

Digital Attenuator

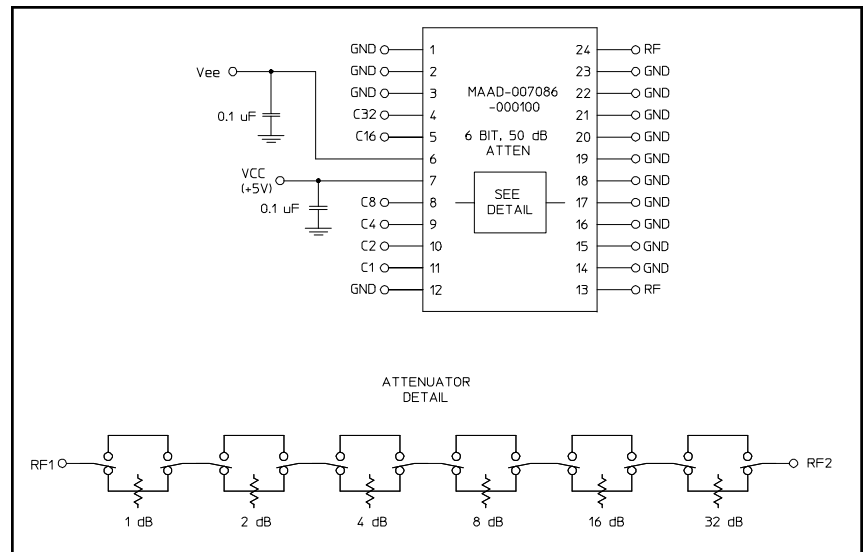
50 dB, 6-Bit, TTL Driver, DC-2.0 GHz

Rev. V3

Features

- Attenuation: 1 dB Steps to 50 dB
- Low DC Power Consumption
- Integral TTL Driver
- 50 ohm Impedance
- Test Boards are Available
- Tape and Reel Packaging Available
- Lead-Free SOW-24 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of AT65-0106

Schematic with Off-Chip Components



Description

M/A-COM's MAAD-007086-000100 is a GaAs FET 6-bit digital attenuator with a 1 dB minimum step size and a 50 dB total attenuation range. This device is in a SOW-24, wide body plastic surface mount package. The MAAD-007086-000100 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required.

Pin Configuration

Pin No.	Function	Pin No.	Function
1	GND	13	RF
2	GND	14	GND
3	GND	15	GND
4	C32	16	GND
5	C16	17	GND
6	VEE	18	GND
7	VCC	19	GND
8	C8	20	GND
9	C4	21	GND
10	C2	22	GND
11	C1	23	GND
12	GND	24	RF

Ordering Information

Part Number	Package
MAAD-007086-000100	Bulk Packaging
MAAD-007086-0001TR	1000 piece reel
MAAD-007086-0001TB	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: $T_A = 25^\circ\text{C}$, $Z_0 = 50\Omega$

