# MASW-000834-13560T

## HMIC™ PIN Diode SPDT 50 Watt Switch for 0.05 - 6.0 GHz Higher Power Applications

Rev. V5

### Features

- Exceptional Broadband Performance, 0.05 - 6.0 GHz
- Low Loss: $T_X$ = 0.33 dB @ 2010 MHz, 5V / 20mA
- $T_X$ = 0.38 dB @ 3.5 GHz, 5V / 20mA
- High Isolation: Rx = 44dB @ 2010 MHz, 20mA / 5V
- Rx = 36dB @ 3.5 GHz, 20mA / 5V
- High $T_X$ RF Input Power = 50 W C.W. @ 2010MHz
- High Tx RF Input Peak Power > 1000 W
- Suitable for Very High Power TD-SCDMA & WiMAX Applications
- Surface Mount 4mm PQFN Package, RoHS* Compliant

### Description and Applications

The MA-COM MASW-000834-13560T is a SPDT Broadband, high linearity, common anode, PIN diode T/R switch for 0.05 - 6.0 GHz applications, including WiMAX & WiFi. The device is provided in industry standard 4mm PQFN plastic packaging. This device incorporates a PIN diode die fabricated with M/A-COM's 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 4mm PQFN package, SPDT switch offers wideband 0.05 - 6.0 GHz performance with excellent isolation to loss ratio for both $T_X$ and $R_X$ states. The PIN diode provides exceptional 50 W C.W. power handling and 65 dBm IIP3 at 2010 MHz for maximum switch performance.

### Absolute Maximum Ratings [1]

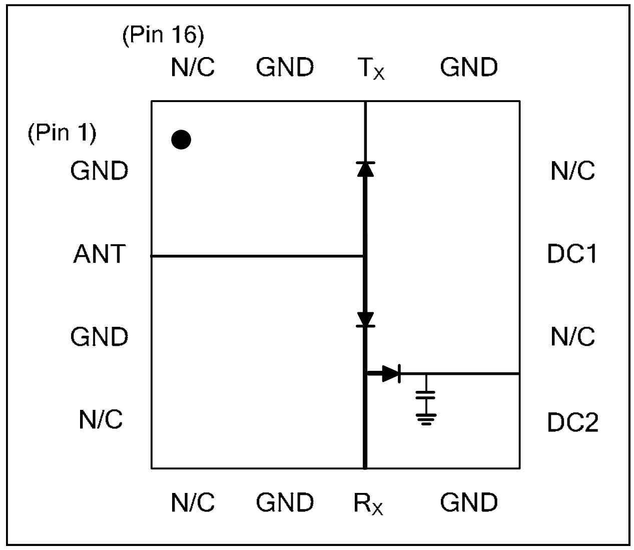
**@ $T_A$ = +25 °C (unless otherwise specified)**

| Parameter | Absolute Maximum |
|---|---|
| Forward Current | \| 100 mA \| |
| Reverse Voltage ( RF & D.C. ) | \| -200 V \| |
| Operating Temperature | -40 °C to +85 °C |
| Storage Temperature | -55 °C to +150 °C |
| Junction Temperature | +175 °C |
| $T_X$ Incident C.W. Power | 50W (47 dBm) [2] @ 2010MHz |
| $T_X$ Peak Incident Power | >300 W, 5us, 1% duty |

1. Exceeding these limits may cause permanent damage.
2. Baseplate Temperature must be controlled to a constant 25°C. See page 7 for derating curve.

* Restrictions on Hazardous Substances, European Union Directive

### Functional Diagram (TOP VIEW)




### Pin Configuration:

**(Center Metal Area is RF, D.C., and Thermal Ground)**

| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | GND | 9 | DC2 |
| 2 | ANT | 10 | N/C |
| 3 | GND | 11 | DC1 |
| 4 | N/C | 12 | N/C |
| 5 | N/C | 13 | GND |
| 6 | GND | 14 | TX |
| 7 | RX | 15 | GND |
| 8 | GND | 16 | N/C |

### Ordering Information

| Part Number | Package |
|---|---|
| MASW-000834-13560T | Tape and Reel |
| MASW-000834-001SMB | Sample Board |
| MADR-008851-0001TB | Sample Board with recommended external Driver & MASW-000834-13560T Switch |

### Static Sensitivity

These devices are rated Class 1B Human Body. Proper ESD control techniques should be used when handling these devices.





