

Features

- 4 PIN diodes in a SOT-25 Plastic Package
- Externally Selectable Bias and RF Matching Network
- 10 – 4,000 MHz Useable Frequency Band
- + 43 dBm IP3 @ 1000 MHz (50 Ω)
- 1.0 dB Loss @ 1000 MHz (50 Ω)
- 30 dB Attenuation @ 1000 MHz (50 Ω)
- Lead-Free SOT-25 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of MA4P274-1225

Description

M/A-COM’s MA4P7455-1225 is a wideband, lower insertion loss, high IP3, Quad PIN diode π attenuator in a low-cost, lead free surface mount SOT-25 package. Four PIN diodes in one package reduce design parasitics and improve circuit density.

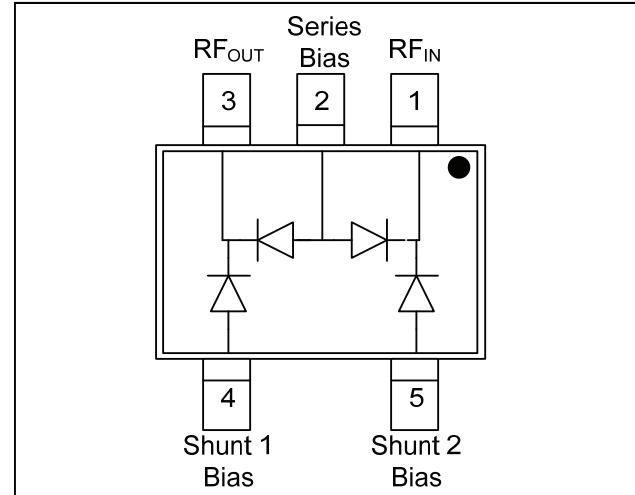
These PIN diode attenuators perform well where RF signal amplitude control is required in 50 Ω handset circuits and 75 Ω broadband CATV systems. Exceptional insertion loss, attenuation range, and IP3 at <10 mA bias make these devices suitable for better power level control in RF amplifiers.

Ordering Information¹

| Model No. | Package |
|--------------------|---------------|
| MA4P7455-1225T | Tape and Reel |
| MADP-007455-001SMB | Sample Board |

1. Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration

| Pin No. | Function | Pin No. | Function |
|---------|-------------|---------|--------------|
| 1 | RF IN | 4 | Shunt 1 Bias |
| 2 | Series Bias | 5 | Shunt 2 Bias |
| 3 | RF OUT | | |

Absolute Maximum Ratings^{2,3}

| Parameter | Absolute Maximum |
|--|-------------------|
| Operating Temperature | -65 °C to +125 °C |
| Storage Temperature No Dissipated Power | -65 °C to +150 °C |
| DC Voltage at Temperature Extremes | - 100 V |
| DC Current | 75 mA |

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. M/A-COM does not recommend sustained operation near these survivability limits.

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

Typical 50 Ω Performance⁴ @ 25°C using Wideband RF Circuit Design

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|------------------------|---|---------|------|------|------|
| Insertion Loss | +3 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz | dB | — | -2.0 | — |
| Insertion Loss | +6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz | dB | — | -1.0 | — |
| Return Loss | +6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz | dB | — | -10 | — |
| Attenuation | 0 mA - Series Diode Bias / 0.75 V - Shunt 1 and 2 Bias 1000 MHz | dB | — | -29 | — |
| Input IP3 | 0 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias +6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias F1 = 1000 MHz, F2 = 1100 MHz | dBm | — | 43 | — |
| | | dBm | — | 43 | — |
| Input IP3 | 0 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias +6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias F1 = 100 MHz, F2 = 110 MHz | dBm | — | 43 | — |
| | | dBm | — | 33 | — |
| Settling Time | Within 1 dB of Final Attenuation Value 1000 MHz | μ S | — | 3 | — |
| RF C.W. Incident Power | 0 - 20 V Series Diode Bias / 0.75 V Shunt 1 and 2 Bias | dBm | — | +20 | — |

