

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

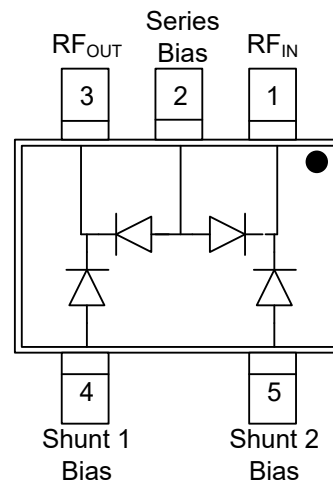
- CATV / Broadband

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 Information¹

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.

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MA4P7455-1225

Rev. V3

Typical 50 Ω Performance²: 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 6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias F1 = 1000 MHz, F2 = 1100 MHz	dBm	—	43 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 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 Performance²: 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 4.5 mA Series Diode Bias / 1 V Shunt 1 and 2 Bias	dB	—	-1.1 -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.

Quad PIN Diode π Attenuator

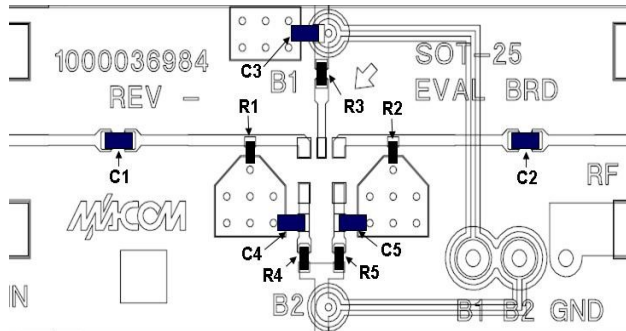
5 - 4000 MHz



MA4P7455-1225

Rev. V3

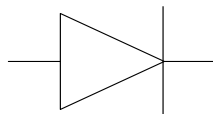
Recommended PCB Layout



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
 $I_s = 1E-14$ 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
 $K_f = 0$
 $A_f = 1$
 $F_{fe} = 1$
 $wBV = 150$ V

Series & Shunt Diode Bias Currents as a Function of V_{series} & V_{shunt} Voltage (Values shown are PER DIODE)

V_{shunt} Bias (V)	V_{series} Bias (V)	I_{series} Diode (mA)	I_{shunt} 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

