

HMIC™ PIN Diode SPDT 80 W Switch for 0.01 - 6.0 GHz High Power Applications



MASW-000932

Rev. V3

Features

- Exceptional Broadband Performance
- Low Loss: $T_x = 0.25 \text{ dB @ 2010 MHz}$
- High Isolation: $R_x = 43 \text{ dB @ 2010 MHz}$
- Suitable for High Power LTE, TD-SCDMA, WiMAX, and Military Radio Applications
- Surface Mount 4 mm PQFN Package
- RoHS* Compliant
- Class 2 ESD Rating (HBM 2kv)

Applications

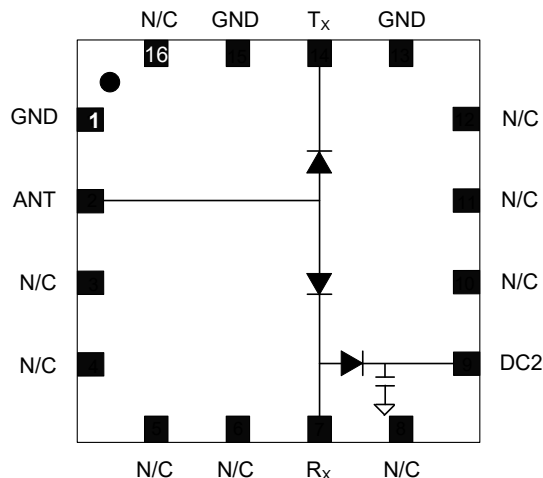
- Aerospace & Defense
- ISM

Description

The MASW-000932 is a SPDT high power, broadband, high linearity, PIN diode T/R switch for 0.01 - 6.0 GHz applications, including WiMAX & WiFi. The device is provided in an industry standard lead free 4 mm PQFN plastic package. This device incorporates a PIN diode die fabricated with MACOMs' patented silicon-glass HMIC™ process. This chip features two silicon pedestals embedded in a low loss, low dispersion glass. The diodes are formed on the top of each pedestal. The topside is fully encapsulated with silicon nitride and has an additional polymer passivation layer. These polymer protective coatings prevent damage and contamination during handling and assembly.

This compact SPDT switch offers wideband performance with excellent isolation to loss ratio for both T_x and R_x states. The PIN diode provides 45 W CW power handling at an 85°C baseplate temperature and 72 dBm IIP3 at 2010 MHz for maximum switch performance.

Functional Diagram (Top View)



Pin Configuration¹

Pin	Function
1, 13, 15	GND
2	ANT
3, 4, 5, 6, 8, 10, 11, 12, 16	N/C ²
7	R_x
9	DC2
14	T_x
17	Pad

1. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.
2. MACOM recommends connecting all No Connection (N/C) pins to ground.

Ordering Information³

Part Number	Package
MASW-000932-13560T	1000 piece reel
MASW-000932-001SMB	Sample Board

3. Reference Application Note M513 for reel size information.

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

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Electrical Specifications⁴: Freq. = 2.0, 2.7, 3.5 GHz, T_A = +25°C, Bias = 100 mA / 28 V

Parameter	100 mA / 28 V Conditions	Units	Min.	Typ.	Max.
Insertion Loss: R _X P _{IN} = 0 dBm	R _X , 2.0 GHz	dB	—	0.60	0.80
	T _X , 2.0 GHz			0.25	—
	R _X , 2.7 GHz			0.72	0.90
	T _X , 2.7 GHz			0.35	—
	R _X , 3.5 GHz			0.80	0.95
	T _X , 3.5 GHz			0.45	—
Isolation P _{IN} = 0 dBm	R _X to Antenna, 2.0 GHz	dB	40.0	43.0	—
	T _X to Antenna, 2.0 GHz		—	14.0	
	R _X to Antenna, 2.7 GHz		39.0	41.5	
	T _X to Antenna, 2.7 GHz		—	12.0	
	R _X to Antenna, 3.5 GHz		34.0	35.0	
	T _X to Antenna, 3.5 GHz		—	10.0	
Input Return Loss	P _{IN} = 0 dBm	dB	—	34	—
	R _X			17	
	T _X			—	
T _X Input P0.1dB	T _X to Antenna	dBm	—	49	—
T _X 2 nd Harmonic	P _{IN} = 30 dBm	dBc	—	80	—
T _X 3 rd Harmonic	P _{IN} = 30 dBm	dBc	—	95	—
T _X IIP3	P _{IN} = 10 dBm, F1 = 2010 MHz, F2 = 2020 MHz	dBm	—	72	—
T _X CW Input Power	25°C Base plate, 2.01 GHz	dBm / W	—	49 / 80	—
T _X CW Input Power	85°C Base plate, 2.01 GHz	dBm / W	—	46.5 / 45.0	—
R _X CW Input Power	—	dBm / W	—	41.5 / 14.0	—
T _X RF Switching Speed	(10 - 90% RF Voltage) 1 MHz Rep Rate in Modulating Mode	ns	—	200	—

