# PIN Diode SPDT 120 W Switch
# 0.05 - 4 GHz

**MASW-011258**
**Rev. V1**

## Features

- Exceptional Broadband Performance
- Low Insertion Loss:
  $T_X$ = 0.20 dB @ 2.7 GHz
- High Isolation:
  $R_X$ = 42 dB @ 2.7 GHz
- High $T_X$ RF Input Power:
  120 W CW @ 2.0 GHz, +85°C
- High $T_X$ RF Input Peak Power: 1000 W
- Positive DC Bias Only Required
- Surface Mount 4 mm PQFN Package
- RoHS* Compliant

## Applications

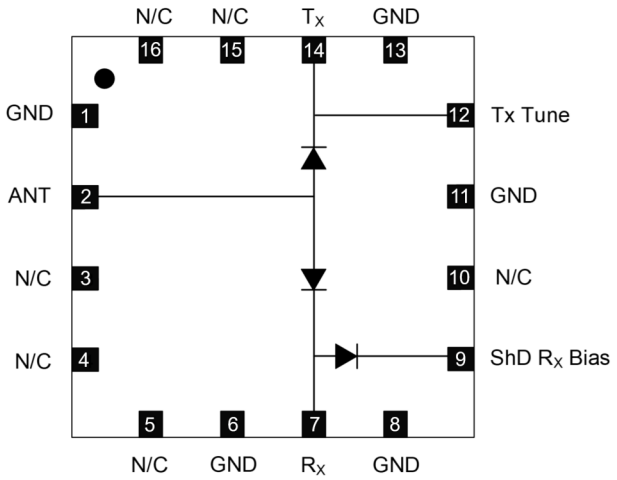
- Suitable for High Power LTE, TD-SCDMA, WiMAX, and Military Radio Applications

## Description

The MASW-011258 is a SPDT high power, broadband, high linearity, PIN diode T/R switch for 0.05 - 4.0 GHz applications, including WiMAX & WiFi. The device is provided in an industry standard lead free 4 mm PQFN plastic package.

This device incorporates PIN diode die fabricated with a low loss, high isolation switching diode process.

## Functional Schematic




## Pin Configuration[2]

| Pin # | Pin Name | Description |
|---|---|---|
| 1, 6, 8, 11, 13 | GND | Ground |
| 2 | ANT | Antenna |
| 3 - 5, 10, 15, 16 | N/C | Not Connected Internally |
| 7 | $R_X$ | Receive |
| 9 | ShD $R_X$ Bias | ShD $R_X$ Bias |
| 12 | $T_X$ Tune | $T_X$ Tune[3] |
| 14 | $T_X$ | Transmit |

2. The exposed pad centered on the package bottom must be connected to RF, DC and Thermal ground.
3. Optional tuning pin. See note 5 for details.

## Ordering Information[1]

| Part Number | Package |
|---|---|
| MASW-011258-TR1000 | 1000 Part Reel |
| MASW-011258-001SMB | Sample Board |

1. Reference Application Note M513 for reel size information.

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

## Pin Description

| Pin # | Name | Description |
|---|---|---|
| 1, 6, 8, 11, 13 | GND | Pins grounded internally |
| 2 | ANT | Antenna pin. DC coupled. |
| 3 - 5, 10, 15, 16 | N/C | Not connected internally.<br>MACOM recommends connecting these pins to ground on PCB board. |
| 7 | $R_X$ | Receive pin. DC coupled. |
| 9 | ShD $R_X$ Bias | Bias pin for RX receive path shunt diode. DC coupled. |
| 12 | Tx Tune | Optional tuning pin. DC coupled. |
| 14 | $T_X$ | Transmit pin. DC coupled. |
| 17 | EP | Exposed backside paddle. Needs to be connected to electrical and thermal ground on PCB. |

