# Quad PIN Diode π Attenuator
# 5 - 4000 MHz

**MA4P7455-1225**
**Rev. V3**

## Features

- 4 PIN Diodes in a SOT-25 Plastic Package
- Externally Selectable Bias and RF Matching Network
- 5 - 4,000 MHz Useable Frequency Band
- 43 dBm IP3 @ 1000 MHz (50 Ω)
- 1 dB Loss @ 1000 MHz (50 Ω)
- 30 dB Attenuation @ 1000 MHz (50 Ω)
- Lead-Free SOT-25 Package
- RoHS* Compliant Version of MA4P274-1225

## Applications

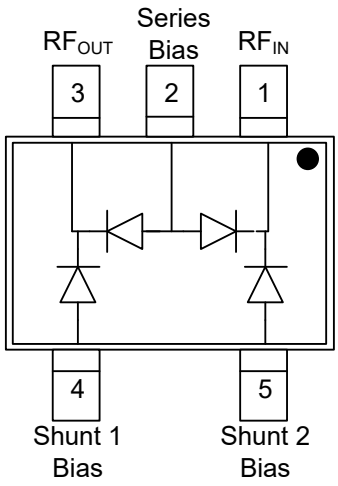
- CATV / Broadband

## Description

The MA4P7455-1225 is a wideband, lower insertion loss, high IP3, Quad PIN diode π Attenuator in a 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.

## Functional Schematic




## Pin Configuration

| Pin # | Function |
|---|---|
| 1 | RF Input |
| 2 | Series Bias |
| 3 | RF Output |
| 4 | Shunt 1 Bias |
| 5 | Shunt 2 Bias |

## Ordering Information[1]

| Part # | Package |
|---|---|
| MA4P7455-1225T | Tape & Reel |
| MADP-007455-001SMB | Sample Board |

1. Reference Application Note M513 for reel size information.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

## Typical 50 Ω Performance[2]: 1000 MHZ @ 25°C using Wideband RF Circuit Design

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Insertion Loss | 3.0 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias | dB | — | -2 | — |
| Insertion Loss | 6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias | dB | — | -1 | — |
| Return Loss | 6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias | dB | — | -10 | — |
| Attenuation | 0 mA - Series Diode Bias / 0.75 V - Shunt 1 and 2 Bias | dB | — | -29 | — |
| Input IP3 | 0 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias<br>6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias<br>F1 = 1000 MHz, F2 = 1100 MHz | dBm | — | 43<br>43 | — |
| Input IP3 | 0 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias<br>6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias<br>F1 = 100 MHz, F2 = 110 MHz | dBm | — | 43<br>33 | — |
| Settling Time | Within 1 dB of Final Attenuation Value | uS | — | 3 | — |
| RF C.W. Incident Power | 0 - 20 V Series Diode Bias / 0.75 V Shunt 1 and 2 Bias | dBm | — | +20 | — |

## Typical 75 Ω Performance[2]: 1000 MHZ @ 25°C using Wideband RF Circuit Design

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Insertion Loss | 2.0 mA Series Diode Bias / 1 V Shunt 1 and 2 Bias<br>4.5 mA Series Diode Bias / 1 V Shunt 1 and 2 Bias | dB | — | -1.1<br>-0.6 | — |
| Attenuation | 0 mA / Series Diode and 1 V Shunt 1 and 2 Bias | dB | — | -27 | — |
| Return Loss | 4.5 mA / Series Diode and 1 V Shunt 1 and 2 Bias | dB | — | -10 | — |

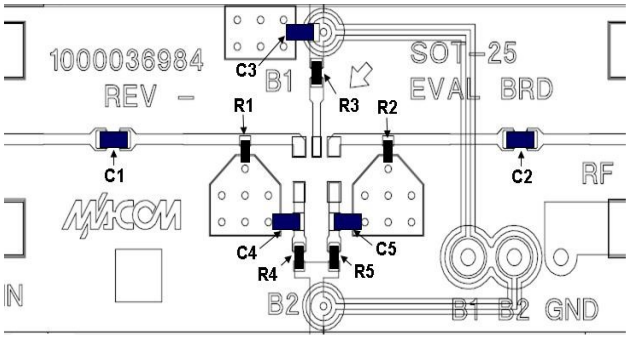
2. Values shown include through loss calibrated out of RF test circuit.

