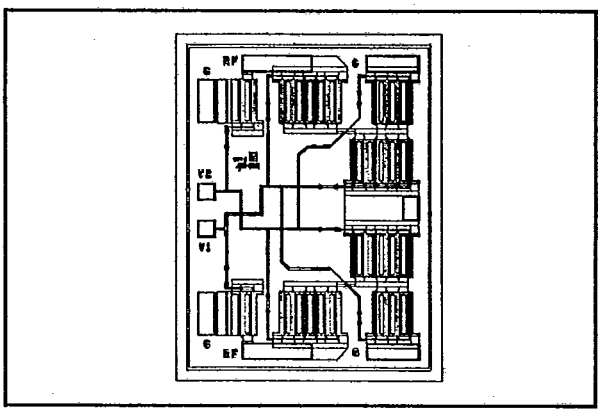
T-74-13-01

MA4GM303-500
2000
2010
2012
2100

## MA4GM303 SERIES

# GaAs MMIC DC - 2 GHz Voltage Variable Absorptive Attenuator



## Description

The MA4GM303 series of DC - 2 GHz GaAs FET MMIC absorptive bridge "T" attenuators will provide up to 32 dB of "matched" attenuation. The input and output SWR is less than 1.5 maximum under all attenuation values. The 0.1 dB compression point is 0 dBm. These attenuators are available as a bondable chip, in a TO-5 package and in three flat pack packages. The control voltage requirements are 0 to −5 volts and maximum control current (leakage) is 50 μA.

This attenuator has two independent bias controls. By varying these two bias voltages, 32 dB of matched attenuation can be obtained.

The attenuator may be also used with "single bias control" by leaving $V_1$ at zero bias and controlling $V_2$ from 0 to −5 volts. Attenuation is reduced to 22 dBm maximum.*

These small attenuators have very flat attenuation from DC - 2 GHz. The electrical performance at both input and output is symmetrical.

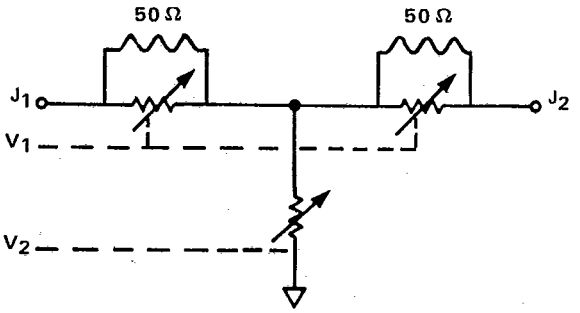
They are suggested as inexpensive, fast attenuators for AGC circuits in military systems, instrumentation, telecommunications and RF equipment or for control of signal levels in signal processing.

*In single bias mode of operation attenuator becomes reflective.

## Features

- SINGLE* OR DUAL DC BIAS CONTROL
- EASILY CASCADABLE
- SMALL SIZE
- ATTENUATION FLATNESS DC - 2 GHz ±.2 dB
- LOW CONTROL CURRENT CONSUMPTION (50 μA)
- LOW PHASE SHIFT
- UP TO 32 dB MATCHED ATTENUATION

### BRIDGE 'T' ATTENUATOR SCHEMATIC



## ELECTRICAL SPECIFICATIONS @ 25°C[1]

| Parameters | Symbol | Test Conditions ($T_A$ = 25°C) | Frequency | Min. | Nominal | Max. | Units |
|---|---|---|---|---|---|---|---|
| Insertion Loss[4] | L | $V_1$ = 0, $V_2$ = −5 | DC - 1.0 GHz<br>1.0 - 2.0 GHz | —<br>— | 1.3<br>1.4 | 1.5<br>1.7 | dB |
| VSWR I/O[1] | SWR | All Attenuation Levels | DC - 1.0 GHz<br>1.0 - 2.0 GHz | —<br>— | 1.1<br>1.25 | 1.5<br>1.5 | — |
| Relative Attenuation (Matched)[1] | — | Linear Attenuation | DC - 2.0 GHz | 30 | 32 | — | dB |
| Relative Attenuation (Single Bias)[2] | — | Linear Attenuation | DC - 2.0 GHz | 20 | 22 | — | dB |
| Compression Point | $P_{-.1\ dB}$ | (See Figure) | — | — | 0 | — | dB |
| Control Voltage[5] | $V_C$ | $I_{GSL}$ <50μA | — | — | 0 | −5 | V |
| Phase Shift | φ | 10 dB Dynamic Range | 1 GHz | — | 3 | — | Degrees |
| Leakage Current | $I_{GSL}$ | @ −5V | — | — | — | 50 | μA |