4. See Bias Table

Absolute Maximum Ratings^{5,6} @ T_A = +25°C (unless otherwise specified)

Parameter	Absolute Maximum
Forward Current	125 mA
DC Reverse Voltage	110 V
T _X Incident CW Power	80 W (49 dBm) ⁷ @ 2010 MHz
T _X Peak Incident Power	>2000 W, 5 μs _i 1% duty Cycle ⁸
Junction Temperature	+175°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +150°C

5. Exceeding these limits may cause permanent damage.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Baseplate temperature must be controlled to a constant +25°C.
8. This rating is guaranteed if the RF ports are terminated.

Minimum Reverse Bias Voltage⁹

Frequency (MHz)	DC Voltage (V)
50	107 ¹⁰
500	72 ¹⁰
1000	44
2000	24
4000	12
6000	8

9. Minimum DC bias voltage to maintain low loss under 80 W of TX power with 1.5:1 VSWR
10. The MADR-009150 driver has a 55 V maximum voltage limit. For higher voltages, consider using the MADR-010574 driver.

2

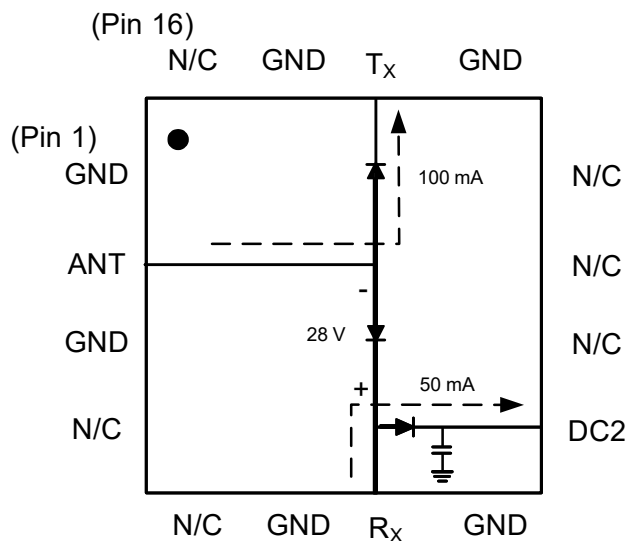
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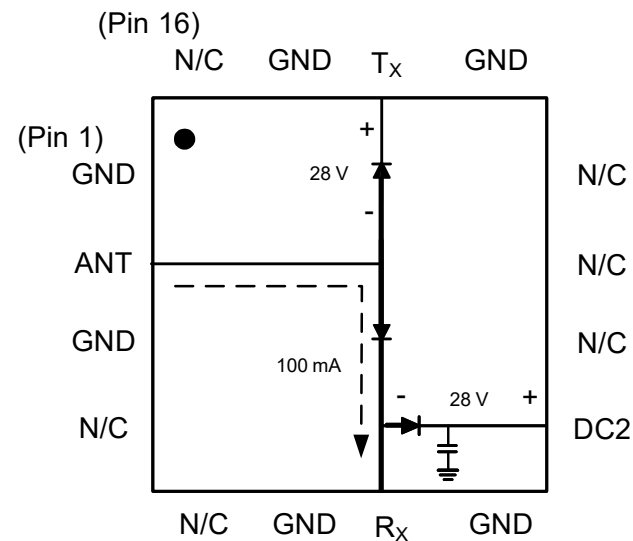
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Bias Diagrams & Tables

