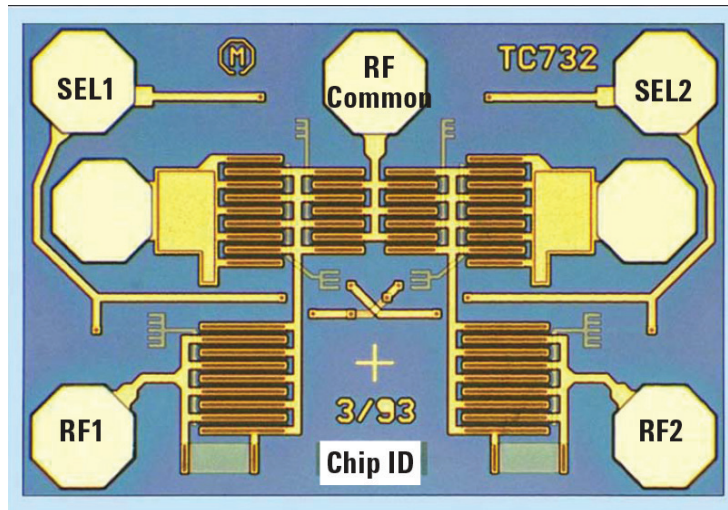


Keysight HMMC-2007

DC–8 GHz Terminated SPDT Switch

1GG7-8004

Data Sheet

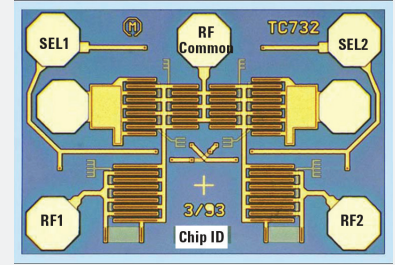


Features

- Outputs terminated in 50 Ω when off
- Frequency range: DC to 8 GHz
- Insertion loss: 1.2 dB @ 8 GHz
- Isolation:
 - > 70 dB @ 45 MHz
 - > 35 dB @ 8 GHz
- Return loss: 25 dB (both input and selected output)
18 dB unselected output
- Switching speed:
 - < 20 μ s (10%–90% RF)
- $P_{-1\text{ dB}}$: 27 dBm
- Harmonics (DC coupled):
 - < -80 dBc @ 10 dBm

Description

The HMMC-2007 is a GaAs monolithic microwave integrated circuit (MMIC) designed for low insertion loss and high isolation from DC to 8 GHz. It is intended for use as a general-purpose, single-pole, double-throw (SP-DT), absorptive switch. Two series and two shunt MESFETs per throw provide 1.4 dB maximum insertion loss and 38 dB typical isolation at 6 GHz. HMMC-2007 chips use through-substrate vias to provide ground connections to the chip backside and minimize the number of wire bonds required.



Chip size:

660 x 960 μm (25.9 x 37.8 mils)

Chip size tolerance:

$\pm 10 \mu\text{m}$ (± 0.4 mils)

Chip thickness:

$127 \pm 15 \mu\text{m}$ (5.0 ± 0.6 mils)

Pad dimensions:

$120 \times 120 \mu\text{m}$ (4.7 x 4.7 mils)

Absolute Maximum Ratings¹

| Symbol | Parameters/conditions | Minimum | Maximum | Units |
|--------------------|------------------------------|---------|---------|--------------------|
| V_{set} | Select voltages 1 & 2 | -10.5 | +10.5 | Volts |
| P_{in} | RF input power | | 27 | dBm |
| T_{op} | Operating temperature | -55 | +125 | $^{\circ}\text{C}$ |
| T_{st} | Storage temperature | -65 | +165 | $^{\circ}\text{C}$ |
| T_{max} | Maximum assembly temperature | | +200 | $^{\circ}\text{C}$ |
| T_{unset} | Power into unselected output | | 27 | dBm |

1. Operation in excess of any one of these ratings may result in permanent damage to this device.
 $T_{\text{A}} = 25 \text{ }^{\circ}\text{C}$ except for T_{op} , T_{st} , and T_{max} .

