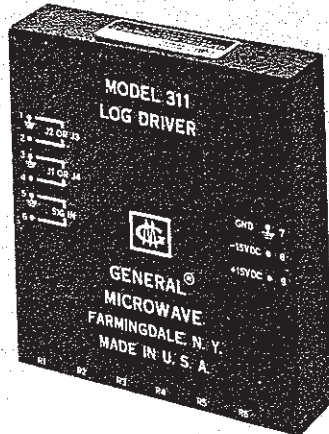
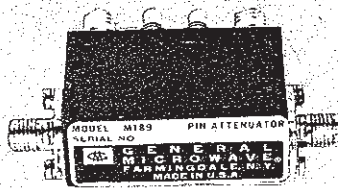
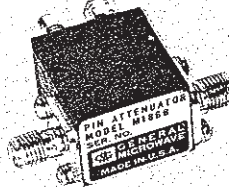


Models M186C, M189C and M190C Ultra-Broadband PIN Diode Attenuator/Modulators

ATTENUATORS
PHASE SHIFTERS

- 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.

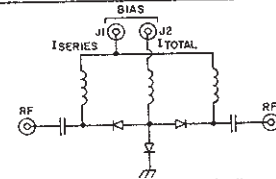


Fig. 1-Model M190C, schematic diagram
(Model M189C consists of two such sections)

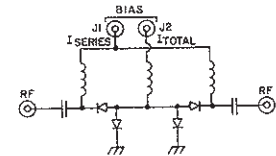


Fig. 2-Model M186C, schematic diagram

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 $+25^{\circ}\text{C}$, 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 state, 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)			MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)	
		0.2 to 8.0	8.0 to 12.4	12.4 to 18.0			0.2 to 8.0	8.0 to 12.4
M186C	Max Insertion Loss (dB)	1.5	2.2	3.0	LM186C	Max Insertion Loss (dB)	1.5	2.6
	Max VSWR	1.5	1.75	2.0		Max VSWR	1.5	1.75
	Min Attenuation (dB)	45 ⁽¹⁾	45	40		Min Attenuation (dB)	40 ⁽²⁾	40
M189C	Max Insertion Loss (dB)	2.5	3.0	5.0	LM189C	Max Insertion Loss (dB)	2.5	3.5
	Max VSWR	1.75	2.0	3.0		Max VSWR	1.75	2.0
	Min Attenuation (dB)	65	65	50		Min Attenuation (dB)	65	60
M190C	Max Insertion Loss (dB)	1.5	1.8	2.5	LM190C	Max Insertion Loss (dB)	1.5	1.8
	Max VSWR	1.5	1.6	2.0		Max VSWR	1.5	1.75
	Min Attenuation (dB)	35	35	30		Min Attenuation (dB)	35	30

FLATNESS (\pm dB)										
FREQUENCY (GHz)										
ATTEN. (dB)	0.2 to 8.0				0.2 to 12.4				12.4 to 18.0	
	M190C	M189C	LM190C	LM189C	M190C	M189C	LM190C	LM189C	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.

ATTENUATORS
PHASE SHIFTERS



Models M186C, M189C and M190C Specifications

ATTENUATORS
PHASE SHIFTERS

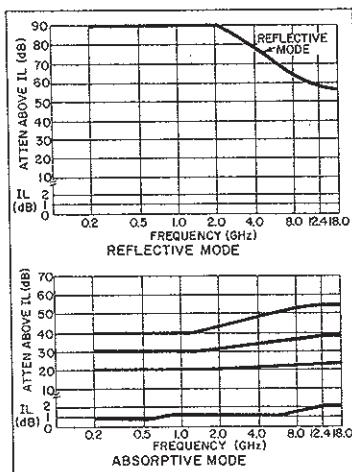


Fig. 3-Typical response curves of Model M186C

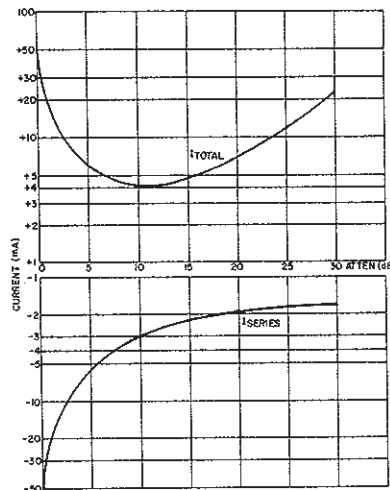


Fig. 4-Typical Models M186C and M190C bias current/attenuation transfer curves

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 $+25^{\circ}\text{C}$; see power derating curve, figure 6 on page 13, for higher temperatures)

