MAATCC0011

Digital Attenuator
31.5 dB, 6-Bit, TTL Driver, DC - 4.0 GHz

Rev. V7

Features

- Attenuation: 0.5 dB Steps to 31.5 dB
- Single Positive Supply
- Contains internal DC to DC converter
- Low DC Power Consumption
- Small Footprint, JEDEC Package
- Integral TTL Driver
- 50 ohm Impedance
- Lead-Free CSP-1 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free "Green" Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of AT90-1107

Description

The MAATCC0011 is a GaAs FET 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.

The MAATCC0011 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required. For dual supply designs without switching noise, use MAATCC0009.

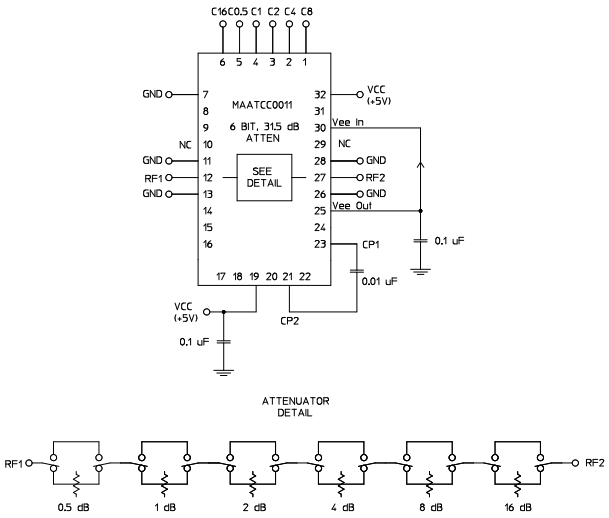
Ordering Information[1]

Part Number	Package
MAATCC0011	Bulk Packaging
MAATCC0011TR	1000 piece reel
MAATCC0011-TB	Sample Test Board

1. Reference Application Note M513 for reel size information.

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

Schematic with Off-Chip Components



Pin Configuration[2]

Pin No.	Function	Pin No.	Function
1	C8	17	NC
2	C4	18	NC
3	C2	19	Vcc
4	C1	20	NC
5	C0.5	21	Cp
6	C16	22	NC
7	GND	23	Cp
8	NC	24	NC
9	NC	25	V_{EE}[4]
10	NC[3]	26	GND
11	GND	27	RF2
12	RF1	28	GND
13	GND	29	NC[3]
14	NC	30	V_{EE}[4]
15	NC	31	NC
16	NC	32	Vcc

2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.
3. Pins 10 & 29 must be isolated.
4. VEE is produced internally and requires a .1 µF cap to GND. Generated noise is typical of switching DC-DC Converters.

Electrical Specifications: Freq. = DC - 4 GHz, T_A = +25°C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	—	dB	—	4.5	5.1
Attenuation Accuracy	Individual Bits 0.5-1-2-4-8-16 dB Any Combination of Bits 1 to 31.5 dB	dB	±(0.3 +7% of atten setting) ±(0.5 +8% of atten setting)		
VSWR	Full Range	Ratio	—	2.0:1	2.2:1
Switching Speed	50% Control to 90%/10% RF 10% to 90% or 90% to 10%	ns	—	75 20	—
1 dB Compression	50 MHz 0.5 - 4.0 GHz	dBm	—	21 24	—
Input IP3	Two-tone inputs up to +5 dBm 50 MHz 0.5 - 4.0 GHz	dB	—	35 48	—
V_{CC}	—	V	4.75	5.0	5.25
V_{IL} V_{IH}	LOW-level input voltage HIGH-level input voltage	V	0.0 2.0	—	0.8 5.0
Input Leakage Current	V_{IN} = V_{CC} or GND	µA	-1.0	—	1.0
I_{CC}[5]	V_{CC} min to max, Logic “0” or “1”	mA	—	6	10
Turn-on Current[6]	For guaranteed start-up	mA	—	—	125
ΔI_{CC} (Additional Supply Current Per TTL Input Pin)	V_{CC} = max, V_{CNTRL} = V_{CC} - 2.1 V	mA	—	—	1.0
Switching Noise	Generated from DC-DC Converter with recommended capacitors @ 3.5 MHz	dBm	—	-93	—
Thermal Resistance θ_{JA}	PCB mount on FR4 material, copper trace, still air at +25°C	°C/W	—	15	—

5. During turn-on, the device requires an initial “Turn-on Current”. Once operational, I_{CC} will drop to the specified levels.
6. The DC-DC converter is guaranteed to start in 100 µs as long as the power supplies can provide a minimum of 100 mA “Turn-on Current”.

