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 dB @ 2010 MHz
- High Isolation: R_X = 43 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

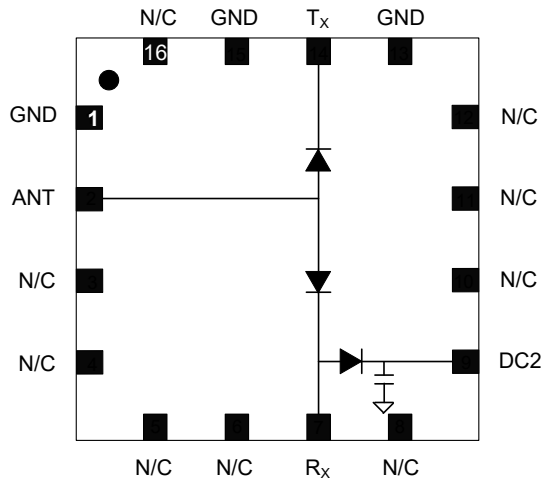
- Aerospace & Defense
- ISM

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 Configuration[1]

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 Information[3]

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.

Electrical Specifications[4]: 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 T_X, 2.0 GHz R_X, 2.7 GHz T_X, 2.7 GHz R_X, 3.5 GHz T_X, 3.5 GHz	dB	—	0.60 0.25 0.72 0.35 0.80 0.45	0.80 — 0.90 — 0.95 —
Isolation P_{IN}= 0 dBm	R_X to Antenna, 2.0 GHz T_X to Antenna, 2.0 GHz R_X to Antenna, 2.7 GHz T_X to Antenna, 2.7 GHz R_X to Antenna, 3.5 GHz T_X to Antenna, 3.5 GHz	dB	40.0 — 39.0 — 34.0 —	43.0 14.0 41.5 12.0 35.0 10.0	—
Input Return Loss	P_{IN}= 0 dBm R_X T_X	dB	—	34 17	—
T_X Input P0.1dB	T_X to Antenna	dBm	—	49	—
T_X 2nd Harmonic	P_{IN} = 30 dBm	dBc	—	80	—
T_X 3rd 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, 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.

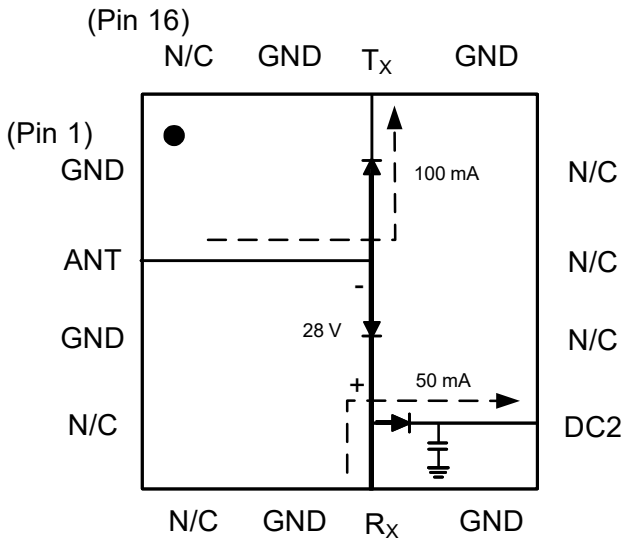
Minimum Reverse Bias Voltage[9]

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

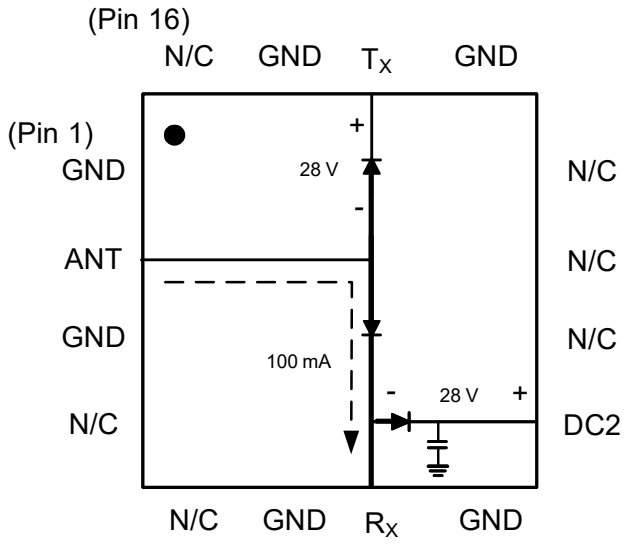
9. Minimum DC bias voltage to maintain low loss under 80 W of TX power with 1.5:1 VSWR
10. The MADR-009150 driver has a 55 V maimum voltage limit. For higher voltages, consider using the MADR-010574 driver.

