SPDT SWITCH GaAs MMIC

**GENERAL DESCRIPTION**

The NJG1669MD7 is a GaAs SPDT switch IC suited for WiMAX CPE and data card application. The NJG1669MD7 features low insertion loss, high power handling and high isolation.

This device exhibits wide frequency coverage up to 6.0GHz. And also this switch MMIC includes ESD protection circuits.

An ultra- small and ultra-thin package of EQFN14-D7 is adopted.

**APPLICATIONS**

WiMAX, WLAN, LTE, 3G applications

High linearity switching applications like CPE, Modem, Router and Access point

Antenna switching, path switching and band switching applications

**FEATURES**

- Control voltage
  
  +2.0V~+5.0V

- Low insertion loss
  
  0.35dB typ. @f=2.5GHz, \( P_{IN}=30\text{dBm} \), \( V_{CTL(H)}=3.0V \)
  
  0.40dB typ. @f=3.5GHz, \( P_{IN}=30\text{dBm} \), \( V_{CTL(H)}=3.0V \)
  
  0.45dB typ. @f=6.0GHz, \( P_{IN}=30\text{dBm} \), \( V_{CTL(H)}=3.0V \)

- High isolation
  
  28dB typ. @f=2.5GHz, \( P_{IN}=30\text{dBm} \), \( V_{CTL(H)}=3.0V \)
  
  29dB typ. @f=3.5GHz, \( P_{IN}=30\text{dBm} \), \( V_{CTL(H)}=3.0V \)
  
  25dB typ. @f=6.0GHz, \( P_{IN}=30\text{dBm} \), \( V_{CTL(H)}=3.0V \)

- High P_{-0.1dB} Compression
  
  37dBm typ. @f=2.5GHz, \( V_{CTL(H)}=3.0V \)
  
  37dBm typ. @f=3.5GHz, \( V_{CTL(H)}=3.0V \)

- Ultra- small and ultra-thin package
  
  EQFN14-D7 (package Size: 1.6 x 1.6 x 0.397mm typ.)

- Lead-free and halogen-free

**PIN CONFIGURATION**

EQFN14-D7 Type (TOP VIEW)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

1. NC(GND) 8. NC(GND)
2. P2 9. CTL1
3. CTL2 10. P1
4. NC(GND) 11. NC(GND)
5. NC(GND) 12. NC(GND)
6. PC 13. GND
7. NC(GND) 14. NC(GND)

**TRUTH TABLE**

<table>
<thead>
<tr>
<th>CTL1</th>
<th>CTL2</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>L</td>
<td>PC-P1</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>PC-P2</td>
</tr>
</tbody>
</table>

"H"=\( V_{CTL(H)} \), "L"=\( V_{CTL(L)} \)

NOTE: The information on this datasheet is subject to change without notice
### ABSOLUTE MAXIMUM RATINGS

(T_a=25°C, Z_s=Z_l=50Ω)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>RATINGS</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input power</td>
<td>P_in</td>
<td>V_CTL=0/3V</td>
<td>38</td>
<td>dBm</td>
</tr>
<tr>
<td>Control voltage</td>
<td>V_CTL</td>
<td>CTL terminal</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>P_D</td>
<td>Four-layer FR4 PCB with through-hole (74.2x74.2mm), Tj=150°C</td>
<td>1300</td>
<td>mW</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>T_opr</td>
<td></td>
<td>-40~+85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_stg</td>
<td></td>
<td>-55~+150</td>
<td>°C</td>
</tr>
</tbody>
</table>