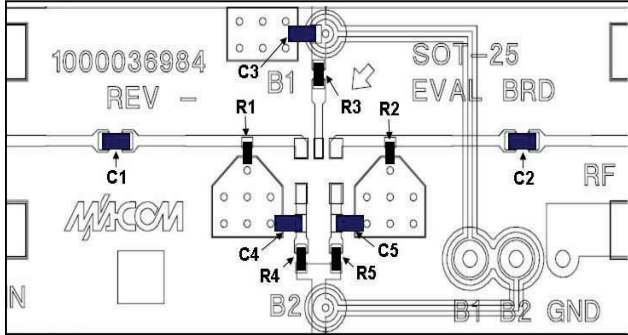
4. Values shown include through loss calibrated out of RF test circuit.

Typical 75 Ω Performance⁵ @ +25°C using Wideband RF Circuit Design

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|----------------|--|-------|------|------|------|
| Insertion Loss | +2 mA Series Diode Bias / 1.0 V Shunt 1 and 2 Bias +4.5 mA Series Diode Bias / 1.0 V Shunt 1 and 2 Bias 1000 MHz | dB | — | -1.1 | — |
| | | dB | — | -0.6 | — |
| Attenuation | 0 mA / Series Diode and 1.0 V Shunt 1 and 2 Bias 1000 MHz | dB | — | -27 | — |
| Return Loss | +4.5 mA / Series Diode and 1.0 V Shunt 1 and 2 Bias 1000 MHz | dB | — | -10 | — |

5. Values shown include through loss calibrated out of RF test circuit.

Recommended PCB Layout



Parts List

| Part | Value | Case Style | Manufacturer |
|--------------------|---------------|------------|--------------|
| C1, C2, C3, C4, C5 | 100 pF | 0603 | Murata |
| R1, R2, R3, R4, R5 | 1000 Ω | 0402 | Panasonic |

