

**MMS008PP3**

**Datasheet**

**DC–8 GHz GaAs MMIC SP4T Non-Reflective Switch**

Released

May 2017



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# 1      **Revision History**

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The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

## 1.1      **Revision 1.0**

Revision 1.0 was published in May 2017. It was the first publication of this document.

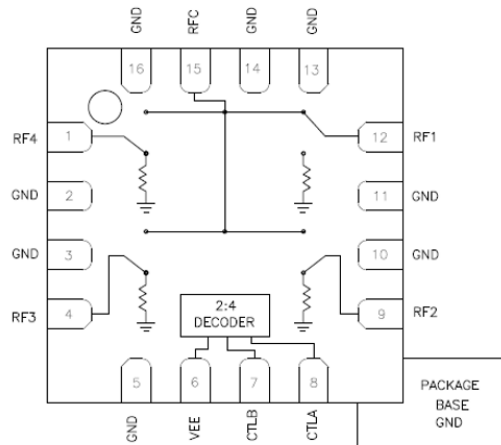
## 2 Product Overview

The MMS008PP3 device is a DC-to-8 GHz, non-reflective gallium arsenide (GaAs) pseudomorphic high-electron-mobility transistor (pHEMT) single-pole 4 throw (SP4T) monolithic microwave integrated circuit (MMIC) switch in a plastic leadless 3 mm × 3 mm surface-mount package. The switch delivers an average of 40 dB of isolation across the DC-to-8 GHz band while maintaining a low insertion loss of 1.8 dB. This switch includes an on-board binary 2:4 decoder circuit which reduces the required logic control lines. The control voltages are 0/–5 V, with a fixed bias of –5 V.

This device is also available in die form as the MMS008AA.

The following illustration shows the primary functional diagram of the MMS008PP3 device.

**Figure 1 • Functional Diagram**



### 2.1 Applications

The MMS008PP3 device is designed for the following applications:

- Test instrumentation
- Military radar, radio, EW, and ECM applications
- General purpose microwave applications

### 2.2 Key Features

The following are key features of the MMS008PP3 device:

- Non-reflective topology
- Broadband performance: DC–8 GHz
- Onboard 2:4 decoder
- Fast switching: 10 ns
- Low insertion loss: 1.5 dB at 6 GHz
- Excellent isolation: 40 dB at 6 GHz
- Compact 16-lead plastic QFN package: 3 mm × 3 mm × 0.85 mm
- High-input P1dB: 29 dBm
- High-input IP3: 44 dBm

## 3 Electrical Specifications

This section details the electrical specifications of the MMS008PP3 device.

### 3.1 Absolute Maximum Ratings

The following table lists the absolute maximum ratings of the MMS008PP3 device.

**Table 1 • Absolute Maximum Ratings**

| Parameter                                | Rating                 |
|------------------------------------------|------------------------|
| Storage temperature                      | –65 °C to 150 °C       |
| Operating temperature                    | –40 °C to 85 °C        |
| Bias voltage range (Vee)                 | –7 VDC                 |
| Control voltage range (A/B)              | Vee –0.5 V to +1.0 VDC |
| Maximum input power (low-loss state)     | 28 dBm                 |
| Channel temperature                      | 150 °C                 |
| Thermal resistance (insertion loss path) | 100 °C/W               |
| Thermal resistance (terminated path)     | 180 °C/W               |
| ESD sensitivity (HBM)                    | Class 1A               |

