

# SPDT Absorptive Switch DC - 67 GHz



MASW-011152

Rev. V2

## Features

- Ultra Wideband: 9 kHz to 67 GHz
- Insertion Loss:
  - 1.9 dB @ 40 GHz
  - 2.2 dB @ 50 GHz
  - 3.3 dB @ 67 GHz
- 48 dB Isolation:
  - 48 dB @ 40 GHz
  - 42 dB @ 50 GHz
  - 38 dB @ 67 GHz
- Input P1dB: 28 dBm
- Input IP3: 52 dBm
- Return Loss at Each RF Port: 16 dB
- Power Handling including Hot Switching: 26 dBm
- No Low Frequency Spurious
- Compatible with 1.8, 2.5, and 3.3 V CMOS Logic
- 3 mm, 20 Pin Laminate Package
- RoHS\* Compliant

## Applications

- Multi Market
- ISM

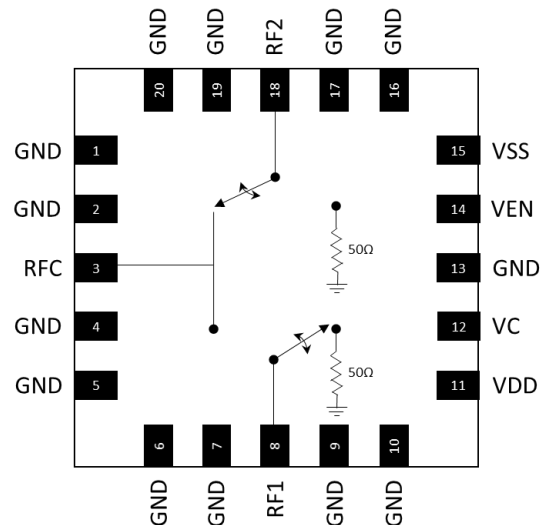
## Description

The MASW-011152 is an absorptive, ultra wideband single pole double throw (SPDT) switch with 2.2 dB of insertion loss at 50 GHz. The RF output ports are terminated in 50  $\Omega$  in the isolated path. The power handling capability is 26 dBm. The input and output return losses in the thru path are typically 16 dB. The logic levels are compatible with standard 1.8, 2.5, or 3.3 V CMOS. Required bias supplies are +3.3 V and -3.3 V.

The MASW-011152 is designed for wideband applications such as Test and Measurement, Aerospace and Defense, Cellular infrastructure (5G millimeter-wave), military radios, radars, microwave radios and very small aperture terminals (VSATs).

The MASW-011152 is manufactured on a Silicon-on-Insulator process. The 3 mm laminate package is lead free and RoHS compliant.

## Functional Schematic



## Pin Configuration<sup>1</sup>

| Pin #                          | Pin Name         | Description            |
|--------------------------------|------------------|------------------------|
| 1,2,4-7,9,10,13<br>16,17,19,20 | GND              | Ground                 |
| 3                              | RFC <sup>4</sup> | Common RF Input/Output |
| 8                              | RF1 <sup>4</sup> | RF Input/Output 1      |
| 11                             | VDD              | +3.3 V                 |
| 12                             | VC               | Control Voltage        |
| 14                             | VEN              | Enable Voltage         |
| 15                             | VSS              | -3.3 V                 |
| 18                             | RF2 <sup>2</sup> | RF Input/Output 2      |

1. The exposed pad centered on the package bottom must be connected to RF, DC, and thermal ground.
2. RF ports are dc-coupled to GND. There are no internal DC blocking capacitors.