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## Electrical Specifications at +25°C, Characteristic Impedance, 20mA / 5V, $Z_0$ = 50 Ω

| Parameter | Symbol | 20mA / 5V Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| **F = 900 MHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.34 | 0.56 |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.26 | 0.445 |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 45.8 | 52.1 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 21.7 | 27.1 | — |
| **F = 1800 MHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.40 | 0.72 |
| Insertion Loss, $T_X$ | Tx IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.32 | 0.49 |
| Isolation, $T_X$ To $R_X$ | Rx ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 43.7 | 48.9 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 18.4 | 21.4 | |
| **F = 2010 MHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.42 | 0.75 |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.33 | 0.5 |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 43.2 | 44.6 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 17.7 | 19.9 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 32.1 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 24.2 | — |

## Electrical Specifications at +25°C, Characteristic Impedance, 20mA / 5V, $Z_0$ = 50 Ω

| Parameter | Symbol | 20mA / 5V Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| **F = 2.3-2.7 GHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.46 | 0.84 |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.35 | 0.525 |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 40.2 | 41.2 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 16.2 | 18.6 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 30.5 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 22.9 | — |
| **F = 3.3-3.8 GHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.56 | 1.0 |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.38 | 0.575 |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 33.7 | 35.9 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | 13.6 | 16.1 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 27.4 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 21.9 | — |
| **F = 4.9-5.9 GHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.78 | — |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 0.52 | — |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 26.4 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 11.8 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 20.3 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 1, pg. 10, Pinc= 0 dBm | dB | — | 24.2 | — |

## Electrical Specifications at +25°C, Characteristic Impedance, 50mA / 25V, $Z_0$ = 50 Ω

| Parameter | Symbol | 50mA / 25V Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| **F = 900 MHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.27 | — |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.22 | — |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 53.3 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 27.4 | — |
| **F = 1800 MHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.32 | — |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.27 | — |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 50.2 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 21.6 | — |
| **F = 2010 MHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.34 | — |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.28 | — |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 45.5 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 20.1 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 33.1 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 24.1 | — |





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## Electrical Specifications at +25°C, Characteristic Impedance, 50mA / 25V, $Z_0$ = 50 Ω

| Parameter | Symbol | 50mA / 25V Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| **F = 2.3-2.7 GHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.38 | — |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.30 | — |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 41.8 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 18.7 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 31.3 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 22.8 | — |
| **F = 3.3-3.8 GHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.47 | — |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.33 | — |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 36.2 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 16.2 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 28.0 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 21.8 | — |
| **F = 4.9-5.9 GHz** | | | | | | |
| Insertion Loss, $R_X$ | $R_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.72 | — |
| Insertion Loss, $T_X$ | $T_X$ IL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 0.48 | — |
| Isolation, $T_X$ To $R_X$ | $R_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 26.6 | — |
| Isolation, $R_X$ To $T_X$ | $T_X$ ISO | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 11.8 | — |
| Input Return Loss, $T_X$ | $T_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 20.5 | — |
| Input Return Loss, $R_X$ | $R_X$ RL | See Bias Table 2, pg. 10, Pinc= 0 dBm | dB | — | 24.2 | — |

## Electrical Specifications at +25°C, Characteristic Impedance, 50mA / 25V, $Z_0$ = 50 Ω

| Parameter | Symbol | 50mA / 25V Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| $T_X$ Input P1dB [2] | $T_X$ P1dB | 2010 MHz, $T_X$ to Antenna | dBm | — | >45.5 | — |
| $T_X$ 2nd Harmonic | $T_X$ 2Fo | 2010 MHz, Pin = + 30 dBm | dBc | — | 80 | — |
| $T_X$ 3rd Harmonic | $T_X$ 3Fo | 2010 MHz, Pin = + 30 dBm | dBc | — | 95 | — |
| $T_X$ Input Third Order Intercept Point | $T_X$ IIP3 | Pi= +10dBm, F1 = 2010 MHz, F2 = 2020 MHz | dBm | — | >64 | — |
| $T_X$ C.W. Input Power [2] | $T_X$ Pinc | F = 2010 MHz | dBm<br>W | — | — | 47<br>50 |
| $R_X$ C.W. Input Power | $R_X$ Pinc | F = 2010 MHz | dBm<br>W | — | — | 41.5<br>14 |
| $T_X$ RF Switching Speed | $t_{RF}$ | F = 2010 MHz ( 10-90% RF Voltage)<br>1MHz Rep Rate in Modulating Mode | ns | — | 200 | — |