## 3.2 Specified Electrical Performance

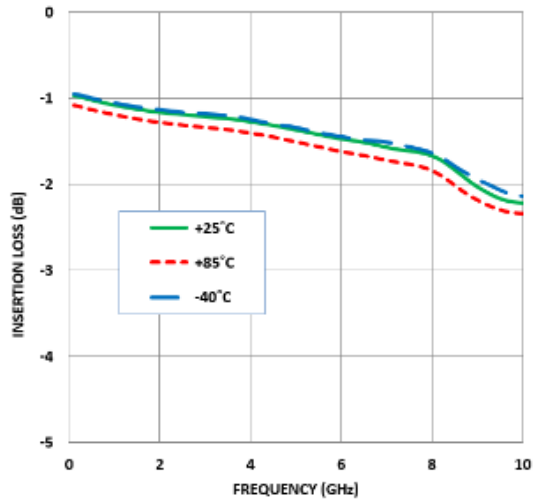
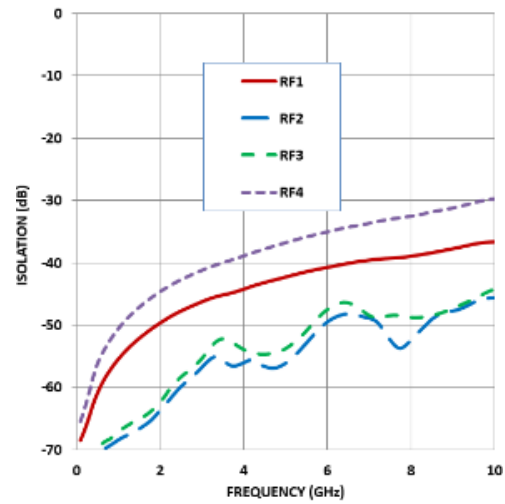
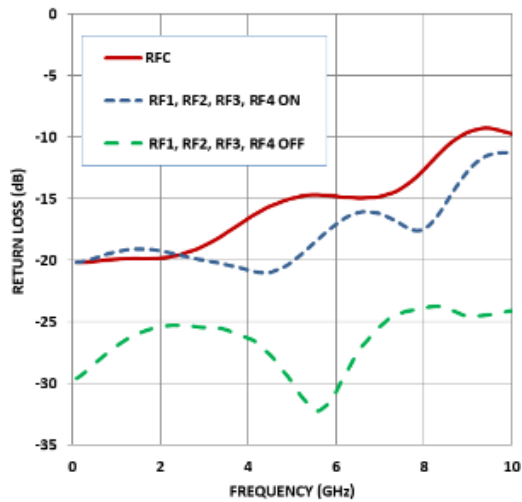
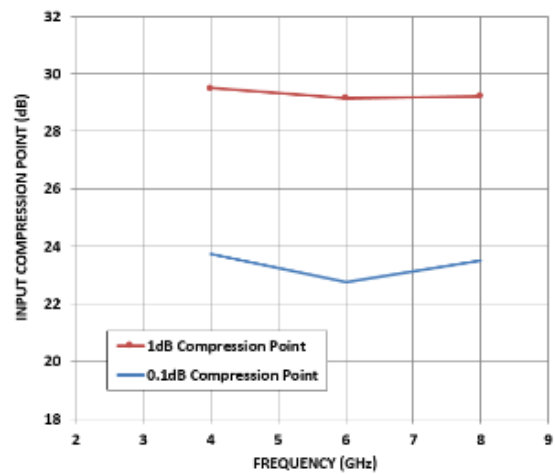
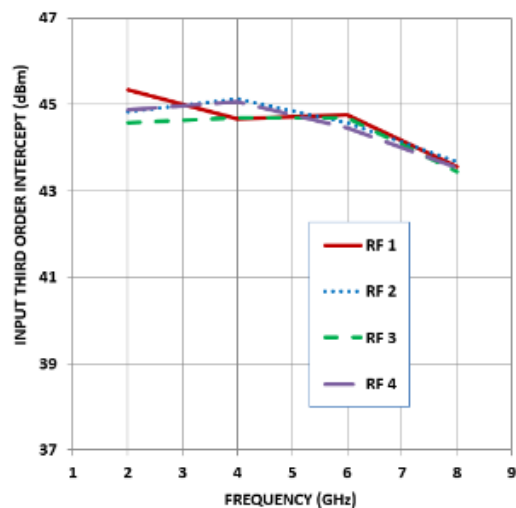
The following table lists the specified electrical performance of the MMS008PP3 device at 25 °C, where  $V_{\text{control}}$  (CTLA/CTLB) is 0 V, –5 V, and Vee is –5 V. The system is 50  $\Omega$ .

