

MMS006PP3

Datasheet

DC–20 GHz GaAs MMIC SP2T Non-Reflective Switch

Released

May 2017



Power Matters.™

Contents

| | | |
|----------|---|-----------|
| 1 | Revision History | 1 |
| 1.1 | Revision 1.0 | 1 |
| 2 | Product Overview | 2 |
| 2.1 | Applications | 2 |
| 2.2 | Key Features | 2 |
| 3 | Electrical Specifications | 3 |
| 3.1 | Absolute Maximum Ratings | 3 |
| 3.2 | Specified Electrical Performance | 3 |
| 3.3 | Typical Performance Curves | 3 |
| 3.4 | Control Voltages | 5 |
| 3.5 | Example Driver Circuit | 5 |
| 4 | Package Specification | 6 |
| 4.1 | Package Outline Drawing | 6 |
| 4.2 | Package Information | 6 |
| 4.3 | Pin Descriptions | 6 |
| 5 | Handling Recommendations | 8 |
| 6 | Evaluation Board Information | 9 |
| 7 | Ordering Information | 10 |

1 Revision History

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

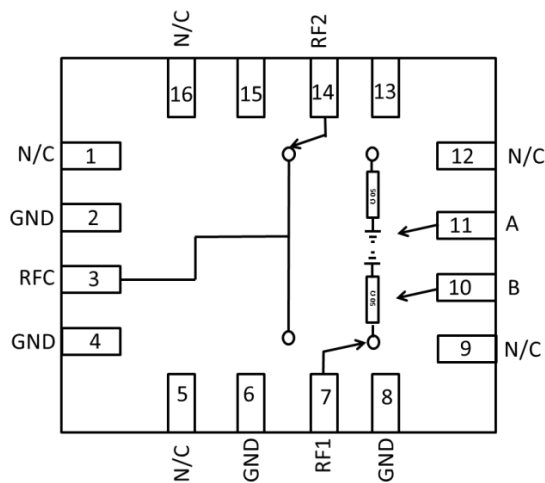
Revision 1.0 was published in May 2017. It was the first publication of this document.

2 Product Overview

The MMS006PP3 is a DC-to-20 GHz, non-reflective gallium arsenide (GaAs) pseudomorphic high-electron-mobility transistor (pHEMT) single pole double throw (SPDT) monolithic microwave integrated circuit (MMIC) switch in a plastic leadless 3 mm × 3 mm surface-mount package. The switch delivers over 40 dB of isolation across the DC-to-20 GHz band while maintaining a low insertion loss of less than 2.0 dB. Also available in die form as the MMS006AA, the RF ports are internally matched to 50 Ω, which allows for easy integration into multi-chip modules (MCMs).

The following illustration shows the primary functional diagram of the MMA006PP3 device.

Figure 1 • Functional Diagram



2.1 Applications

The MMS006PP3 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 MMS006PP3 device:

- Non-reflective topology
- Broadband performance: DC–20 GHz
- Fast switching: 10 ns
- Low insertion loss: 1.2 dB at 10 GHz
- Excellent isolation: 42 dB at 10 GHz
- Compact 16-lead plastic QFN package: 3 mm × 3 mm × 0.85 mm
- High input P1dB: 25 dBm
- High input IP3: 43 dBm

3 Electrical Specifications

This section details the electrical specifications of the MMS006PP3 device.

3.1 Absolute Maximum Ratings

The following table lists the absolute maximum ratings of the MMS006PP3 device.

Table 1 • Absolute Maximum Ratings

| Parameter | Rating |
|--|-------------------|
| Storage temperature | –65 °C to 150 °C |
| Operating temperature | –40 °C to 85 °C |
| Control voltage range (CTLA/CTLB) | 0.5 V to –7.5 VDC |
| RF input power | 30 dBm |
| Hot switching power | 7 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 MMS006PP3 device at 25 °C, where V_{CONTROL} (CTLA/CTLB) is 0 V, –5 V. The system is 50 Ω .