| Parameter | Symbol | 50mA / 25V Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| $T_X$ Input P1dB | $T_X$ IP1dB | 3.5 GHz, $T_X$ to Antenna | dBm | — | >45 | — |
| $T_X$ 2nd Harmonic | $T_X$ 2Fo | 3.5 GHz, Pin = + 30 dBm | dBc | — | 88 | — |
| $T_X$ 3rd Harmonic | $T_X$ 3Fo | 3.5 GHz, Pin = + 30 dBm | dBc | — | 105 | — |
| $T_X$ Input Third Order Intercept Point | $T_X$ IIP3 | Pi= +10dBm, F1 = 3.500 GHz, F2 = 3.510 GHz | dBm | — | >64 | — |
| $R_X$ C.W. Input Power | $R_X$ Pinc | F = 3.5 GHz | dBm<br>W | — | — | 40.5<br>11 |
| $T_X$ RF Switching Speed | $t_{RF}$ | F = 3.5 GHz ( 10-90% RF Voltage)<br>1MHz Rep Rate in Modulating Mode | ns | — | 200 | — |





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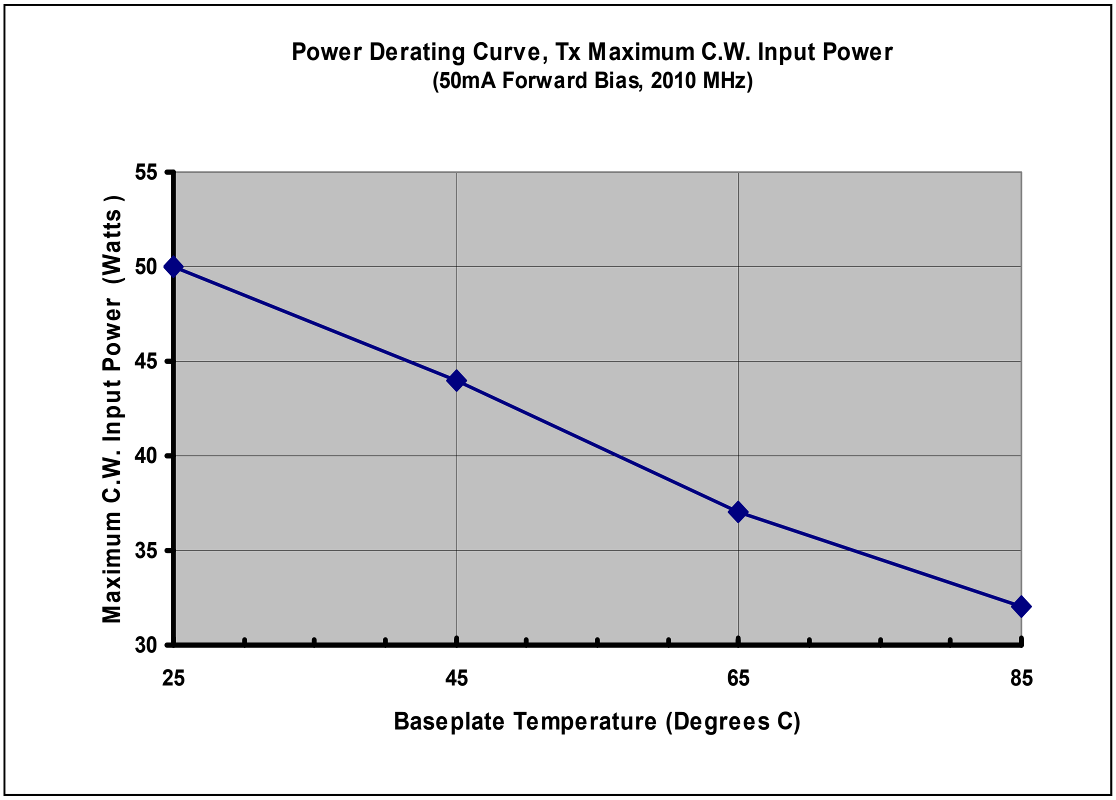
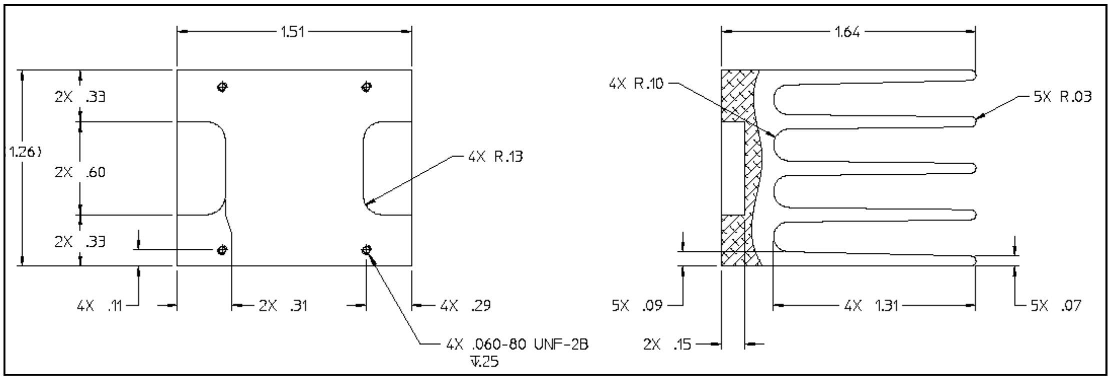
## Electrical Specifications at +25°C, Characteristic Impedance, 50mA / 25V, $Z_0$ = 50 Ω