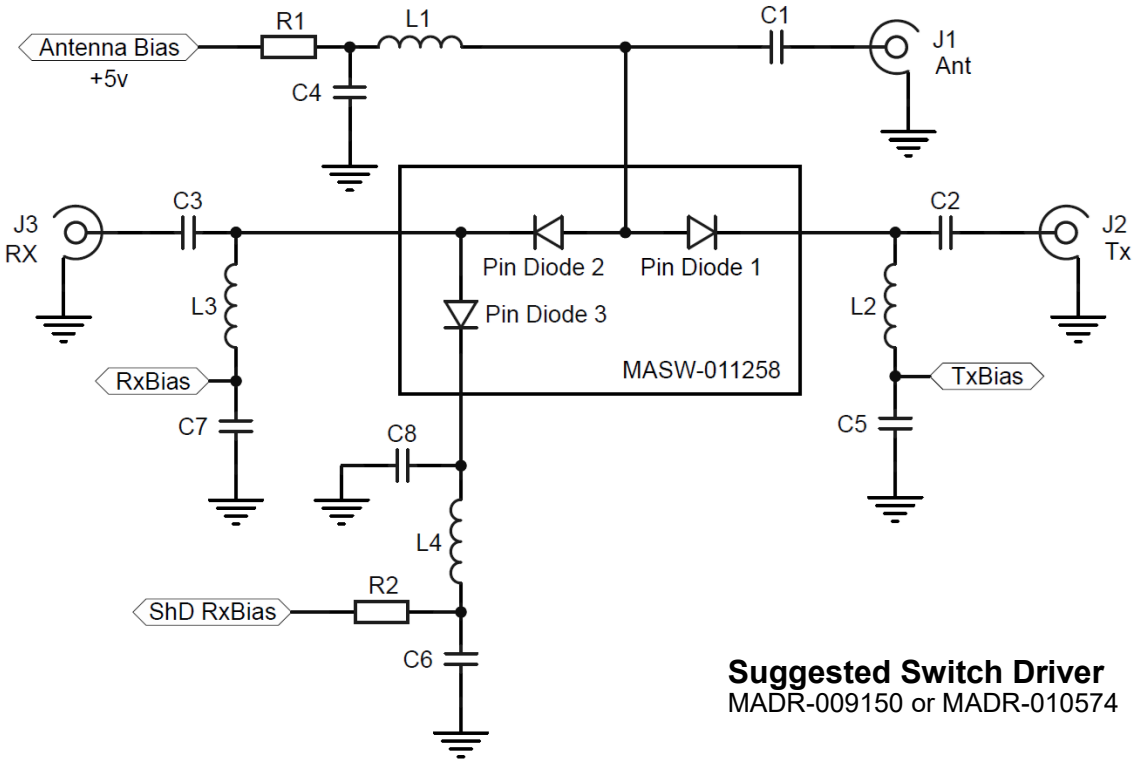
## Electrical Specifications: $P_{IN}$= -5 dBm, $T_A$ = 25°C, $Z_0$ = 50 Ω, (See Bias Table).