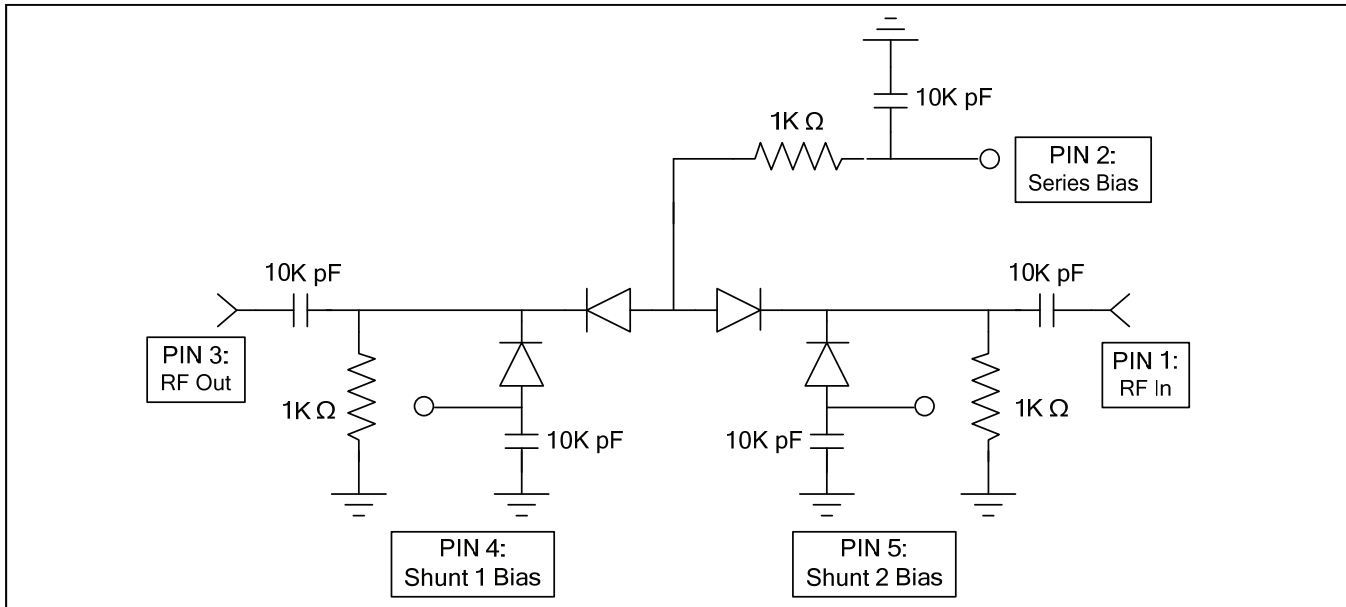
MA4P7455-1225T Spice Model

Pin Diode Model
NLPINM2
 $I_s = 1E-14$ A
 $V_i = 0$ V
 $U_n = 900$ cm²/V-sec
 $W_i = 60$ μ m
 $R_r = 1.25$ Ohm
 $C_{min} = 0.20$ pF
 $\tau = 1.0$ usec
 $R_s = 0.1$ Ohm
 $C_{jo} = 0.27$ pF
 $V_j = 0.7$ V
 $M = 0.5$
 $F_c = 0.5$
 $I_{max} = 2.5E+6$ A/m²
 $K_f = 0$
 $A_f = 1$

Series and Shunt Diode Bias Currents as a Function of Vseries and Vshunt Voltage (Values shown are PER DIODE)

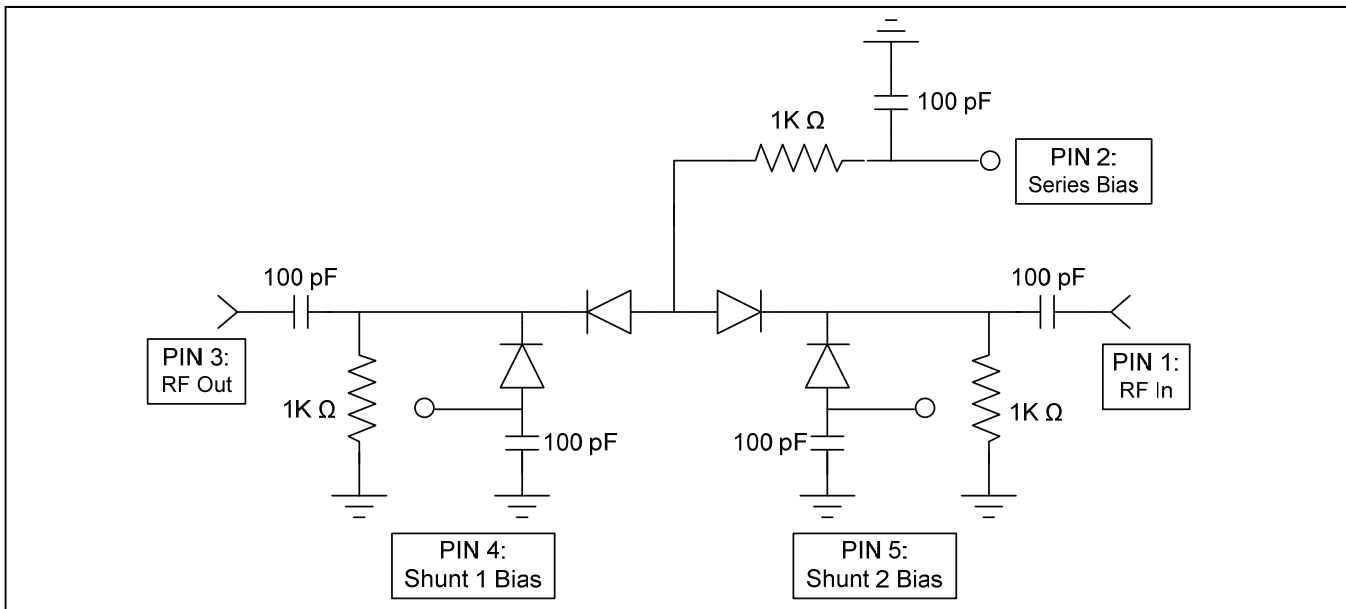
| Vshunt Bias (V) | Vseries Bias (V) | Iseries Diode (mA) | Ishunt Diode (mA) |
|-----------------|------------------|--------------------|-------------------|
| 0.75 | 0 | 0.000 | 0.192 |
| 0.75 | 1 | 0.106 | 0.120 |
| 0.75 | 2 | 0.443 | 0.048 |
| 0.75 | 3 | 0.773 | 0 |
| 0.75 | 4 | 1.099 | 0 |
| 0.75 | 5 | 1.426 | 0 |
| 0.75 | 6 | 1.750 | 0 |
| 0.75 | 7 | 2.092 | 0 |
| 0.75 | 8 | 2.424 | 0 |
| 0.75 | 9 | 2.756 | 0 |
| 0.75 | 10 | 3.088 | 0 |
| 0.75 | 11 | 3.421 | 0 |
| 0.75 | 12 | 3.754 | 0 |
| 0.75 | 13 | 4.087 | 0 |
| 0.75 | 14 | 4.410 | 0 |
| 0.75 | 15 | 4.743 | 0 |
| 0.75 | 16 | 5.081 | 0 |
| 0.75 | 17 | 5.406 | 0 |
| 0.75 | 18 | 5.750 | 0 |
| 0.75 | 19 | 6.079 | 0 |
| 0.75 | 20 | 6.413 | 0 |