**Table 2 • Specified Electrical Performance**

| Parameter                             | Frequency                                                | Min | Typ    | Max | Units |
|---------------------------------------|----------------------------------------------------------|-----|--------|-----|-------|
| Operational frequency range           |                                                          | DC  |        | 8.0 | GHz   |
| Insertion loss                        | DC–2.0 GHz                                               |     | 1.2    | 2.0 | dB    |
| Insertion loss                        | DC–6.0 GHz                                               |     | 1.5    | 2.2 | dB    |
| Insertion loss                        | DC–8.0 GHz                                               |     | 1.7    | 2.5 | dB    |
| Isolation                             | DC–2.0 GHz                                               | 43  | 55     |     |       |
| Isolation                             | DC–4.0 GHz                                               | 35  | 48     |     | dB    |
| Isolation                             | DC–6.0 GHz                                               | 32  | 43     |     | dB    |
| Isolation                             | DC–8.0 GHz                                               | 30  | 43     |     | dB    |
| $T_{\text{RISE}}$ , $T_{\text{FALL}}$ | DC–8.0 GHz<br><br>(10% to 90% and 90% to 10% RF)         |     | 10, 10 |     | ns    |
| $T_{\text{ON}}$ , $T_{\text{OFF}}$    | DC–8.0 GHz<br><br>(50% control to 10/90%, and 90/10% RF) |     | 85, 35 |     | ns    |
| Return loss (on state)                | DC–2.0 GHz                                               |     | 19     |     | dB    |
| Return loss (on state)                | DC–4.0 GHz                                               |     | 21     |     | dB    |
| Return loss (on state)                | DC–6.0 GHz                                               |     | 17     |     | dB    |
| Return loss (on state)                | DC–8.0 GHz                                               |     | 17     |     | dB    |
| Return loss (off state)               | DC–8.0 GHz                                               |     | 24     |     | dB    |
| Input power for 0.1 dB compression    | 0.5 GHz–8.0 GHz                                          |     | 23     |     | dBm   |
| Input power for 1.0 dB compression    | 0.5 GHz–8.0 GHz                                          |     | 29     |     | dBm   |
| Input third-order intercept (IIP3)    | 0.5 GHz–8.0 GHz (two-tone input power, +7 dBm each tone) | 40  | 45     |     | dBm   |

## 3.3 Typical Performance Curves

This section details the typical performance curves of the MMS008PP3 device.

**Figure 2 • Insertion Loss vs. Temperature****Figure 3 • Isolation****Figure 4 • Return Loss****Figure 5 • 0.1 dB and 1 dB Input Compression Point****Figure 6 • Input Third Order Intercept Point**

### 3.4 Control Voltages

The following tables lists the control voltages of the MMS008PP3 device.

**Table 3 • Switch Control Truth**

| Control Input A | Control Input B | Signal Path Condition<br>RF Common to RF1 | Signal Path Condition<br>RF Common to RF2 | Signal Path Condition<br>RF Common to RF3 | Signal Path Condition<br>RF Common to RF4 |
|-----------------|-----------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| High            | High            | On                                        | Off                                       | Off                                       | Off                                       |
| Low             | High            | Off                                       | On                                        | Off                                       | Off                                       |
| High            | Low             | Off                                       | Off                                       | On                                        | Off                                       |
| Low             | Low             | Off                                       | Off                                       | Off                                       | On                                        |

**Table 4 • Digital Control Voltages**

| State | Bias Condition                     |
|-------|------------------------------------|
| Low   | –3 V to 0 V, 250 $\mu$ A typ       |
| High  | –5.0 V to –4.2 V, 0.95 $\mu$ A typ |

The following table lists the bias voltage and current of the MMS008PP3 devices where the Vee range is –5.0 VDC  $\pm$ 10%.

