MAAD-008791-000100

Digital Attenuator
31.5 dB, 6-Bit, TTL Driver, DC-3.0 GHz

Rev. V1

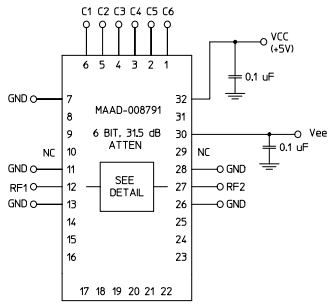
Features

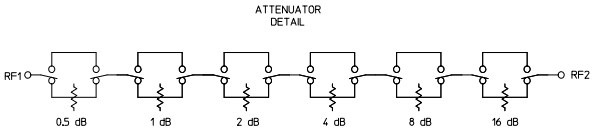
- Attenuation: 0.5 dB Steps to 31.5 dB
- Low DC Power Consumption
- Small Footprint, PQFN Package
- Integral TTL Driver
- 50 ohm Impedance
- Test Boards are Available
- RoHS* Compliant

Description

M/A-COM's MAAD-008791-000100 is a GaAs pHEMT 6-bit digital attenuator with integral TTL driver. Step size is 0.5 dB providing a 31.5 dB total attenuation range. This device is in an PQFN plastic surface mount package. MAAD-008791-000100 is ideally suited for use where accuracy, very low power consumption and low costs are required.

Functional Schematic





Pin Configuration[1]

Pin No.	Function	Pin No.	Function
1	C6	17	NC
2	C5	18	NC
3	C4	19	NC
4	C3	20	NC
5	C2	21	NC
6	C1	22	NC
7	GND	23	NC
8	NC	24	NC
9	NC	25	NC
10	NC[2]	26	GND
11	GND	27	RF2
12	RF1	28	GND
13	GND	29	NC[2]
14	NC	30	Vee
15	NC	31	NC
16	NC	32	+Vcc

1. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)
2. Pins 10 & 29 must be isolated

Ordering Information

Part Number	Package
MAAD-008791-000100	Bulk Packaging
MAAD-008791-0001TR	1000 piece reel
MAAD-008791-0001TB	Sample Test Board

Note: Reference Application Note M513 for reel size information.

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

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Electrical Specifications: T_A = 25°C, Z_0 = 50Ω, V_{CC} = +5.0V, V_{EE} = -5.0V

Parameter	Test Conditions	Frequency	Units	Min	Typ	Max
Operating Power	—	—	dBm	—	—	+20
Reference Insertion Loss	—	DC - 2.0 GHz 2.0 - 3.0 GHz	dB dB	— —	— —	1.8 2.2
Attenuation Accuracy[3] Relative to Reference Loss State	Any Single Bit Any Combination of Bits	DC - 3.0 GHz DC - 3.0 GHz	±(0.25 +2% of atten setting in dB) ±(0.25 +2% of atten setting in dB)			
VSWR	Full Range	DC - 3.0 GHz	Ratio	—	—	1.8:1
Switching Speed[4] Ton Toff Trise Tfall	 1.3 V Cntl to 90% RF 1.3 V Cntl to 90% RF 10% RF to 90% RF 90% RF to 10% RF	 — — — —	 us ns us ns	 — — — —	 4.0 12 4.0 4	 — — — —
1 dB Compression[5]	Reference State Reference State	0.05 GHz 0.5 - 3.0 GHz	dBm dBm	— —	+25 >+27	— —
Input IP3	Two-tone inputs up to +5 dBm	0.05-3.0 GHz	dBm	—	See Table	—
Input IP2	Two-tone inputs up to +5 dBm	0.05-3.0 GHz	dBm	—	See Table	—
Vcc Vee	— —	— —	V V	4.5 -8.0	5.0 -5.0	5.5 -4.5
V_{IL} V_{IH}	LOW-level input voltage HIGH-level input voltage	— —	V V	0.0 2.0	0.0 5.0	0.8 5.0
Iin (Input Leakage Current)	Vin = V_{CC} or GND	—	uA	-1	—	1
Icc (Quiescent Supply Current)	Vcntrl = V_{CC} or GND	—	uA	—	250	400
ΔIcc (Additional Supply Current Per TTL Input Pin)	V_{CC} = Max Vcntrl = V_{CC} - 2.1 V	—	mA	—	—	1.5
I_{EE}	V_{EE} min to max Vin = V_{IL} or V_{IH}	—	mA	-1.0	-0.2	—
Thermal Resistance θjc	—	—	°C/W	—	35	—

3. This attenuator is guaranteed monotonic.
4. Switching speed was measured between reference loss state and 31.5 dB attenuation state.
5. 1 dB Compression was measured up to +27 dBm, which is the absolute maximum rating for this device.