## Ordering Information<sup>3,4</sup>

| Part Number        | Package        |
|--------------------|----------------|
| MASW-011152-TR0500 | 500 Piece Reel |
| MASW-011152-SMB    | Sample Board   |

3. Reference Application Note M513 for reel size information.
4. All sample boards include 3 loose parts.

<sup>1</sup> \* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

# SPDT Absorptive Switch

## DC - 67 GHz



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### Electrical Specifications<sup>5</sup>:

$V_{DD} = +3.3\text{ V}$ ,  $V_{SS} = -3.3\text{ V}$ ,  $V_C = 0\text{ V}$  or  $1.8\text{ V}$ ,  $T_{PADDLE} = 25^{\circ}\text{C}$ ,  $Z_0 = 50\ \Omega$

| Parameter                              | Test Conditions  | Units         | Min.  | Typ.  | Max.  |
|--|--|---------------|-------|-------|-------|
| Insertion Loss                         | DC to 18 GHz   | dB            | —     | 1.25  | 1.6   |
|  | 26 GHz   |               |       | 1.43  | 1.9   |
|  | 40 GHz   |               |       | 1.91  | 2.6   |
|  | 50 GHz   |               |       | 2.20  | 3.6   |
|  | 67 GHz   |               |       | 3.30  | —     |
| Isolation, Between RF1 to RF2          | DC to 18 GHz   | dB            | —     | 67    | —     |
|  | 26 GHz   |               |       | 64    |       |
|  | 40 GHz   |               |       | 48    |       |
|  | 50 GHz   |               |       | 42    |       |
|  | 67 GHz   |               |       | 38    |       |
| Isolation, RFC to RF1 / RF2            | DC to 18 GHz   | dB            | 55    | 58    | —     |
|  | 26 GHz   |               | 50    | 58    |       |
|  | 40 GHz   |               | 40    | 45    |       |
|  | 50 GHz   |               | 40    | 45    |       |
|  | 67 GHz   |               | —     | 38    |       |
| RFC Return Loss                        | DC - 67 GHz  | dB            | —     | 16    | —     |
| RF1/RF2 Return Loss, Thru Port         | DC - 67 GHz  | dB            | —     | 16    | —     |
| RF1/RF2 Return Loss, Isolated Port     | DC - 67 GHz  | dB            | —     | 16    | —     |
| Input P0.1dB                           | 10 MHz - 67 GHz  | dBm           | —     | 27.5  | —     |
| Input P1dB                             | 10 MHz - 67 GHz  | dBm           | —     | 28    | —     |
| Input IP3                              | Two tone, $P_{IN}/\text{tone} = +14\text{ dBm}$<br>10 MHz - 67 GHz | dBm           | —     | 52    | —     |
| $T_{ON}$                               | 50% control to 90% RF  | $\mu\text{s}$ | —     | 0.9   | —     |
| $T_{RISE}$                             | 10% to 90% RF  | $\mu\text{s}$ | —     | 0.35  | —     |
| $T_{OFF}$                              | 50% control to 10% RF  | $\mu\text{s}$ | —     | 0.2   | —     |
| $T_{FALL}$                             | 90% to 10% RF  | $\mu\text{s}$ | —     | 0.04  | —     |
| Voltage Supply, VDD                    | —  | V             | 3.15  | 3.3   | 3.45  |
| Voltage Supply, VSS                    | —  | V             | -3.45 | -3.3  | -3.15 |
| Logic Voltage, Input Low ( $V_{IL}$ )  | —  | V             | 0.0   | —     | 0.8   |
| Logic Voltage, Input High ( $V_{IH}$ ) | —  | V             | 1.2   | —     | VDD   |
| Supply Current, VDD                    | —  | mA            | —     | 0.3   | 0.5   |
| Supply Current, VSS                    | —  | mA            | —     | 0.65  | 1.0   |
| Logic Pin Current (VC)                 | Pulled down to GND with 100 k $\Omega$ resistor internally         | $\mu\text{A}$ | —     | VC*10 | —     |