Absolute Maximum Ratings[4,5]

Parameter	Absolute Maximum
Input Power 0.05 GHz 0.5 - 2.0 GHz	 +27 dBm +34 dBm
V_{CC}	-0.5 V ≤ V_{CC} ≤ +6.0 V
V_{IN}	-0.5 V ≤ V_{IN} ≤ V_{CC} + 0.5 V
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +125°C

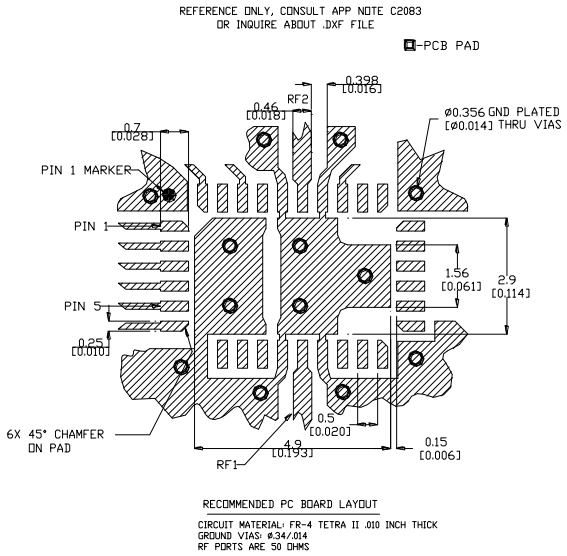
4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.

Truth Table (Digital Attenuator)

C16	C8	C4	C2	C1	C0.	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

0 = TTL Low; 1 = TTL High

Recommended PCB Configuration[8]



RECOMMENDED PC BOARD LAYOUT

CIRCUIT MATERIAL: FR-4 TETRA II .010 INCH THICK
GROUND VIAS: Ø.34/.014
RF PORTS ARE 50 OHMS

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

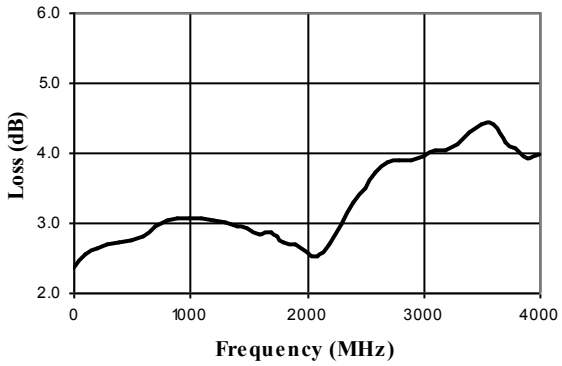
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Moisture Sensitivity

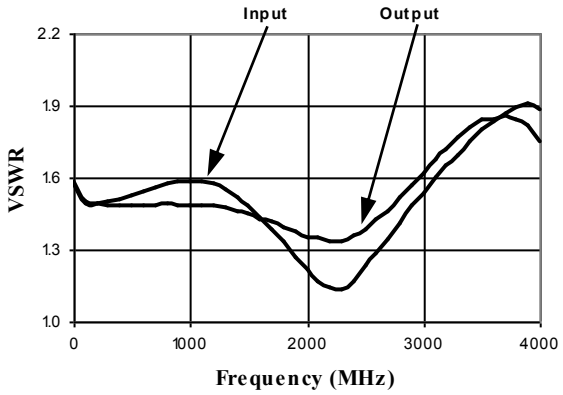
The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