Quad PIN Diode π Attenuator

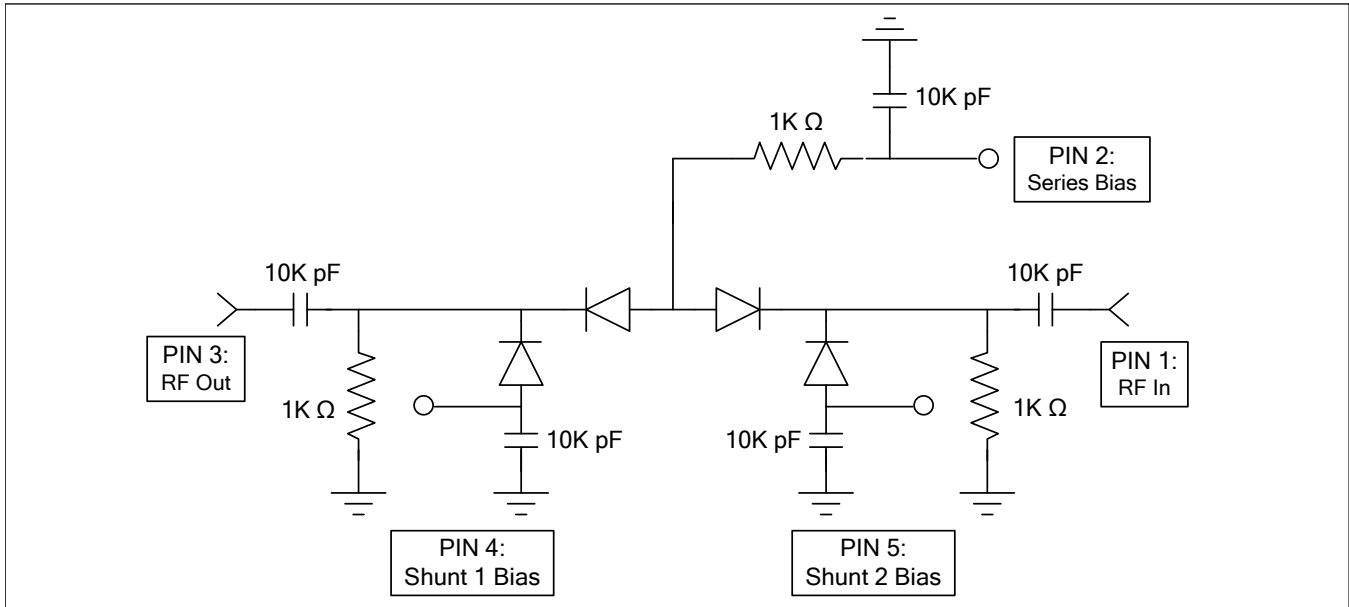
5 - 4000 MHz



MA4P7455-1225

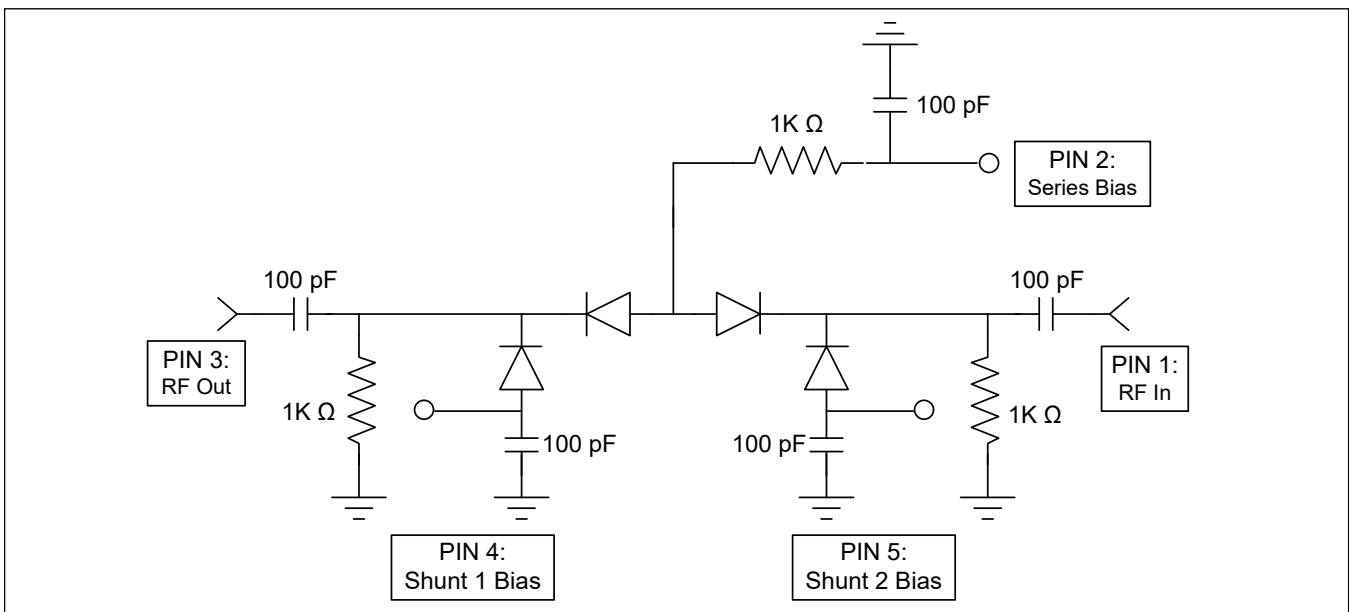
Rev. V3

Schematic 5 - 1000 MHz, 50 Ω , RF Circuit⁵