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Insertion Loss (RX Mode) | $R_X$ to ANT, 0.8 GHz, RX Mode<br>$R_X$ to ANT, 2.0 GHz, RX Mode<br>$R_X$ to ANT, 2.7 GHz, RX Mode<br>$R_X$ to ANT, 3.5 GHz, RX Mode | dB | — | 0.20<br>0.35<br>0.45<br>0.60 | —<br>0.55<br>0.75<br>0.95 |
| Insertion Loss (TX Mode) | $T_X$ to ANT, 0.8 GHz, TX Mode<br>$T_X$ to ANT, 2.0 GHz, TX Mode<br>$T_X$ to ANT, 2.7 GHz, TX Mode<br>$T_X$ to ANT, 3.5 GHz, TX Mode | dB | — | 0.09<br>0.10<br>0.15<br>0.32 | — |
| Isolation (RX Mode) | $R_X$ to ANT, 2.0 GHz, RX Mode<br>$R_X$ to ANT, 2.7 GHz, RX Mode<br>$R_X$ to ANT, 3.5 GHz, RX Mode | dB | 36<br>35<br>25 | 42<br>42<br>32 | — |
| Isolation (TX Mode) | $T_X$ to ANT, 2.0 GHz, TX Mode<br>$T_X$ to ANT, 2.7 GHz, TX Mode<br>$T_X$ to ANT, 3.5 GHz, TX Mode | dB | — | 16<br>14<br>13 | — |
| Return Loss (RX Mode) | $R_X$ Port, 2.0 GHz, RX Mode<br>$R_X$ Port, 2.7 GHz, RX Mode<br>$R_X$ Port, 3.5 GHz, RX Mode | dB | — | 20<br>22<br>23 | — |
| Return Loss (TX Mode) | $T_X$ Port, 2.0 GHz, TX Mode<br>$T_X$ Port, 2.7 GHz, TX Mode<br>$T_X$ Port, 3.5 GHz, TX Mode | dB | — | 30<br>23<br>17 | — |
| Input P0.1 dB (TX Mode) | $T_X$ to ANT, 2.0 GHz<br>$T_X$ to ANT, 2.7 GHz<br>$T_X$ to ANT, 3.5 GHz | dBm | — | >50 | — |
| Input P0.1 dB (RX Mode) | $R_X$ to ANT, 2.0 GHz<br>$R_X$ to ANT, 2.7 GHz<br>$R_X$ to ANT, 3.5 GHz | dBm | — | >40 | — |
| IIP3 (TX Mode) | $P_{IN}$ = 30 dBm:<br>F1 = 2.7 GHz, F2 = 2.71 GHz<br>F1 = 3.5 GHz, F2 = 3.51 GHz | dBm | — | 81<br>76 | — |
| CW Input Power (TX Mode) | 85°C Base plate<br>2.0 GHz<br>2.7 GHz<br>3.5 GHz | dBm / W | — | 50.8 / 120<br>50.0 / 100<br>49.0 / 80 | — |
| CW Input Power (RX Mode) | 85°C Base plate<br>2.0 GHz | dBm<br>W | — | 41.5<br>14.0 | — |
| RX to TX Mode Switching Speed | (10 - 90% RF Voltage)<br>1 MHz Rep Rate in Modulating Mode | ns | — | 200 | — |

## Bias Table

| Mode | Switch State | $T_X$ Bias | $R_X$ Bias | ShD $R_X$ Bias | ANT Bias |
|---|---|---|---|---|---|
| RX Mode (RXM) | $R_X$ to ANT Switch Path On,<br>$T_X$ Port Isolated | (+28 V), 0 mA | (GND), -100 mA | (+28 V), 0 mA | +5 V |
| TX Mode (TXM) | $T_X$ to ANT Switch Path On,<br>$R_X$ Port Isolated | (GND), -100 mA | (+28 V), +56 mA | (GND), -56 mA | +5 V |

## Bias Schematic




**Suggested Switch Driver**
MADR-009150 or MADR-010574

## Parts List[4,5]

| Component | Value | Package |
|---|---|---|
| C1 - C7 | 27 pF | 0603 |
| C8[6] | 3.3 pF | 0402 |
| L1 - L4 | 68 nH | 0603 |
| R1 | 39 Ω | See note 7 |
| R2 | 480 Ω | See note 7 |

4. Parts listing optimized specifically for the 0.5 - 3.6 GHz band on MACOM evaluation board. For custom tunes within the 0.05 - 4 GHz band please contact MACOM applications support.
5. Not shown, adding an LC network to pin 12 can improve $R_X$ performance between 2.0 and 2.7 GHz but may limit performance above 3.0 GHz. For broadband applications MACOM recommends not using pin 12 and not connecting it to any metal trace.
6. C8 needs to be connected as close as possible to the ShD Rx bias pin (Pin 9)
7. R1 and R2 values equal to ((Applied Bias Voltage) - (Forward Voltage of Diode)) / (Ibias) where the Forward Voltage of Diode (Vf) can be approximated as 1 V. The size of the package will depend on the power rating needed.