T_X-ANT Insertion Loss, R_X-ANT Isolation



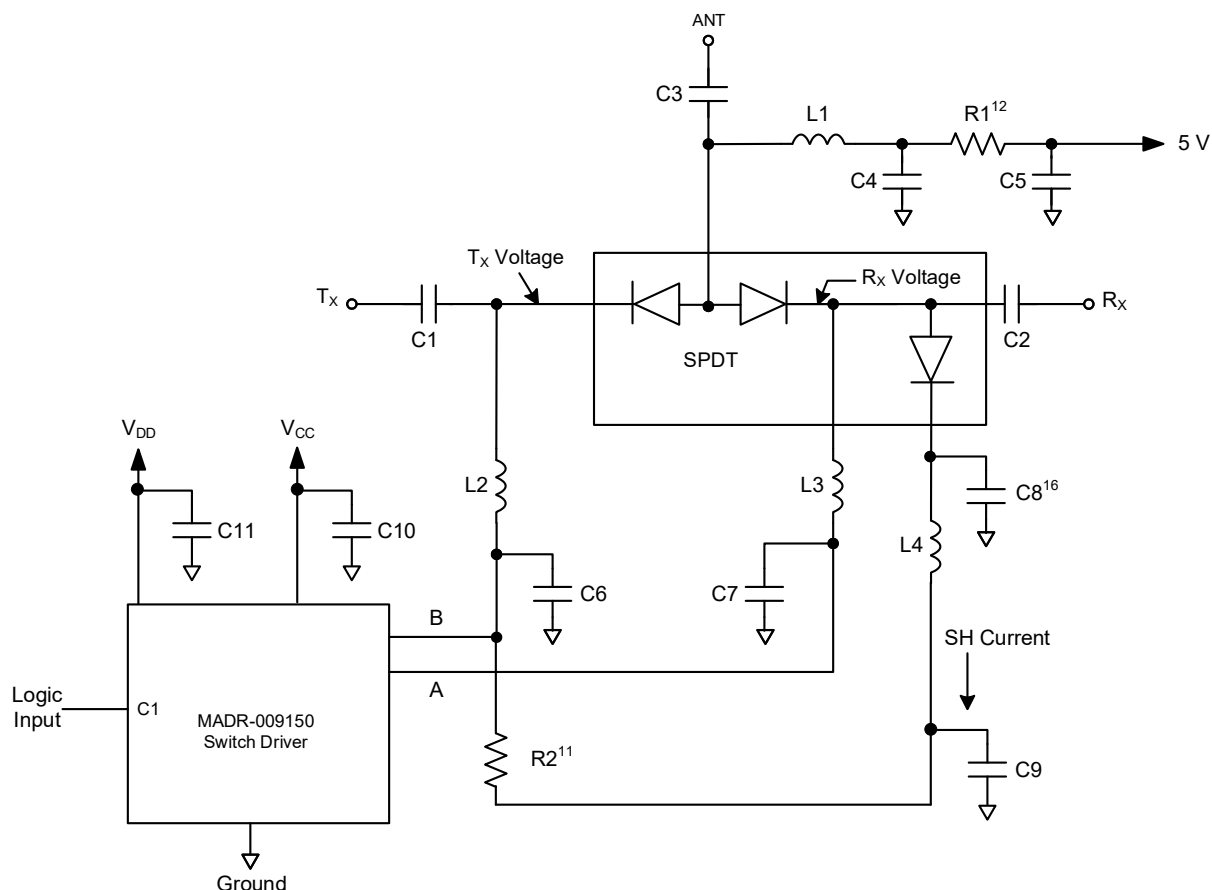
R_X-ANT Insertion Loss, T_X-ANT Isolation



Bias Table

Bias Table	T _X	R _X	DC2	ANT
Pin	Pin 14	Pin 7	Pin 9	Pin 2
T _X -ANT Isolation	+28 V, 0 mA	-100 mA	+28 V, 0 mA	0 V, +100 mA
T _X -ANT Insertion Loss	-100 mA	+28 V, +50 mA	-50 mA	0 V, +100 mA
R _X -ANT Isolation	-100 mA	+28 V, +50 mA	-50 mA	0 V, +100 mA
R _X -ANT Insertion Loss	+28 V, 0 mA	-100 mA	+28 V, 0 mA	0 V, +100 mA