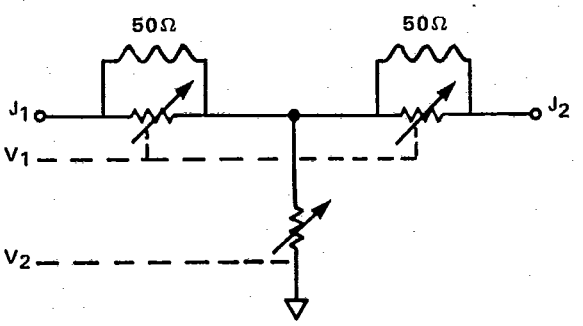
**Notes:**

1. Two dc bias voltages required.
2. One dc bias voltage required.
3. All data in data sheet refer to dual dc bias control except for page 3 and line item referenced in note 2.
4. Insertion loss is .2 dB lower for chip
5. The control range for operation is 0 to −5 volts.

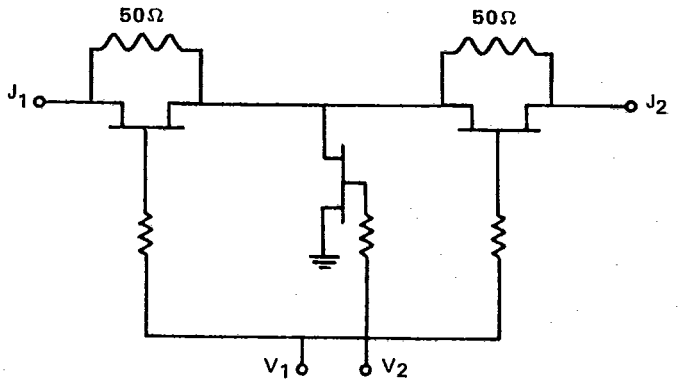
## ABSOLUTE MAXIMUM RATINGS @ 25°C

| Symbol | Parameters | Units | Recommended Maximum |
|---|---|---|---|
| $V_C$ | Control Voltage ($V_1$, $V_2$) | V | −9 |
| $P_{IN}$ | Input Power: Operating<br>Survival | dBm | see figures<br>27 |
| $T_{st}$ | Storage Temperature | °C | −55 to +150 |
| $T_{op}$ | Operating Temperature | °C | −55 to +125 |

