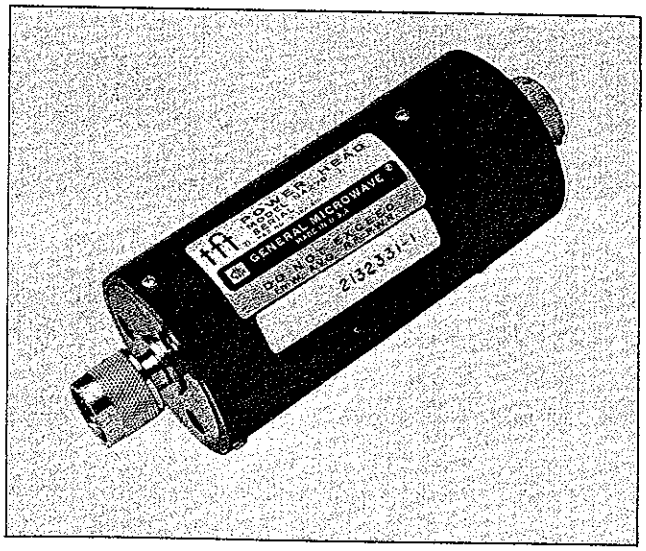
This guide applies whether the radiation is continuous or intermittent.

(ii) These formulated recommendations pertain to both whole body irradiation and partial body irradiation. Partial body irradiation must be included since it has been shown that some parts of the human body (e.g., eyes, testicles) may be harmed if exposed to incident radiation levels significantly in excess of the recommended levels.

GMC has designed and manufactured a large number of special and modified instruments for dedicated customer applications. Descriptions of some of them appear on these pages.

MILITARIZED TEMPERATURE-STABILIZED THERMOELECTRIC POWER MONITOR

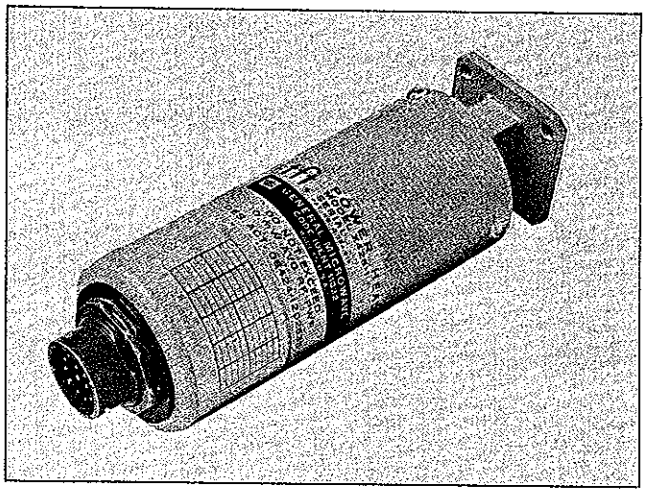
This militarized unit is used aboard a high-performance fighter aircraft. It contains a temperature-stabilizing network to maintain its accuracy over a wide temperature range.



MODEL N427B-3 POWER MONITOR

INTEGRATED WAVEGUIDE THERMOELECTRIC POWER MONITOR

This unit is a version of GMC's Model N425B Integrated Coaxial Thermoelectric Power Monitor that is equipped with an X-Band waveguide flange in lieu of the standard type N connector. Similar units can be made available with U, K- and A-Band waveguide flanges.

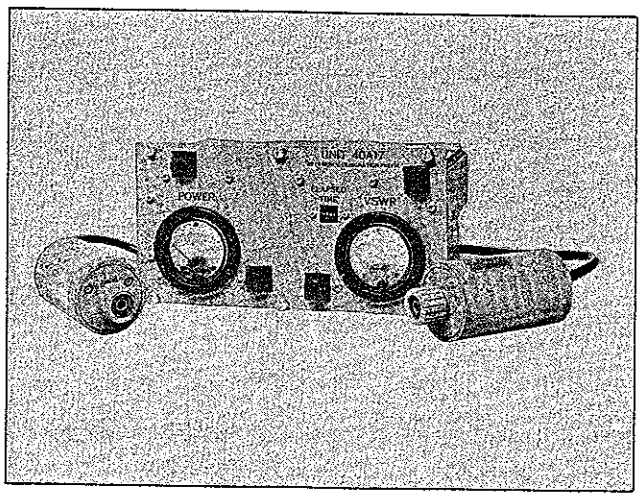


MODEL X425-1 POWER MONITOR

and Modified Instruments

MILITARIZED (AIRBORNE ENVIRONMENT) POWER/VSWR MONITOR

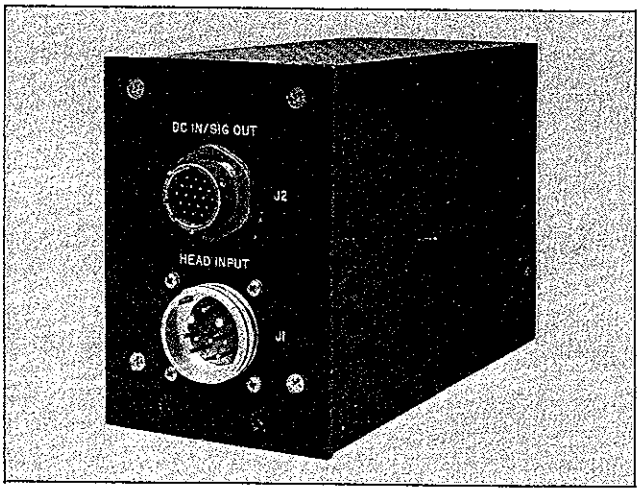
This instrument is used in an aircraft radar, and simultaneously measures and displays its output power and antenna VSWR. In addition, it provides logic signal alarms if either level exceeds pre-set acceptable performance limits.