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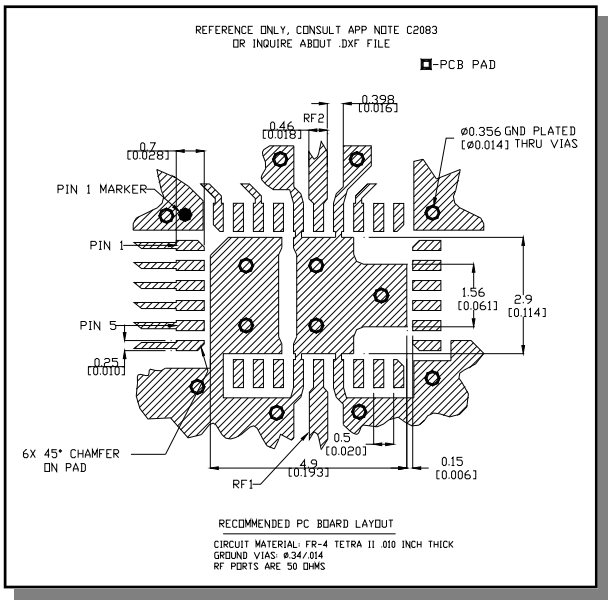
Absolute Maximum Ratings [6,7]

Parameter	Absolute Maximum
Max. Input Power	+27 dBm
V_{CC}	-0.5V ≤ V_{CC} ≤ +7.0V
V_{EE}	-8.5V ≤ V_{EE} ≤ +0.5V
V_{CC} - V_{EE}	-0.5V ≤ V_{CC} - V_{EE} ≤ 14.5V
Vin[8]	-0.5V ≤ Vin ≤ V_{CC} + 0.5V
Operating Temperature	-40ºC to +85ºC
Storage Temperature	-65ºC to +125ºC

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. M/A-COM does not recommend sustained operation near these survivability limits.
8. Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

Recommended PCB Configuration [9]



9. Application Note S2083 is available on line at www.macom.com

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Moisture Sensitivity

The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

Truth Table (Digital Attenuator)

C6	C5	C4	C3	C2	C1	Attenuation
0	0	0	0	0	0	Loss, Reference
0	0	0	0	0	1	0.5 dB
0	0	0	0	1	0	1.0 dB
0	0	0	1	0	0	2.0 dB
0	0	1	0	0	0	4.0 dB
0	1	0	0	0	0	8.0 dB
1	0	0	0	0	0	16.0 dB
1	1	1	1	1	1	31.5 dB

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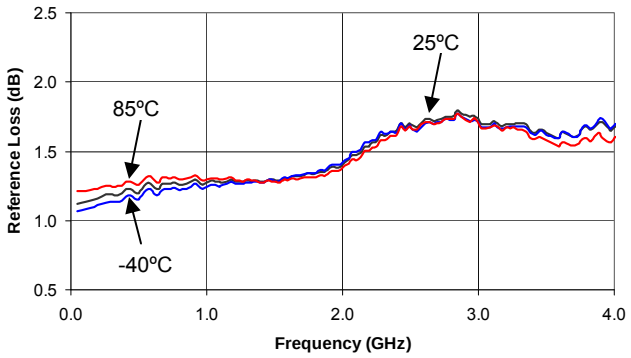
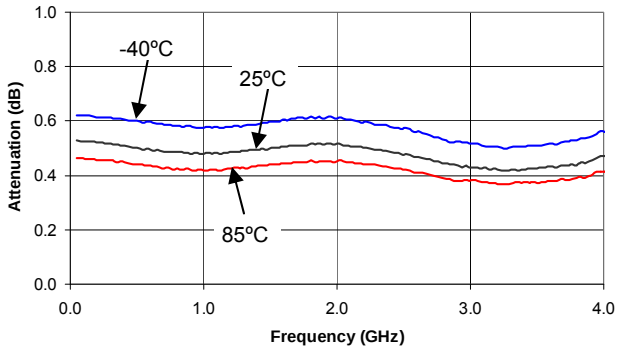
Typical Performance Curves

