

# SW-226-PIN / -227-PIN / -228-PIN

GaAs SPDT Switch  
DC - 4 GHz

Rev. V6

## Features

- Terminated (SW-226-PIN), High Isolation (SW-227-PIN), Low Loss (SW-228-PIN)
- Fast Switching Speed: 6 nS Typical
- Ultra Low DC Power Consumption
- Lead-Free 7-Lead Ceramic Package
- RoHS\* Compliant and 260°C Reflow Compatible

## Description

M/A-COM's SW-226/227/228-PIN are GaAs MMIC SPDT switches packaged in lead-free, surface mount CR-2 ceramic style packages. The SW-226-PIN is a terminated SPDT. The SW-227-PIN offers high isolation. The SW-228-PIN offers low insertion loss. This ceramic switch platform has a common footprint for all three designs. The CR-2 package is hermetically sealed, making these switches ideal for space, military radios, and other environmentally harsh applications.

Typical applications include synthesizer switching, transmit/receive switching, switch matrices and filter banks in systems such as radio and cellular equipment, PCM, GPS, and fiber optic modules.

The SW-226/227/228-PIN are fabricated as monolithic GaAs MMICs using a 1.0 micron MESFET process.

## Ordering Information

| Part Number | Package        |
|-------------|----------------|
| SW-226-PIN  | Ceramic (CR-2) |
| SW-227-PIN  | Ceramic (CR-2) |
| SW-228-PIN  | Ceramic (CR-2) |

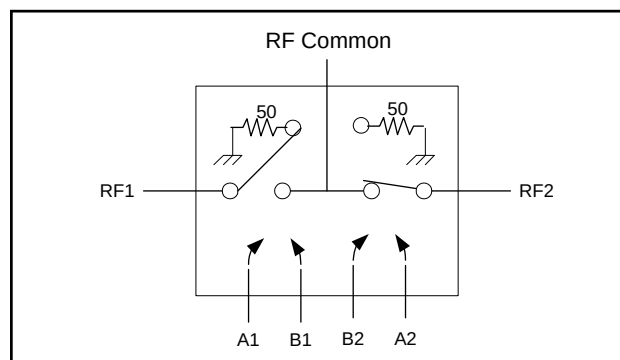
## Absolute Maximum Ratings<sup>1,2</sup>

| Parameter                                | Absolute Maximum               |
|------------------------------------------|--------------------------------|
| Input Power<br>0.05 GHz<br>0.5 - 4.0 GHz | +27 dBm<br>+34 dBm             |
| Control Voltage                          | -8.5 V ≤ V <sub>c</sub> ≤ +5 V |
| Operating Temperature                    | -55°C to +125°C                |
| Storage Temperature                      | -65°C to +150°C                |

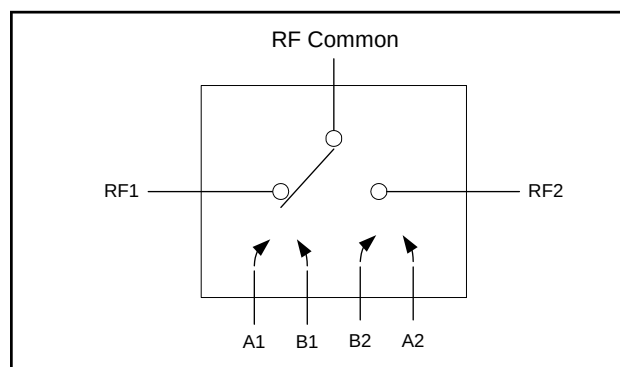
1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. M/A-COM does not recommend sustained operation near these survivability limits.

\* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

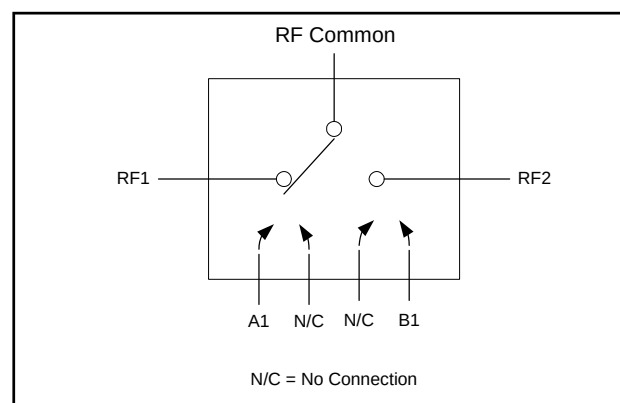
## Block Diagram/Pin Configuration SW-226-PIN<sup>3</sup>



## Block Diagram/Pin Configuration SW-227-PIN<sup>3</sup>



## Block Diagram/Pin Configuration SW-228-PIN<sup>3</sup>



3. Bottom of case is RF ground.

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**Electrical Specifications:**  $T_A = -55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_c = 0\text{ V} / -5\text{ V}$ ,  $Z_0 = 50\ \Omega$  <sup>4</sup>

| Parameter                                       | Test Conditions                              | Units | Min. | Typ. | Max.  |
|-------------------------------------------------|----------------------------------------------|-------|------|------|-------|
| Insertion Loss (SW-226-PIN)                     | DC - 0.5 GHz                                 | dB    | —    | —    | 0.9   |
|                                                 | DC - 1 GHz                                   | dB    | —    | —    | 1.0   |
|                                                 | DC - 2 GHz                                   | dB    | —    | —    | 1.2   |
|                                                 | DC - 4 GHz                                   | dB    | —    | —    | 1.5   |
| Insertion Loss (SW-227-PIN)                     | DC - 0.5 GHz                                 | dB    | —    | —    | 0.9   |
|                                                 | DC - 1 GHz                                   | dB    | —    | —    | 1.0   |
|                                                 | DC - 2 GHz                                   | dB    | —    | —    | 1.1   |
|                                                 | DC - 4 GHz                                   | dB    | —    | —    | 1.4   |
| Insertion Loss (SW-228-PIN)                     | DC - 0.5 GHz                                 | dB    | —    | —    | 0.7   |
|                                                 | DC - 1 GHz                                   | dB    | —    | —    | 0.7   |
|                                                 | DC - 2 GHz                                   | dB    | —    | —    | 0.8   |
|                                                 | DC - 4 GHz                                   | dB    | —    | —    | 1.0   |
| Isolation (SW-226-PIN)                          | DC - 0.5 GHz                                 | dB    | 53   | —    | —     |
|                                                 | DC - 1 GHz                                   | dB    | 48   | —    | —     |
|                                                 | DC - 2 GHz                                   | dB    | 40   | —    | —     |
|                                                 | DC - 4 GHz                                   | dB    | 25   | —    | —     |
| Isolation (SW-227-PIN)                          | DC - 0.5 GHz                                 | dB    | 55   | —    | —     |
|                                                 | DC - 1 GHz                                   | dB    | 50   | —    | —     |
|                                                 | DC - 2 GHz                                   | dB    | 40   | —    | —     |
|                                                 | DC - 4 GHz                                   | dB    | 35   | —    | —     |
| Isolation (SW-228-PIN)                          | DC - 0.5 GHz                                 | dB    | 50   | —    | —     |
|                                                 | DC - 1 GHz                                   | dB    | 42   | —    | —     |
|                                                 | DC - 2 GHz                                   | dB    | 32   | —    | —     |
|                                                 | DC - 4 GHz                                   | dB    | 22   | —    | —     |
| VSWR (SW-226-PIN)                               | DC - 0.5 GHz                                 | Ratio | —    | —    | 1.2:1 |
|                                                 | DC - 1 GHz                                   | Ratio | —    | —    | 1.4:1 |
|                                                 | DC - 2 GHz                                   | Ratio | —    | —    | 1.6:1 |
|                                                 | DC - 4 GHz                                   | Ratio | —    | —    | 2.3:1 |
| VSWR (SW-227-PIN)                               | DC - 0.5 GHz                                 | Ratio | —    | —    | 1.2:1 |
|                                                 | DC - 1 GHz                                   | Ratio | —    | —    | 1.4:1 |
|                                                 | DC - 2 GHz                                   | Ratio | —    | —    | 1.6:1 |
|                                                 | DC - 4 GHz                                   | Ratio | —    | —    | 2.0:1 |
| VSWR (SW-228-PIN)                               | DC - 0.5 GHz                                 | Ratio | —    | —    | 1.2:1 |
|                                                 | DC - 1 GHz                                   | Ratio | —    | —    | 1.2:1 |
|                                                 | DC - 2 GHz                                   | Ratio | —    | —    | 1.3:1 |
|                                                 | DC - 4 GHz                                   | Ratio | —    | —    | 1.9:1 |
| Trise, Tfall <sup>5</sup>                       | 10% to 90% RF, 90% to 10% RF                 | nS    | —    | 3    | —     |
| Ton, Toff <sup>5</sup>                          | 50% control to 90% RF, 50% control to 10% RF | nS    | —    | 6    | —     |
| Transients <sup>5</sup> (SW-226-PIN,SW-227-PIN) | In-Band                                      | mV    | —    | 30   | —     |
| Transients <sup>5</sup> (SW-228-PIN)            | In-Band                                      | mV    | —    | 10   | —     |