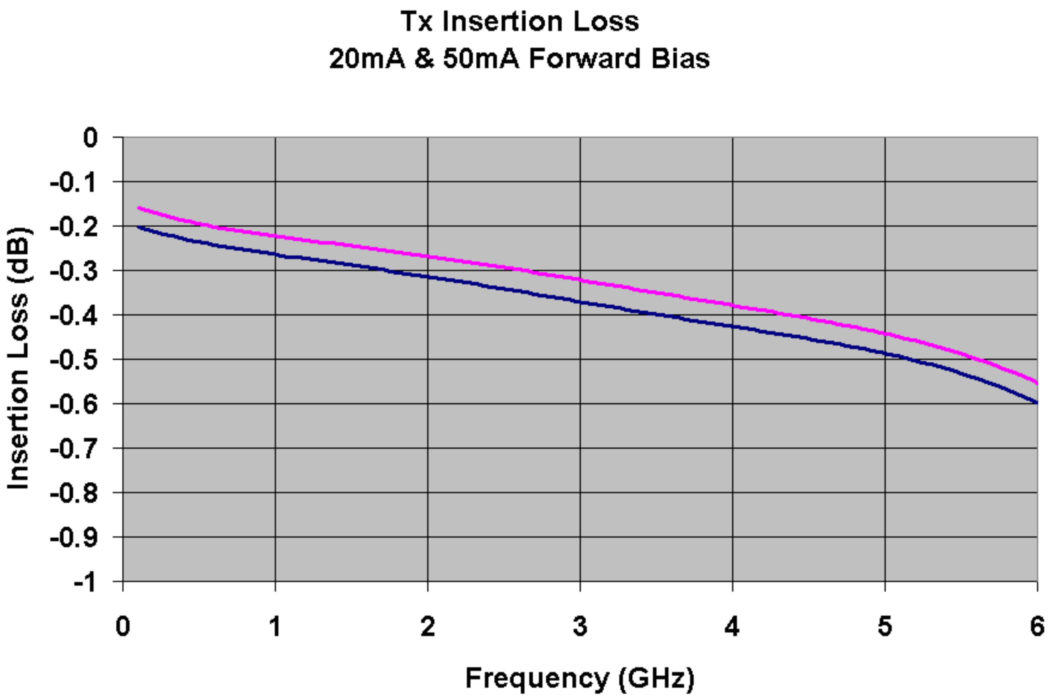


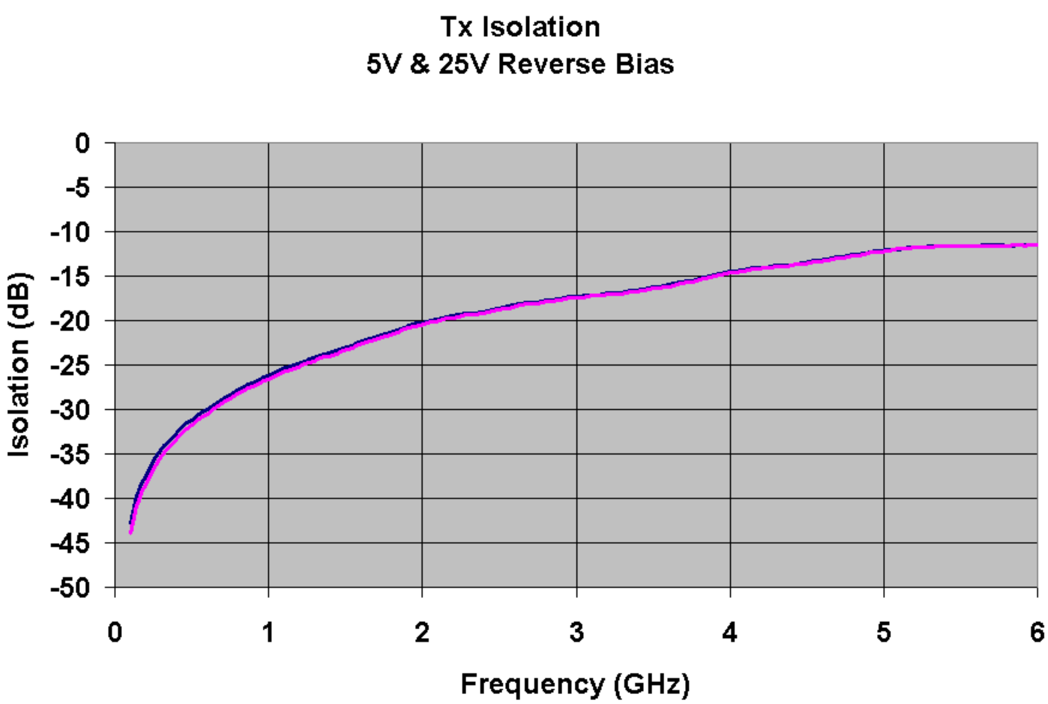

Note that this part must be held to a constant baseplate temperature to achieve the power handling results specified above. Adding a heatsink to the baseplate will improve performance to values greater than shown here. The increase in maximum input power from using a heatsink depends on the specific heatsink design.

With a sample board mounted onto a heatsink of dimensions and fins shown below, this switch can handle up to 35 Watts C.W. of incident power.