Parameter	Test Conditions	Frequency	Units	Min	Typ	Max
Insertion Loss	—	DC - 2.0 GHz	dB	—	4.2	4.7
Attenuation Accuracy	Individual Bits 1-2-4-8-16-32 dB Any Combination of Bits 3 to 15 dB Any Combination of Bits 17 to 31 dB Any Combination of Bits 32 to 50 dB	DC - 2.0 GHz DC - 2.0 GHz DC - 2.0 GHz DC - 2.0 GHz	dB dB dB dB	— — — —	— — — —	$\pm(.3 + 3\%$ of atten setting) $\pm(.5 + 5\%$ of atten setting) $\pm(.3 + 3\%$ of atten setting) $\pm(.5 + 7\%$ of atten setting)
VSWR	Full Range	DC - 2.0 GHz	Ratio	—	1.8:1	2:1
Switching Speed ¹	50% Cntl to 90%/10% RF 10% to 90% or 90% to 10%	— —	ns ns	— —	75 20	150 50
1 dB Compression	— —	50 MHz 0.5 - 2.0 GHz	dBm dBm	— —	+21 +24	— —
Input IP_3	Two-tone inputs up to +5 dBm @ 0 dB Attenuation	50 MHz 0.5-2.0 GHz	dB dB	— —	+35 +48	— —
V_{CC} V_{EE}	— —	— —	V V	4.75 -8.0	5.0 -5.0	5.25 -4.75
V_{IL} V_{IH}	LOW-level input voltage HIGH-level input voltage	— —	V V	0.0 2.0	— —	0.8 5.0
I_{in} (Input Leakage Current)	$V_{in} = V_{CC}$ or GND	—	μA	-1.0	—	1.0
I_{CC} (Quiescent Supply Current)	$V_{cntrl} = V_{CC}$ or GND	—	μA	—	250	400
ΔI_{CC} (Additional Supply Current Per TTL Input Pin)	$V_{CC} = \text{Max}$, $V_{cntrl} = V_{CC} - 2.1 \text{ V}$	—	mA	—	—	1.0
I_{EE}	V_{EE} min to max, $V_{in} = V_{IL}$ or V_{IH}	—	mA	-1.0	-0.2	—
Thermal Resistance θ_{JA}	PCB mount on FR4 material, copper trace, still air at +25°C	—	$^\circ\text{C/W}$	—	60-80	—

1. Decoupling capacitors (.01 μF) are required on power supply lines.

Absolute Maximum Ratings^{2,3}

Parameter	Absolute Maximum
Max. Input Power 0.05 GHz 0.5 - 2.0 GHz	+27 dBm +34 dBm
V_{CC}	$-0.5\text{V} \leq V_{CC} \leq +7.0\text{V}$
V_{EE}	$-8.5\text{V} \leq V_{EE} \leq +0.5\text{V}$
$V_{CC} - V_{EE}$	$-0.5\text{V} \leq V_{CC} - V_{EE} \leq 14.5\text{V}$
V_{in}^4	$-0.5\text{V} \leq V_{in} \leq V_{CC} + 0.5\text{V}$
Operating Temperature	-40°C to $+85^\circ\text{C}$
Storage Temperature	-65°C to $+125^\circ\text{C}$

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

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.

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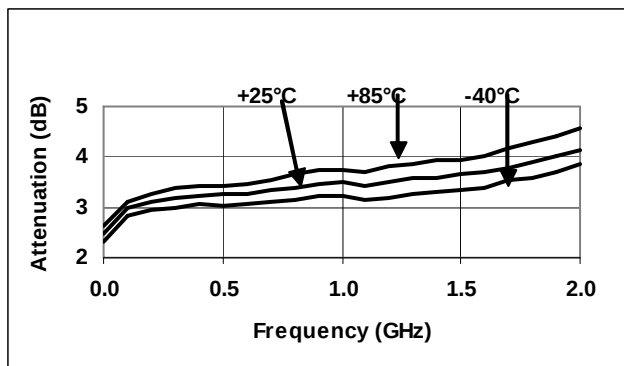
Truth Table (Digital Attenuator)

C32	C16	C8	C4	C2	C1	Attenuation
0	0	0	0	0	0	Loss, Reference
0	0	0	0	0	1	1 dB
0	0	0	0	1	0	2 dB
0	0	0	1	0	0	4 dB
0	0	1	0	0	0	8 dB
0	1	0	0	0	0	16 dB
1	0	0	0	0	0	32 dB
1	1	0	0	1	0	50 dB