4. See MIL-STD-883 for environmental screening options.

5. Faster switching speed can be achieved with enhanced driver waveform.

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**Electrical Specifications (continued):**  $T_A = -55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_c = 0\text{ V} / -5\text{ V}$ ,  $Z_0 = 50\ \Omega$

| Parameter       | Test Conditions                               | Units         | Min. | Typ. | Max. |
|-----------------|-----------------------------------------------|---------------|------|------|------|
| Input P1dB      | 0.5 - 4 GHz, 0 / -5 VDC                       | dBm           | —    | 27   | —    |
|                 | 0.05 GHz, 0 / -5 VDC                          | dBm           | —    | 21   | —    |
|                 | 0.5 - 4 GHz, 0 / -8 VDC                       | dBm           | —    | 33   | —    |
|                 | 0.05 GHz, 0 / -8 VDC                          | dBm           | —    | 26   | —    |
| IP2             | For two-tone input power up to +13 dBm        |               |      |      |      |
|                 | 0.5 - 4 GHz                                   | dBm           | —    | 68   | —    |
| IP3             | For two-tone input power up to +13 dBm        |               |      |      |      |
|                 | 0.5 - 4 GHz                                   | dBm           | —    | 46   | —    |
| Control Current | 0.05 GHz                                      | dBm           | —    | 40   | —    |
|                 |                                               |               |      |      |      |
| Control Current | $ V_c  = 0$ to $0.2\text{ V}$                 | $\mu\text{A}$ | —    | —    | 20   |
|                 | $ V_c  = 5\text{ V}$ (SW-226-PIN, SW-227-PIN) | $\mu\text{A}$ | —    | 110  | —    |
|                 | $ V_c  = 8\text{ V}$ (SW-226-PIN, SW-227-PIN) | $\mu\text{A}$ | —    | —    | 600  |
|                 | $ V_c  = 5\text{ V}$ (SW-228-PIN)             | $\mu\text{A}$ | —    | 50   | —    |
|                 | $ V_c  = 8\text{ V}$ (SW-228-PIN)             | $\mu\text{A}$ | —    | —    | 300  |
|                 |                                               |               |      |      |      |

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

## SW-226-PIN and SW-227-PIN Truth Table<sup>6,7</sup>

| Control Input |    |    |    | Condition of Switch, RF Common to each RF Port |     |
|---------------|----|----|----|------------------------------------------------|-----|
| A1            | B1 | A2 | B2 | RF1                                            | RF2 |
| 1             | 0  | 0  | 1  | ON                                             | OFF |
| 0             | 1  | 1  | 0  | OFF                                            | ON  |