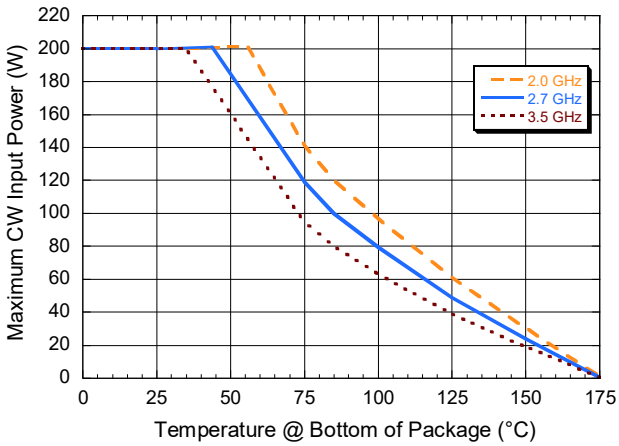
## Absolute Maximum Ratings[8,9,10]

**@ $T_A$ = +25°C (unless otherwise specified)**

| Parameter | Absolute Maximum |
|---|---|
| Forward Current | 150 mA |
| DC Reverse Voltage | 130 V |
| $T_X$ Incident CW Power | See Power De-rating Curve |
| $T_X$ Incident Peak Power (10 µs Pulse Width[11] ) | 1000 W |
| $R_X$ Incident CW Power | 41.5 dBm (14 W) @ 2 GHz, +85°C |
| Junction Temperature | +175°C |
| Operating Temperature | -40°C to +100°C |
| Storage Temperature | -55°C to +150°C |

8. Exceeding these limits may cause permanent damage.
9. MACOM does not recommend sustained operation near these survivability limits.
10. Operating at nominal conditions with $T_J \leq +175°C$ will ensure MTTF > 1 x $10^6$ hours.
11. Measured with 4 ms pulse period, up to +100°C case temperature.

***$T_X$ Input Power De-rating @ 20 dB I/O Return Loss***




## Minimum Reverse Bias Voltage[12]

| Frequency (MHz) | DC Voltage (V) |
|---|---|
| 50 | 130[13] |
| 500 | 91[13] |
| 1000 | 57[13] |
| 2000 | 31 |
| 4000 | 16 |

12. Minimum DC bias voltage to maintain low loss under 120 W of Tx power with 1.5:1 VSWR
13. The MADR-009150 switch driver has a maximum output voltage of 55 V. If a higher output voltage is desired, then one may want to consider using the MADR-010574 switch driver.

## Handling Procedures

Please observe the following precautions to avoid damage:

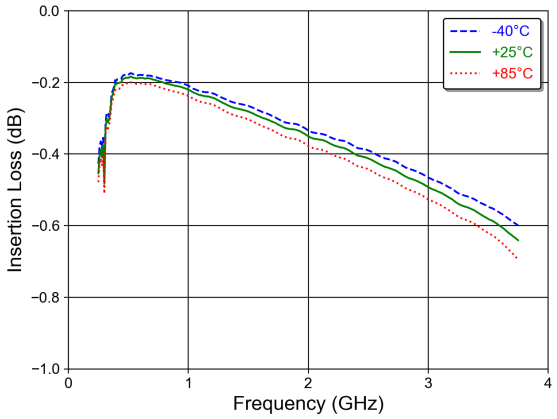
### Static Sensitivity

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 devices.

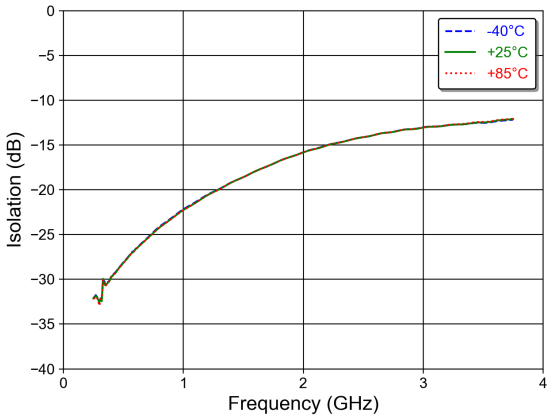
| Parameter | Rating | Standard |
|---|---|---|
| Human Body Model (HBM) | 1000 V (Class 1C) | ESDA/JEDEC JS-001 |
| Charged Device Model (CDM) | 500 V (Class C2) | ESDA/JEDEC JS-002 |