Application Schematic using MADR-009150 Driver^{11,12,13,14,15,16}



11. Forward Bias Diode Voltage: DV_F is ~ 0.9 V @ 22 mA; DV_F is ~ 1.0 V @ 35 mA
12. R1 is calculated by $(V_{CC} - 1.3 \text{ V approximation since Tx and Rx voltages "B" \& "A" on the driver will be slightly different}) / I_{SERIES}$, where I_{SERIES} is the desired bias current for the series diodes.
13. R2 is calculated by $(V_{DD} - 1.5 \text{ V}) / I_{SHUNT}$, where I_{SHUNT} is the desired forward bias current for the shunt diode. The power dissipation is calculated by $I_{SHUNT} \times (V_{DD} - 1.5 \text{ V})$.
14. The current in through the back-biased diodes will be the leakage current for the diodes.
15. C1 - C7, C9 - C11, L1 - L4, R1, R2, and the switch are discrete components that should be installed on the users board. It is recommended that Coilcraft 0603CS-27NXJLW or equivalent be used for L1 - L4 at 2 GHz (values may vary based on the frequency).
16. C8 is already built-in for MASW-000932-13560 switch.

Parts List

Part	Value
C1 - C3	27 pF
C4	1000 pF
C5, C10, C11	0.1 μ F
C6, C7, C8 ¹⁶ , C9	50 pF
L1, L2, L3, L4	27 nH
R1	39 Ω ¹²
R2	see note 13

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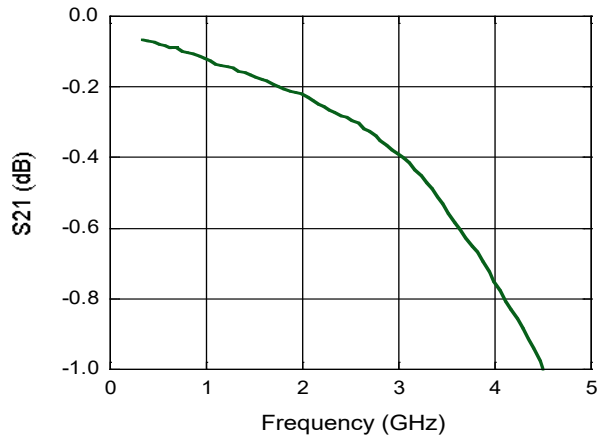


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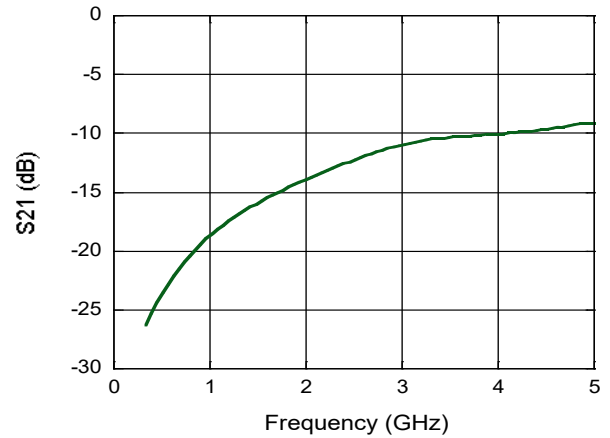
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Typical Performance Curves, T_x (100 mA Bias Current)