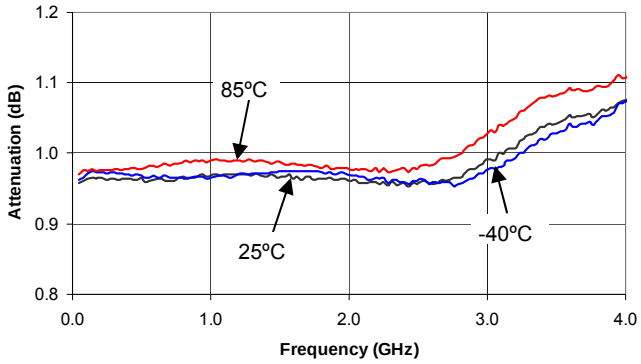
Reference Loss vs. Frequency



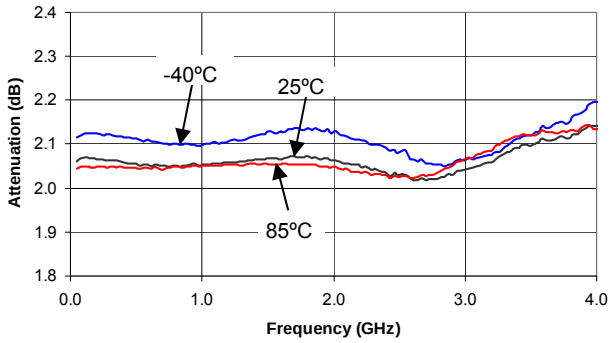
Attenuation - 0.5 dB Bit vs. Frequency



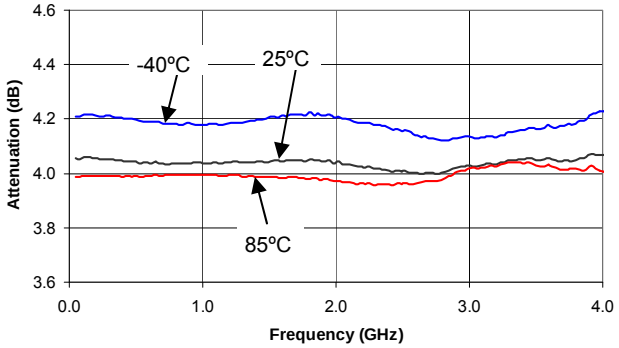
Attenuation - 1 dB Bit vs. Frequency



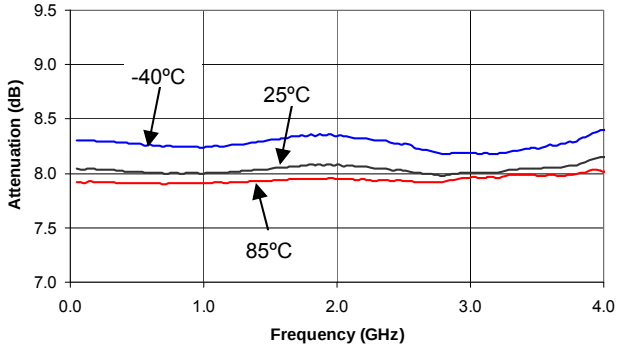
Attenuation - 2 dB Bit vs. Frequency



Attenuation - 4 dB Bit vs. Frequency