## Typical SMB Performance Curves: (0.5 - 3.6 GHz Tune[4]):
## $P_{IN}$ = -5 dBm, $Z_0$ = 50 Ω, RX Mode (See Bias Table)

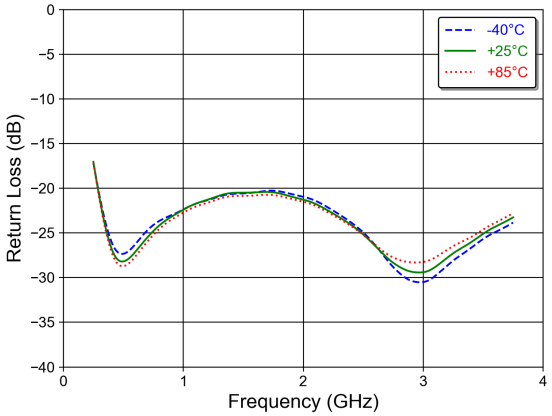
***Insertion Loss[14], ANT to $R_X$ Port***



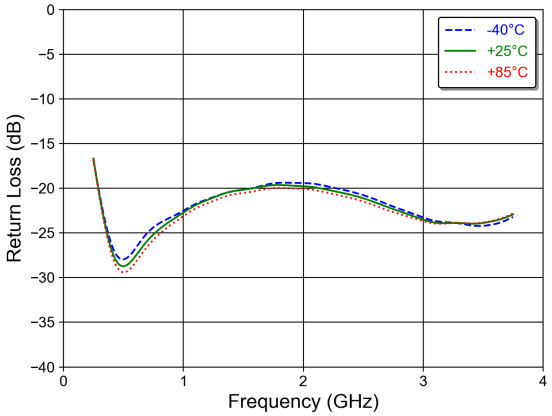

***Isolation[14], ANT to $T_X$ Port***



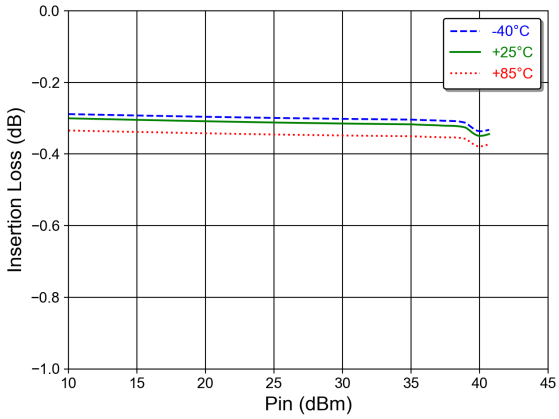

***Input Return Loss, ANT Port***



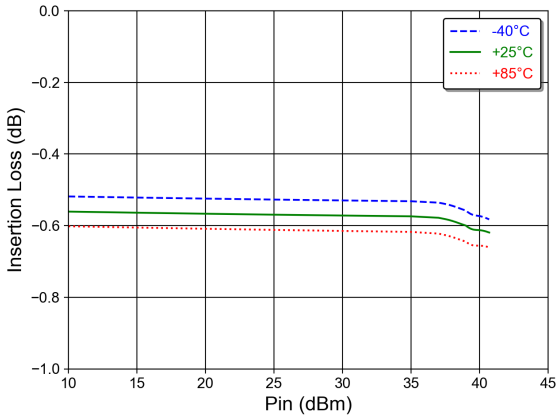