Schematic 10 - 1000 MHz, 50 Ω , RF Circuit ⁹



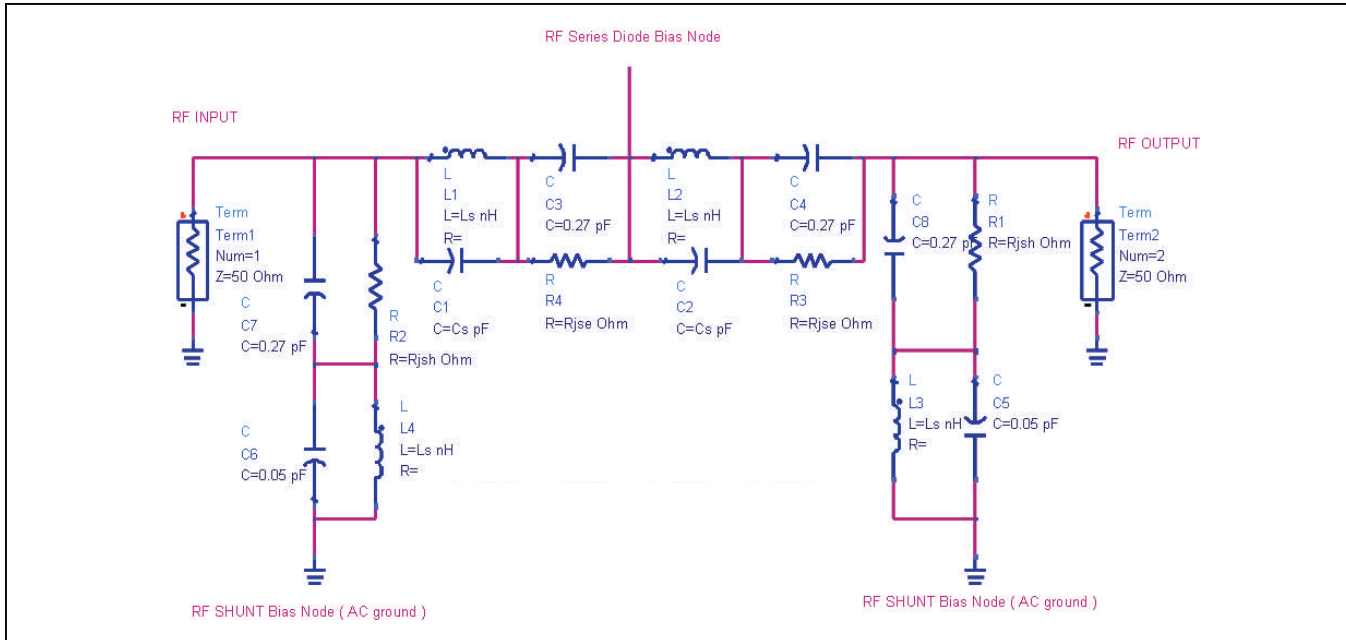
9. Keeping PIN 4 & PIN 5 as Separate Bias Points (Same V) reduces RF leakage (increases attenuation) through an otherwise connected Common Anode Bias Note.