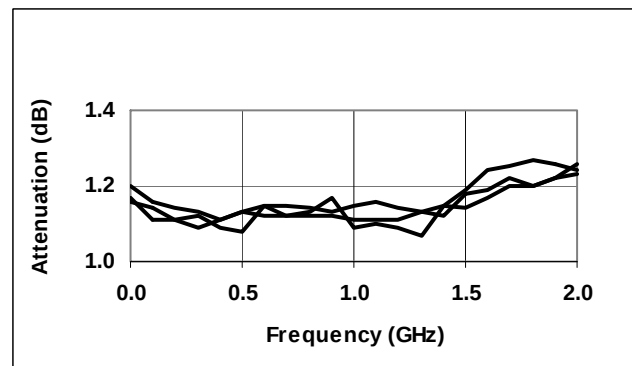
0 = TTL Low; 1 = TTL High

Typical Performance Curves

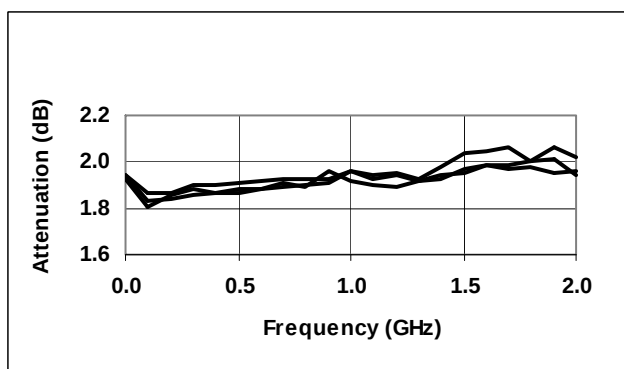
Insertion Loss vs. Temperature



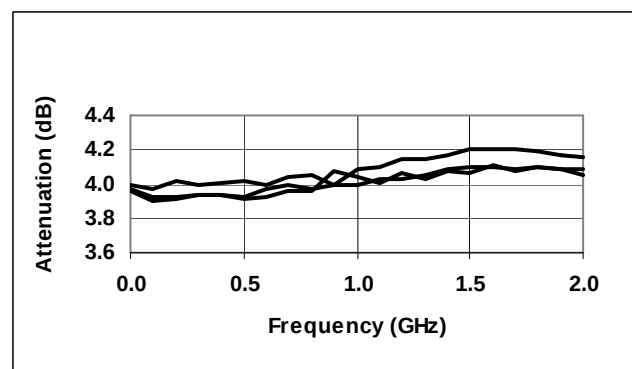
1 dB Attenuation Variation from -40°C to +85°C



2 dB Attenuation Variation from -40°C to +85°C



4 dB Attenuation Variation from -40°C to +85°C

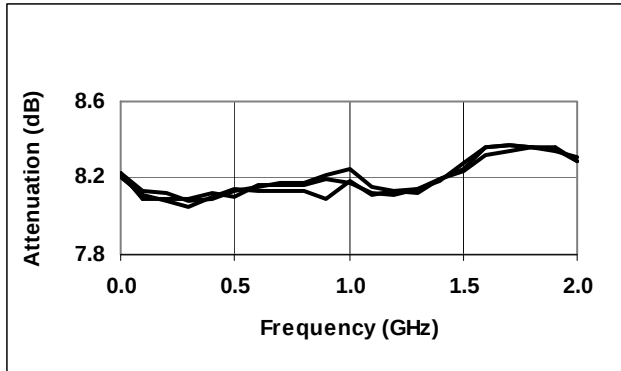


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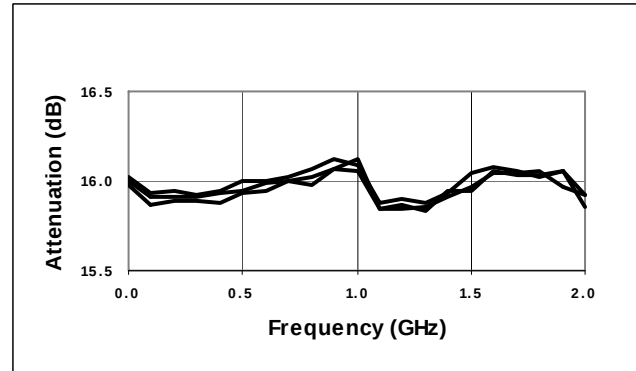
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Typical Performance Curves