***Output Return Loss, $R_X$ Port***




***Insertion Loss[14] vs. Power (2 GHz), ANT to $R_X$ Port***



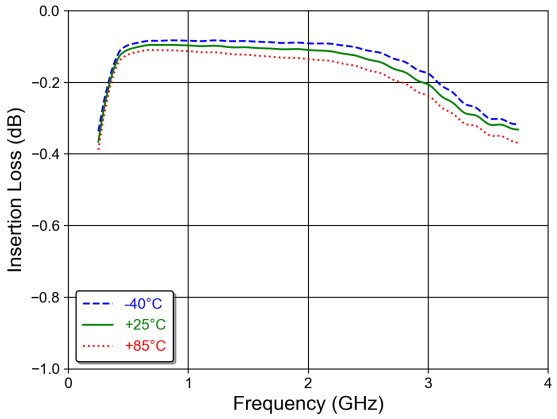

***Insertion Loss[14] vs. Power (3.5 GHz), ANT to $R_X$ Port***



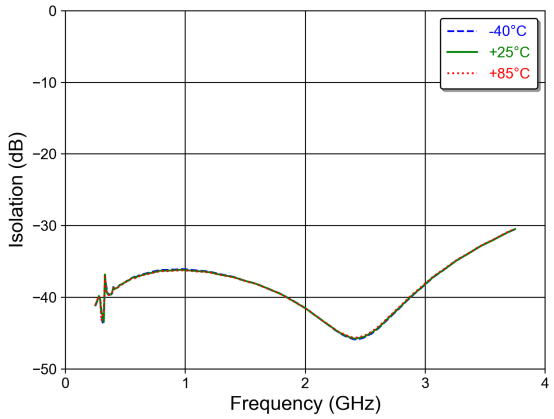

14. For insertion loss and isolation plots, RF trace and connector losses are de-embedded.

## Typical SMB Performance Curves: (0.5 - 3.6 GHz Tune[4]):
## $P_{IN}$ = -5 dBm, $Z_0$ = 50 Ω, TX Mode (See Bias Table)

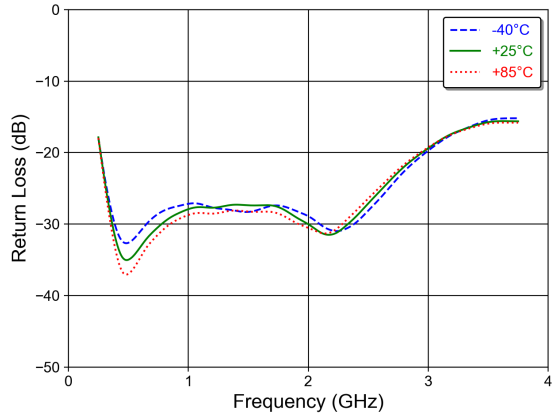
***Insertion Loss[14], ANT to $T_X$ Port***