Typical Performance Curves

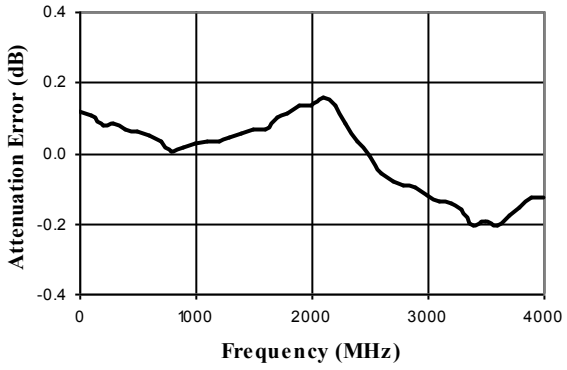
Insertion Loss



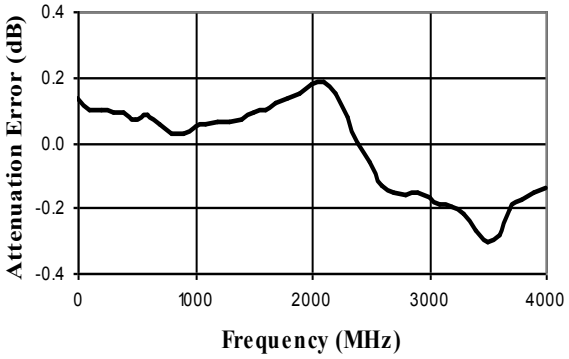
VSWR @ Insertion Loss



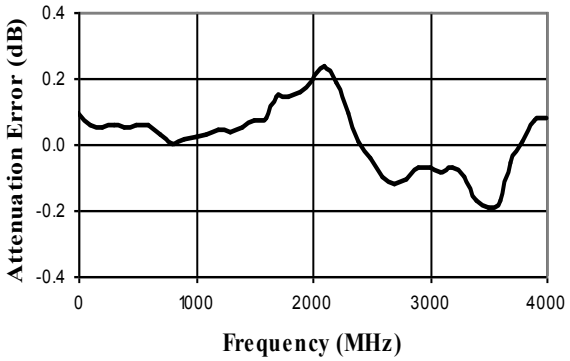
Attenuation Error, 0.5 dB Bit



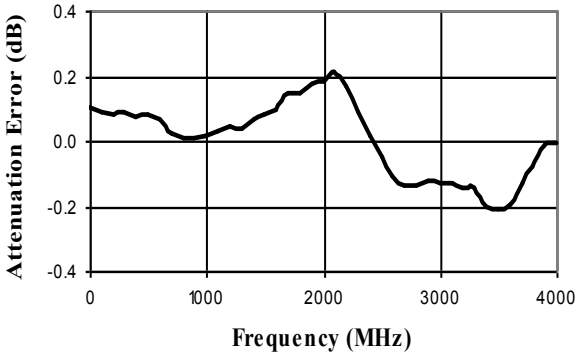
Attenuation Error, 1 dB Bit



Attenuation Error, 2 dB Bit

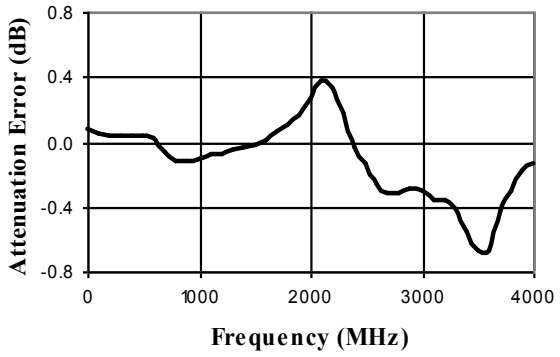


Attenuation Error, 4 dB Bit

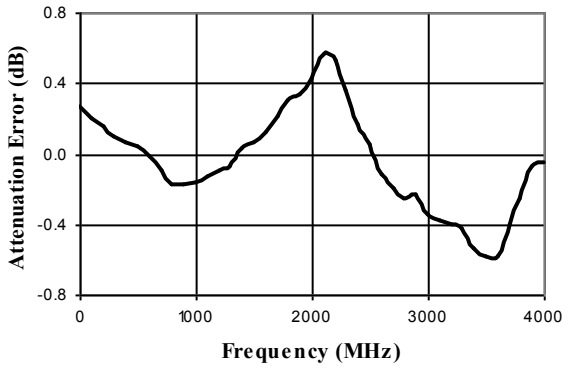