## Absolute Maximum Ratings[3,4]

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

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

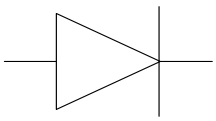
## Recommended PCB Layout




## Parts List

| Part | Value | Case Style | Manufacturer |
|---|---|---|---|
| C1 - C5 | 100 pF | 0603 | Murata |
| R1 - R5 | 1000 Ω | 0402 | Panasonic |

## Spice Model

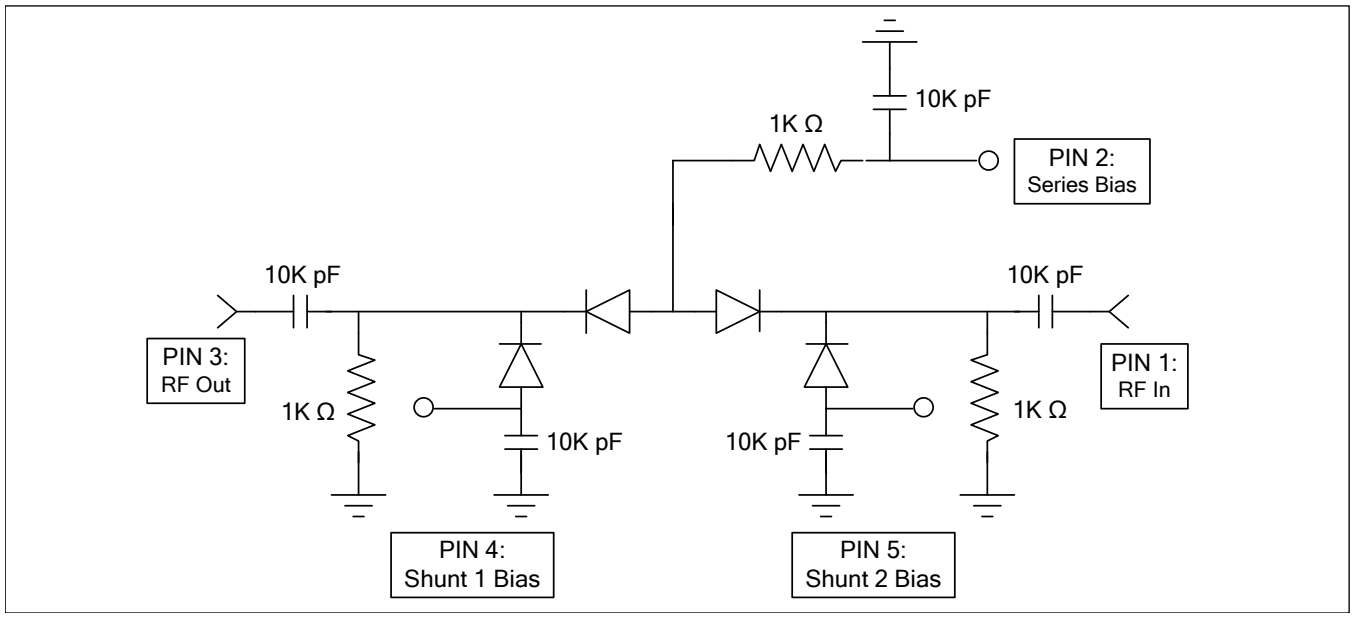


Pin Diode Model
NLPINM2
Is = 1E-14 A
Vi = 0 V
Un = 900 $cm^2$/V-sec
Wi = 60 um
Rr = 1.25 Ohm
Cmin = 0.20 pF
Tau = 1.0 usec
Rs = 0.1 Ohm
Cjo = 0.27 pF
Vj = 0.7 V
M = 0.5
Fc = 0.5
Imax = 2.5E+6 $A/m^2$
Kf = 0
Af = 1
Ffe = 1
wBV = 150 V