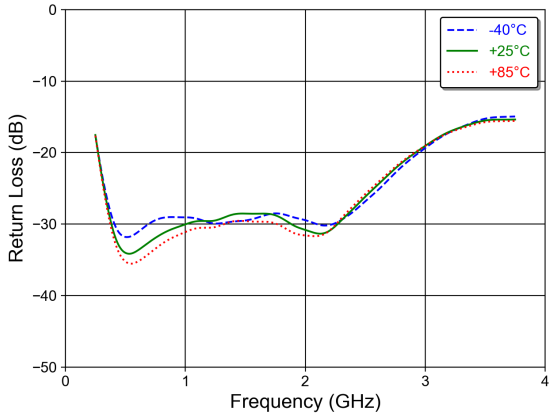

***Isolation[14], ANT to $R_X$ Port***



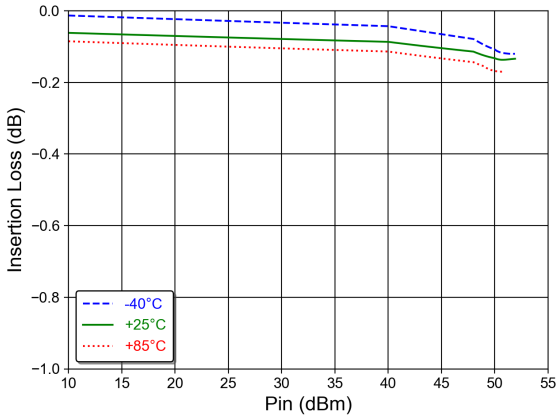

***Input Return Loss, ANT Port***



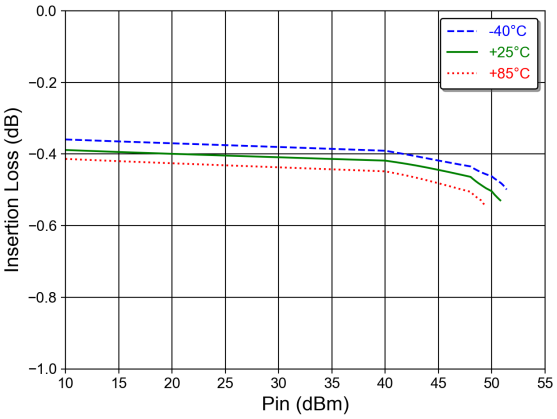

***Output Return Loss, $T_X$ Port***




***Insertion Loss[14] vs. Power (2 GHz), ANT to $T_X$ Port***

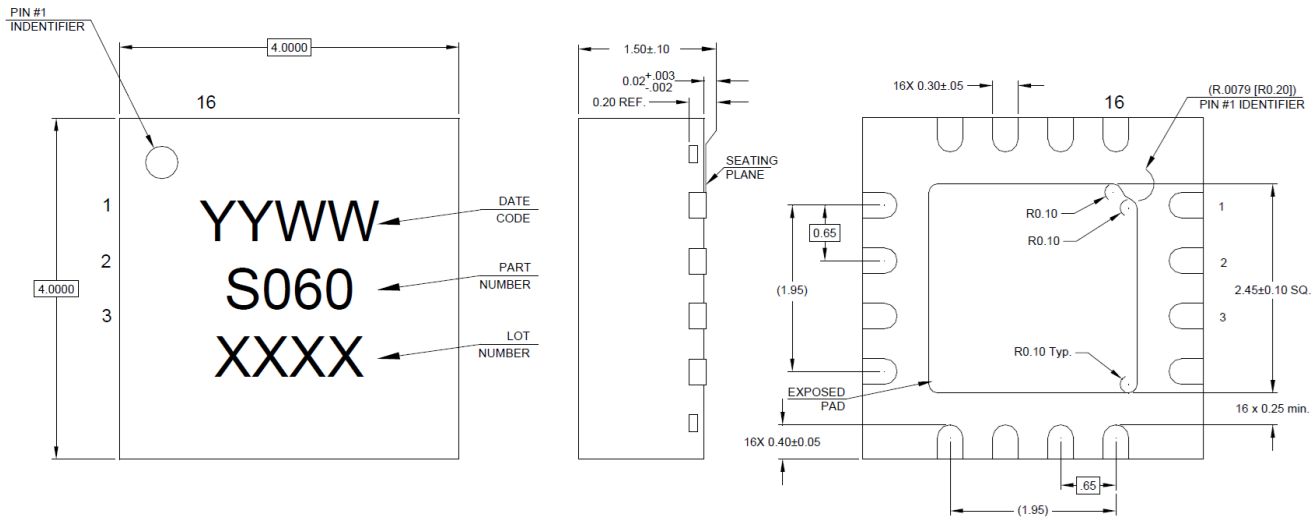



***Insertion Loss[14] vs. Power (3.5 GHz), ANT to $T_X$ Port***




14. For insertion loss and isolation plots, RF trace and connector losses are de-embedded.

## Lead-Free 4 mm 16-Lead PQFN†




Notes:
1. All dimensions shown in mm.
2. Reference JEDEC MO-220 for additional dimensional and tolerance information.

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 1 requirements.
Plating is NiPdAuAg.

## Revision History

| Rev | Date | Change Description |
|---|---|---|
| V1 | 12/16/24 | Production release. |
| | | |