DC Specifications/Physical Properties

($T_A = 25\text{ }^\circ\text{C}$)

| Symbol | Parameters/conditions | Typ | Min | Max | Units |
|-----------------------------|---|-----|-------|-------|---------------|
| $I_{\text{SEL}-10\text{V}}$ | Leakage current @ -10 V | | | 200 | μA |
| $I_{\text{SEL}+10\text{V}}$ | Leakage current @ +10 V | | | 20 | μA |
| V_P | Pinch-off voltage ($V_{\text{SEL}2} = V_P$, $V_{\text{RFout}2} = +2\text{ V}$, $I_{\text{RFout}2} = 4\text{ mA}$, $V_{\text{SEL}1} = -10\text{ V}$, $V_{\text{RFout}1} = \text{open circuit}$, $V_{\text{RFin}} = \text{GND}$) | | -6.75 | -3.00 | Volts |
| BV | Breakdown voltage (test FET w/ $V_D = V_S = \text{GND}$, $I_G = -50\text{ }\mu\text{A}$) | | | -13.0 | Volts |

RF Specifications

($T_A = 25\text{ }^\circ\text{C}$, $Z_0 = 50\text{ }\Omega$, $V_{\text{sel-high}} = +10\text{ V}$, $V_{\text{sel-low}} = -10\text{ V}$)

| Symbol | Parameters/conditions | Typ | Min | Max | Units |
|------------------------------|--|-----|-----|-----|---------------|
| BW | Guaranteed operating bandwidth | | DC | 8.0 | GHz |
| IL | Insertion loss, RF_{in} to selected RF_{out} (on throw), 6 GHz | 1.1 | | 1.4 | dB |
| ISO | Isolation, RF_{in} to unselected RF_{out} (off throw), 6 GHz | 38 | | | dB |
| RL_{in} | Input return loss @ 6 GHz | 25 | | | dB |
| $\text{RL}_{\text{out ON}}$ | Output return loss, on throw @ 6 GHz | 25 | | | dB |
| $\text{RL}_{\text{out OFF}}$ | Output return loss, off throw @ 6 GHz | 18 | | | dB |
| P-1 dB | Input power where IL increases by 1 dB, $f_{\text{in}} = 2\text{ GHz}$ | 27 | | | dBm |
| t_s | Switching speed, 10%-90% RF envelope, $f_{\text{in}} = 2\text{ GHz}$ | 20 | | | μs |

Applications

The HMMC-2007 can be used in instrumentation, communications, radar, ECM, EW, and many other systems requiring SPDT switching. It can be used for pulse modulation, port isolation, transfer switching, high-speed switching, replacement of mechanical switches, and so on.

Assembly Techniques

GaAs MMICs are ESD sensitive. ESD preventive measures must be employed in all aspects of storage, handling, and assembly.

MMIC ESD precautions, handling considerations, die attach and bonding methods are critical factors in successful GaAs MMIC performance and reliability.

GaAs MMIC ESD, Die Attach and Bonding Guidelines, Application Note (5991-3484EN) provides basic information on these subjects.

Additional References

FET Switch Speed and Settling Time, Application Note (5991-3516EN)

S-Parameters¹

($T_A = 25\text{ }^\circ\text{C}$, $Z_0 = 50\ \Omega$, $V_{\text{sel}} \text{ high} = +10\ \text{V}$, $V_{\text{sel}} \text{ low} = -10\ \text{V}$)