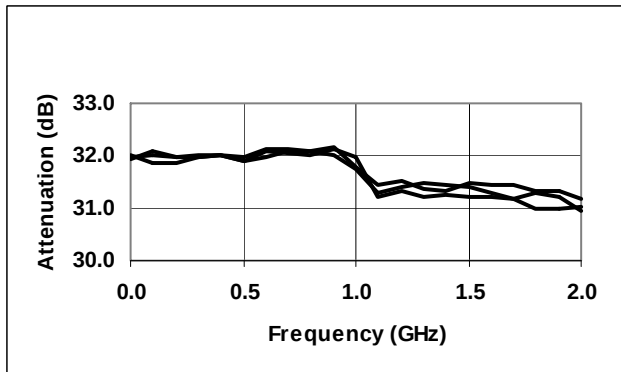
8 dB Attenuation Variation from -40°C to +85°C



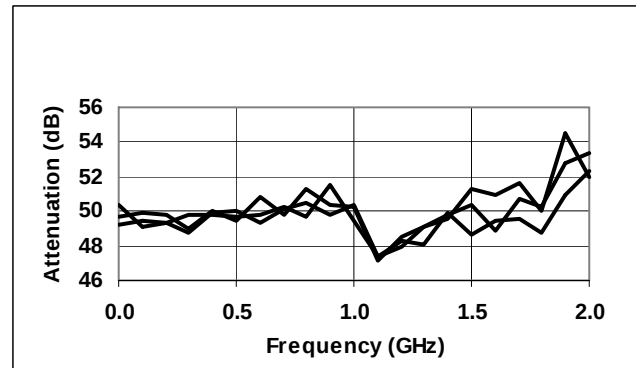
16 dB Attenuation Variation from -40°C to +85°C



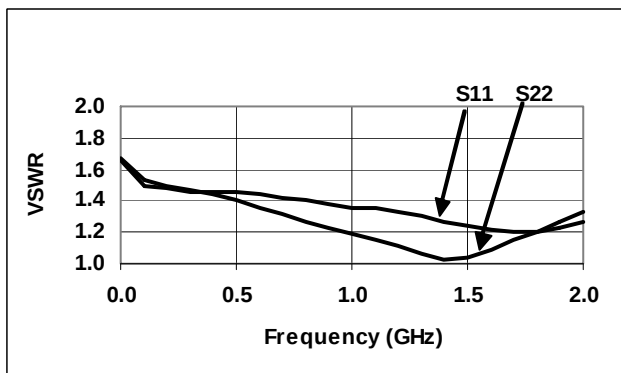
32 dB Attenuation Variation from -40°C to +85°C



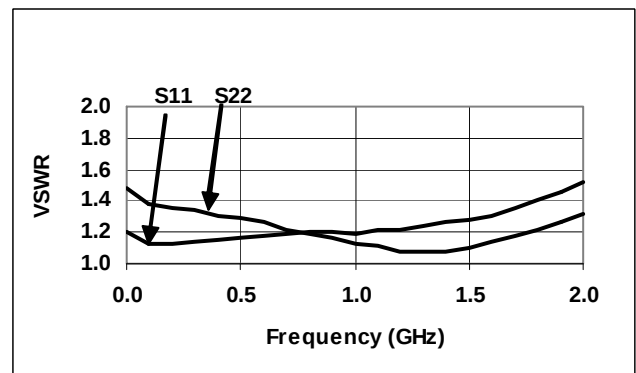
Max. Attenuation Variation from -40°C to +85°C



Reference Loss VSWR (S11, S22)



1 dB VSWR (S11, S22)