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

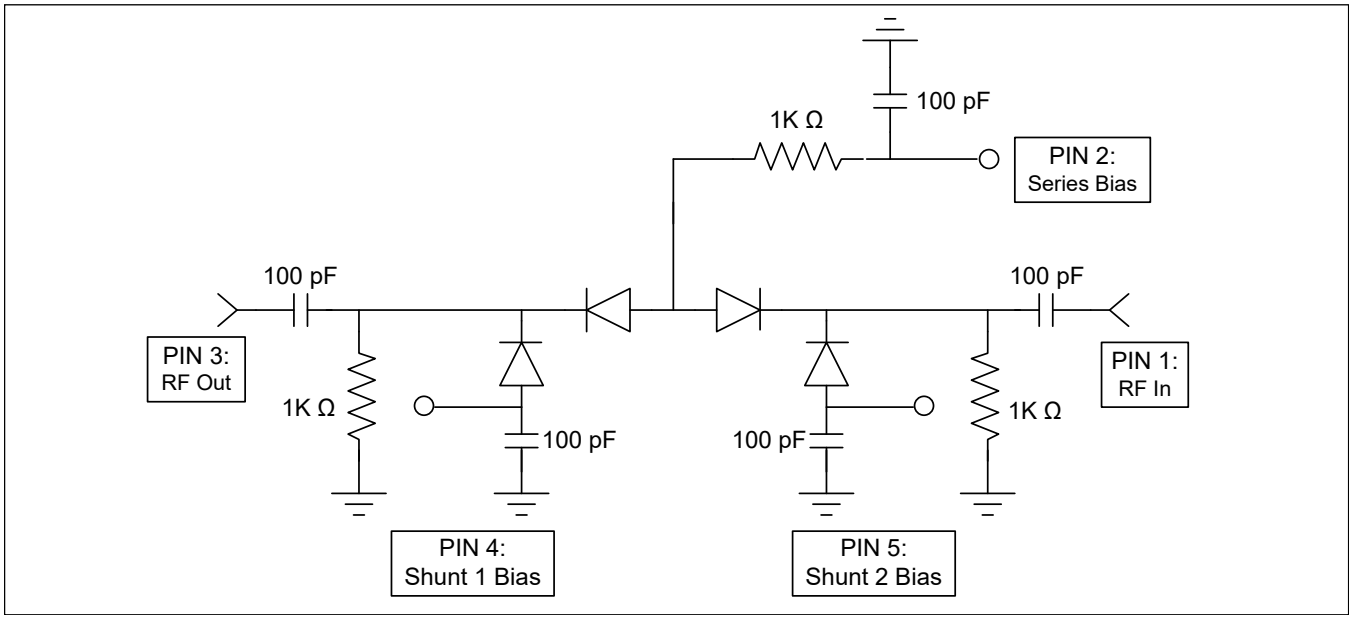
| Vshunt Bias (V) | Vseries Bias (V) | Iseries Diode (mA) | Ishunt Diode (mA) |
|---|---|---|---|
| 0.75 | 0 | 0.000 | 0.192 |
| 0.75 | 1 | 0.106 | 0.120 |
| 0.75 | 2 | 0.443 | 0.048 |
| 0.75 | 3 | 0/773 | 0 |
| 0.75 | 4 | 1.099 | 0 |
| 0.75 | 5 | 1.426 | 0 |
| 0.75 | 6 | 1.750 | 0 |
| 0.75 | 7 | 2.092 | 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 5 - 1000 MHz, 50 Ω, RF Circuit[5]