5. Parameters are measured on a test board that includes impedance matching. Impedance match included in measurements.

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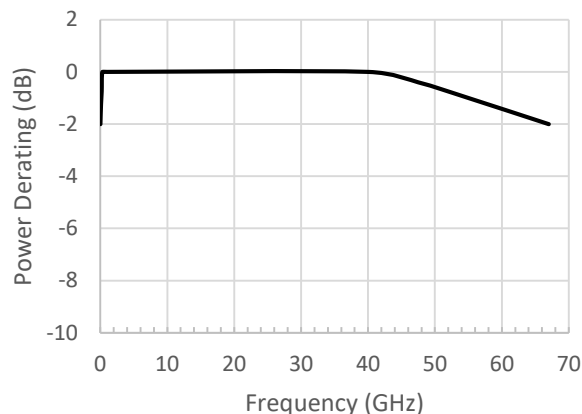
## Maximum Operating Ratings

| Parameter  | Maximum                    |
|--|----------------------------|
| Input Power, 300 MHz to 40 GHz,<br>RFC Port <sup>6</sup><br>RF1 / RF2 Port Thru Path <sup>6</sup><br>RF1 / RF2 Port Terminated Path <sup>6</sup> | 26 dBm<br>26 dBm<br>24 dBm |
| VDD  | -0.3 to +3.45 V            |
| VSS  | -3.45 to +0.3 V            |
| VC / VEN   | -0.3 to 3.45 V             |
| Operating Temperature <sup>7</sup>   | -40 to +105°C              |

6.  $T_{\text{PADDLE}} = 105^{\circ}\text{C}$ . See power derating curves for details.

7. Guarantees 10 years lifetime.

## Power Derating Curve<sup>6</sup>



## Absolute Maximum Ratings<sup>8,9,10</sup>

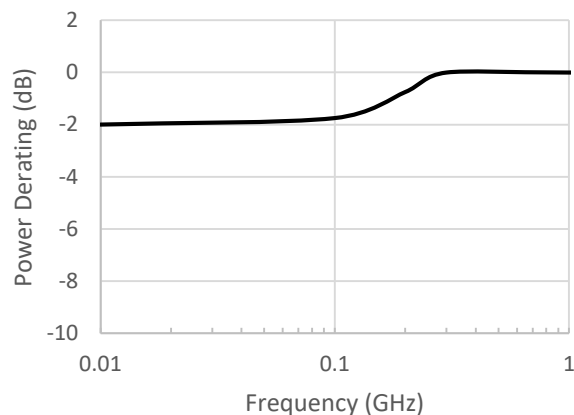
| Parameter  | Maximum                    |
|--|----------------------------|
| Input Power, 300 MHz to 67 GHz,<br>RFC Port <sup>6</sup><br>RF1 / RF2 Port Thru Path <sup>6</sup><br>RF1 / RF2 Port Terminated Path <sup>6</sup> | 27 dBm<br>27 dBm<br>25 dBm |
| VDD  | -0.3 to +3.6 V             |
| VSS  | -3.6 to +0.3 V             |
| VC / VEN   | -0.3 to 3.6 V              |
| Junction Temperature <sup>7</sup>  | +135°C                     |

8. Exceeding any one or combination of these limits may cause permanent damage to this device.

9. MACOM does not recommend sustained operation near these survivability limits.

10. Based on testing with input power applied for 30 seconds.

## Low Frequency Power Derating Detail<sup>6</sup>



## Truth Table

| Enable          | Control         | Condition of Switch |     |
|-----------------|-----------------|---------------------|-----|
| VEN             | VC              | RF1                 | RF2 |
| V <sub>IL</sub> | V <sub>IL</sub> | Off                 | On  |
| V <sub>IL</sub> | V <sub>IH</sub> | On                  | Off |
| V <sub>IH</sub> | V <sub>IL</sub> | Off                 | Off |
| V <sub>IH</sub> | V <sub>IH</sub> | Off                 | Off |

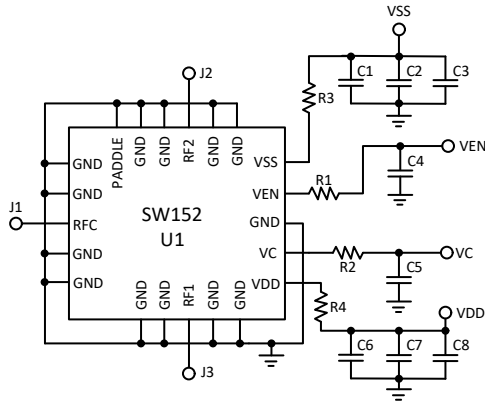
## Handling Procedures

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 1C devices.