Schematic 1 - 4 GHz, 50 Ω , RF Circuit ¹⁰

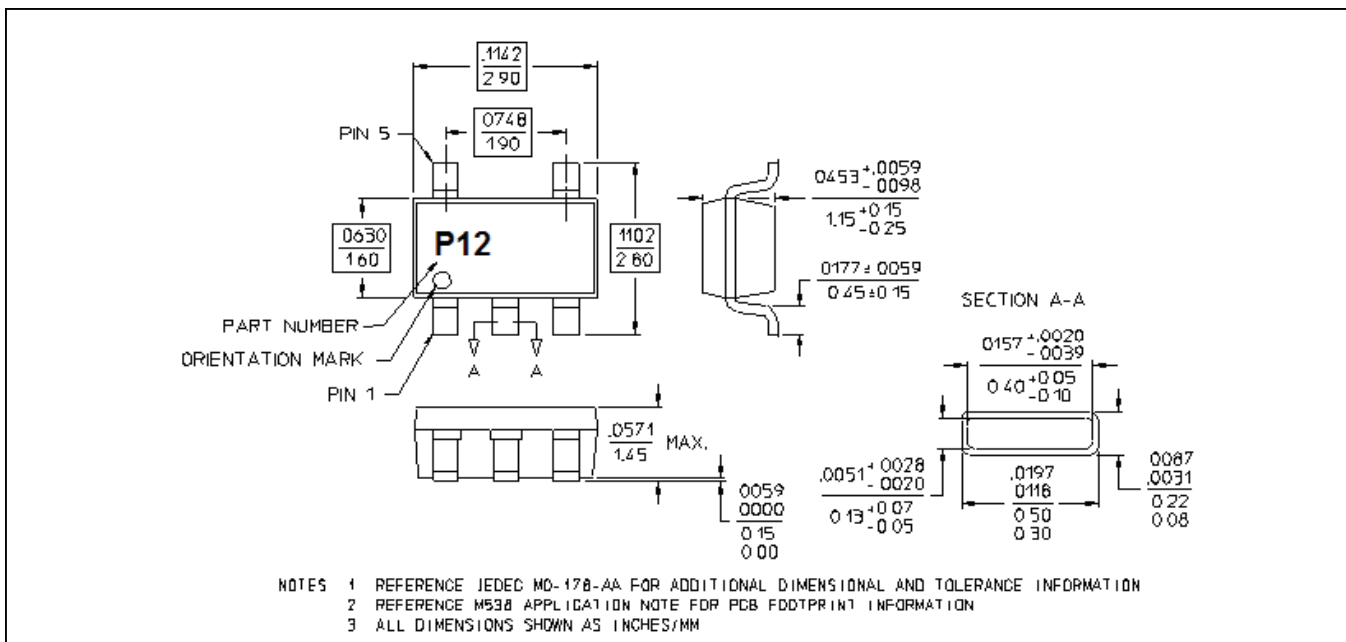


10. Keeping PIN 4 & PIN 5 as Separate Bias Points (Same V) reduces RF leakage through an otherwise connected Common Anode Bias Node.