| Frequency (GHz) | S_{11} | | | S_{21} (insertion loss) | | | S_{31} (isolation) | S_{22} (ON throw) | | | S_{33} (OFF throw) | | |
|--------------------|----------|-------|---------|---------------------------|------|---------|-------------------------|---------------------|------|---------|----------------------|-------|---------|
| | dB | mag | ang | dB | mag | ang | dB | dB | mag | ang | dB | mag | ang |
| 0.5 | -26.41 | 0.048 | -57.11 | -1.08 | 0.88 | -49.06 | -67.74 | -28.40 | 0.03 | -47.94 | -32.26 | 0.024 | 47.18 |
| 1.0 | -27.53 | 0.042 | -113.83 | -1.13 | 0.88 | -93.69 | -60.55 | -24.74 | 0.05 | -117.54 | -30.79 | 0.029 | -38.11 |
| 1.5 | -30.69 | 0.029 | -176.73 | -1.18 | 0.87 | -138.08 | -56.17 | -31.91 | 0.02 | 168.76 | -30.35 | 0.030 | -64.68 |
| 2.0 | -32.37 | 0.024 | 115.57 | -1.21 | 0.87 | 177.39 | -53.18 | -31.31 | 0.02 | 119.22 | -26.21 | 0.049 | -134.70 |
| 2.5 | -31.79 | 0.026 | 61.35 | -1.25 | 0.87 | 133.00 | -50.38 | -28.90 | 0.03 | 68.41 | -26.38 | 0.048 | 151.66 |
| 3.0 | -30.60 | 0.030 | 4.27 | -1.30 | 0.86 | 88.53 | -47.63 | -32.95 | 0.02 | -11.68 | -25.66 | 0.052 | 103.24 |
| 3.5 | -28.53 | 0.037 | -58.32 | -1.33 | 0.86 | 44.08 | -45.67 | -29.26 | 0.03 | -44.21 | -22.99 | 0.071 | 38.61 |
| 4.0 | -27.14 | 0.044 | -124.01 | -1.34 | 0.86 | -0.53 | -44.12 | -30.61 | 0.02 | -113.40 | -22.41 | 0.076 | -21.25 |
| 4.5 | -26.46 | 0.048 | 172.69 | -1.37 | 0.85 | -45.16 | -42.68 | -32.21 | 0.02 | 165.53 | -21.68 | 0.082 | -75.25 |
| 5.0 | -27.03 | 0.045 | 107.19 | -1.40 | 0.85 | -89.79 | -41.45 | -36.49 | 0.01 | 141.98 | -19.88 | 0.101 | -133.81 |
| 5.5 | -28.64 | 0.037 | 32.44 | -1.42 | 0.85 | -134.56 | -40.28 | -34.51 | 0.01 | 4.26 | 19.89 | 0.101 | 167.02 |
| 6.0 | -29.55 | 0.033 | -59.18 | -1.45 | 0.85 | -179.46 | -39.16 | -32.44 | 0.02 | -100.27 | -19.03 | 0.112 | 115.49 |
| 6.5 | -26.88 | 0.045 | -156.32 | -1.51 | 0.84 | 135.54 | -38.12 | -27.18 | 0.04 | 176.54 | -18.28 | 0.122 | 56.80 |
| 7.0 | -23.24 | 0.069 | 130.95 | -1.56 | 0.84 | 90.76 | -37.13 | -23.83 | 0.06 | 122.00 | -18.67 | 0.117 | -2.63 |
| 7.5 | -21.53 | 0.084 | 70.91 | -1.52 | 0.84 | 46.04 | -36.36 | -21.48 | 0.08 | 51.31 | -18.61 | 0.117 | -60.32 |
| 8.0 | -21.21 | 0.087 | 15.06 | -1.62 | 0.83 | 0.47 | -35.64 | -21.73 | 0.08 | -15.06 | -17.65 | 0.131 | -124.25 |
| 8.5 | -20.92 | 0.090 | -41.26 | -1.64 | 0.83 | -44.44 | -34.83 | -22.22 | 0.07 | -81.88 | -16.95 | 0.142 | 172.46 |
| 9.0 | -19.88 | 0.101 | -104.30 | -1.66 | 0.83 | -90.23 | -34.13 | -20.42 | 0.09 | -145.01 | -16.07 | 0.157 | 115.03 |
| 9.5 | -18.65 | 0.117 | -175.05 | -1.84 | 0.81 | -135.81 | -33.62 | -18.17 | 0.12 | 145.14 | -14.94 | 0.179 | 59.82 |
| 10.0 | -17.04 | 0.141 | 116.96 | -1.90 | 0.80 | 179.24 | -34.14 | -16.31 | 0.15 | 85.15 | -14.31 | 0.193 | 3.39 |

1. Three-port wafer-probed data: Port 1 = RF input, Port 2 = selected RF output (i.e., ON throw), and Port 3 = unselected RF output (i.e., OFF throw)