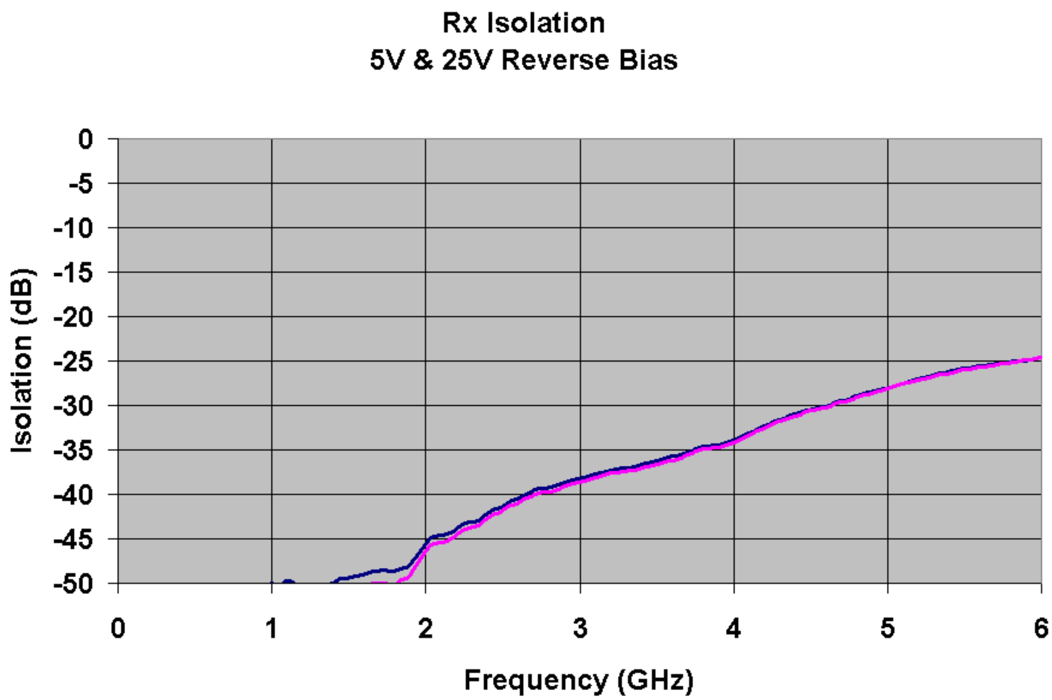


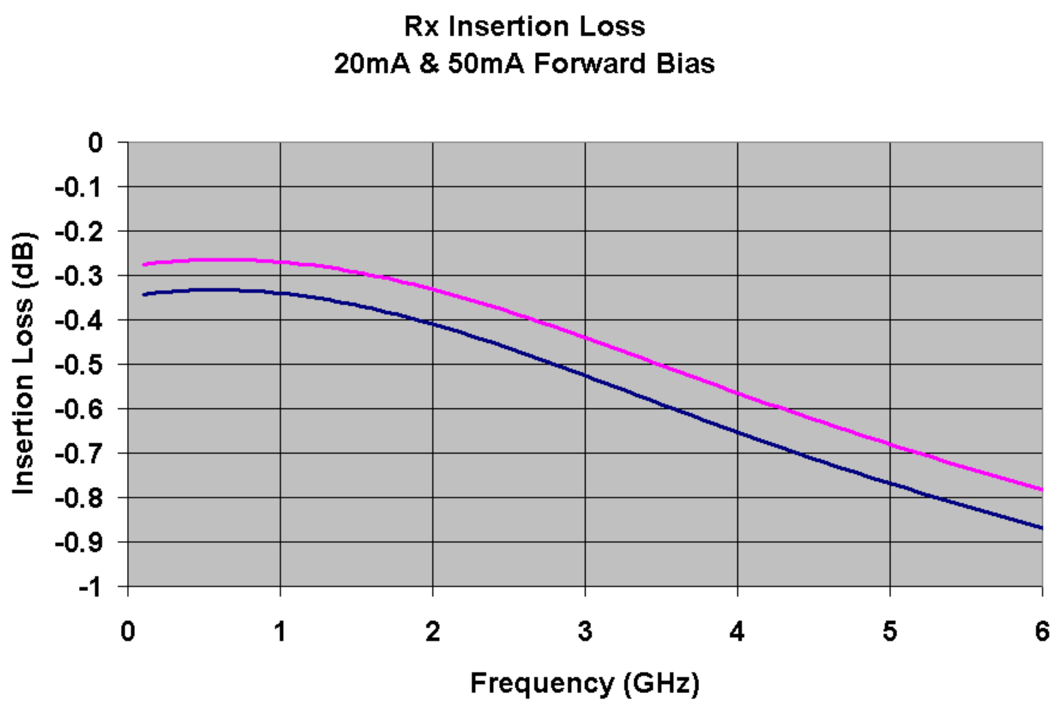
## $T_X$ Performance Curves at +25°C, Characteristic Impedance, $Z_0$ = 50 Ω



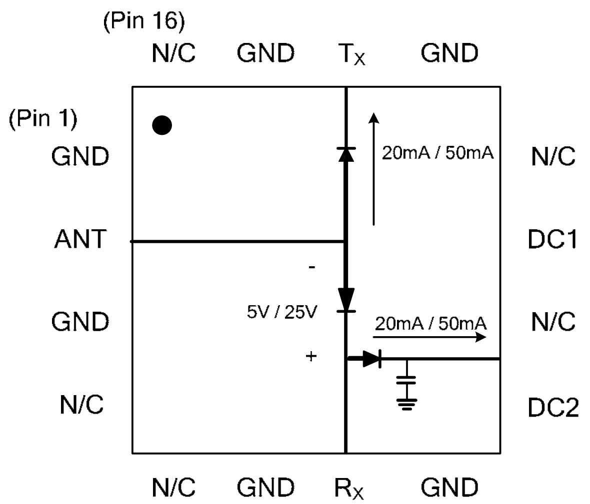
## $R_X$ Performance Curves at +25°C, Characteristic Impedance, $Z_0$ = 50 Ω