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

Schematic 1 - 4 GHz, 50 Ω , RF Circuit⁶



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

Quad PIN Diode π Attenuator

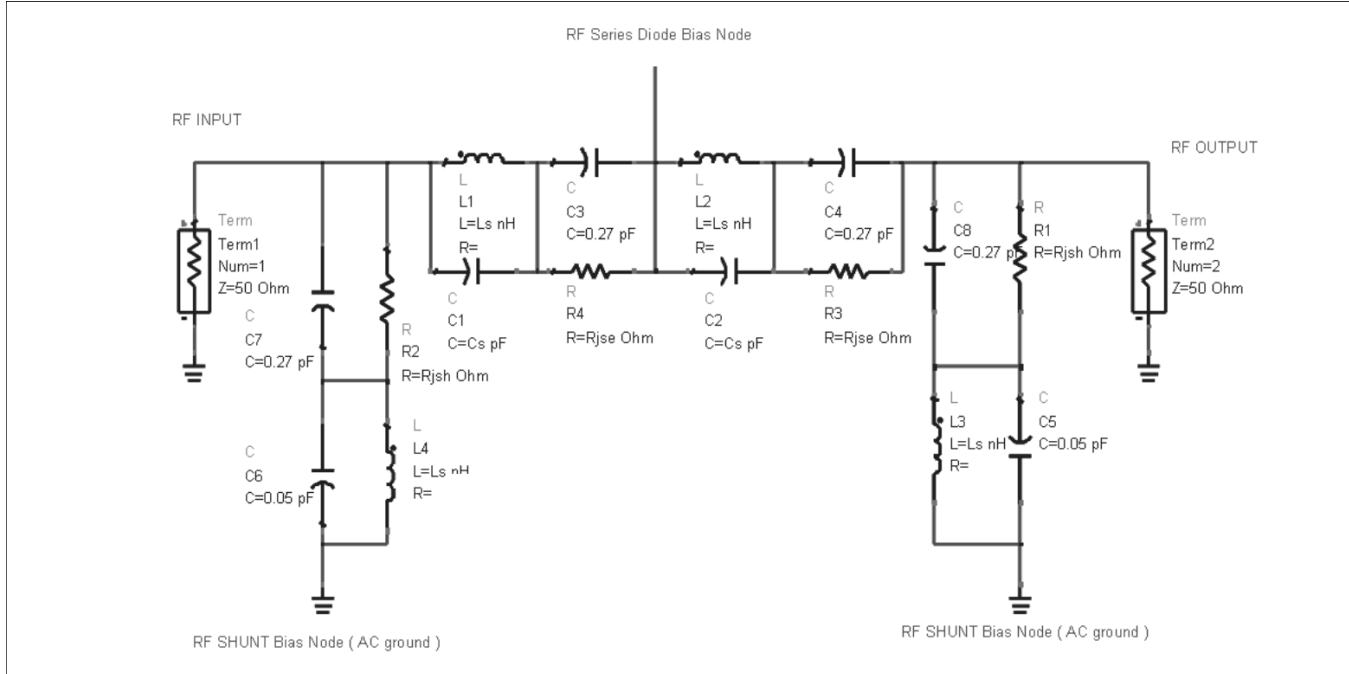
5 - 4000 MHz



