# Series 349 and 349H Octave-Band 11 Bit Digital PIN Diode Attenuators

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Applicaion Notes for Microwave Attenuator

The Series 349 and 349H programmable attenuators provide greater than octave-band performance and wide programming flexibility in compact rugged packages. Attenuation ranges up to 80 dB are available with attenuation increments as low as 0.03 dB.

Each Series 349 and 349H unit is an integrated assembly of a balanced PIN diode attenuator and a driver circuit consisting of a PROM, a D/A converter and a current-to-voltage converter. See Figure 1. This arrangement provides a high degree of accuracy and repeatability and preserves the inherent monotonicity of the attenuator.

**SERIES 349**
The maximum programmable attenuation range in every band except the 8.0–18.0 GHz frequency range is 80 dB. Attenuators limited in range to 64 dB exhibit switching times less than 500 nsec while the 80 dB units switch in less than 2 µsec.

**SERIES 349H**
If even faster switching of 64 dB units is required, GMC offers its Series 349H attenuators. These units switch in less than 300 nsec with essentially the same performance specifications as the 64 dB Series 349 units.
All the attenuators are available with either a strobe/ latch or a non-linear current or voltage controlled attenuation capability. Refer to the Available Options table and the Notes following the Pin Functions table.

- **Absorptive**
- **64 or 80 dB range**
- **.03 dB resolution**
- **Binary or BCD programming**
- **Guaranteed monotonicity**
- **Frequency range: 0.75 to 18 GHz**

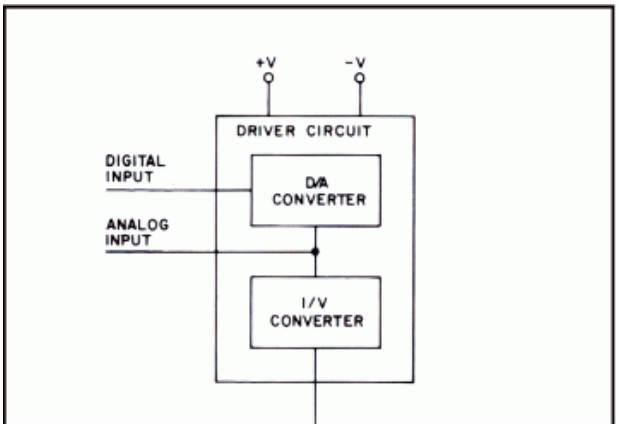




*Fig. 1–Series 349 and 349H block diagram*

## PERFORMANCE CHARACTERISTICS: SERIES 349

| MODEL | FREQUENCY RANGE GHZ | MAX. INSERTION LOSS(dB) | MAX. VSWR | MAX. FLATNESS (±dB) AT MEAN ATTENUATION LEVELS UP TO | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 10 dB | 20 dB | 40 dB | 60 dB (4) | 80 dB(1) |
| 3491-64<br>3491-80 | 1.0 - 2.0 | 1.6 | 1.5 | 0.3 | 1.0 | 1.5 | 1.6 | 1.9 |
| | 0.75 - 2.25(2) | 1.7 | 2.0 | 0.5 | 1.4 | 3.0 | 3.5 | 3.8 |
| 3492-64<br>3492-80 | 2.0 - 4.0 | 1.8 | 1.5 | 0.3 | 1.0 | 1.5 | 1.6 | 1.9 |
| | 1.5-4.5(2) | 1.9 | 2.0 | 0.5 | 1.4 | 3.0 | 3.5 | 3.8 |
| 3493-64<br>3493-80 | 2.6-5.2 | 2.0 | 1.6 | 0.3 | 1.0 | 1.5 | 1.6 | 1.9 |
| | 1.95-5.85(2) | 2.1 | 2.1 | 0.5 | 1.4 | 3.0 | 3.5 | 3.8 |
| 3494-64<br>3494-80 | 4.0 - 8.0 | 2.4 | 1.7 | 0.3 | 1.0 | 1.5 | 1.6 | 1.9 |
| | 3.0-9.0(2) | 2.5 | 2.2 | 0.5 | 1.4 | 3.0 | 3.5 | 3.8 |
| 3495-64<br>3495-80 | 5.0 - 10.0 | 2.6 | 1.7 | 0.5 | 1.0 | 1.5 | 1.6 | 1.9 |
| | 3.75 - 11.25(2) | 2.7 | 2.2 | 0.7 | 1.4 | 3.0 | 3.5 | 3.8 |
| 3496-64<br>3496-80 | 6.0-12.0 | 2.7 | 1.8 | 0.7 | 1.0 | 1.5 | 1.6 | 1.9 |
| | 4.5-13.5(2) | 2.8 | 2.2 | 0.9 | 1.5 | 3.0 | 3.5 | 3.8 |
| 3498-64 | 8.0-18.0 | 3.0(3) | 1.8(3) | 0.7 | 1.0 | 1.5 | 1.6 | - |
| | 6.0-18.0(2) | 3.0(3) | 1.8(3) | 0.9 | 1.5 | 3.0 | 3.5 | - |