## ATTENUATOR EQUIVALENT CIRCUIT



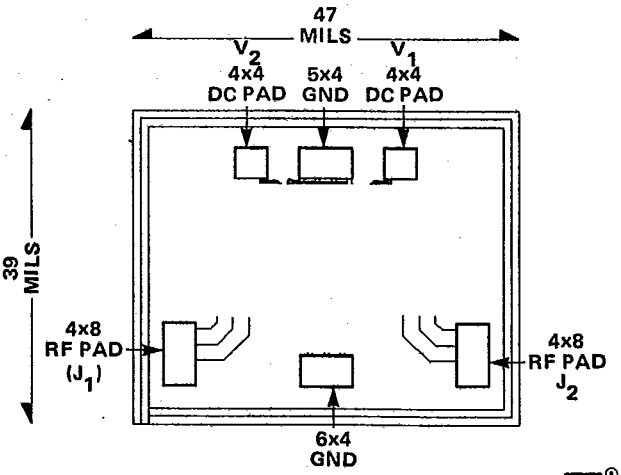

## ATTENUATOR SCHEMATIC DIAGRAM




**Note:** All dc points have an impedance of at least 5K Ω

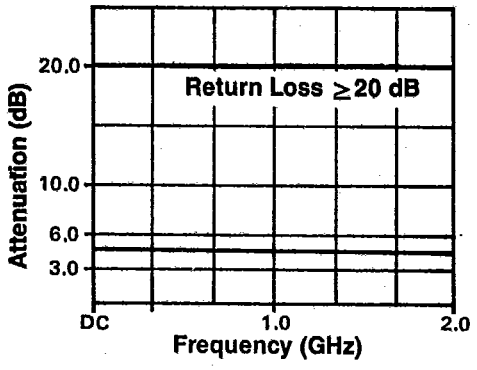
**Attenuation Variation with Temperature for Dual Bias Mode with Return Loss >20 dB.**
Worst case variation of attenuation over the temperature range of −55°C to +125°C is ±0.5 dB or ±10% of the nominal value, whichever is greater. However, it is possible to minimize this tolerance by trading off return loss.