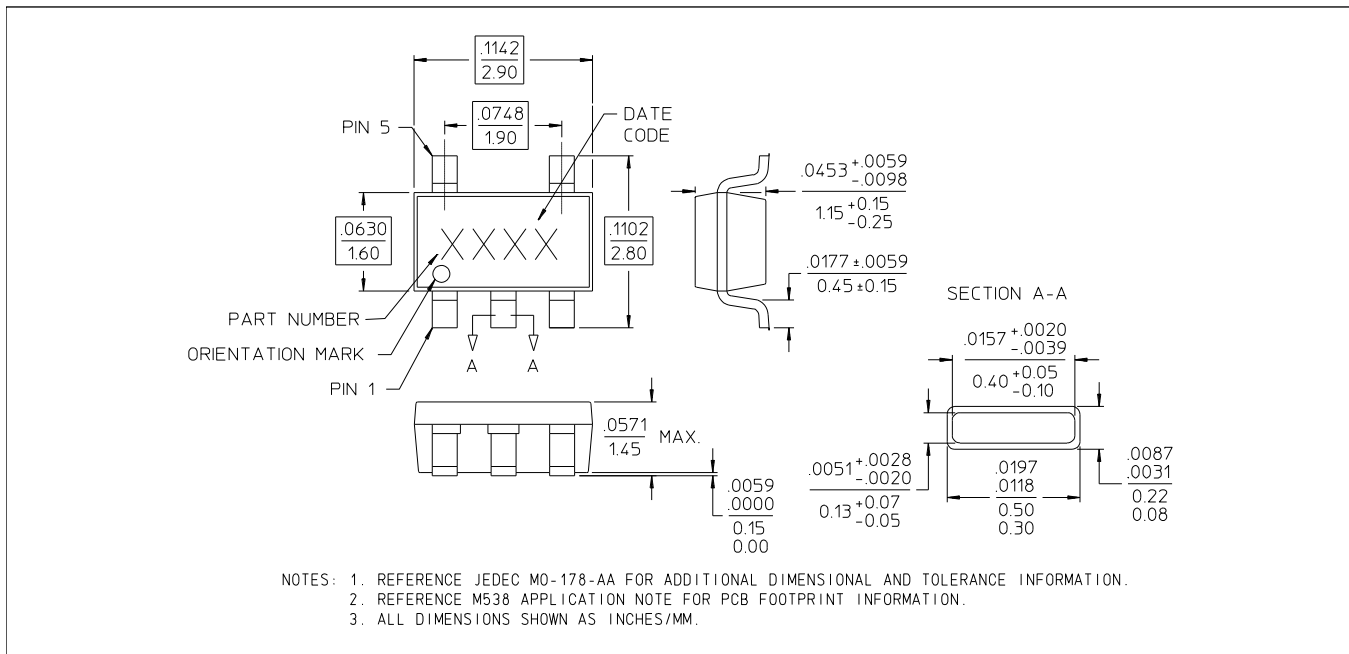
MA4P7455-1225

Rev. V3

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.

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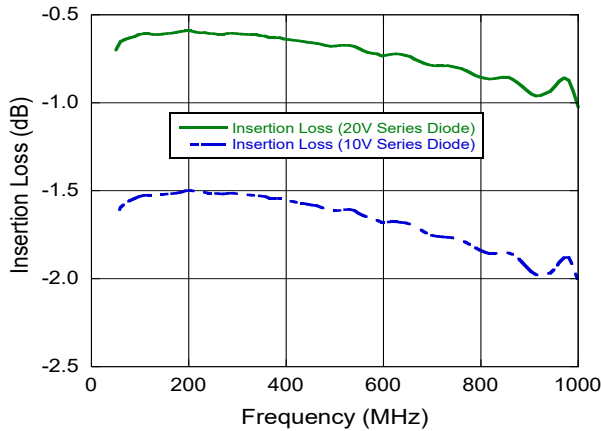


