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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW-226-PIN</td>
<td>Ceramic (CR-2)</td>
</tr>
<tr>
<td>SW-227-PIN</td>
<td>Ceramic (CR-2)</td>
</tr>
<tr>
<td>SW-228-PIN</td>
<td>Ceramic (CR-2)</td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power 0.05 GHz</td>
<td>+27 dBm</td>
</tr>
<tr>
<td>Input Power 0.5 - 4.0 GHz</td>
<td>+34 dBm</td>
</tr>
<tr>
<td>Control Voltage</td>
<td>-8.5 V ≤ Vc ≤ +5 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-55°C to +125°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

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.
3. Bottom of case is RF ground.

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For further information and support please visit: https://www.macom.com/support
### Electrical Specifications: \( T_A = -55^\circ \text{C} \) to \(+85^\circ \text{C}, V_c = 0 \text{ V} / -5 \text{ V}, Z_0 = 50 \, \Omega \)

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

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5. Faster switching speed can be achieved with enhanced driver waveform.
GaAs SPDT Switch
DC - 4 GHz

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input P1dB</td>
<td>0.5 - 4 GHz, 0 / -5 VDC</td>
<td>dBm</td>
<td>—</td>
<td>27</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.05 GHz, 0 / -5 VDC</td>
<td>dBm</td>
<td>—</td>
<td>21</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.5 - 4 GHz, 0 / -8 VDC</td>
<td>dBm</td>
<td>—</td>
<td>33</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.05 GHz, 0 / -8 VDC</td>
<td>dBm</td>
<td>—</td>
<td>26</td>
<td>—</td>
</tr>
<tr>
<td>IP2</td>
<td>For two-tone input power up to +13 dBm</td>
<td>dBm</td>
<td>—</td>
<td>68</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.5 - 4 GHz</td>
<td>dBm</td>
<td>—</td>
<td>62</td>
<td>—</td>
</tr>
<tr>
<td>IP3</td>
<td>For two-tone input power up to +13 dBm</td>
<td>dBm</td>
<td>—</td>
<td>46</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.5 - 4 GHz</td>
<td>dBm</td>
<td>—</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>Control Current</td>
<td>[</td>
<td>V_c</td>
<td>= 0 \text{ to } 0.2 \text{ V}]</td>
<td>( \mu A )</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[</td>
<td>V_c</td>
<td>= 5 \text{ V (SW-226-PIN, SW-227-PIN)}]</td>
<td>( \mu A )</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[</td>
<td>V_c</td>
<td>= 8 \text{ V (SW-226-PIN, SW-227-PIN)}]</td>
<td>( \mu A )</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[</td>
<td>V_c</td>
<td>= 5 \text{ V (SW-228-PIN)}]</td>
<td>( \mu A )</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>[</td>
<td>V_c</td>
<td>= 8 \text{ V (SW-228-PIN)}]</td>
<td>( \mu A )</td>
<td>—</td>
</tr>
</tbody>
</table>

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 6,7

<table>
<thead>
<tr>
<th>Control Input</th>
<th>Condition of Switch, RF Common to each RF Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 B1 A2 B2 RF1 RF2</td>
<td></td>
</tr>
<tr>
<td>1 0 0 1</td>
<td>ON OFF</td>
</tr>
<tr>
<td>0 1 1 0</td>
<td>OFF ON</td>
</tr>
</tbody>
</table>

SW-228-PIN Truth Table 6,7

<table>
<thead>
<tr>
<th>Control Input</th>
<th>Condition of Switch, RF Common to each RF Port</th>
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<tbody>
<tr>
<td>A1 B1 RF1 RF2</td>
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</tr>
<tr>
<td>1 0</td>
<td>ON OFF</td>
</tr>
<tr>
<td>0 1</td>
<td>OFF ON</td>
</tr>
</tbody>
</table>

6. \( 0 = 0 \text{ V to } -0.2 \text{ V}, 1 = -5 \text{ V to } -8 \text{ V} \)
7. For the SW-227-PIN and SW-228-PIN only, when an RF output is “OFF” it is shorted to case ground.
Typical Performance Curves

**Insertion Loss**

![Insertion Loss Graph](image)

**Isolation**

![Isolation Graph](image)

**VSWR**

![VSWR Graph](image)

**Lead-Free CR-2†**

![Lead-Free CR-2 Diagram](image)

† Reference Application Note M538 for lead-free solder reflow recommendations.
GaAs SPDT Switch
DC - 4 GHz
Rev. V6

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