Bias Diagrams & Tables

T_X-ANT Insertion Loss, R_X-ANT Isolation



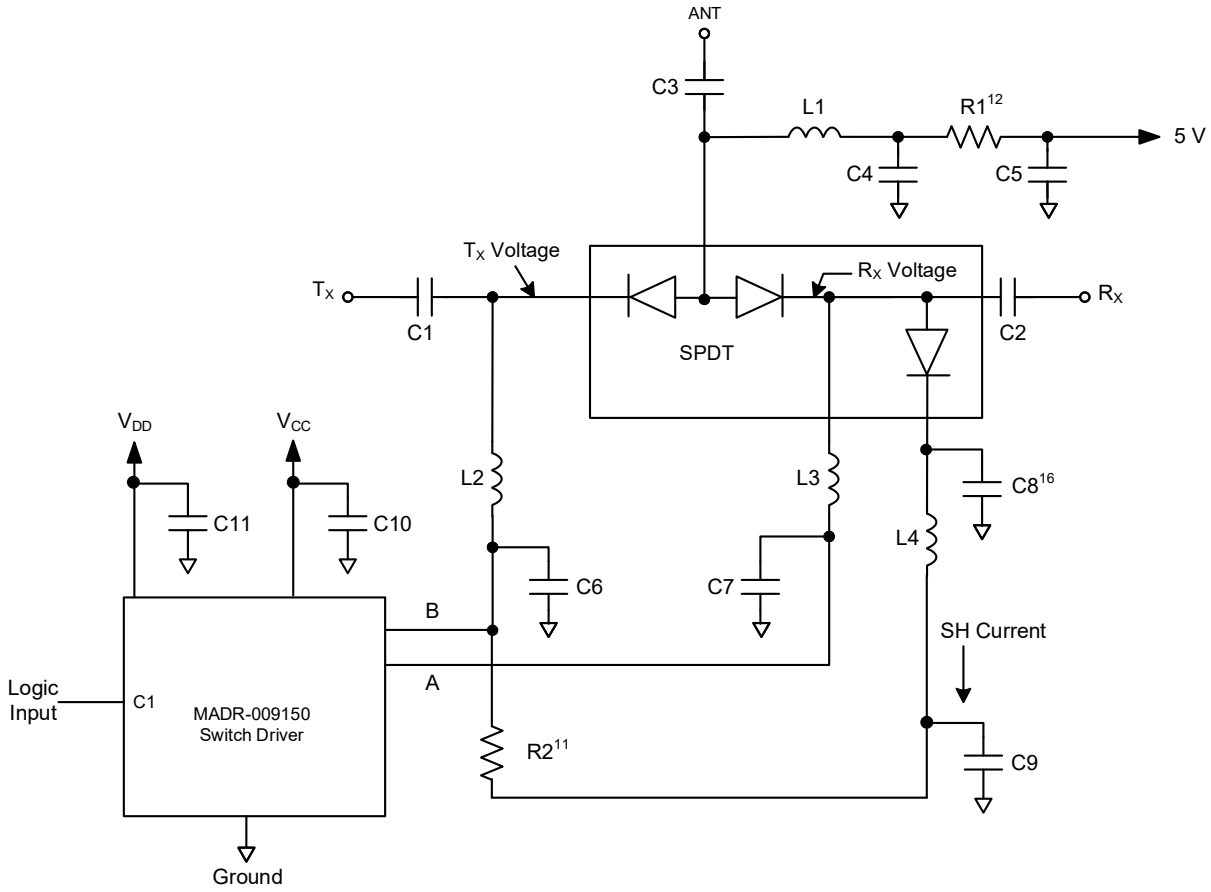
R_X-ANT Insertion Loss, T_X-ANT Isolation