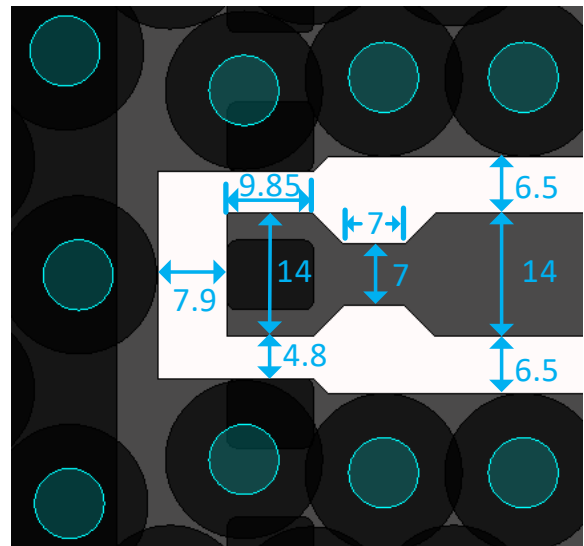
### Application Schematic



### Impedance Match

MASW-011152-SMB is a 2-layer board with 8 mil Rogers RO4003 dielectric material and 1 oz copper on top and bottom layers. For this stack-up, 7 mil traces with 7 mil width are used for all RF port matching, as shown below.

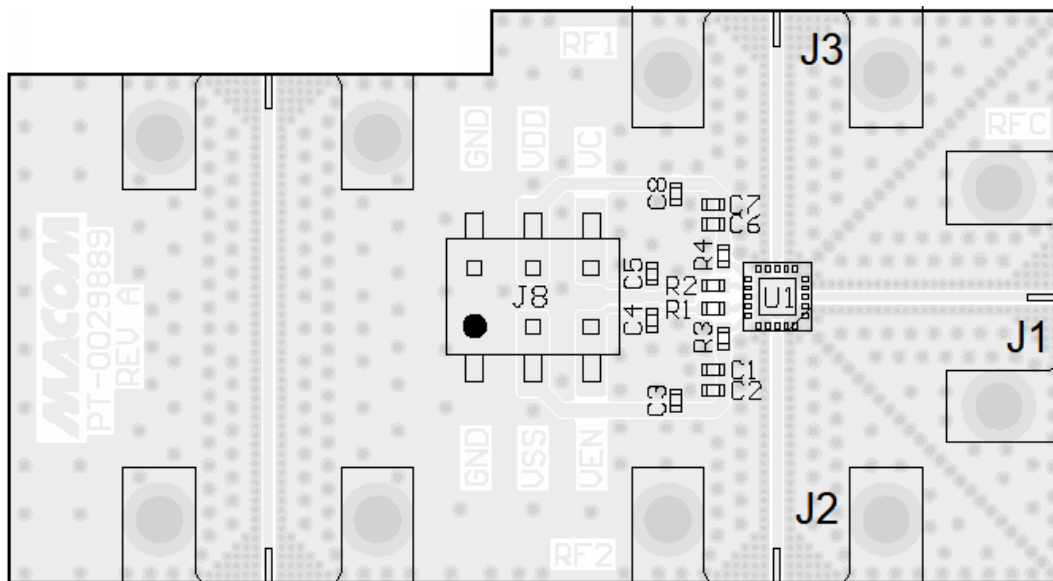
The 50Ω RF transmission lines are CPWG of 14 mil width with 6.5 mil gap.