All units 2W average or peak (1 μ sec 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 $+85^{\circ}\text{C}$

Non-Operating Temperature Range ... -65°C to $+125^{\circ}\text{C}$



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

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)

Models M186C, M189C and M190C Specifications

MODEL 311 CHARACTERISTICS⁽¹⁾ (cont)

Switching Time	100 μ sec max
Power Supply Requirements	+15V \pm 0.1%, 125 mA
	-15V \pm 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.

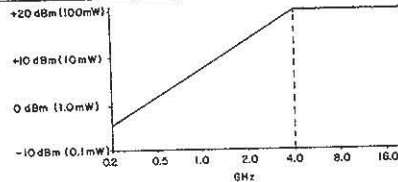


Fig. 5-Models M186C, M190C and M189C, maximum peak and average operating power without performance degradation

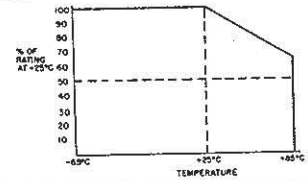
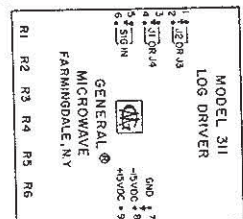
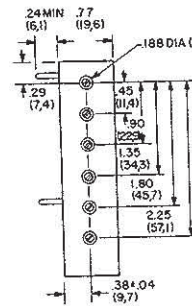
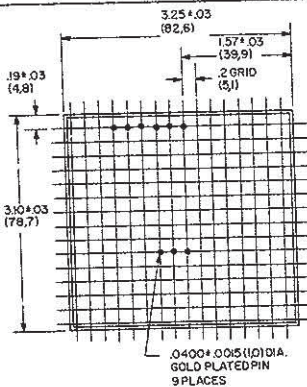
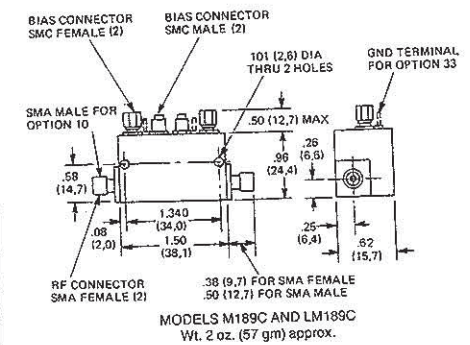
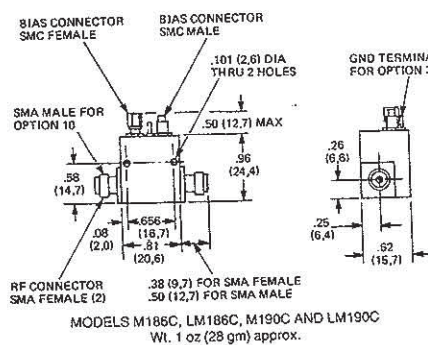


Fig. 6-Models M186C, LM186C, M189C, LM189C, M190C and LM190C, survival power derating factors