MODEL 6346-1 POWER/VSWR MONITOR

MILITARIZED AUTO-RANGING POWER METER AMPLIFIER

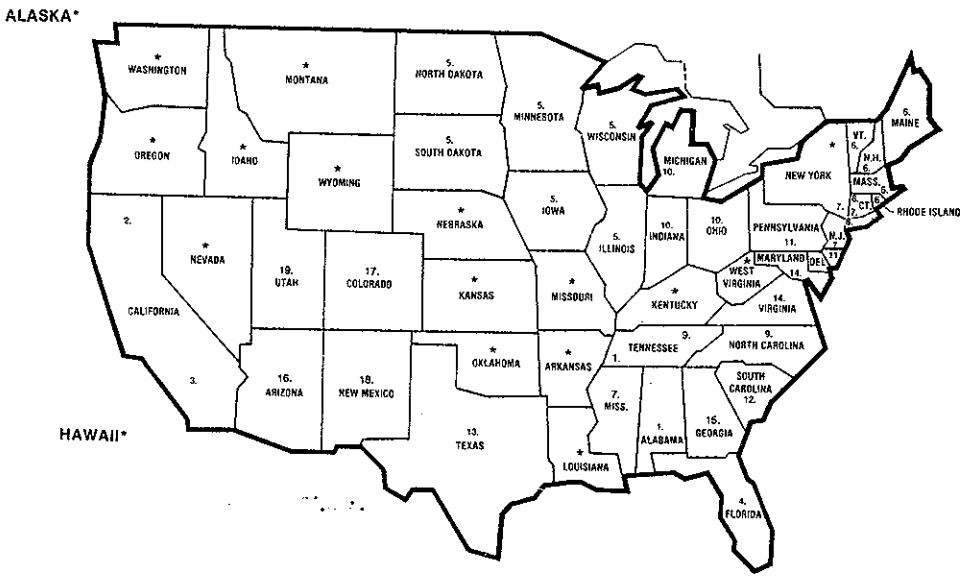
This unit is a special militarized version of the GMC Model 468 Power Meter Amplifier that contains an added fully-automatic range-selection network. Other units are available with such features as automatic zeroing networks and built-in power supplies. Requirements for other variations are invited.



MODEL 468-3 POWER METER AMPLIFIER

Sales Representatives

United States



1. Saber Associates, Inc.
   PO Box 5990
   Huntsville, AL 35805
   Tel: 305-724-0920

2. RF Associates, Inc.
   800 San Antonia Rd.
   Palo Alto, CA 94303
   Tel: 415-494-3331

3. RF Associates, Inc.
   2127 Sawtelle Blvd.
   Los Angeles, CA 90025
   Tel: 213-478-1586

4. Saber Associates, Inc.
   PO Box 1599
   Melbourne, FL 32902
   Tel: 305-724-0920

5. Cain-Forlaw Co. Inc.
   350 W. Kensington Rd.,
   Suite 113
   Mt. Prospect, IL 60056
   Tel: 312-253-3578

6. Microwave Marketing Specialists, Inc.
   279 Cambridge St.,
   8 Colonial Pk.
   Burlington, MA 01803
   Tel: 617-272-7530

7. E-F Technical Sales, Inc.
   60 Northfield Ave.
   W. Orange, NJ 07052
   Tel: 201-731-7203

8. E-F Technical Sales, Inc.
   825 E. Jericho Tpke.
   Huntington Station, NY 11746
   Tel: 516-549-1818

9. Saber Associates
   PO Box 826
   Clayton, NC 27520
   Tel: 305-724-0920

10. Cain-Forlaw Co.
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    Box 903 - RR2
    Lancaster, OH 43130
    Tel: 614-654-4800

11. HES Associates
    PO Box 1047
    Bensalem, PA 19020
    Tel: 215-245-5250

12. Saber Associates, Inc.
    PO Box 2772
    Columbia, SC 29202
    Tel: 305-724-0920

13. Cain & Co.
    2630 Northaven Rd., Suite 110
    Dallas, TX 75229
    Tel: 214-247-3901

14. Creative Marketing Assoc.
    6716 Old McLean Village Dr.
    McLean, VA 22101
    Tel: 703-442-9100

15. Saber Associates, Inc.
    PO Box 830
    Griffin, GA 30224
    Tel: 305-724-0920

16. Odyssey 1
    2432 W. Peoria Ave. Suite 1062B
    Phoenix, Az 85029
    Tel: 602-246-8846

17. Odyssey 1
    6444 South Quebec St., Bldg. 7-F
    Englewood, Co 80111
    Tel: 303-773-8176

18. Odyssey 1
    4300 F Silver Ave., S.E.
    Albuquerque, NM 87108
    Tel: 505-265-6645

19. Odyssey 1
    3353 S. Main, Suite 281
    Salt Lake City, UT 84115
    Tel: 801-531-1216

*General Microwave (Direct Service)

International

To place orders and for information about our microwave instruments and components, please contact your local representative.

Pour toute commande ou information sur nos composants et nos instruments de haute qualité pour ondes centimétriques, veuillez contacter votre représentant local.

Wenn sie bauteile und instrumente von höchster qualitat für mikrowellen benötigen, wenden sie sich bitten an uns.

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