### Parts List

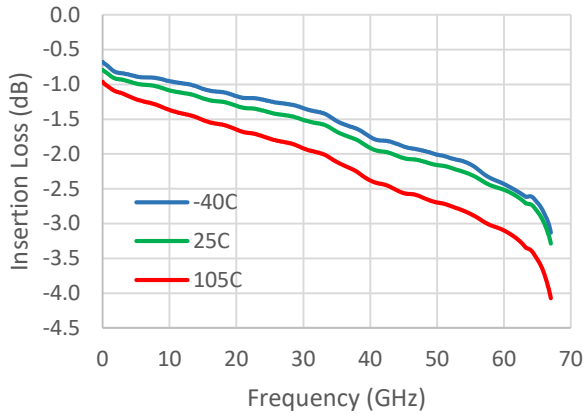
| Part    | Value                    | Case Style    |
|---------|--------------------------|---------------|
| U1      | MASW-011152              | 3 mm, 20 Lead |
| C1, C6  | Capacitor, 10 pF, 50 V   | 0402          |
| C2, C7  | Capacitor, 1000 pF, 25 V | 0402          |
| C3, C8  | Capacitor, 1 μF, 10 V    | 0402          |
| R1 - R4 | Resistor, 0 Ω            | 0402          |
| J1 - J3 | Southwest 1892-04A-6     | End Launch    |

### Evaluation Board Layout

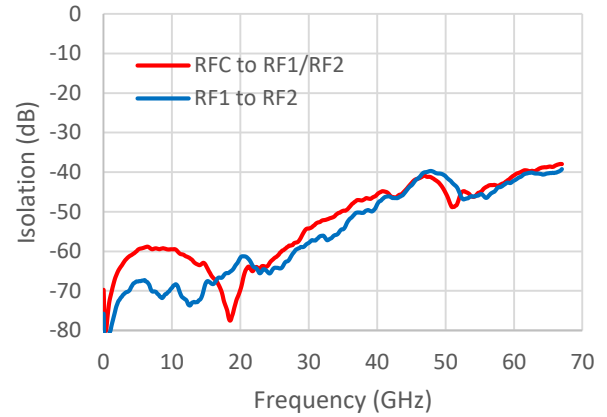


**Typical Performance Curves**

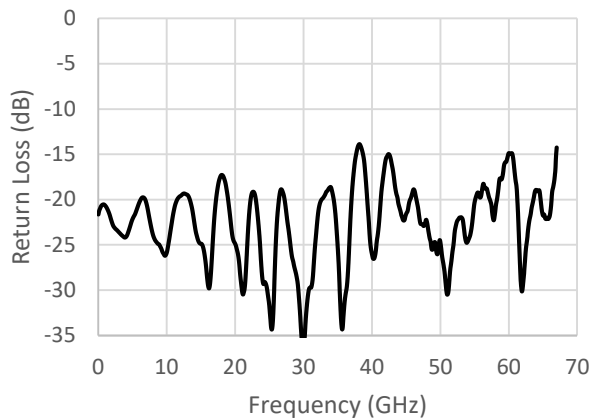
**Insertion Loss with Impedance Match<sup>11</sup>**



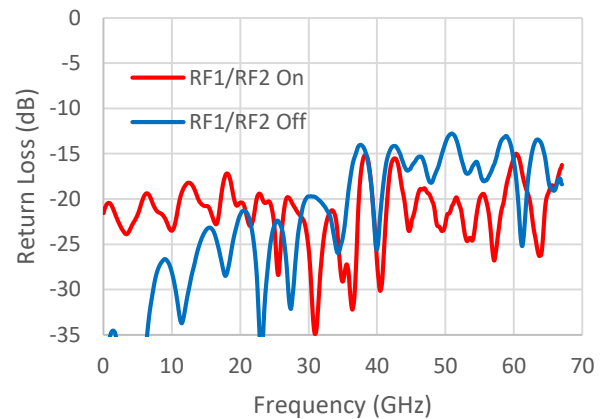
**Isolation with Impedance Match<sup>11</sup>**