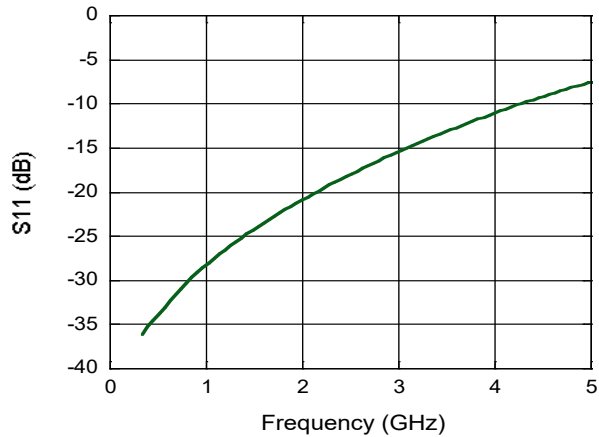
Insertion Loss, T_x



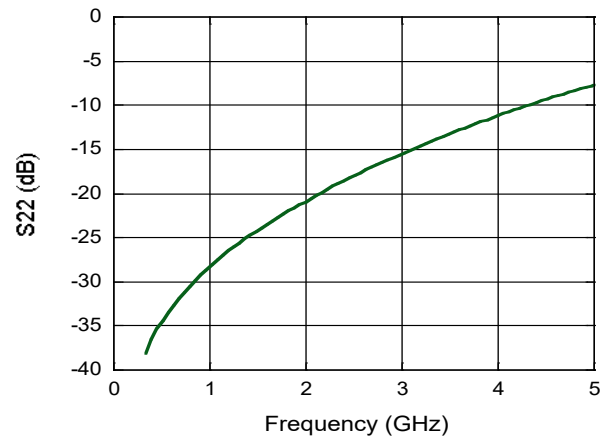
Isolation, T_x



Input Return Loss, T_x

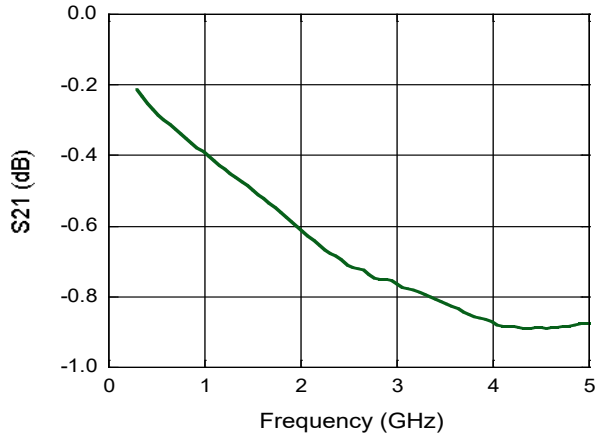


Output Return Loss, T_x

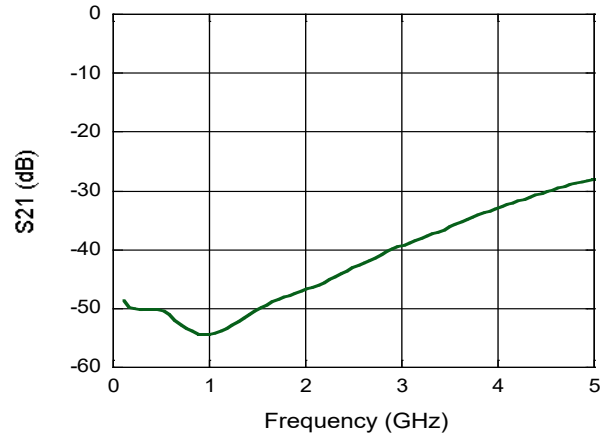


Typical Performance Curves, R_x (100 mA Bias Current)