Lumped Element Model for MA4P7455-1225 PIN Diode π Attenuator in SOT-25



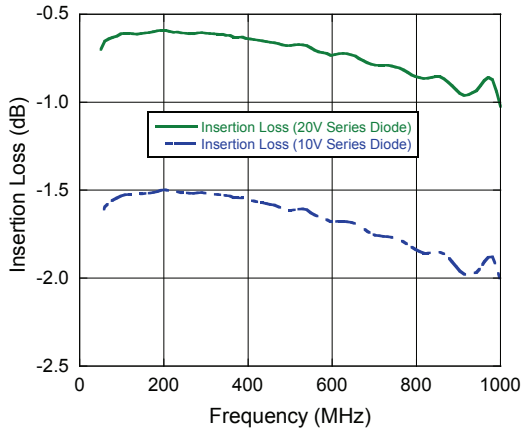
Lead Free SOT-25 †



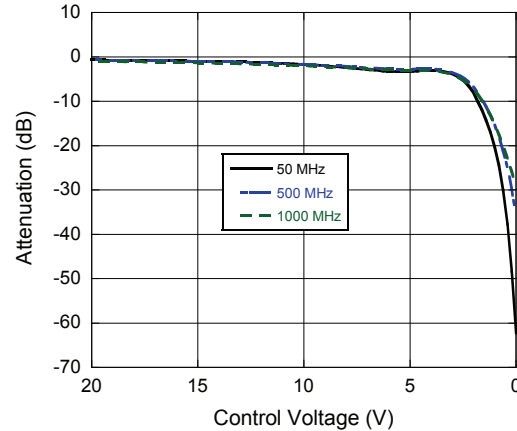
† Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.