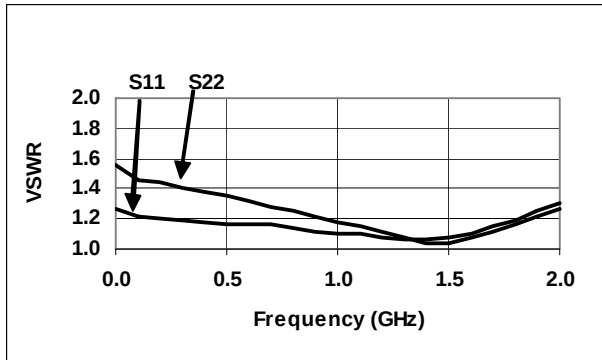


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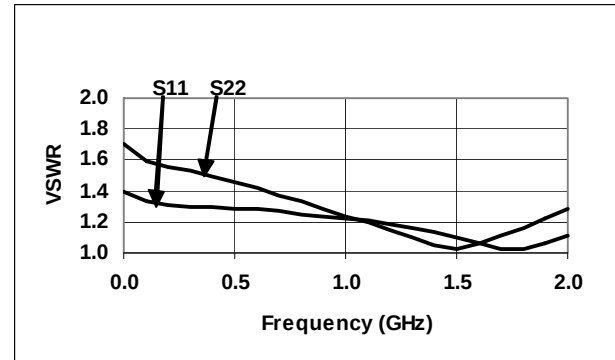
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Typical Performance Curves

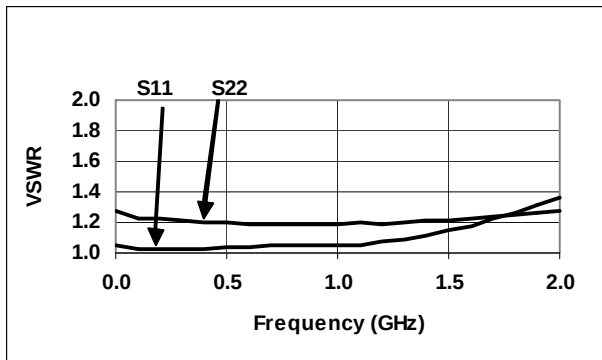
2 dB VSWR (S11, S22)



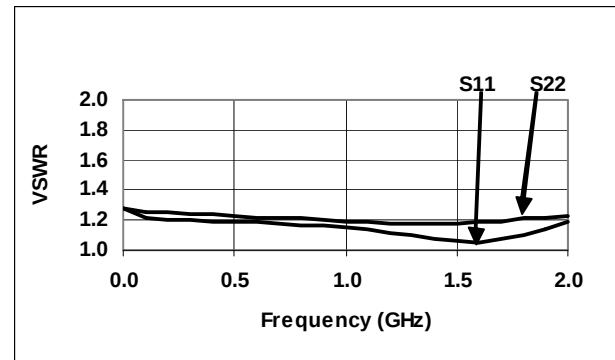
4 dB VSWR (S11, S22)



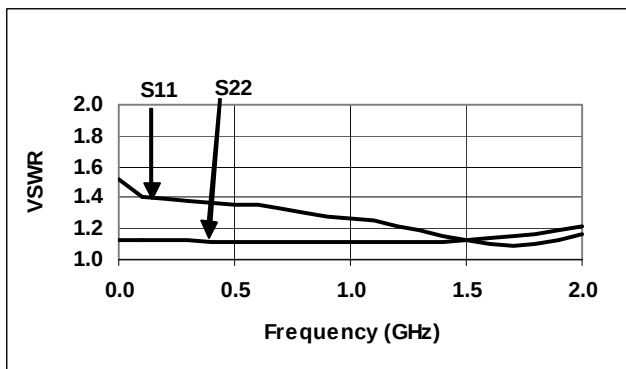
8 dB VSWR (S11, S22)



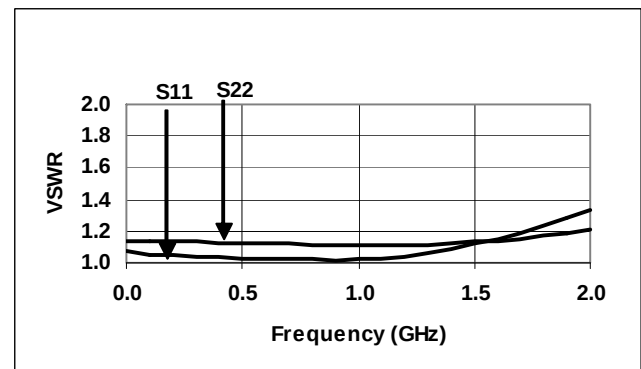
16 dB VSWR (S11, S22)