## PERFORMANCE CHARACTERISTICS: SERIES 349H

| MODEL | FREQUENCY RANGE GHZ | MAX. INSERTION LOSS(dB) | MAX. VSWR | MAX. FLATNESS (Â±dB) AT MEAN ATTENUATION LEVELS UP TO | | | |
|---|---|---|---|---|---|---|---|
| | | | | 10 dB | 20 dB | 40 dB | 60 dB (4) |
| 3491H-64 | 1.0 - 2.0 | 1.6 | 1.5 | 0.5 | 1.0 | 1.5 | 1.6 |
| | 0.75 - 2.25(2) | 1.7 | 2.0 | 0.7 | 1.6 | 3.0 | 3.5 |
| 3492H-64 | 2.0 - 4.0 | 1.8 | 1.5 | 0.5 | 1.0 | 1.5 | 1.6 |
| | 1.5-4.5(2) | 1.9 | 2.0 | 0.7 | 1.6 | 3.0 | 3.5 |
| 3493H-64 | 2.6-5.2 | 2.0 | 1.6 | 0.5 | 1.0 | 1.5 | 1.6 |
| | 1.95-5.85(2) | 2.1 | 2.1 | 0.7 | 1.6 | 3.0 | 3.5 |
| 3494H-64 | 4.0 - 8.0 | 2.4 | 1.7 | 0.5 | 1.0 | 1.5 | 1.6 |
| | 3.0-9.0(2) | 2.5 | 2.2 | 0.7 | 1.6 | 3.0 | 3.5 |
| 3495H-64 | 5.0 - 10.0 | 2.6 | 1.7 | 0.7 | 1.0 | 1.5 | 1.6 |
| | 3.75 -11.25(2) | 2.7 | 2.2 | 0.9 | 1.6 | 3.0 | 3.5 |
| 3496H-64 | 6.0-12.0 | 2.7 | 1.8 | 0.7 | 1.0 | 1.5 | 1.6 |
| | 4.5-13.5(2) | 2.8 | 2.2 | 0.9 | 1.6 | 3.0 | 3.5 |
| 3498H-64 | 8.0-18.0 | 3.0(3) | 1.8(3) | 0.7 | 1.0 | 1.5 | 1.6 |
| | 6.0-18.0(2) | 3.0(3) | 1.8(3) | 0.9 | 1.6 | 3.0 | 3.5 |

(1) Applicable only to 80 dB versions.
(2) Specifications for the extended frequency ranges are typical
(3) Except from 16-18 GHz where insertion loss is 4.2 dB max. and VSWR is 2.2.
(4) Flatness specification, at 64 dB level is ±0.2dB higher than at 60 dB level

## Series 349 and 349H Specifications

**Mean Attenuation Range**

| | |
|---|---|
| 349(x)-64, 349(x)H-64 | 64 dB |

**Accuracy of Attenuation**

| | |
|---|---|
| 0 to 30dB | ± 0.5 dB |
| > 30 to 50 dB | ± 1.0 dB |
| > 50 to 64 dB | ± 1.5 dB |
| > 64 to 80 dB | ± 2.0 dB |
| **Monotonicity** | Guaranteed |
| **Temperature Coefficient** | ± 0.025 dB/ °C |

**Power Handling Capability**

**Without Performance Degradation**

| | |
|---|---|
| 3491, 3492H, 3498H | 10 mW cw or peak |
| 3491H | 1 mW cw or peak |
| All other Units | 100 mW cw or peak |