Typical Performance Curves

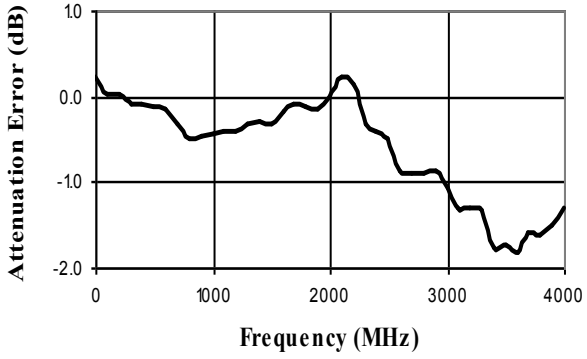
Attenuation Error, 8 dB Bit



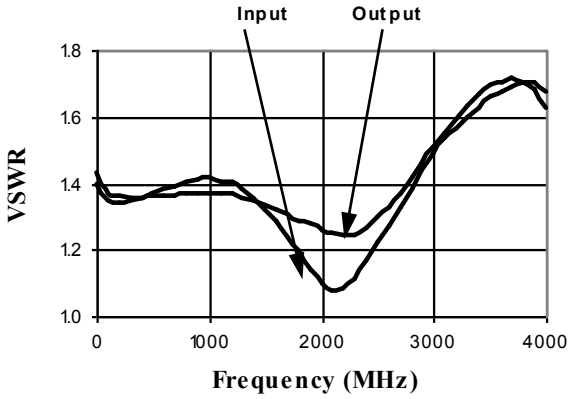
Attenuation Error, 16 dB Bit



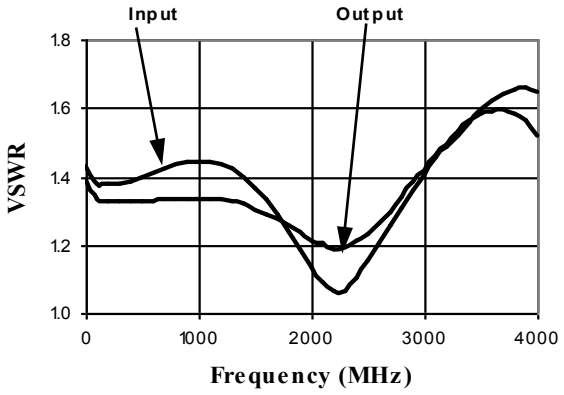
Attenuation Error, Max. Attenuation



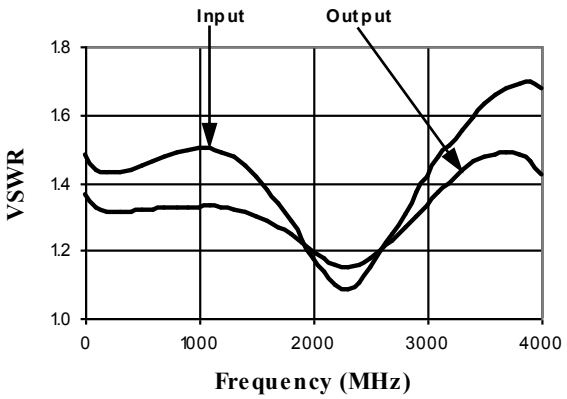
VSWR, 0.5 dB Bit



VSWR, 1 dB Bit

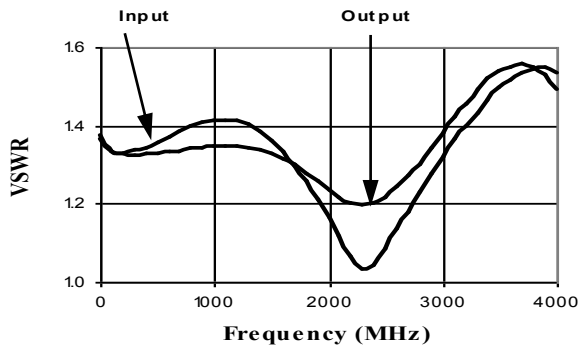


VSWR, 2 dB Bit

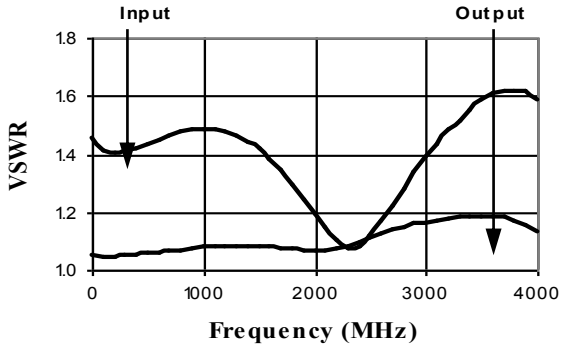