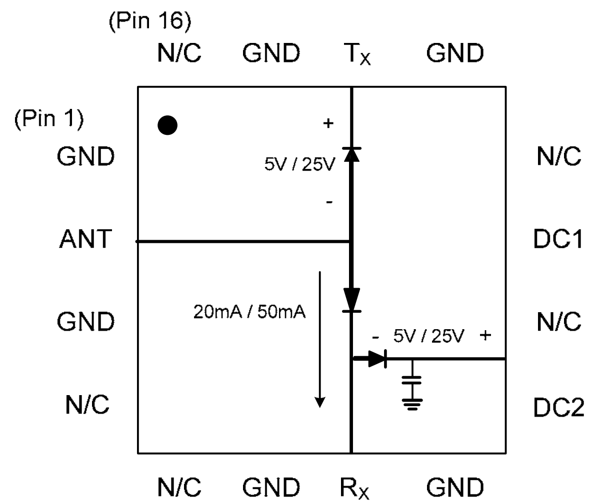



## Bias Diagrams & Tables

### $T_X$-ANT Insertion Loss
### $R_X$-ANT Isolation



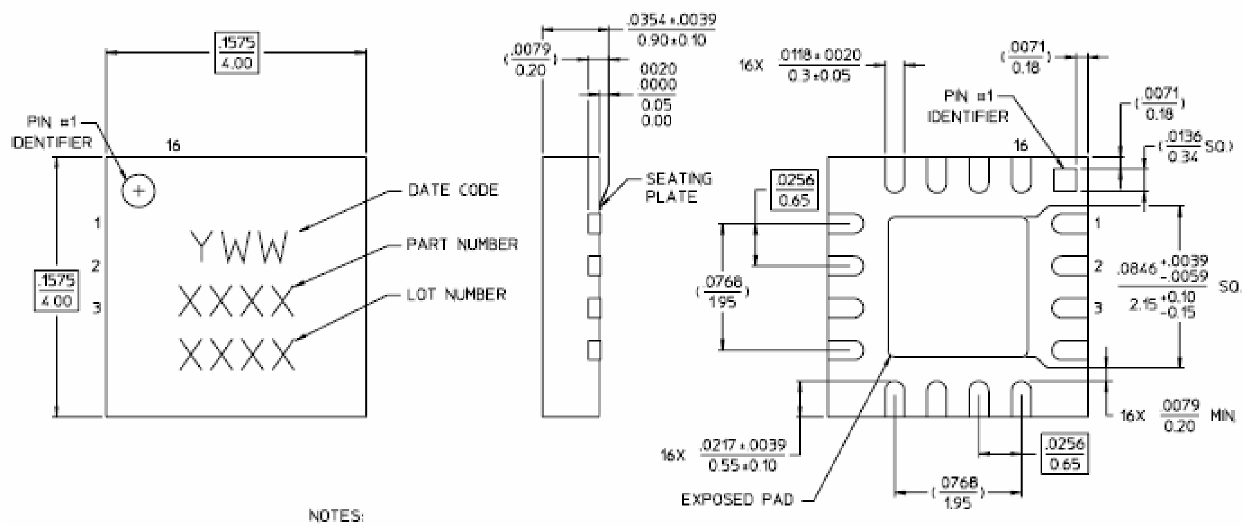

### $R_X$-ANT Insertion Loss
### $T_X$-ANT Isolation




| Bias Table 1 | $T_X$ | $R_X$ | DC2 | ANT |
|---|---|---|---|---|
| **Pin** | **Pin 14** | **Pin 7** | **Pin 9** | **Pin 2** |
| **$T_X$-ANT Isolation** | +5V, 0 mA | -20 mA | +5V, 0 mA | 0V |
| **$T_X$-ANT Insertion Loss** | -20 mA | +5V, 0 mA | -20 mA | 0V |
| **$R_X$-ANT Isolation** | -20 mA | +5V, 0 mA | -20 mA | 0V |
| **$R_X$-ANT Insertion Loss** | +5V, 0 mA | -20 mA | +5V, 0 mA | 0V |

| Bias Table 2 | $T_X$ | $R_X$ | DC2 | ANT |
|---|---|---|---|---|
| **Pin** | **Pin 14** | **Pin 7** | **Pin 9** | **Pin 2** |
| **$T_X$-ANT Isolation** | +25V, 0 mA | -50 mA | +25V, 0 mA | 0V |
| **$T_X$-ANT Insertion Loss** | -50 mA | +25V, 0 mA | -50 mA | 0V |
| **$R_X$-ANT Isolation** | -50 mA | +25V, 0 mA | -50 mA | 0V |
| **$R_X$-ANT Insertion Loss** | +25V, 0 mA | -50 mA | +25V, 0 mA | 0V |