MA4P7455-1225

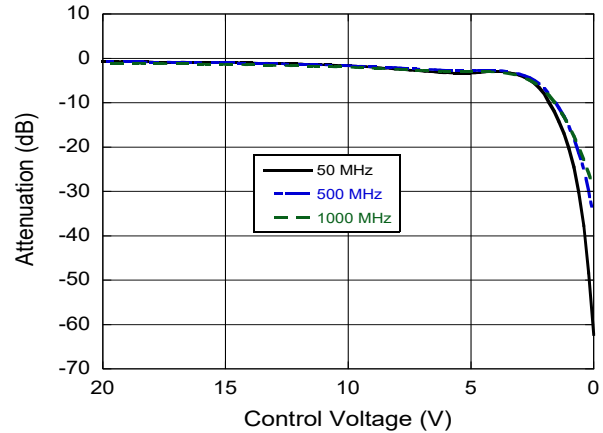
Rev. V3

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

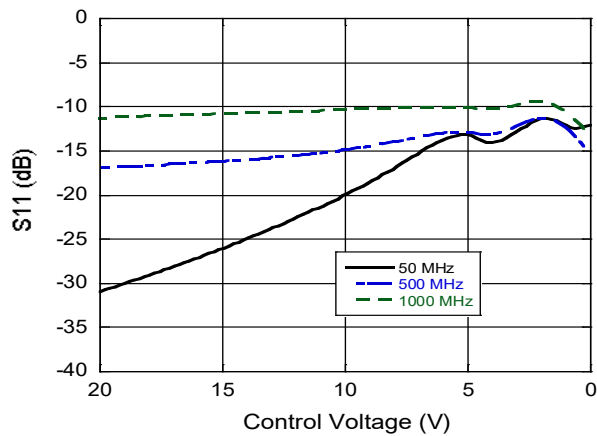
Insertion Loss vs. Frequency



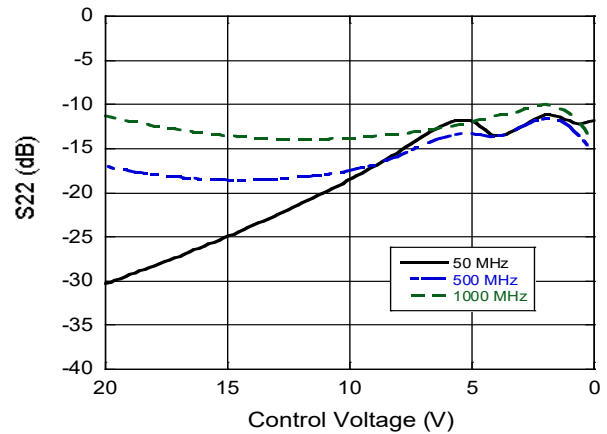
Attenuation vs. Control Voltage



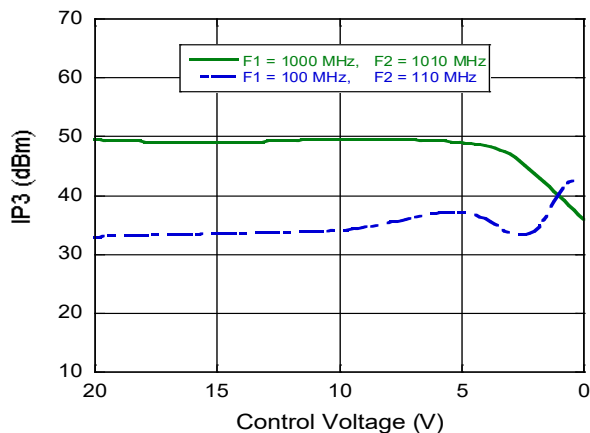
Input Return Loss vs. Control Voltage



Output Return Loss vs. Control Voltage



IP3 vs. Control Voltage



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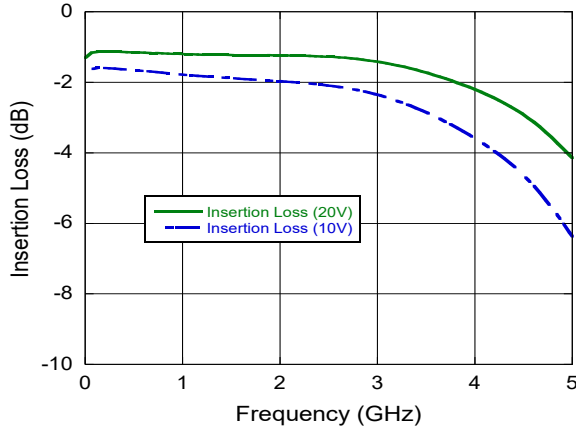


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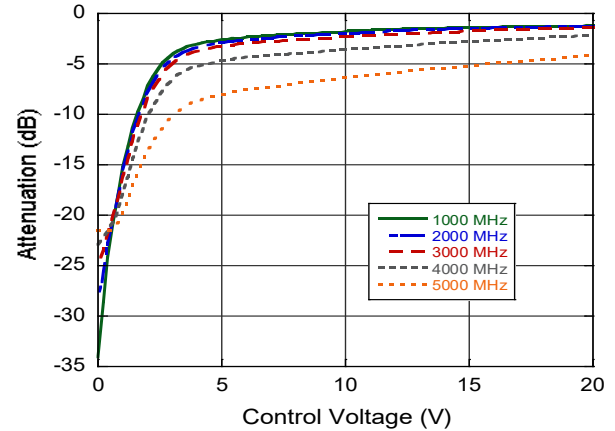
Rev. V3