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]



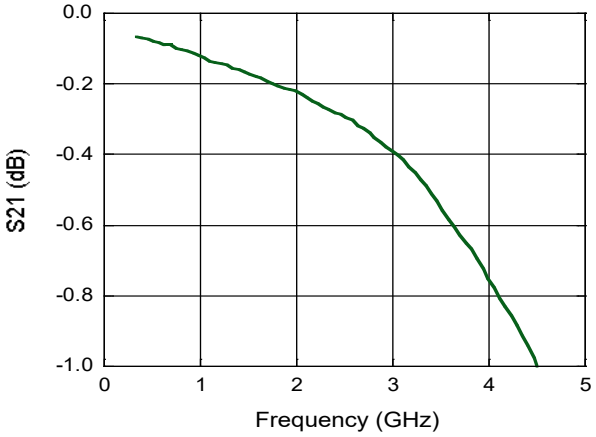
11. Forward Bias Diode Voltage: DV_F is ~0.9 V @ 22 mA; DV_F is ~1.0 V @ 35 mA
12. R1 is calculated by (V_{CC} - 1.3 V approximation since Tx and Rx voltages "B" & "A" on the driver will be slightly different)/I_{SERIES}, where I_{SERIES} is the desired bias current for the series diodes.
13. R2 is calculated by (V_{DD} - 1.5 V)/I_{SHUNT}, where I_{SHUNT} is the desired forward bias current for the shunt diode. The power dissipation is calculated by I_{SHUNT} x (V_{DD} - 1.5 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

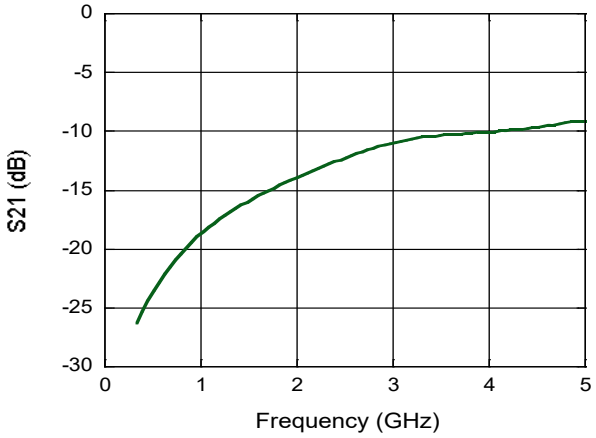
Part	Value
C1 - C3	27 pF
C4	1000 pF
C5, C10, C11	0.1 µF
C6, C7, C8[16], C9	50 pF
L1, L2, L3, L4	27 nH
R1	39 Ω[12]
R2	see note 13

Typical Performance Curves, T_X (100 mA Bias Current)