### ELECTRICAL CHARACTERISTICS

(General conditions: T_a=+25°C, V_CTL(L)=0V, V_CTL(H)=3V, Z_s=Z_l=50Ω)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control voltage (L)</td>
<td>V_CTL(L)</td>
<td>f=2.5GHz</td>
<td>-0.2</td>
<td>-</td>
<td>0.2</td>
<td>V</td>
</tr>
<tr>
<td>Control voltage (H)</td>
<td>V_CTL(H)</td>
<td></td>
<td>2.0</td>
<td>3.0</td>
<td>5.0</td>
<td>V</td>
</tr>
<tr>
<td>Control current</td>
<td>I_CTL</td>
<td></td>
<td>-</td>
<td>15</td>
<td>30</td>
<td>µA</td>
</tr>
<tr>
<td>Insertion loss 1</td>
<td>LOSS1</td>
<td>f=2.5GHz</td>
<td>-</td>
<td>0.35</td>
<td>0.55</td>
<td>dB</td>
</tr>
<tr>
<td>Insertion loss 2</td>
<td>LOSS2</td>
<td>f=3.5GHz</td>
<td>-</td>
<td>0.40</td>
<td>0.60</td>
<td>dB</td>
</tr>
<tr>
<td>Insertion loss 3</td>
<td>LOSS3</td>
<td>f=6.0GHz</td>
<td>-</td>
<td>0.45</td>
<td>0.65</td>
<td>dB</td>
</tr>
<tr>
<td>Isolation 1</td>
<td>ISL1</td>
<td>f=2.5GHz</td>
<td>25</td>
<td>28</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Isolation 2</td>
<td>ISL2</td>
<td>f=3.5GHz</td>
<td>26</td>
<td>29</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Isolation 3</td>
<td>ISL3</td>
<td>f=6.0GHz</td>
<td>22</td>
<td>25</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Input power at 0.1dB compression point 1</td>
<td>P_0.1dB(1)</td>
<td>f=2.5GHz</td>
<td>34</td>
<td>37</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Input power at 0.1dB compression point 2</td>
<td>P_0.1dB(2)</td>
<td>f=3.5GHz</td>
<td>34</td>
<td>37</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>VSWR</td>
<td>VSWR</td>
<td>f=3.5GHz, ON STATE</td>
<td>-</td>
<td>1.1</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>2nd Harmonics 1</td>
<td>2f_0(1)</td>
<td>f=2.5GHz, P_in=30dBm</td>
<td>-</td>
<td>-40</td>
<td>-30</td>
<td>dBm</td>
</tr>
<tr>
<td>2nd Harmonics 2</td>
<td>2f_0(2)</td>
<td>f=3.5GHz, P_in=30dBm</td>
<td>-</td>
<td>-40</td>
<td>-30</td>
<td>dBm</td>
</tr>
<tr>
<td>3rd Harmonics 1</td>
<td>3f_0(1)</td>
<td>f=2.5GHz, P_in=30dBm</td>
<td>-</td>
<td>-40</td>
<td>-30</td>
<td>dBm</td>
</tr>
<tr>
<td>3rd Harmonics 2</td>
<td>3f_0(2)</td>
<td>f=3.5GHz, P_in=30dBm</td>
<td>-</td>
<td>-40</td>
<td>-30</td>
<td>dBm</td>
</tr>
<tr>
<td>Switching time</td>
<td>T_sw</td>
<td>50% DC to 10/90% RF</td>
<td>-</td>
<td>350</td>
<td>-</td>
<td>ns</td>
</tr>
</tbody>
</table>
## TERMINAL INFORMATION

<table>
<thead>
<tr>
<th>No.</th>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,4,5,7,8, 11,12,14</td>
<td>NC (GND)</td>
<td>No connected terminals. Please connect these terminals with a ground plane as close as possible for good RF performance.</td>
</tr>
<tr>
<td>2</td>
<td>P2</td>
<td>RF port. This port is connected with PC port by controlling 3rd pin to $V_{CTL(H)}$ and 9th pin to $V_{CTL(L)}$. An external capacitor is required to block the DC bias voltage of internal circuit.</td>
</tr>
<tr>
<td>3</td>
<td>CTL2</td>
<td>Control signal input terminal. Please connect a bypass capacitor (10pF) with a ground plane for avoiding RF noise from outside.</td>
</tr>
<tr>
<td>6</td>
<td>PC</td>
<td>Common RF port. An external capacitor is required to block the DC bias voltage of internal circuit.</td>
</tr>
<tr>
<td>9</td>
<td>CTL1</td>
<td>Control signal input terminal. Please connect a bypass capacitor (10pF) with a ground plane for avoiding RF noise from outside.</td>
</tr>
<tr>
<td>10</td>
<td>P1</td>
<td>RF port. This port is connected with PC port by controlling 3rd pin to $V_{CTL(L)}$ and 9th pin to $V_{CTL(H)}$. An external capacitor is required to block the DC bias voltage of internal circuit.</td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>Ground terminal. Please connect this terminal with a ground plane as close as possible for good RF performance.</td>
</tr>
</tbody>
</table>
ELECTRICAL CHARACTERISTICS (With Application circuit, Loss of external circuit are excluded)
ELECTRICAL CHARACTERISTICS (With Application circuit, Loss of external circuit are excluded)