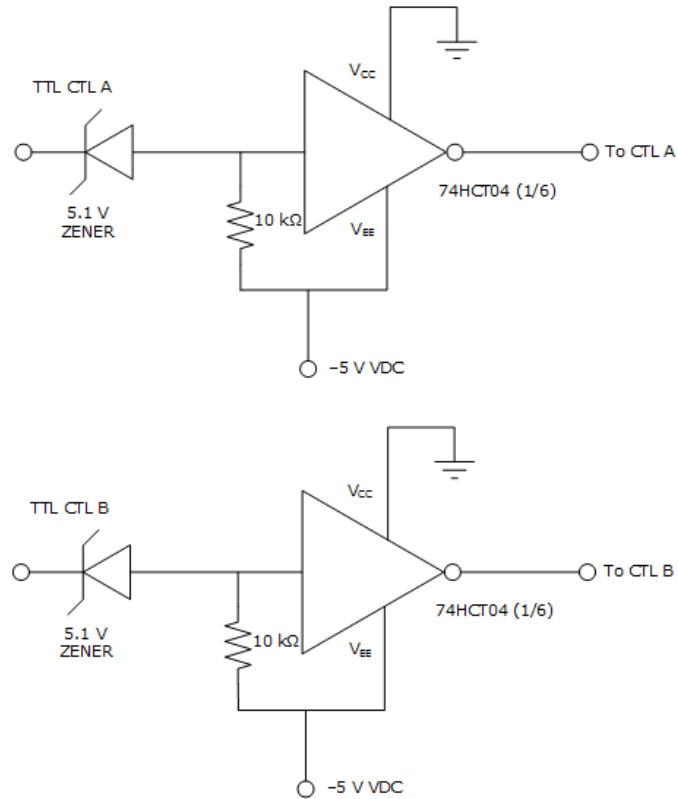
**Table 5 • Bias Voltage and Current**

| Vee      | I <sub>ee</sub> (Typ) | I <sub>ee</sub> (Max) |
|----------|-----------------------|-----------------------|
| –5.0 VDC | 4.4 mA                | 6.0 mA                |

### 3.5 TTL Interface Circuit

The following image shows an example of a possible control voltage driver circuit.

**Figure 7 • Control Voltage Driver Circuit Example**



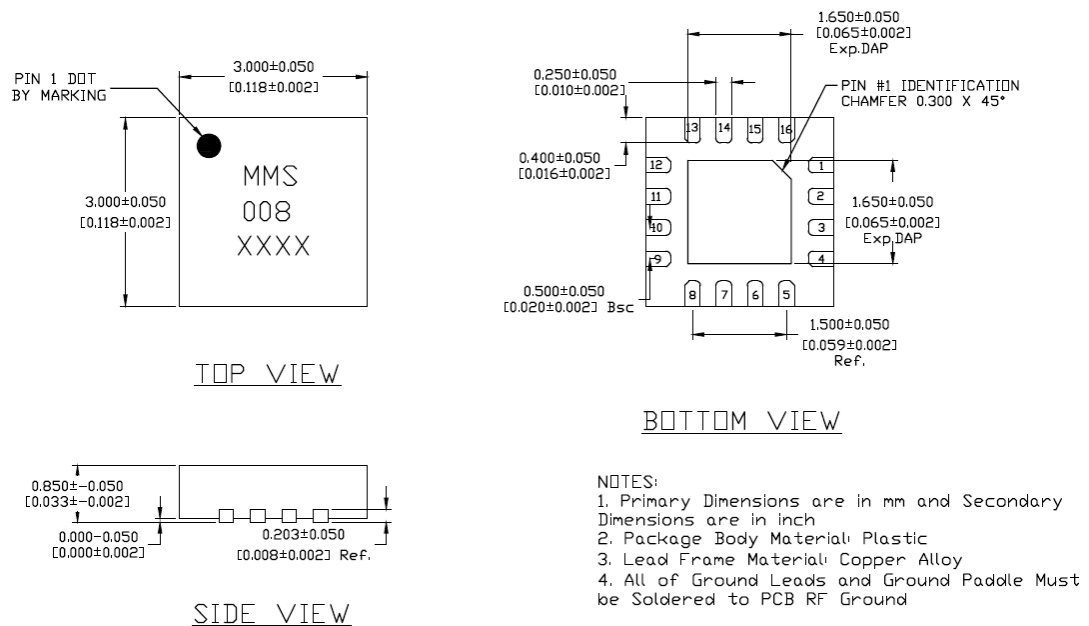
## 4 Package Outline Drawing, Package Information, and Pin Descriptions

This section details the package details of the MMS008PP3 device.

### 4.1 Package Outline

The following illustration shows the package outline of the MMS008PP3 device. Dimensions are in millimeters [inches].

**Figure 8 • Package Outline**



### 4.2 Package Information

The following table lists the package information for the MMS008PP3 device. Contact your Microsemi sales representative for additional packaging information.

**Table 6 • Package Information**

| Part Number | Package body Material               | Lead Finish   | MSL Rating | Package Marking    |
|-------------|-------------------------------------|---------------|------------|--------------------|
| MMS008PP3   | Low-stress injection molded plastic | 100% matte Sn | TBD        | MMS<br>008<br>wwyy |

## 4.3 Pin Descriptions

The following table lists the pin descriptions for the MMS008PP3 device.