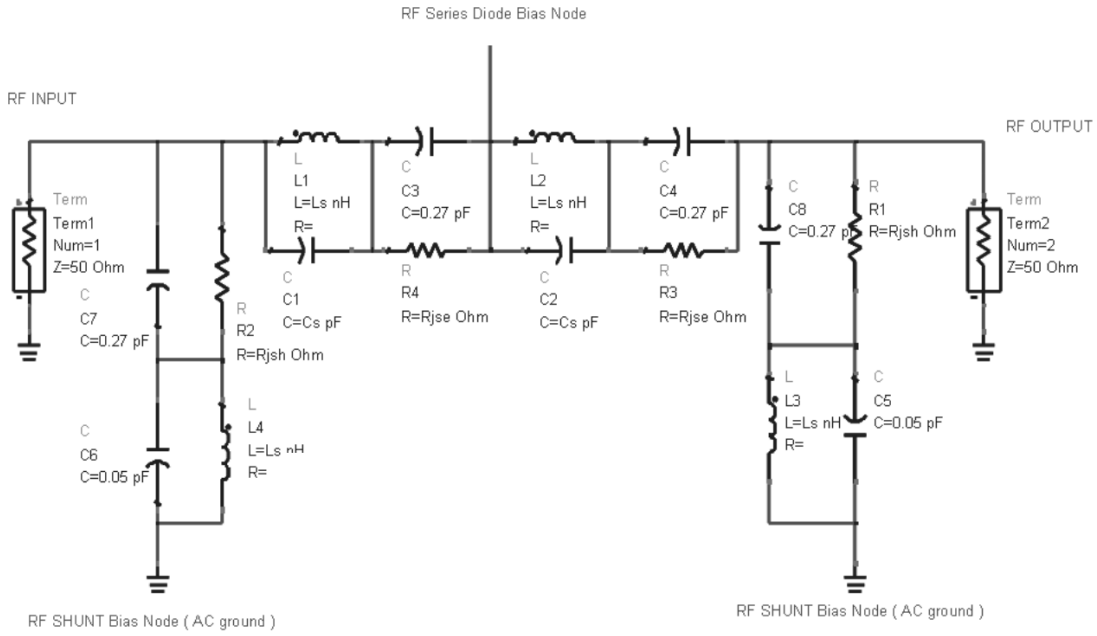

5. Keeping pin 4 & pin 5 as separate bias points (same V) reduces RF leakage (increases attenuation) through an otherwise connected common anode bias note.

## Schematic 1 - 4 GHz, 50 Ω, RF Circuit[6]

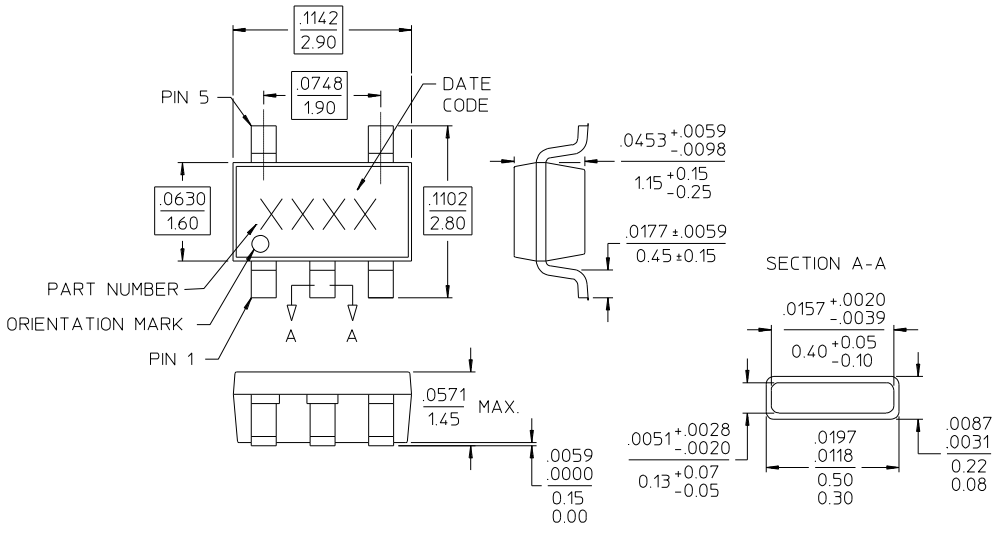



6. Keeping pin 4 & pin 5 as separate bias points (same V) reduces RF leakage through an otherwise connected common anode bias node.