Output Power, $I_{\text{CTL}}$ vs. Input Power

- Frequency: 2.5GHz, PC-P1 ON, $V_{\text{CTL(L)}} = 0V$

Loss, ISL vs. Input Power

- Frequency: 2.5GHz, PC-P1 ON, $V_{\text{CTL(L)}} = 0V$

Output Power, $I_{\text{CTL}}$ vs. Input Power

- Frequency: 3.5GHz, PC-P1 ON, $V_{\text{CTL(L)}} = 0V$

Loss, ISL vs. Input Power

- Frequency: 3.5GHz, PC-P1 ON, $V_{\text{CTL(L)}} = 0V$
ELECTRICAL CHARACTERISTICS (With Application circuit, Loss of external circuit are excluded)

2nd Harmonics vs. Input Power

(f=2.5GHz, PC-P1 ON, \( V_{\text{CTL(L)}} = 0 \) V)

2nd Harmonics vs. Input Power

(f=3.5GHz, PC-P1 ON, \( V_{\text{CTL(L)}} = 0 \) V)

3rd Harmonics vs. Input Power

(f=2.5GHz, PC-P1 ON, \( V_{\text{CTL(L)}} = 0 \) V)

3rd Harmonics vs. Input Power

(f=3.5GHz, PC-P1 ON, \( V_{\text{CTL(L)}} = 0 \) V)

Switching Time

(PC-P1/P2, \( V_{\text{CTL}} = 3 \) V)

Voltage (arb unit)

Time (400ns/div)
ELECTRICAL CHARACTERISTICS (With Application circuit, Loss of external circuit are excluded)

- **Loss, ISL vs. Ambient Temperature**
  - 2.0
  - 1.8
  - 1.6
  - 1.4
  - 1.2
  - 1.0
  - 0.8
  - 0.6
  - 0.4
  - 0.2
  - 0.0

- **VSWR vs. Ambient Temperature**
  - 2.0
  - 1.8
  - 1.6
  - 1.4
  - 1.2
  - 1.0
  - 0.8
  - 0.6
  - 0.4
  - 0.2
  - 0.0

- **Control Current I\textsubscript{CTL} vs. Ambient Temperature**
  - 30
  - 25
  - 20
  - 15
  - 10
  - 5
  - 0

- **P\textsubscript{0.1dB} vs. Ambient Temperature**
  - 50
  - 45
  - 40
  - 35
  - 30
  - 25
  - 20
  - 15
  - 10
  - 5
  - 0

- **2nd Harmonics vs. Ambient Temperature**
  - -80
  - -70
  - -60
  - -50
  - -40
  - -30
  - -20
  - -10
  - 0

- **3rd Harmonics vs. Ambient Temperature**
  - -80
  - -70
  - -60
  - -50
  - -40
  - -30
  - -20
  - -10
  - 0
APPLICATION CIRCUIT

(TOP VIEW)

TEST PCB LAYOUT

(Top View)

PARTS LIST

<table>
<thead>
<tr>
<th>Parts ID</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1~C3</td>
<td>27pF</td>
<td>Murata MFG (GRM15)</td>
</tr>
<tr>
<td>C4, C5</td>
<td>10pF</td>
<td></td>
</tr>
</tbody>
</table>

PRECAUTIONS

[1] The DC blocking capacitors have to be placed at RF terminal of P1, P2 and PC. Please choose appropriate capacitance values to the application frequency.

[2] For avoiding the degradation of RF performance, please place bypass capacitors (C4 and C5) as close as possible to each terminal.

[3] For good RF performance, the GND terminals must be connected with the ground plane of substrate, and through-holes for GND should be placed the IC near.
**NJG1669MD7**

### PACKAGE OUTLINE (EQFN14-D7)

Units: mm
Board: Cu
Terminal treat: SnBi
Molding material: Epoxy resin
Weight: 3.3mg

**Cautions on using this product**

- This product contains Gallium-Arsenide (GaAs) which is a harmful material.
- Do NOT eat or put into mouth.
- Do NOT dispose in fire or break up this product.
- Do NOT chemically make gas or powder with this product.
- To waste this product, please obey the relating law of your country.

This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.

[CAUTION]
The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.