## MASW-000834-13560T Outline – 4mm PQFN 16-Lead Saw Singulated



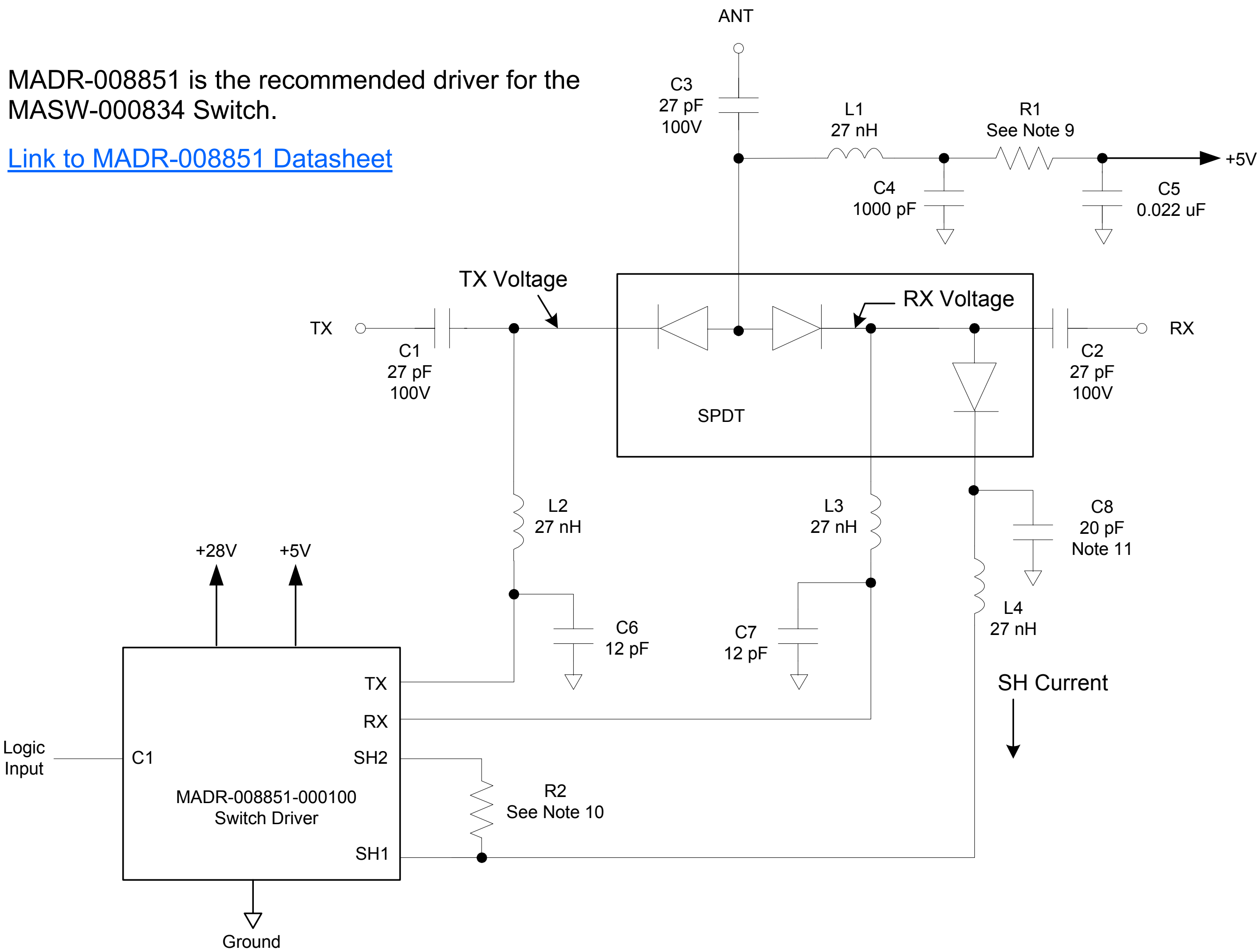

NOTES:
1. REFERENCE JEDEC MO-220, VAR. VGGC FOR ADDITIONAL DIMENSIONAL AND TOLERANCE INFORMATION.
2. REFERENCE S2083 APPLICATION NOTE FOR PCB FOOTPRINT INFORMATION.
3. ALL DIMENSIONS SHOWN AS INCHES/MM.

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.

## MASW-000834 and Recommended Driver with +5V & +28V DC Power

MADR-008851 is the recommended driver for the MASW-000834 Switch.

Link to MADR-008851 Datasheet




8. Forward Bias Diode Voltage: ∆Vf is ~0.9V @ 22 mA; ∆Vf is ~1.0V @ 35 mA
9. R1 is calculated by (Vcc-1.5V)/$I_{series}$, where $I_{series}$ is the desired bias current for the series diodes. For 21 mA load current, R1 = 165 Ω @ VCC = 5.0V and 82 Ω @ VCC = 3.3V. For 32 mA load current, R1 = 110 Ω @ VCC = 5.0V and 56 Ω @ VCC= 3.3V.
10. R2 is calculated by (Vdd-1V)/$I_{shunt}$, where $I_{shunt}$ is the desired forward bias current for the shunt diode. The power dissipation is calculated by $I_{shunt}$ x 27V. For 20 mA of $I_{shunt}$, R2 should use a 2511, 1W, 1.3k ohm resistor.
11. C8 is already built-in for M/A-COM MASW-000834-13560T switch.
12. The voltage at the common anode will be approximately 1.5V.
13. The current in through the back-biased diodes will be the leakage current for the diodes
14. C1-C5, L1-L4, R1, R2, and the switch are discrete components that should be installed on the user's 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).
15. There are 33 pF bypass capacitors included in the driver for the RX, TX, and SH1 ports. There are cases, especially at higher frequencies, where the optional 12 pF bypass capacitors (C6 and C7) that are shown on the schematic are needed.