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

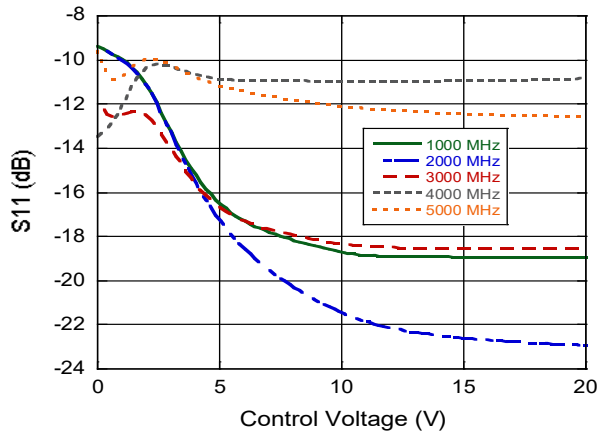
Insertion Loss vs. Frequency



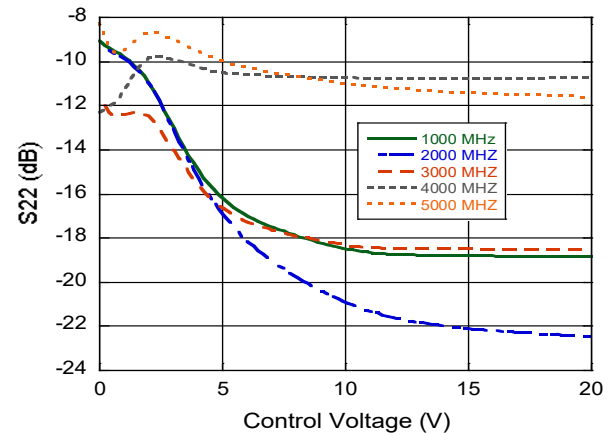
Attenuation vs. Control Voltage



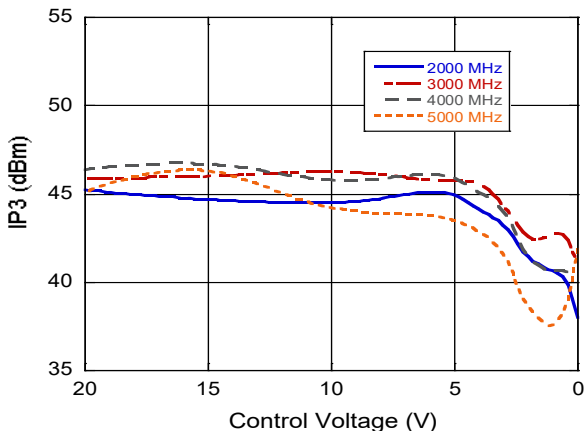
Input Return Loss vs. Control Voltage



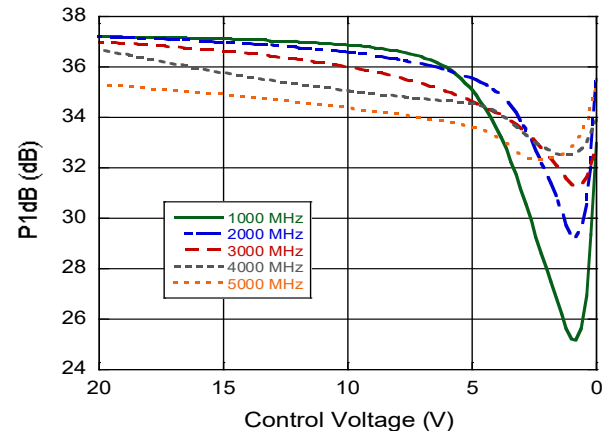
Output Return Loss vs. Control Voltage



IP3 vs. Control Voltage (10 MHz Spacing)



P1dB vs. Control Voltage



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MA4P7455-1225

Rev. V3

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