Typical Performance Curves

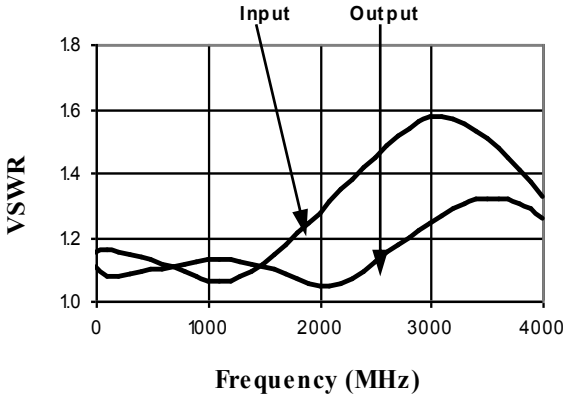
VSWR, 4 dB Bit



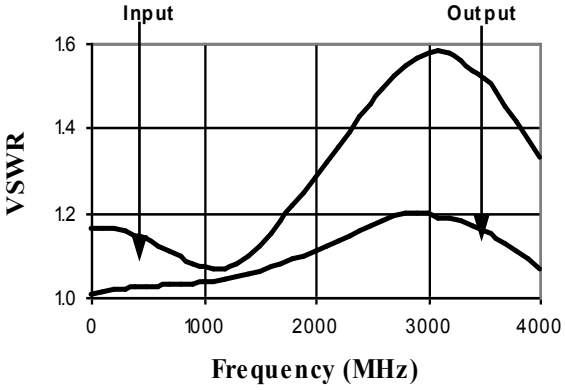
VSWR, 8 dB Bit



VSWR, 16 dB Bit

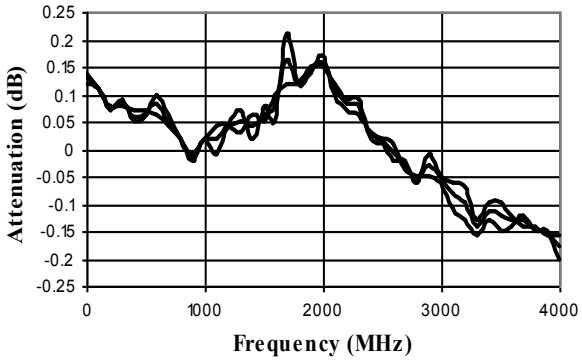


VSWR, Max. Attenuation

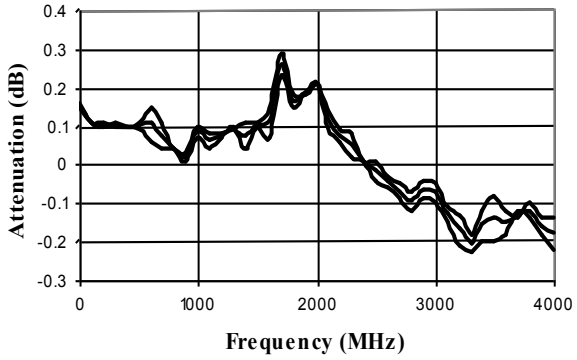


Typical Performance Curves

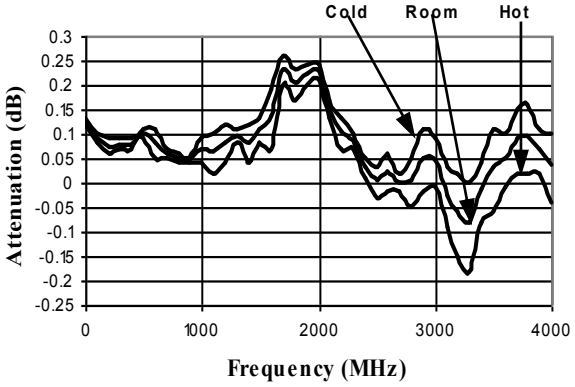
Typical Attenuation Deviation vs. Temperature for 0.5 dB Bit