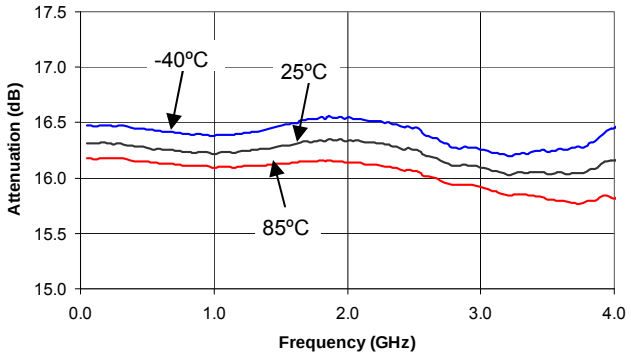


Attenuation - 8 dB Bit vs. Frequency

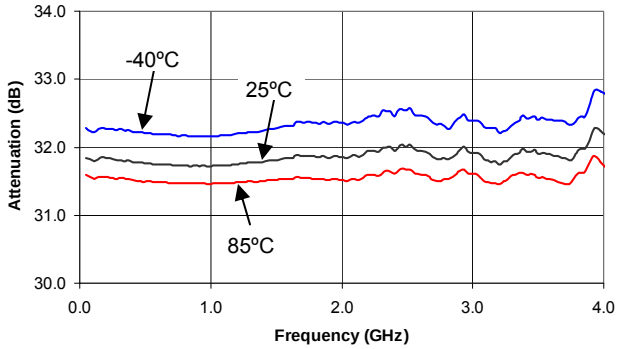


Typical Performance Curves

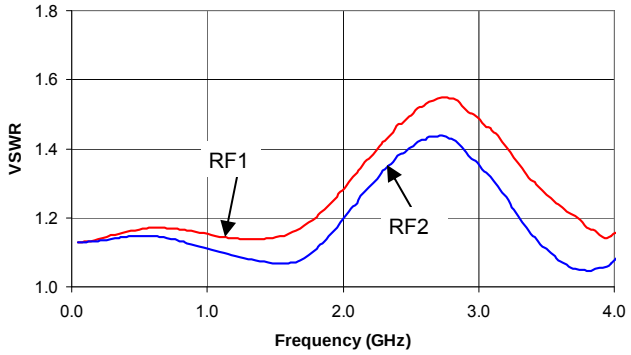
Attenuation - 16 dB Bit vs. Frequency



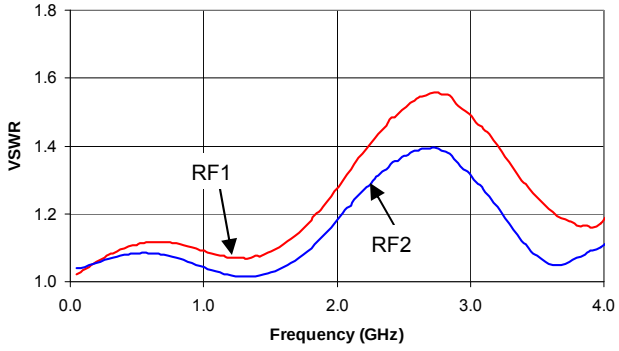
Attenuation - 31.5 dB Attenuation vs. Frequency