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



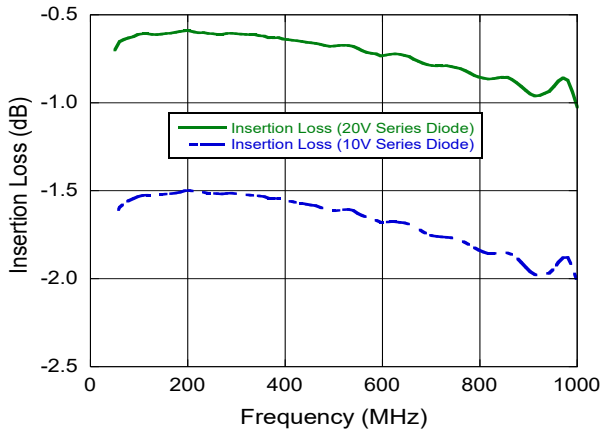

## *Lead Free* SOT-25†



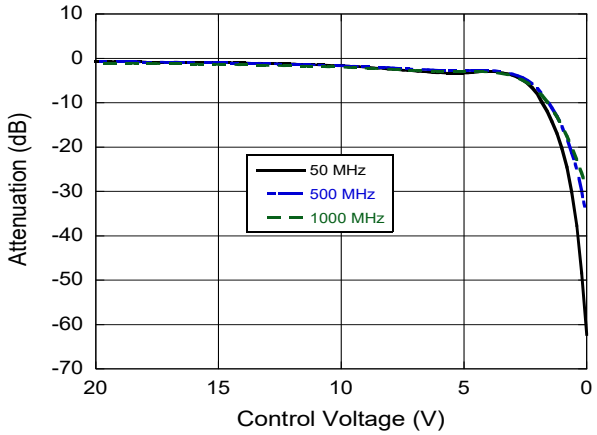

† Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.