## BONDING DIAGRAM MA4GM303-500

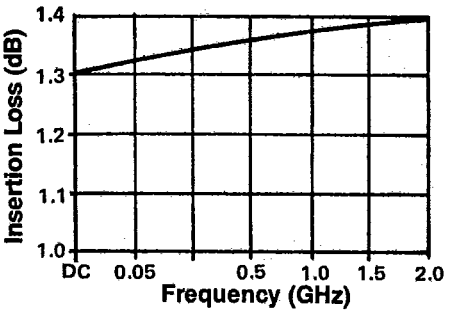



*M* M/A-COM

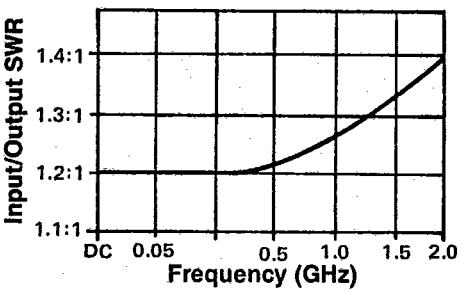
## TYPICAL PERFORMANCE CURVES FOR DUAL BIAS CONDITION



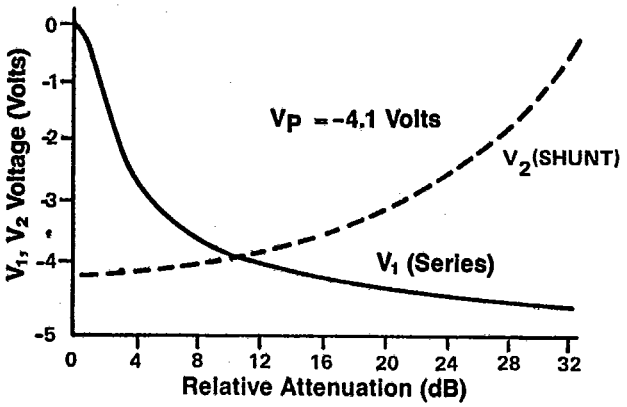

Attenuation vs. Frequency for Various Levels of Attenuation



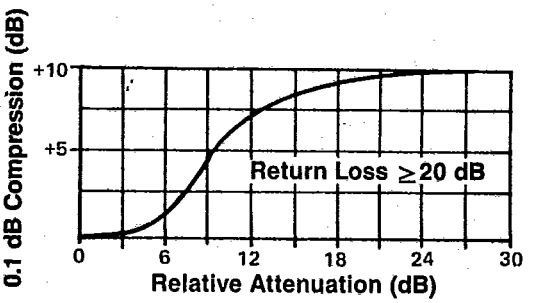

Insertion Loss vs. Frequency




(Insertion Loss Condition)
SWR vs. Frequency

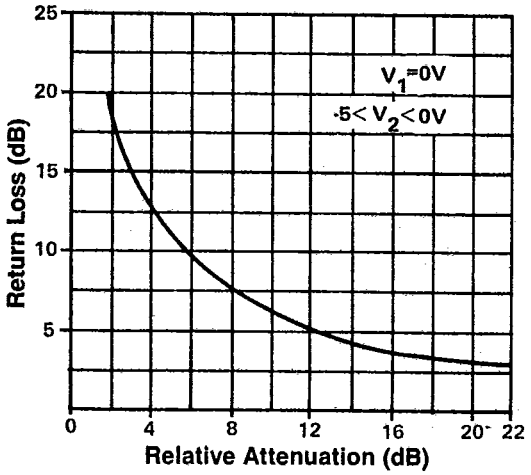



Attenuation under matched conditions vs. voltage bias for dual bias operation. All device types are specified with a .3 volt pinch off range.

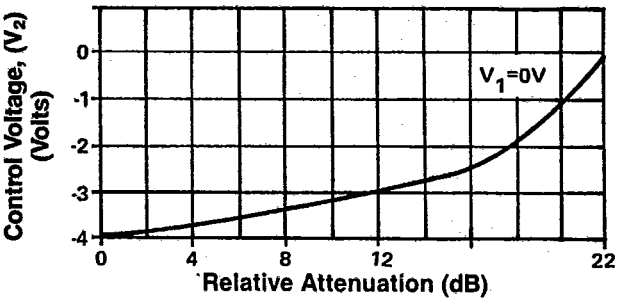


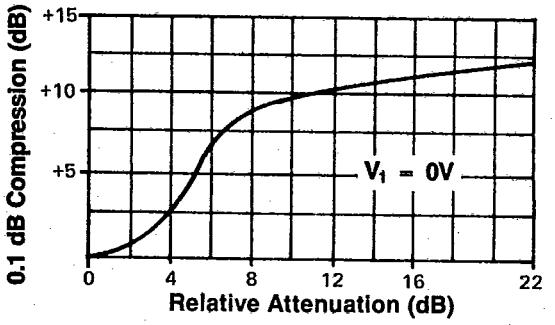

0.1 dB Compression vs. Relative Attenuation for Dual Bias

## TYPICAL PERFORMANCE CURVES FOR SINGLE BIAS CONDITION ($V_1$ = 0 VOLTS)




Return Loss vs. Relative Attenuation for Single Bias

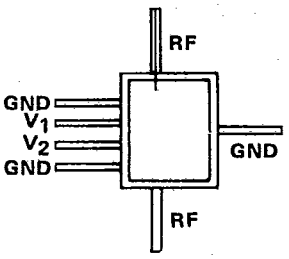


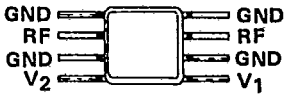

0.1 dB Compression vs. Relative Attenuation for Single Bias

## PIN OUT DIAGRAMS — TOP VIEW (ALL PACKAGES)

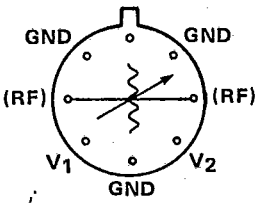
### 2000 AND 2100 PIN OUT




### 2012 PIN OUT




### 2010 PIN OUT

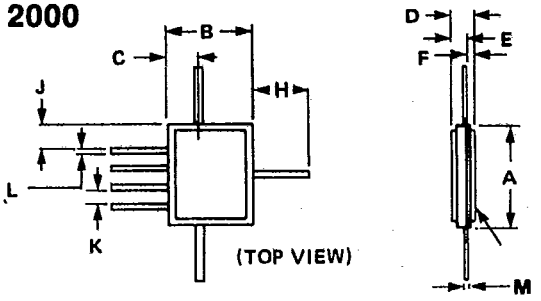



**Note:** Bottom surface of all packages and leads marked 'GND' are electrical ground for the circuit. Isolation specifications were measured with optimum condition (bottom surface grounded). This is important above 500 MHz.