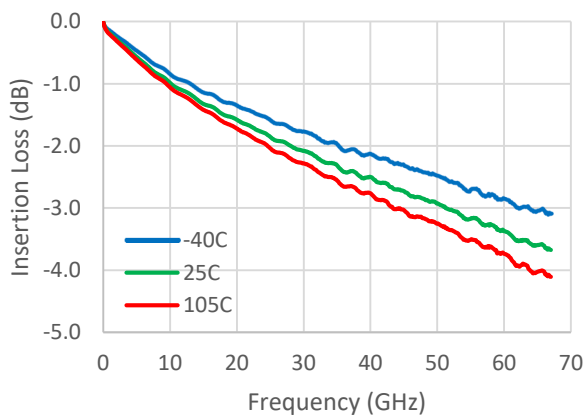
**RFC Return Loss with Impedance Match<sup>12</sup>**



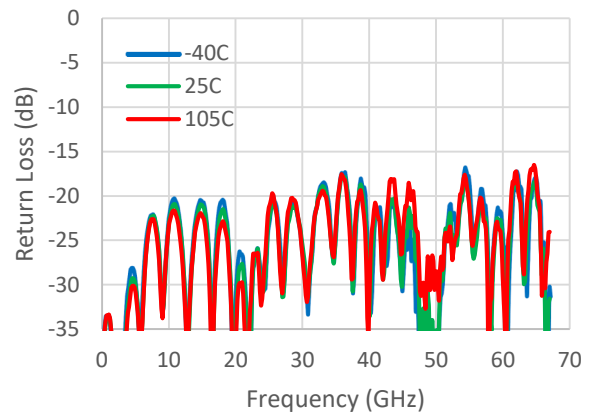
**RF1/RF2 Return Loss with Impedance Match<sup>12</sup>**



**Evaluation Board Thru Line Insertion Loss**



**Evaluation Board Thru Line Return Loss**

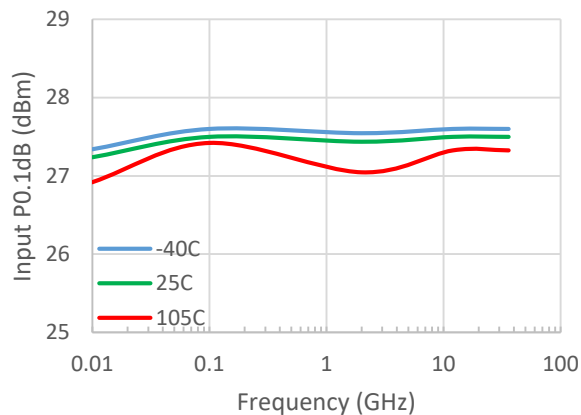


11. Insertion Loss and Isolation with impedance match were measured using connectorized evaluation board, and normalized using the insertion loss of the 50Ω thru line.

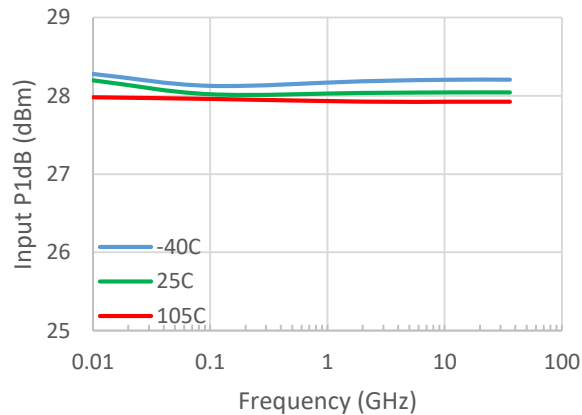
5 12. Return Loss with impedance match were measured using connectorized evaluation board.