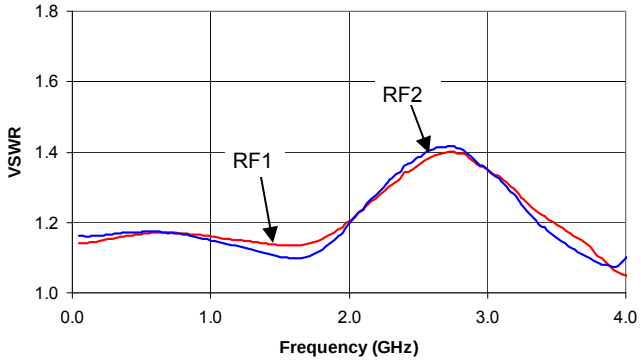
VSWR - Reference State vs. Frequency



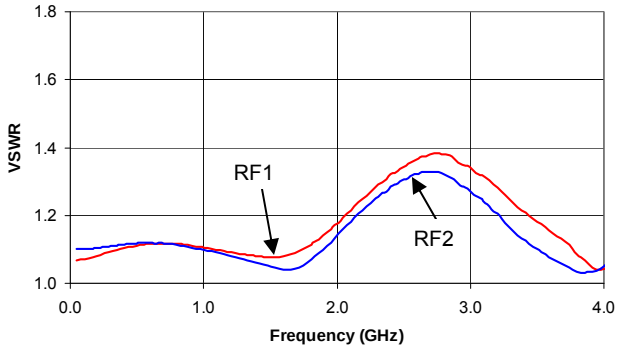
VSWR - 0.5 dB Bit vs. Frequency



VSWR - 1 dB Bit vs. Frequency



VSWR - 2 dB Bit vs. Frequency



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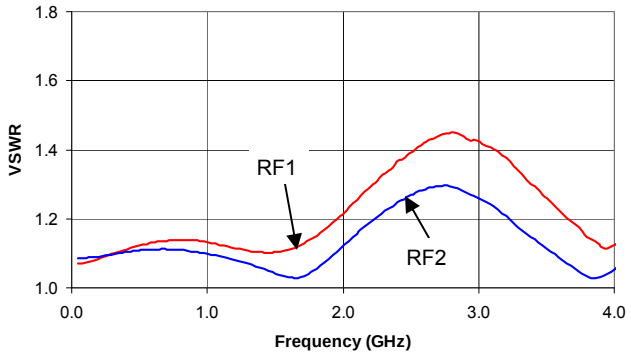
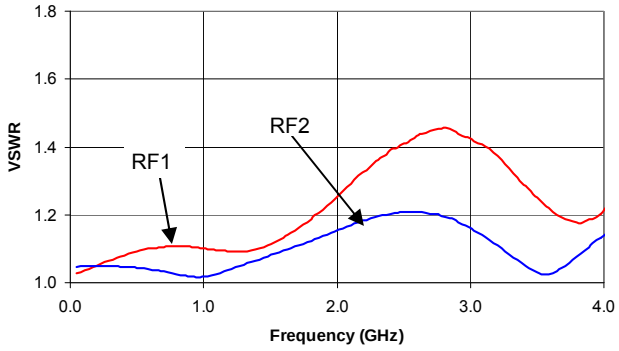
Typical Performance Curves