Table 2 • Specified Electrical Performance

| Parameter | Frequency | Min | Typ | Max | Unit |
|------------------------------------|---|-----|-----|------|------|
| Operational frequency range | | DC | | 20 | GHz |
| Insertion loss (all states) | DC–20 GHz | | 2.0 | 2.25 | dB |
| Return loss (on state) | DC–20 GHz | | –10 | | dB |
| Isolation | DC–20 GHz | 35 | 40 | | dB |
| $T_{\text{RISE}}, T_{\text{FALL}}$ | DC–20 GHz (10% to 90% and 90% to 10% RF) | | 10 | | ns |
| $T_{\text{ON}}, T_{\text{OFF}}$ | DC–20 GHz (50% control to 90% RF and 50% control to 90% RF) | | 10 | | ns |
| Input power for P1 dB | 1 GHz–20 GHz | | 25 | | dBm |
| Input third order intercept (IIP3) | 2 GHz–20 GHz (two-tone input power, 7 dBm/tone) | | 43 | | dBm |

3.3 Typical Performance Curves

The following graphs show the typical performance curves of the MMS006PP3 device.

Figure 2 • Insertion Loss vs. Temperature

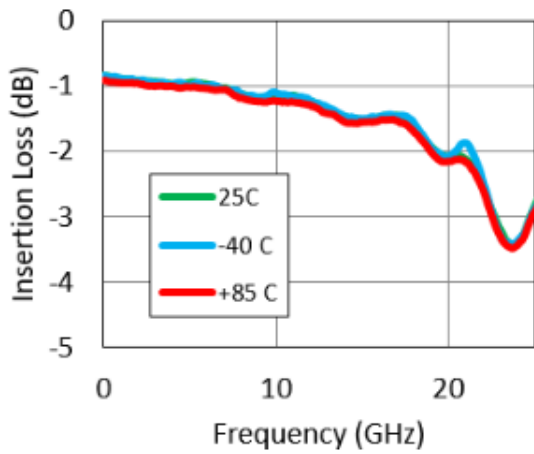


Figure 3 • Isolation

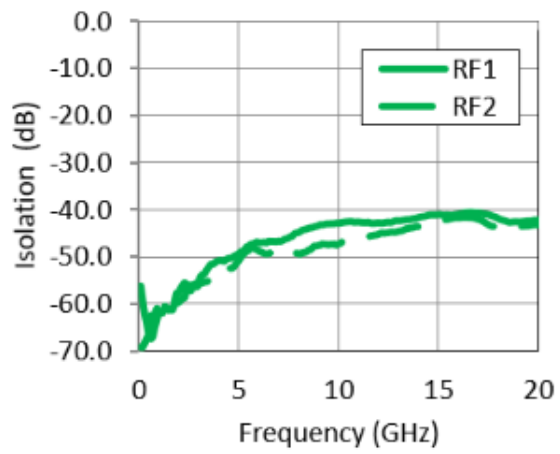


Figure 4 • Return Loss

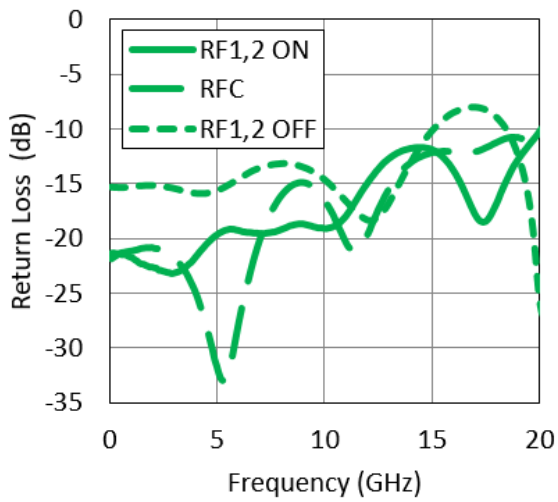


Figure 5 • 0.1 dB and 1 dB Compression Point

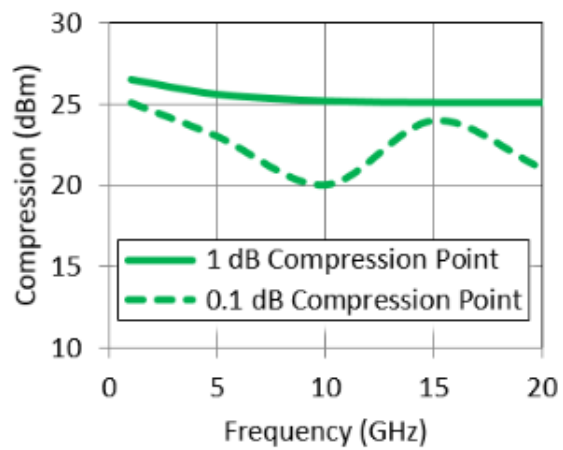
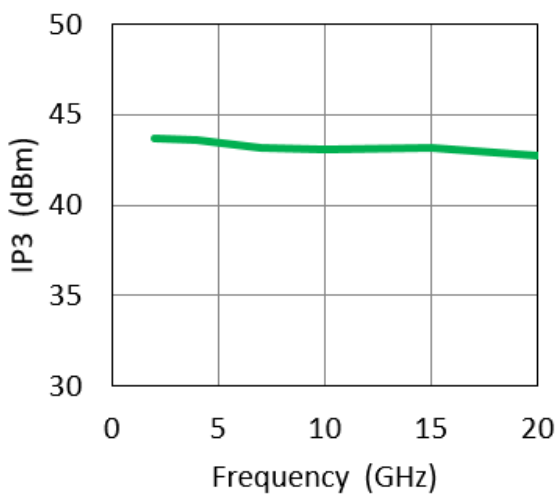


Figure 6 • Input Third Order Intercept Point



3.4 Control Voltages

The following tables list the control voltages of the MMS006PP3 device.

Table 3 • Switch Control Truth Table

| Control Input A | Control Input B | Signal Path Condition: RF Common to RF1 | Signal Path Condition: RF Common to RF2 |
|-----------------|-----------------|--|--|
| High | Low | On | Off |
| Low | High | Off | On |

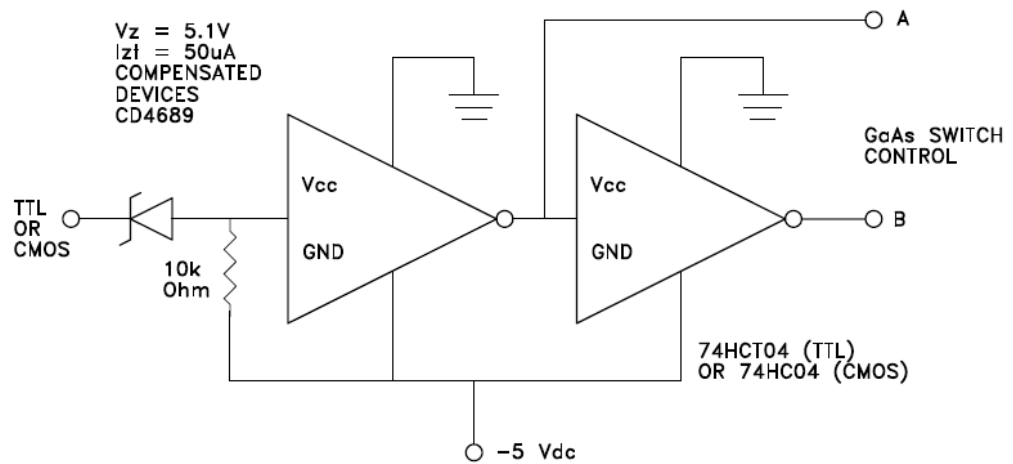
Table 4 • Digital Control Voltages

| State | Bias Condition |
|-------|------------------|
| Low | –3 V to 0 V |
| High | –5.0 V to –4.2 V |