## Typical Performance Curves

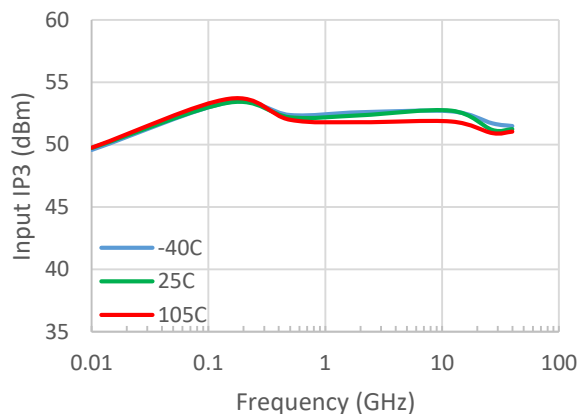
**Input P0.1dB**



**Input P1dB**



**Input IP3<sup>13</sup>**



13. Input IP3 were measured using connectorized evaluation board with impedance matching. The RF input power was 14 dBm per tone with spacing of 1 MHz. The IP3 rolloff below 150 MHz is due to rolloff of test system IP3.

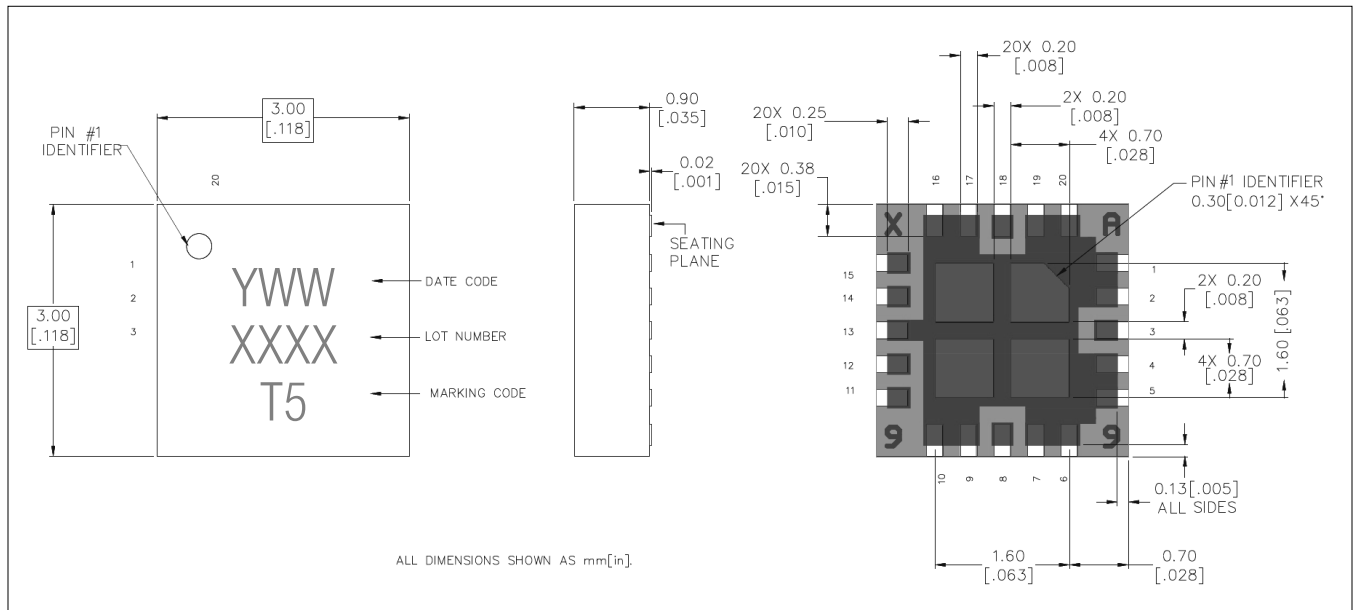
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MASW-011152

Rev. V2

## Lead-Free 3 mm, 20-Lead Laminate Package<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations.  
Meets JEDEC moisture sensitivity level 3 requirements.  
Plating is NiPdAu (ENEPIG) finish.

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