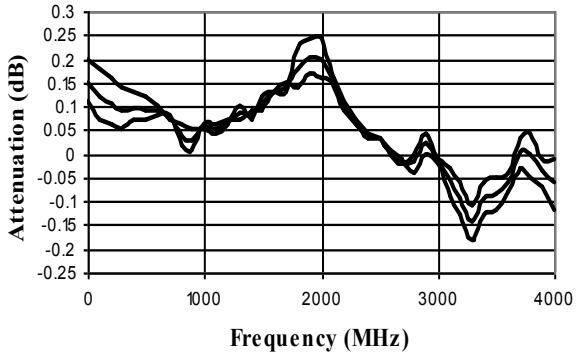
Typical Attenuation Deviation vs. Temperature for 1 dB Bit



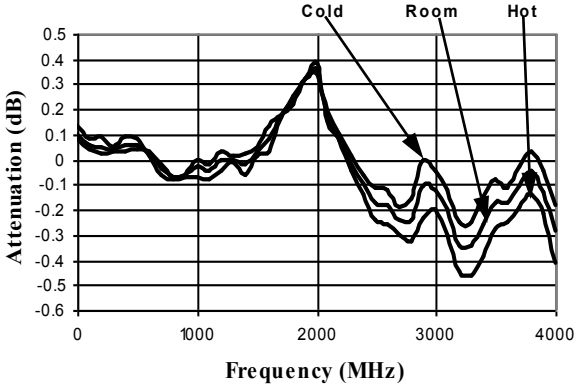
Typical Attenuation Deviation vs. Temperature for 2 dB Bit



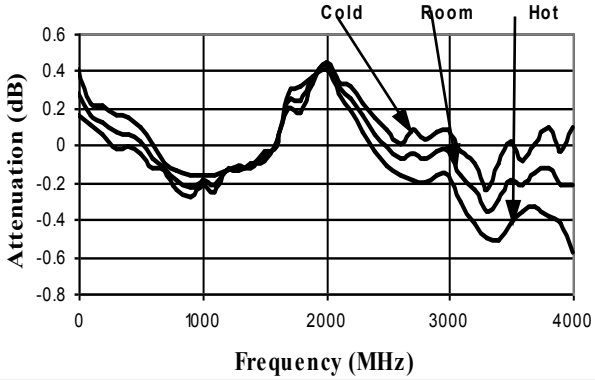
Typical Attenuation Deviation vs. Temperature for 4 dB Bit