3.5 Example Driver Circuit

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

Figure 7 • Driver Circuit Example



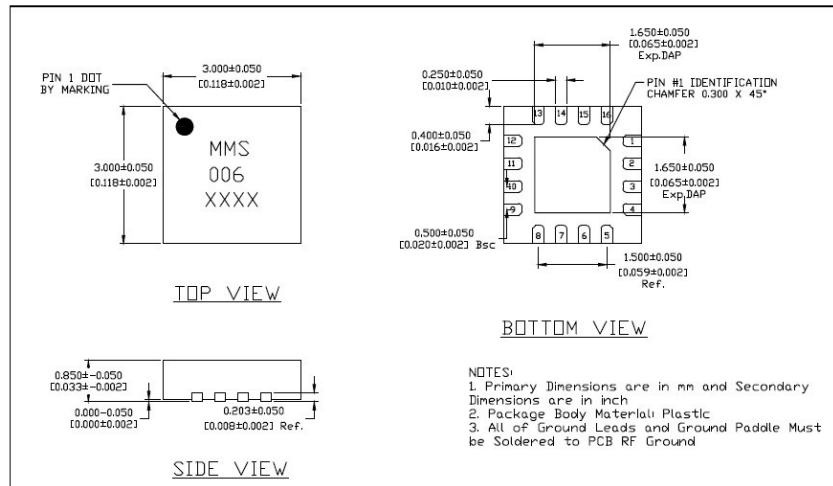
4 Package Specification

This section details the package specifications of the MMS006PP3 device.

4.1 Package Outline Drawing

The following illustration shows the package outline of the MMS006PP3 device. Dimensions are in millimeters [inches].

Figure 8 • Package Outline



4.2 Package Information

The following table lists the package information for the MMS006PP3 device. For additional packaging information, contact your Microsemi sales representative.

Table 5 • Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking |
|-------------|-------------------------------------|---------------|------------|-------------------|
| MMS006PP3 | Low-stress injection molded plastic | 100% matte Sn | TBD | MMS 006 www |

4.3 Pin Descriptions

The following table describes the pins of the MMS006PP3 device.

Table 6 • Pin Description Information

| Pin Number | Pin Name | Description |
|--------------------|--------------|--|
| 1, 5, 9, 12, 16 | N/C | These pins should be connected to PCB RF ground to maximize isolation. |
| 2, 4, 6, 8, 13, 15 | GND | Package bottom has an exposed metal paddle that must be connected to PCB RF ground. |
| 3, 7, 14 | RF, RF1, RF2 | This pin is DC-coupled and matched to 50 Ω. Blocking capacitors are required if RF line potential is not equal to 0 V. |

| Pin Number | Pin Name | Description |
|--------------------|--------------|--|
| 10 | CTLB | For details, see Switch Control Truth Table (see page 5) and Digital Control Voltages (see page 5) . |
| 11 | CTLA | For details, see Switch Control Truth Table (see page 5) and Digital Control Voltages (see page 5) . |
| Backside paddle | RF/DC GND | RF/DC ground. |

5 Handling Recommendations

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 circuit board used in the application should be generated with proper RF circuit design techniques. Signal lines at the RF port should have 50 Ω impedance and the package ground leads and backside ground paddle should be connected directly to the ground plane as shown (or similar).

Figure 9 • Evaluation Board

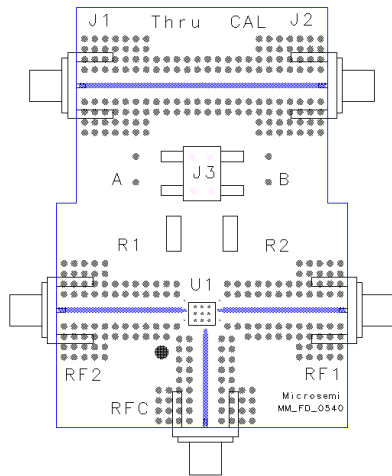


Table 7 • Materials for Evaluation PCB MMS006PP3E

| Item | Description |
|-----------------------|---|
| J1, J2, RFC, RF1, RF2 | Amphenol end launch SMA RF connector. P/N: 132255RP |
| J3 | Surface mount header pin. P/N: 95278-102-04LF for A, B, GND |
| R1, R2 | 100 Ω resistor, 0603 package |
| U1 | MMS006PP3 |
| PCB ¹ | Evaluation PCB: 1.29 inches x 1.55 inches |

¹ Circuit board material: Rogers 4350.

7 Ordering Information

The following table lists the ordering information for the MMS006PP3 device.

Table 8 • Ordering Information

| Part Number | Package |
|-------------|---------------------------------|
| MMS006PP3 | 3 mm × 3 mm plastic QFN package |
| MMS006PP3E | Evaluation board for MMS006PP3 |

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