**Survival Power (from -40°C to +25°C; see Fig. 2 for higher temperatures)**

| | |
|---|---|
| All units | 1 W average 25W peak (1 µsec max pulse width) |

**Switching Time**

| | |
|---|---|
| 349(x)H-64 | 300 nsec max |
| 349(x)-64 | 550 nsec max |
| 349(x)-80 | 2 µsec max |
| **Programming** | Positive true binary (standard) or BCD (Option 1). For complementary code, specify Option 2. |

**Minimum Attenuation Step(5)**

Binary Units

| | |
|---|---|
| 349(x)-64, 349(x)H-64 | 0.03 dB |
| 349(x)-80 | 0.04 dB |
| BCD Units | 0.10 dB |

**Logic Input**

| | |
|---|---|
| Logic "O" (Bit Off) | -0.3 to +0.8 V |
| Logic "I" (Bit On) | +2.0 to +5.0 V |
| Logic Input Sink Current | 0.3 µA max. |
| Logic Input Source Current | 3 µA max |

**Analog Input(6)**

| | |
|---|---|
| 349(x)-64, 349(x)H-64 | 0 to 6.4 V |
| 349(x)-80 | 0 to 8 V |
| Input Resistance | 10 K ohms |

| | |
|---|---|
| **Power Supply Requirements** | +12 to +15V, 120 mA<br>-12 to -15 V 50 mA |
| **Power Supply Rejection** | Less than 0.1 dB/volt change in either supply |

## ENVIRONMENTAL RATINGS

| | |
|---|---|
| **Operating Temperature Range** | -40°C to + 85°C |
| **Non-Operating Temperature Range** | -54°C to + 100°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 |

## ACCESSORIES FURNISHED

Mating power/logic connector

## AVAILABLE OPTIONS

| Option No | Description |
|---|---|
| 1 | BCD programming (Binary is standard |
| 2 | Complementary programming (logic "O" is Bit On) |
| 4 | Strobe latch for date input. Attenuator responds to data input when logic "0" is applied. Attenuator latched to data input when logic "1" is applied. |
| 7 | Two SMA male RF connectors |
| G06 | Switching speed for analog input is no longer than with a digital input |
| 10 | One SMA male RF connector (J1) and one SMA female RF connector (J2). |