## CASE STYLES

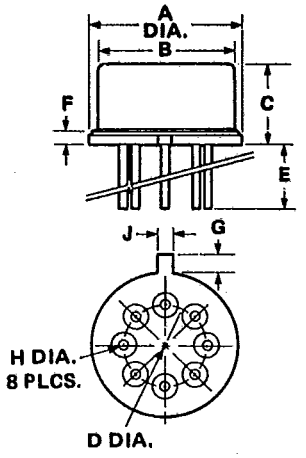


### 2000



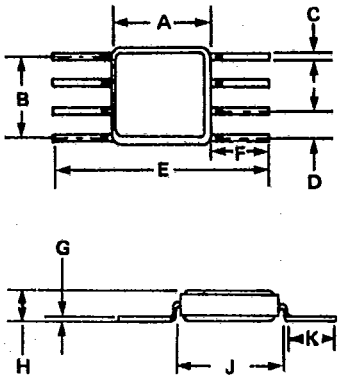

| DIM. | INCHES MIN. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS MAX. |
|---|---|---|---|---|
| A | .252 | .268 | 6,40 | 6,80 |
| B | .207 | .223 | 5,25 | 5,66 |
| C | .075 | .085 | 1,90 | 2,15 |
| D | .050 | .065 | 1,27 | 1,65 |
| E | .027 | .035 | ,685 | ,889 |
| F | .020 | .030 | ,508 | ,762 |
| H | .120 | .160 | 3,05 | 4,06 |
| J | .053 | .063 | 1,34 | 1,60 |
| K | .032 | .038 | ,812 | ,965 |
| L | .008 | .012 | ,203 | ,304 |
| M | .004 | .007 | ,101 | ,177 |

### 2010



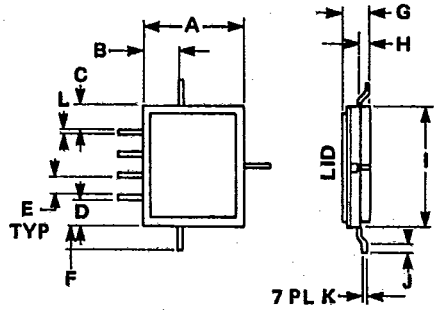

| DIM. | INCHES MIN. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS MAX. |
|---|---|---|---|---|
| A | .335 | .370 | 8,50 | 9,39 |
| B | .305 | .335 | 7,74 | 8,50 |
| C | .180 | .200 | 4,57 | 5,08 |
| D | T.P. | .200 | T.P. | 5,08 |
| E | .250 | — | 6,35 | — |
| F | — | .040 | — | 1,02 |
| G | .029 | .045 | 0,737 | 1,14 |
| H | .016 | .019 | 0,41 | 0,48 |
| J | .028 | .034 | 0,68 | 0,86 |

### 2012




| DIM. | INCHES MIN. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS MAX. |
|---|---|---|---|---|
| A | .175 | .185 | 4,44 | 4,69 |
| B | .145 | .155 | 3,68 | 3,93 |
| C | .014 | .016 | 0,35 | 0,40 |
| D | .045 | .055 | 1,14 | 1,40 |
| E | — | .400 | — | 10,16 |
| F | .090 | .110 | 2,29 | 2,79 |
| G | .004 | .006 | 0,10 | 0,15 |
| H | — | .075 | — | 1,90 |
| J | .205 | .215 | 5,20 | 5,46 |
| K | .060 | .080 | 1,52 | 2,03 |

### 2100




| DIM. | INCHES MIN. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS MAX. |
|---|---|---|---|---|
| A | .233 | .207 | 5,64 | 5,25 |
| B | .085 | .075 | 2,15 | 1,90 |
| C | .063 | .053 | 1,60 | 1,34 |
| D | .063 | .053 | 1,60 | 1,34 |
| E | .038 | .032 | 0,94 | 0,81 |
| F | .070 | .050 | 1,77 | 1,27 |
| G | .065 | .050 | 1,65 | 1,27 |
| H | .034 | .024 | 0,91 | 0,61 |
| I | .268 | .252 | 6,80 | 6,40 |
| J | .025 | .015 | 0,43 | 0,34 |
| K | .007 | .004 | 0,17 | 0,10 |
| L | .012 | .006 | 0,30 | 0,20 |