Typical Attenuation Deviation vs. Temperature for 8 dB Bit

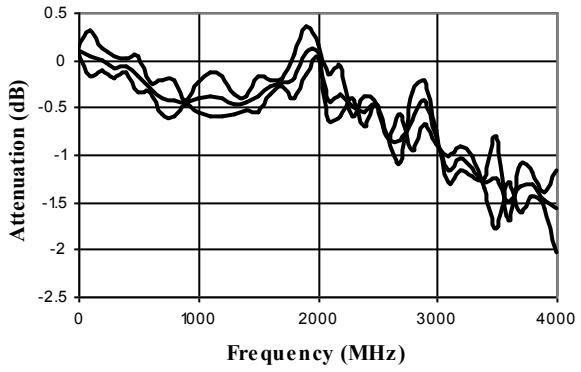


Typical Attenuation Deviation vs. Temperature for 16 dB Bit

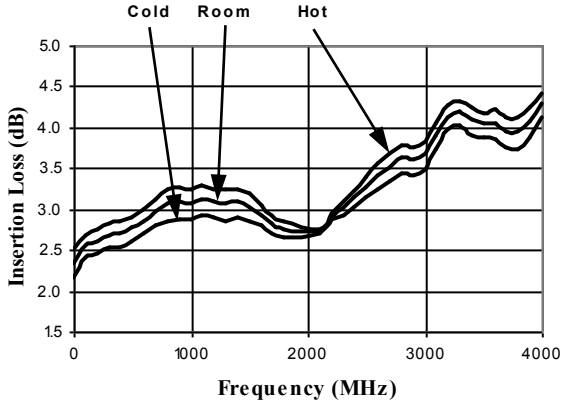


Typical Performance Curves

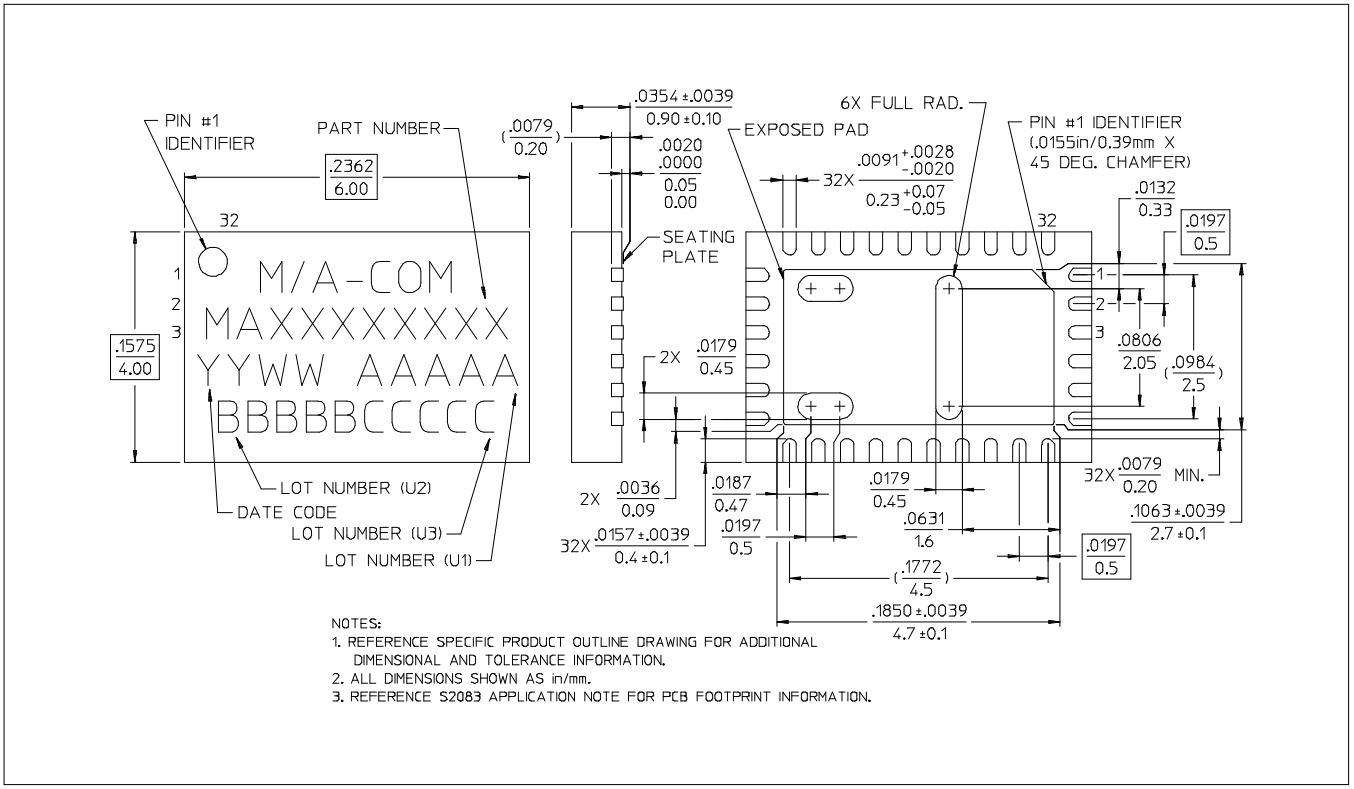
Typical Attenuation Deviation vs. Temperature at Maximum Attenuation



Insertion Loss vs. Temperature



CSP-1, Lead-Free 4 x 6 mm, 32-lead PQFN†



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

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