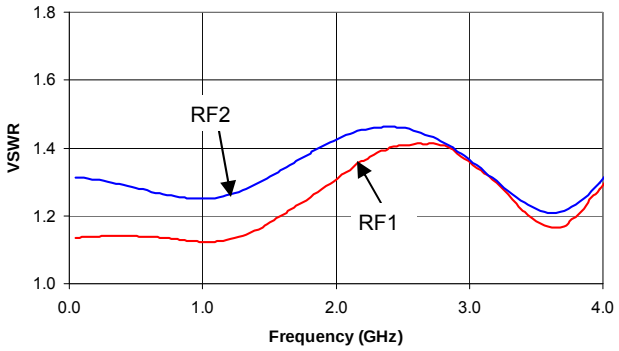
VSWR - 4 dB Bit vs. Frequency



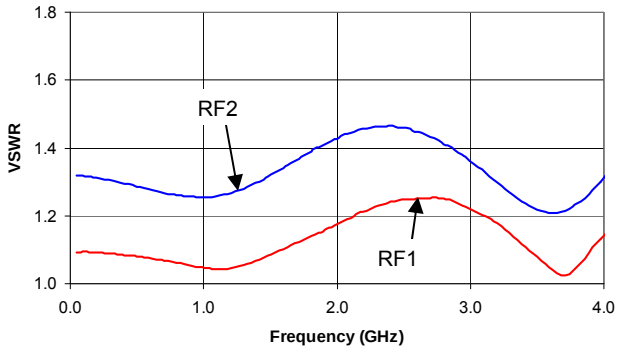
VSWR - 8 dB Bit vs. Frequency



VSWR - 16 dB Bit vs. Frequency



VSWR - 31.5 dB Attenuation vs. Frequency



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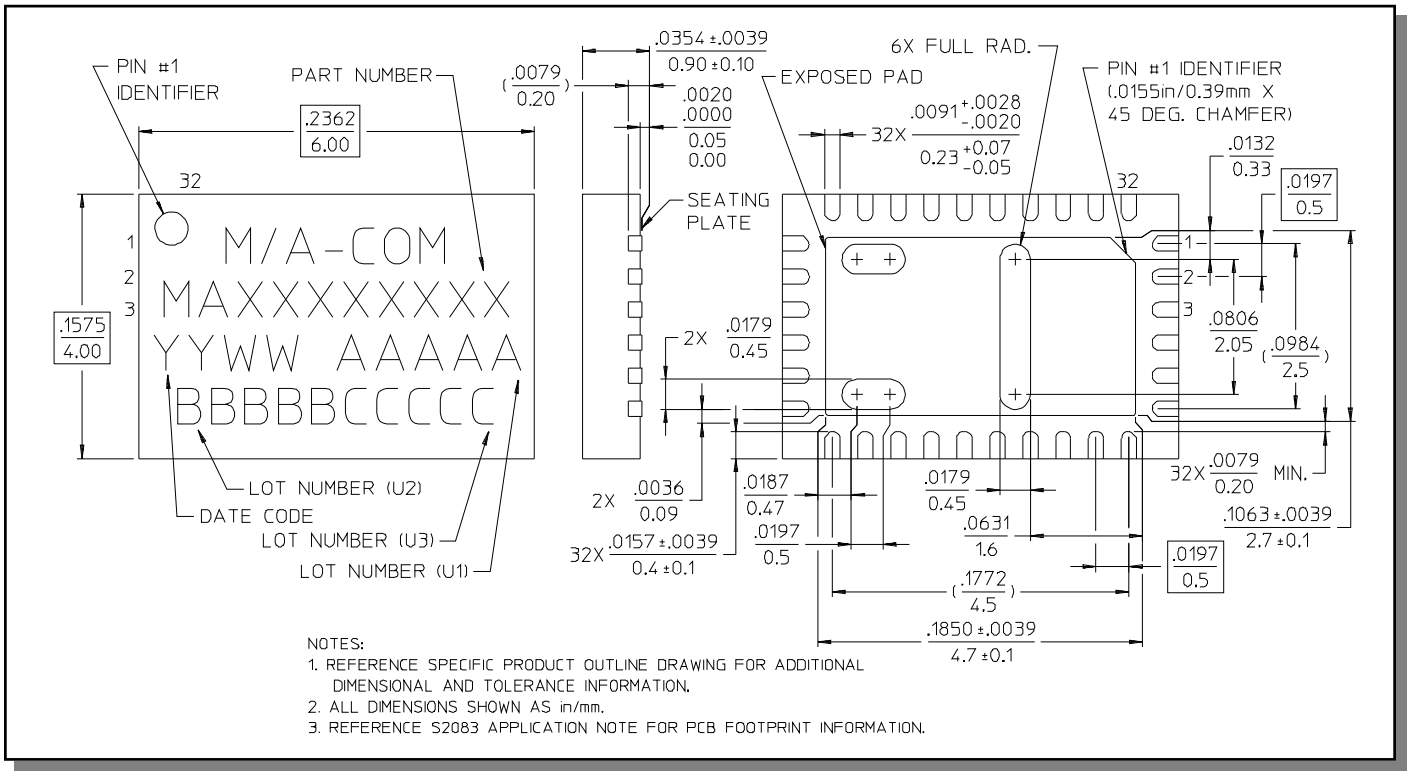
Typical Performance

Typical Input IP2 and IP3 at Room Temperature[10]

Attenuation	IP2				IP3				Units
	50 MHz	500 MHz	1 GHz	3 GHz	50 MHz	500 MHz	1 GHz	3 GHz	
Reference State	58	74	78	78	40	40	40	40	dBm
0.5 dB	58	74	78	80	40	42	40	41	dBm
1 dB	58	74	78	80	40	42	40	41	dBm
2 dB	60	74	78	80	40	38	40	41	dBm
4 dB	60	74	78	80	33	38	36	36	dBm
8 dB	53	70	74	78	40	36	42	42	dBm
16 dB	47	68	64	67	33	33	38	38	dBm
31.5 dB	55	70	64	67	36	36	38	38	dBm

10. IP2 and IP3 are measured with two-tone inputs F1 and F2 up to +5 dBm with 1 MHz spacing.

CSP-1, 4 x 6 mm, 32-lead PQFN†



† Reference Application Note M538 for lead-free solder reflow recommendations.