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

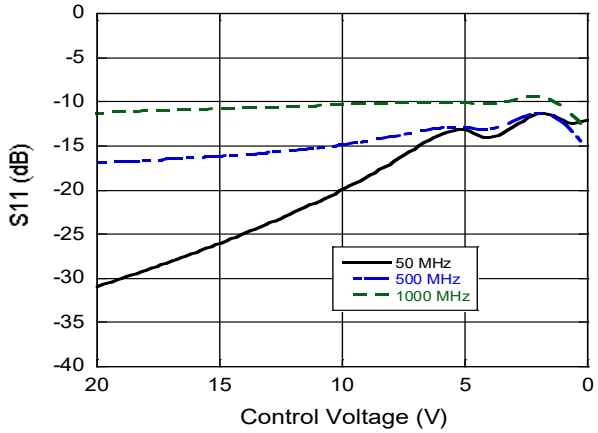
***Insertion Loss vs. Frequency***



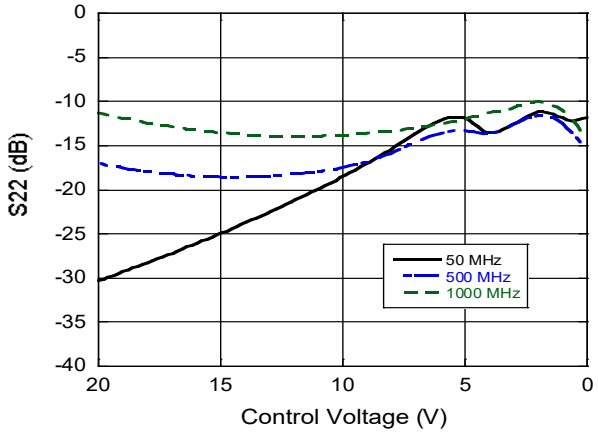

***Attenuation vs. Control Voltage***



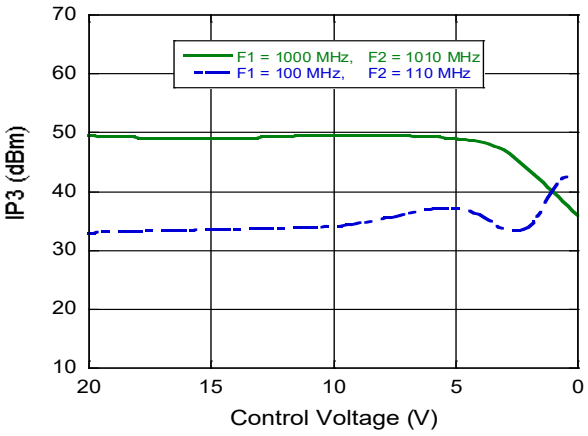

***Input Return Loss vs. Control Voltage***




***Output Return Loss vs. Control Voltage***

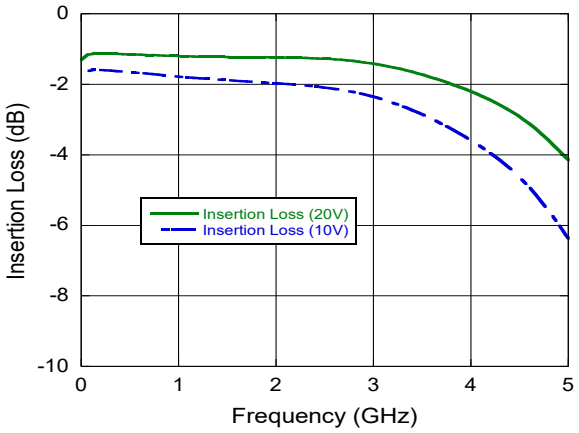



***IP3 vs. Control Voltage***

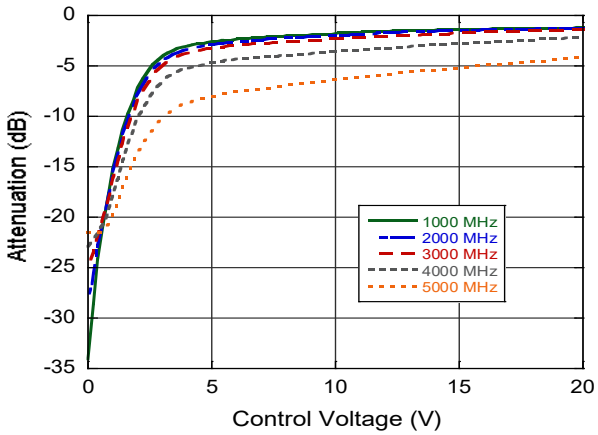


## Typical Performance Curves @ +25°C, 1000 - 5000 MHz, Shunt Bias = 0.75 Volts

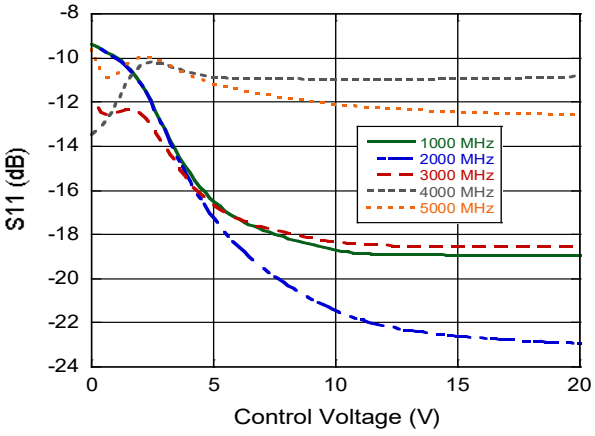
***Insertion Loss vs. Frequency***



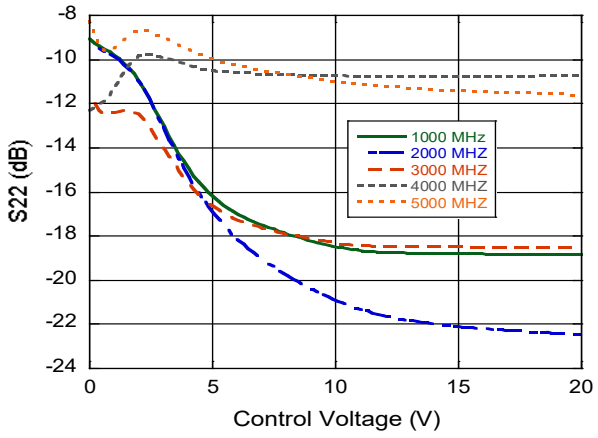

***Attenuation vs. Control Voltage***



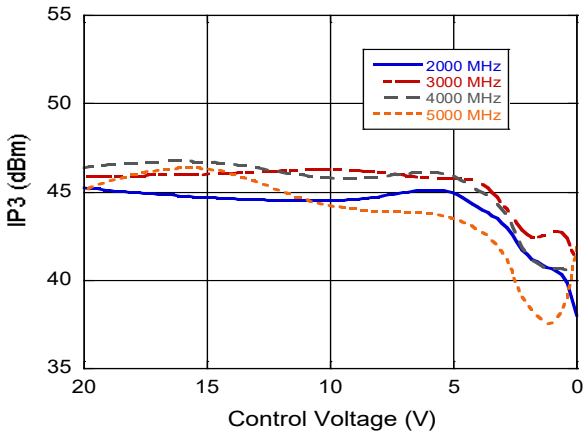

***Input Return Loss vs. Control Voltage***




***Output Return Loss vs. Control Voltage***




***IP3 vs. Control Voltage (10 MHz Spacing)***




***P1dB vs. Control Voltage***