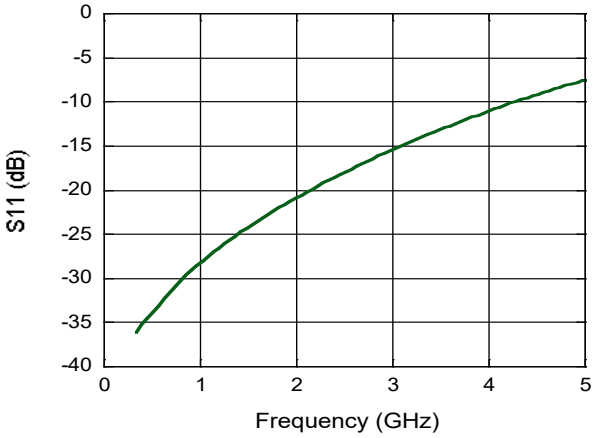
Insertion Loss, T_X



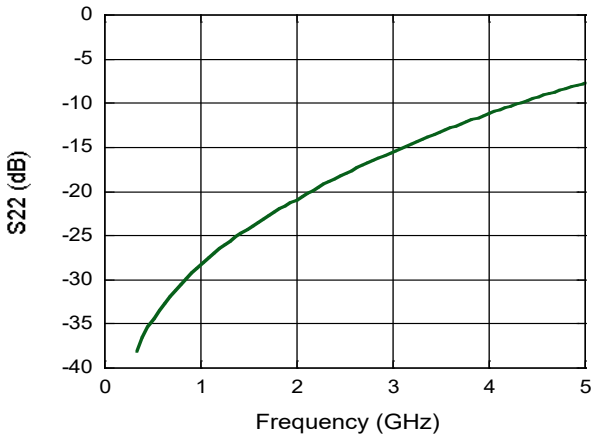
Isolation, T_X



Input Return Loss, T_X

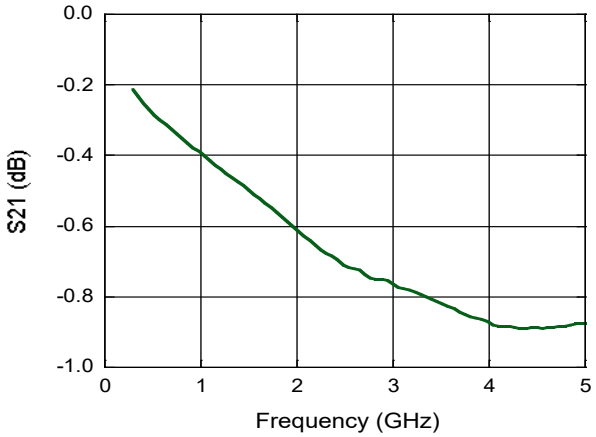


Output Return Loss, T_X

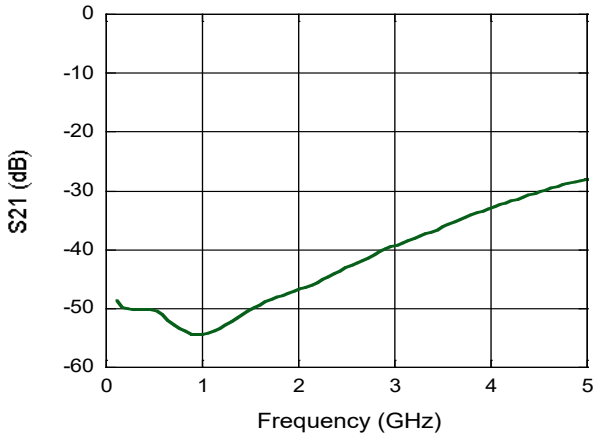


Typical Performance Curves, R_X (100 mA Bias Current)