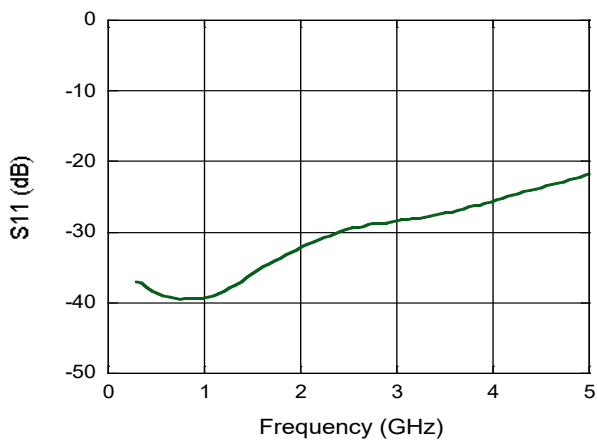
Insertion Loss, R_x



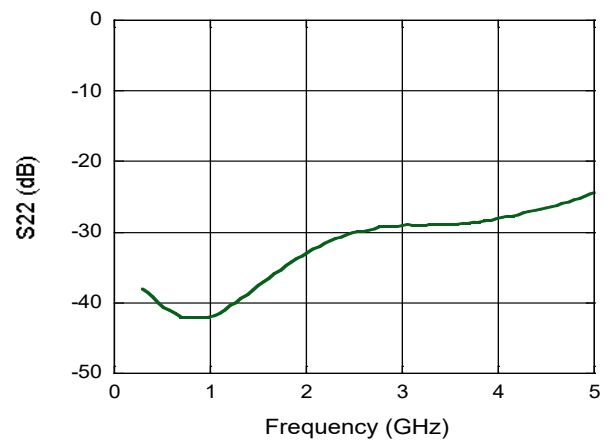
Isolation, R_x



Input Return Loss, R_x



Output Return Loss, R_x



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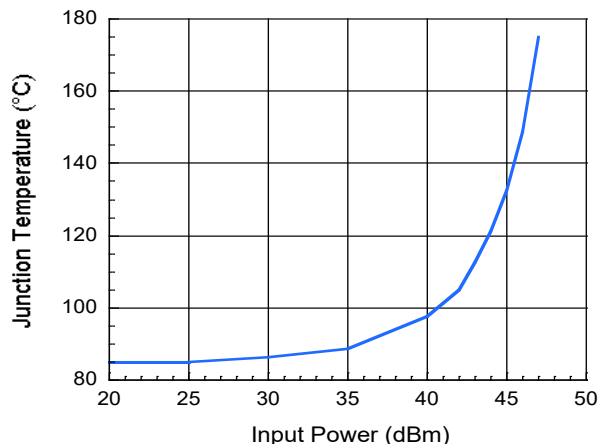


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Typical Performance Curves¹⁴: +85°C base plate temperature, 2000 MHz

Power



Handling Procedures

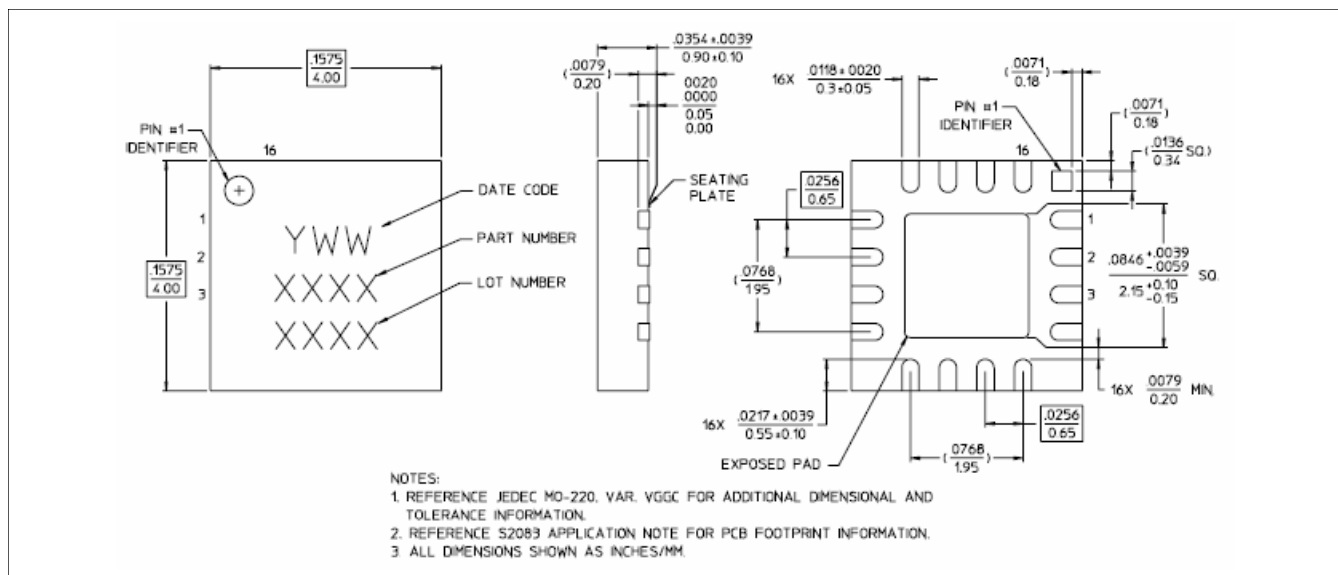
Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 2 devices.

14. Maximum Junction Temperature for this device is 175°C.

Lead Free 4 mm 16-Lead PQFN †



† Reference Application Note S2083 for lead-free solder reflow recommendations.
 Meets JEDEC moisture sensitivity level 1 requirements.
 Plating is 100% matte tin over copper.

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