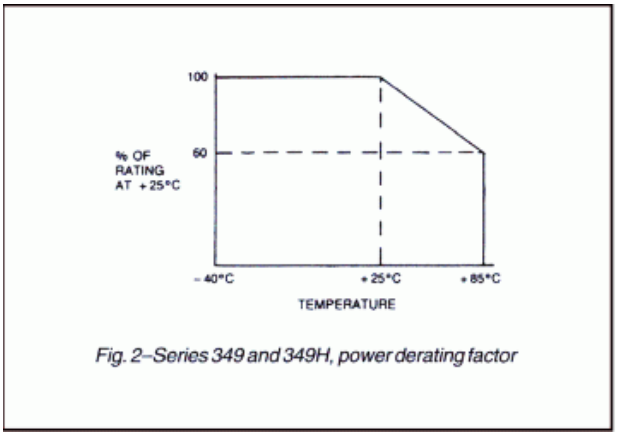


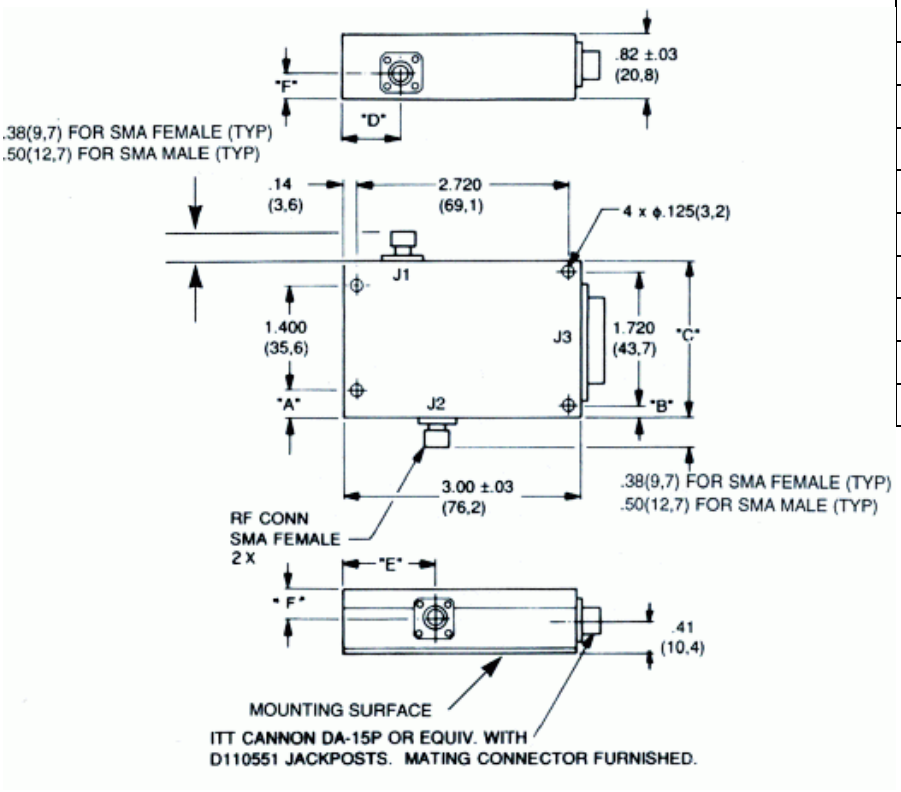

*Fig. 2–Series 349 and 349H, power derating factor*

(5) The Series 349 attenuators are 11-bit digital attenuators. In order to use this device with lesser number of bits (lower resolution), the user may simply ground the logic pins for the lower order unused bots. For example, a Series 349 unit operating as an 8-bit unit would have Pin 15, Pin 1 and Pin 2 connected to ground. All other parameters remain unchanged.

(6) Switcjing speed for analog input is 100 µsec. typical. With Option G06 it is not longer than with a digital input.

## DIMENSIONS AND WEIGHT

| J3 PIN FUNCTIONS(1) | | | |
|---|---|---|---|
| PIN | BINARY | | BDC |
| | 64 dB | 80 dB | |
| 1 | 0.06 dB | 0.08 dB | 0.2 dB |
| 2 | 0.13 dB | 0.16 dB | 0.4 dB |
| 3 | Analog Input / Strobe Latch(2)(3) | | |
| 4 | GND | | |
| 5 | 0.25 dB | 0.31 dB | 0.8 dB |
| 6 | 0.5 dB | 0.63 dB | 1 dB |
| 7 | 1 dB | 1.25 dB | 2 dB |
| 8 | 2 dB | 2.5 dB | 4 dB |
| 9 | 4 dB | 5 dB | 8 dB |
| 10 | 8 dB | 10 dB | 10 dB |
| 11 | 16 dB | 20 dB | 20 dB |
| 12 | 32 dB | 40 dB | 40 dB |
| 13 | +12 to +15 V | | |
| 14 | -12 to -15 V | | |
| 15 | 0.03 dB | 0.04 dB | 0.1 dB |




Series 349, 349H
Wt: 4 oz. (113 gm) approx.

| MODEL | DIM "A" | DIM "B" | DIM "C" | DIM "D" | DIM "E" | DIM "F" |
|---|---|---|---|---|---|---|
| 3491, 3491H | .58 (14,7) | .42 (10,7) | 2.56±.03 (65,0) | .56 (14,2) | 1.53 (38,9) | .34 (8,6) |
| 3492,93, 3492H,93H | .30 (7,6) | .14 (3,6) | 2.00±.03 (50,8) | .50 (12,7) | 1.29 (32,8) | .34 (8,6) |
| 3494,95,96, 3494H,95H,96H | .30 (7,6) | .14 (3,6) | 2.00±.03 (50,8) | .75 (19,1) | 1.19 (30,2) | .34 (8,6) |
| 3498, 34498H | .30 (7,6) | .14 (3,6) | 2.00±.03 (50,8) | .75 (19,1) | 1.00 (25,4) | .34 (8,6) |

**Notes:**

1. The Series 349 attenuators are 11-bit digital attenuators. In order to use this device with lesser number of bits (lower resolution), the user may simply ground the logic pins for the lower order unused bits. For example, a Series 349 unit operating as an 8-bit unit would have Pin 15, Pin 1 ansd Pin 2 connected to ground. All other parameters remain unchanged.

2. Normally supplied as an Analog input. Leave pin open if analog input is not used. Optionally available as a strobe latch function for input data.

3. Pin 3 is available to apply a current or voltage to control the attenuator in a non-linear fashion.

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