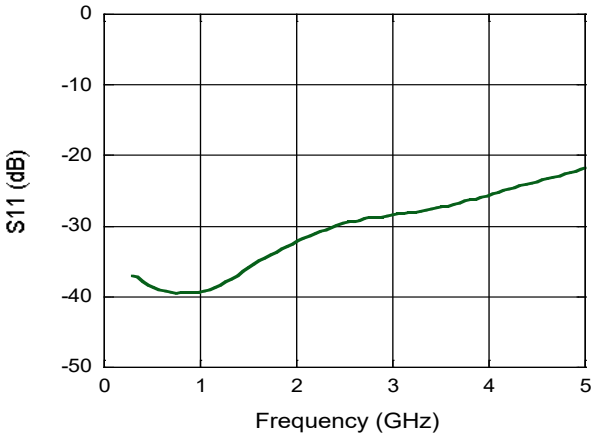
Insertion Loss, R_X



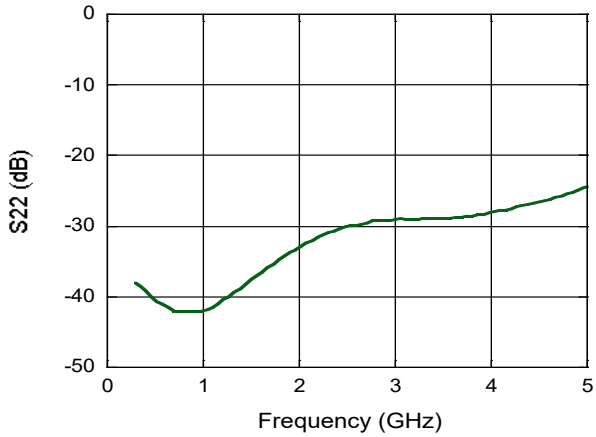
Isolation, R_X



Input Return Loss, R_X

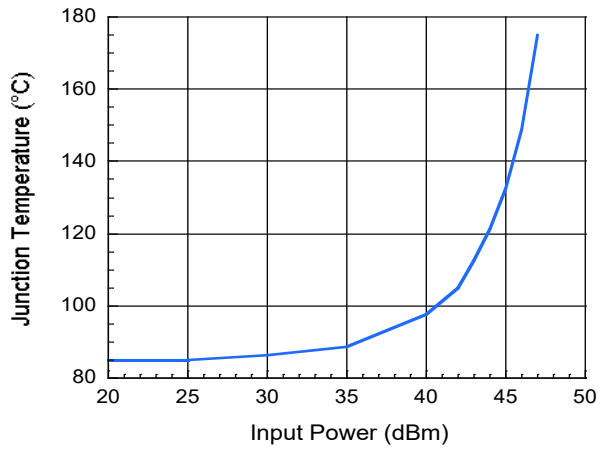


Output Return Loss, R_X



Typical Performance Curves[14]: +85°C base plate temperature, 2000 MHz

Power



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

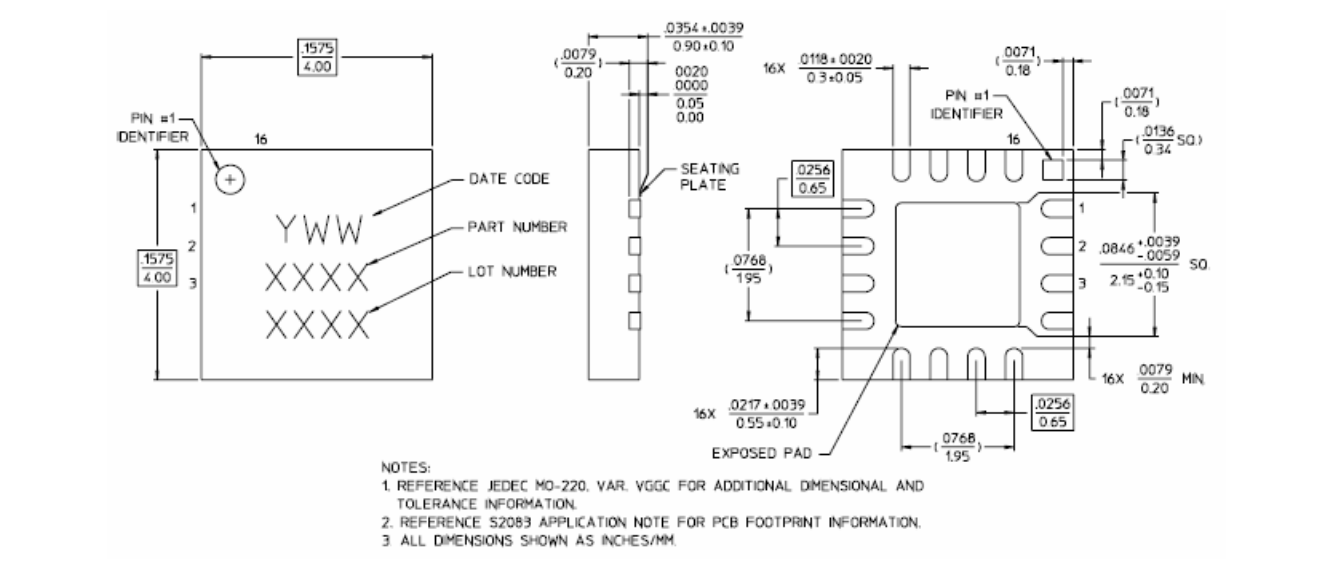
Handling Procedures

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.

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.