Typical Performance Curves @ +25°C, 50 - 1000 MHz, Shunt Bias = 0.75 Volts

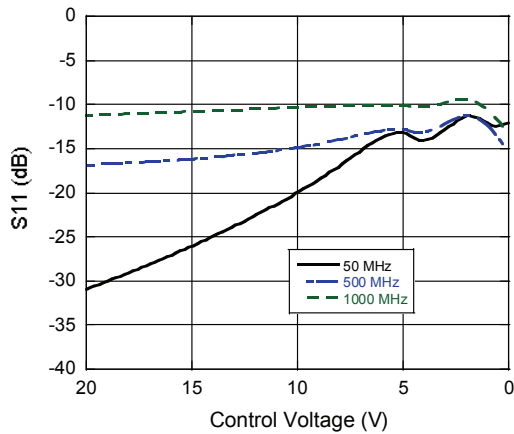
Insertion Loss vs. Frequency



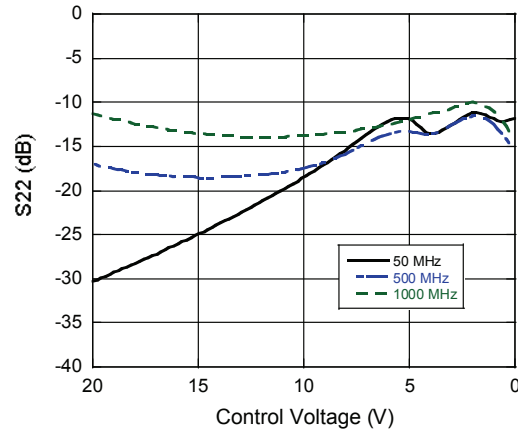
Attenuation vs. Control Voltage



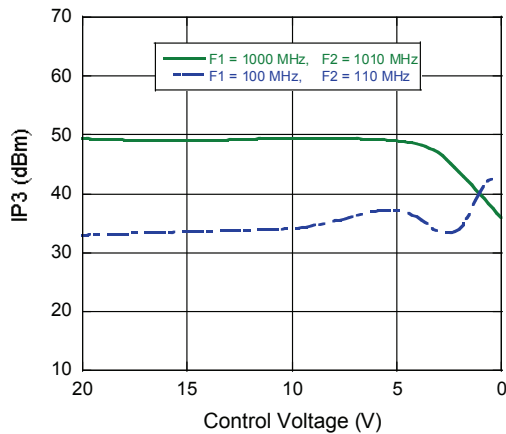
Input Return Loss vs. Control Voltage



Output Return Loss vs. Control Voltage



IP3 vs. Control Voltage



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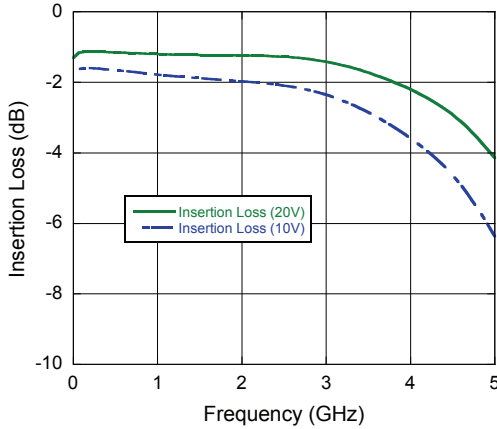
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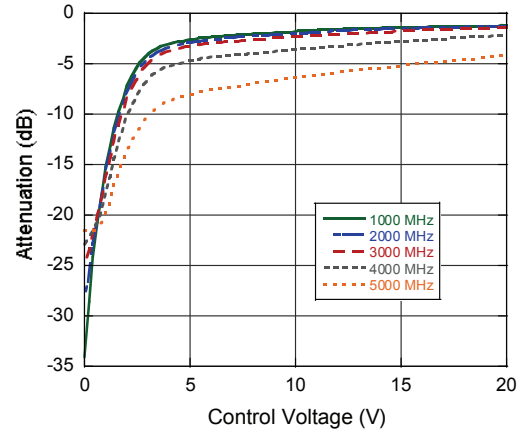
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Typical Performance Curves @ +25°C, 1000 - 5000 MHz, Shunt Bias = 0.75 Volts

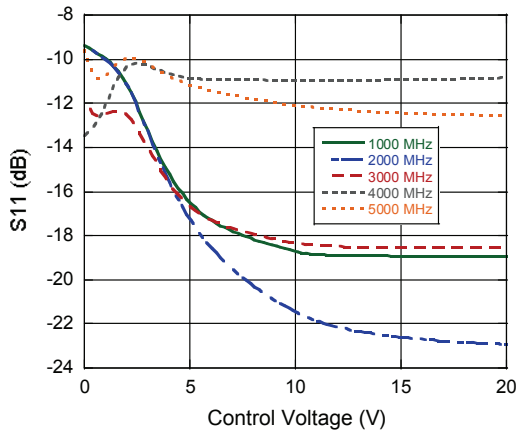
Insertion Loss vs. Frequency



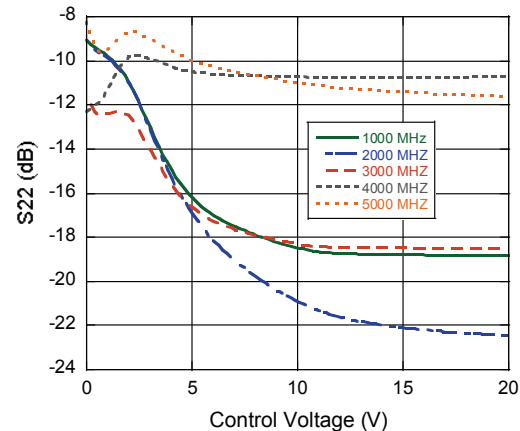
Attenuation vs. Control Voltage



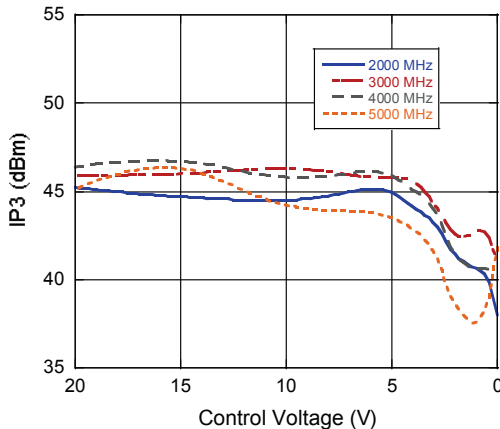
Input Return Loss vs. Control Voltage



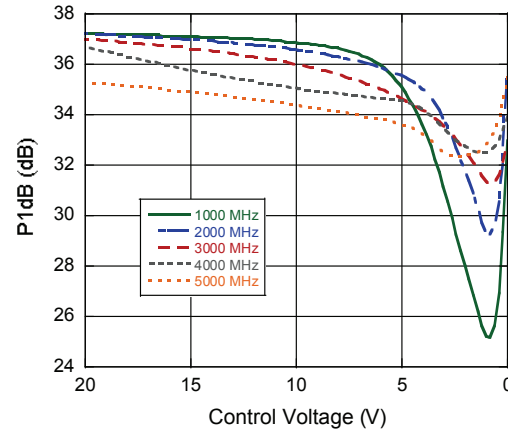
Output Return Loss vs. Control Voltage



IP3 vs. Control Voltage (10 MHz Spacing)



P1dB vs. Control Voltage



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