**Table 7 • Pin Description Information**

| Pin Number                  | Pin Name                | Description                                                                                                                    |
|-----------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 1, 4, 9, 12, 15             | RF4, RF3, RF2, RF1, RFC | These pins are DC-coupled and matched to 50 Ω. DC-blocking capacitors are required if RF line potentials are not equal to 0 V. |
| 2, 3, 5, 10, 11, 13, 14, 16 | GND                     | Package bottom has exposed metal paddle that must be connected to PCB RF ground.                                               |
| 6                           | VEE                     | DC voltage supply: –5.0 VDC ±10%.                                                                                              |
| 7                           | CTLB                    | See <a href="#">Switch Control Truth table (see page 6)</a> and <a href="#">Digital Control Voltage table (see page 6)</a> .   |
| 8                           | CTLA                    | See <a href="#">Switch Control Truth table (see page 6)</a> and <a href="#">Digital Control Voltage table (see page 6)</a> .   |
| Backside Paddle             | RF/DC GND               | RF/DC ground.                                                                                                                  |

## 5 Handling Recommendations

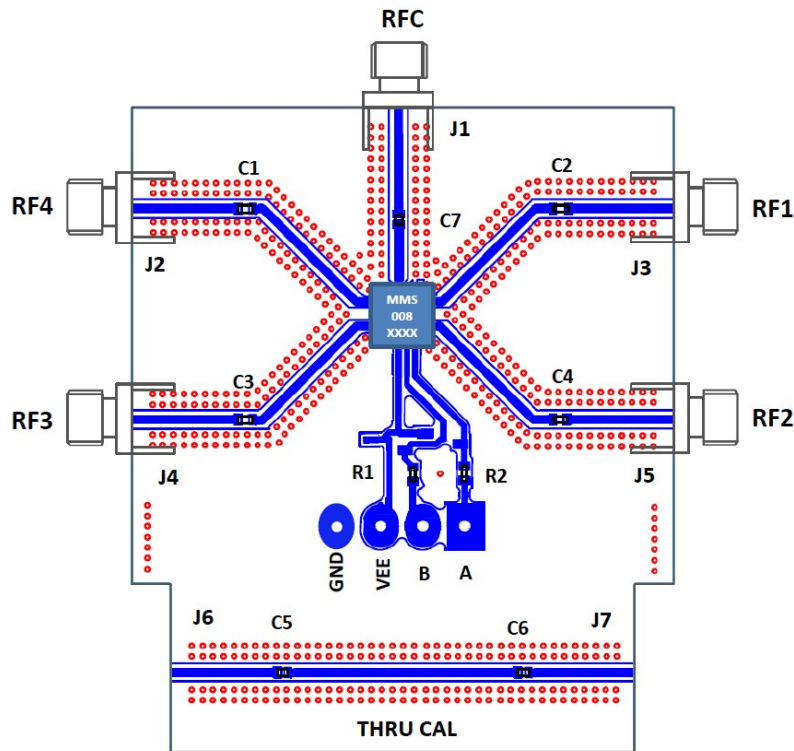
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Gallium arsenide integrated circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. It is recommended to follow all procedures and guidelines outlined in the Microsemi application note [AN01 GaAs MMIC Handling and Die Attach Recommendations](#).

## 6 Evaluation Board Information

The following image shows the evaluation board of the MMS008PP3 device.

**Figure 9 • Evaluation Board**



The circuit board used in the application should be generated with proper RF circuit design techniques. Signal lines at the RF port should have 50  $\Omega$  impedance, and the package ground leads and backside ground paddle should be connected directly to the ground plane similar to the previous image.

The following table lists the list of materials for the evaluation PCB MMS008PP3E.

**Table 8 • Materials for Evaluation PCB MMS008PP3E**

| Item                         | Description                              |
|------------------------------|------------------------------------------|
| J1-J5                        | PCB mount SMA RF connector               |
| A (CTLA), B (CTLB), VEE, GND | DC control pin                           |
| C1–C7                        | Zero ohm resistor, 0402package [3]       |
| R1, R2                       | Zero ohm resistor, 0402 package          |
| U1                           | MMS008PP3                                |
| PCB [1]                      | Evaluation PCB 1.29 inches × 1.55 inches |

## 7 Ordering Information

The following table lists the ordering information for the MMS008PP3 device and for the MMS008PP3E evaluation PCB.

**Table 9 • Ordering Information**

| Part Number | Package                         |
|-------------|---------------------------------|
| MMS008PP3   | 3 mm × 3 mm plastic QFN package |
| MMS008PP3E  | Evaluation board for MMS008PP3  |

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