## SW-228-PIN Truth Table<sup>6,7</sup>

| Control Input |    | Condition of Switch, RF Common to each RF Port |     |
|---------------|----|------------------------------------------------|-----|
| A1            | B1 | RF1                                            | RF2 |
| 1             | 0  | ON                                             | OFF |
| 0             | 1  | OFF                                            | ON  |

6. 0 = 0 V to -0.2 V, 1 = -5 V to -8 V

7. For the SW-227-PIN and SW-228-PIN only, when an RF output is "OFF" it is shorted to case ground.

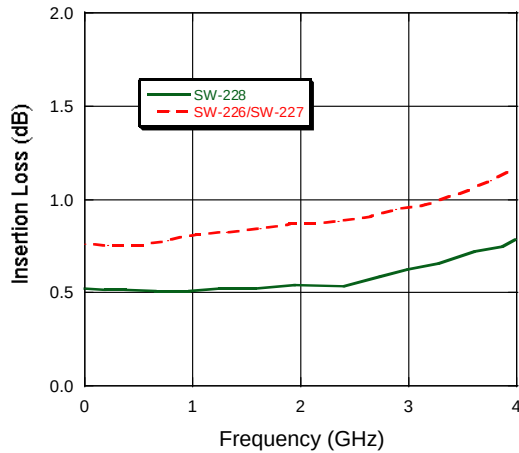
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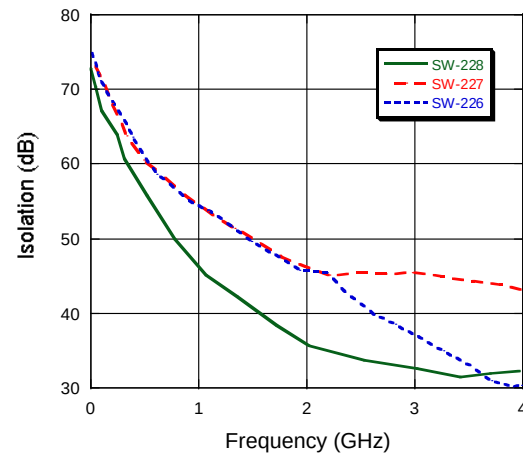
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## Typical Performance Curves

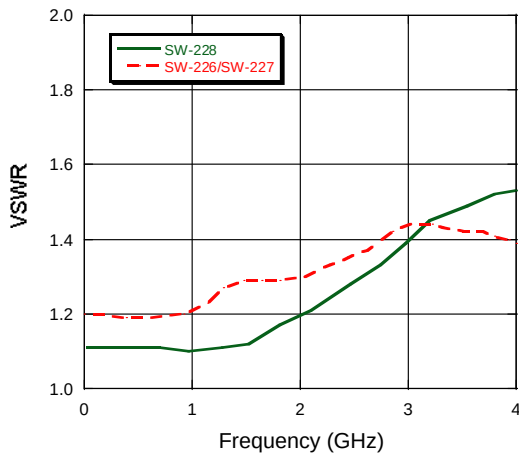
**Insertion Loss**



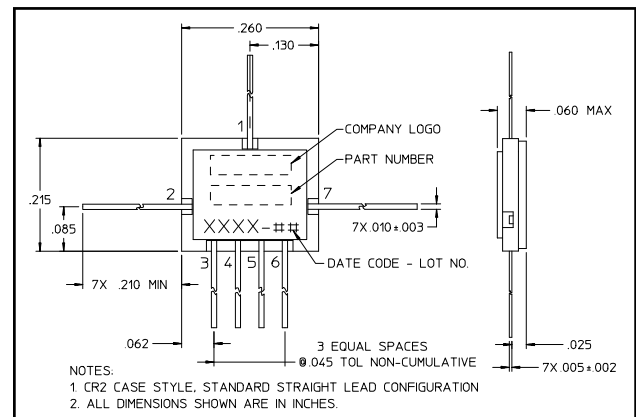
**Isolation**



**VSWR**



**Lead-Free CR-2<sup>†</sup>**



<sup>†</sup> Reference Application Note M538 for lead-free solder reflow recommendations.