32 dB VSWR (S11, S22)



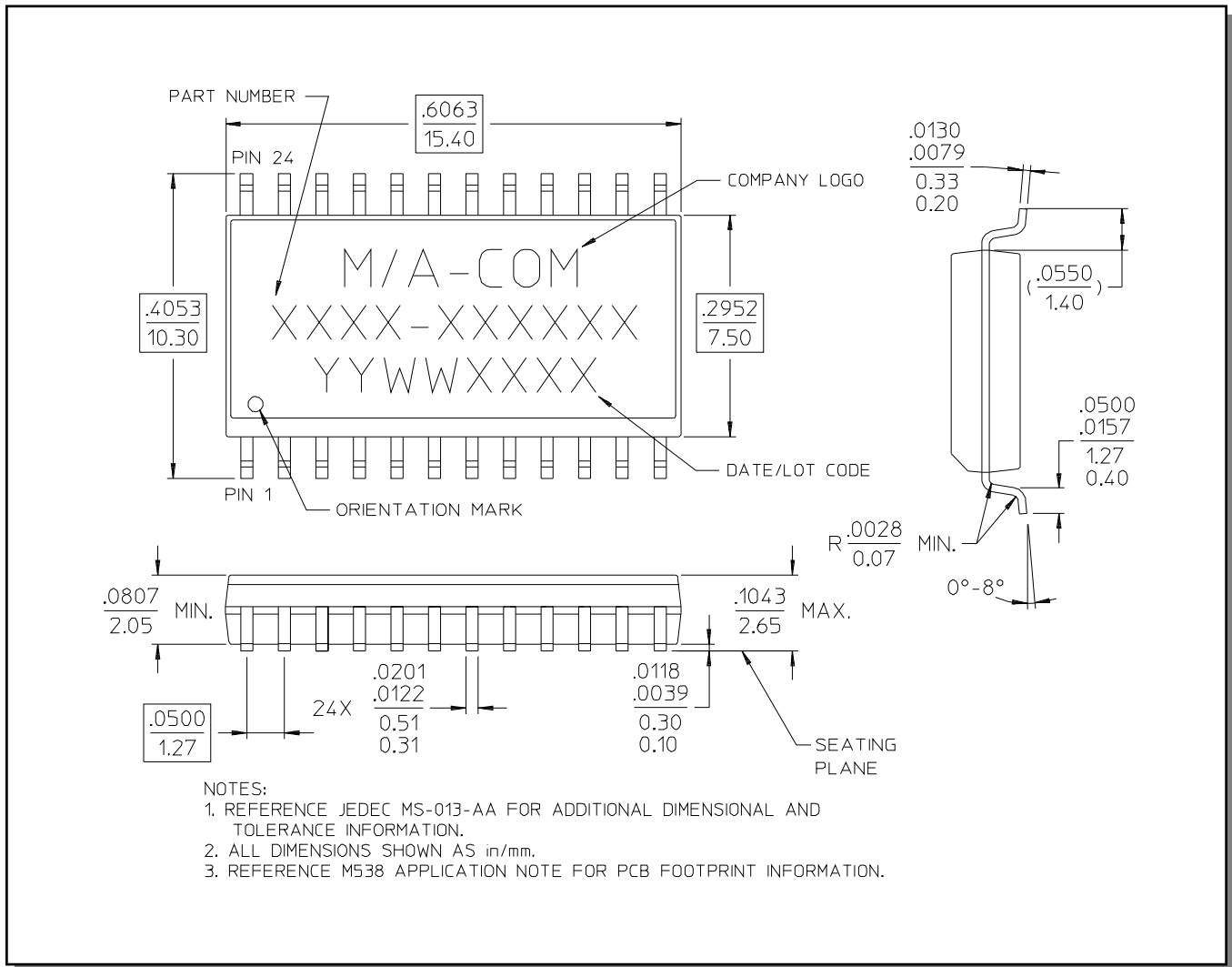
50 dB VSWR (S11, S22)



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Lead-Free, SOW-24[†]



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