DIMENSIONS AND WEIGHTS



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

Dimensional Tolerances, unless otherwise indicated: .XX \pm .02, .XXX \pm .005

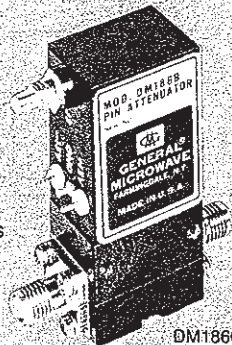


Models DM186CH, DM189CH, and DM190CH Absorptive Ultra-Broadband Pulse Modulators

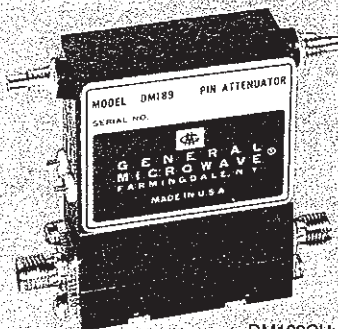
ATTENUATORS
PHASE SHIFTERS

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

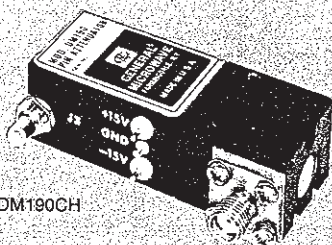
THE THREE UNITS
IN THIS SERIES
ARE EQUIPPED WITH
INTEGRATED DRIVERS



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.

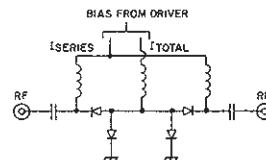


Fig. 1-Model DM186CH, rf schematic diagram

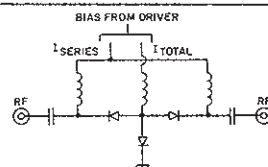


Fig. 2-Model DM190CH, rf schematic diagram
(Model DM189CH consists of two such sections)

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.

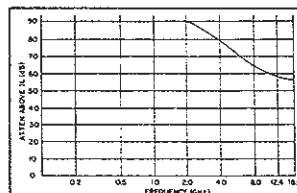


Fig. 3-Typical DM186CH-31 response curve

Models DM186CH, DM189CH, and DM190CH Specifications

ATTENUATORS
DIPAGE SHIFTERS

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.

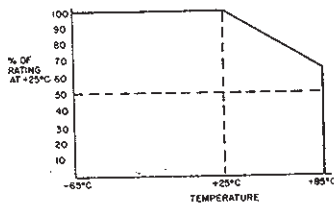


Fig. 4-Models DM186CH, DM189CH and DM190CH, survival power derating factors

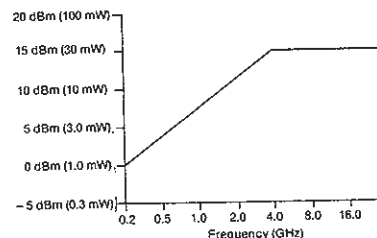


Fig. 5-Models DM186CH, DM189CH and DM190CH, maximum peak and average operating power without performance degradation



Models DM186CH, DM189CH, and DM190CH Specifications

ATTENUATORS
PHASE SHIFTERS

ENVIRONMENTAL RATINGS

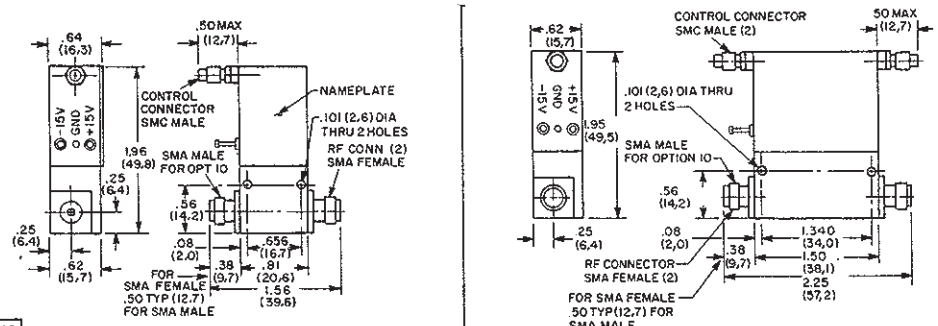
Operating Temperature	
Range	-65°C to +85°C
Non-Operating Temperature	
Range	-65°C to +125°C
Humidity	MIL-STD-202F, Method 103B, Cond. B (96 hrs. at 95%)
Shock	MIL-STD-202F, Method 213B, Cond. B (75G, 6 msec)
Vibration	MIL-STD-202F, Method 204D, Cond. B (.06" double amplitude or 15G, whichever is less)
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 im- pedance
31	High isolation (reflective) design
33	EMI filter solder-type control ter- minal(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