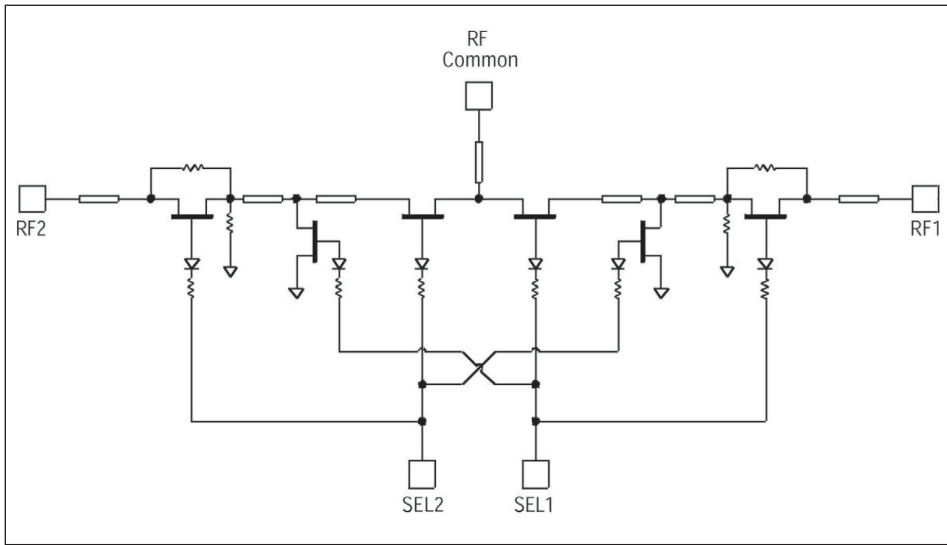


Figure 1. Schematic

| Select line | | RF path | |
|-------------|-------|------------------|------------------|
| SEL1 | SEL2 | RF IN to RF OUT2 | RF IN to RF OUT1 |
| +10 V | -10 V | Isolated | Low loss |
| -10 V | +10 V | Low loss | Isolated |

Figure 2. Recommended operating conditions
($T_A = 25\text{ }^\circ\text{C}$)

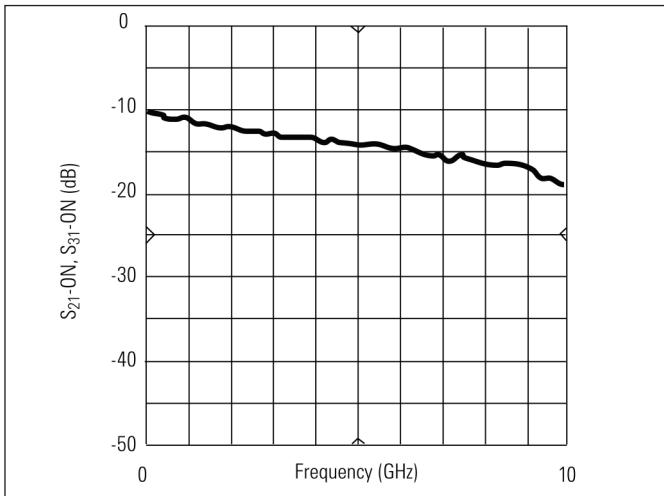


Figure 3. Insertion loss¹

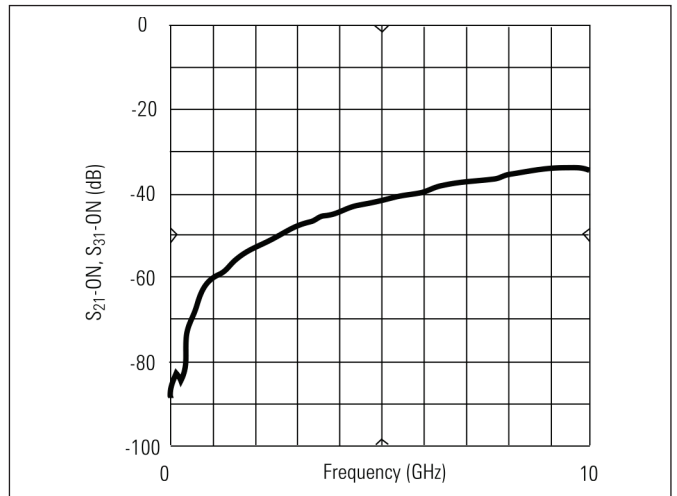


Figure 4. Input-to-output isolation¹

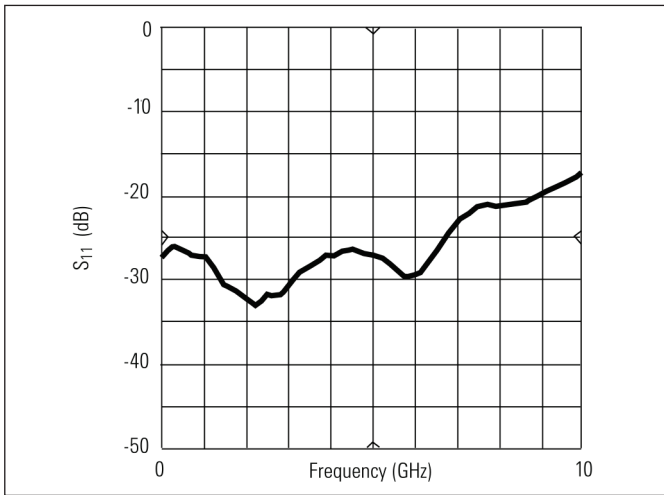


Figure 5. Input return loss¹

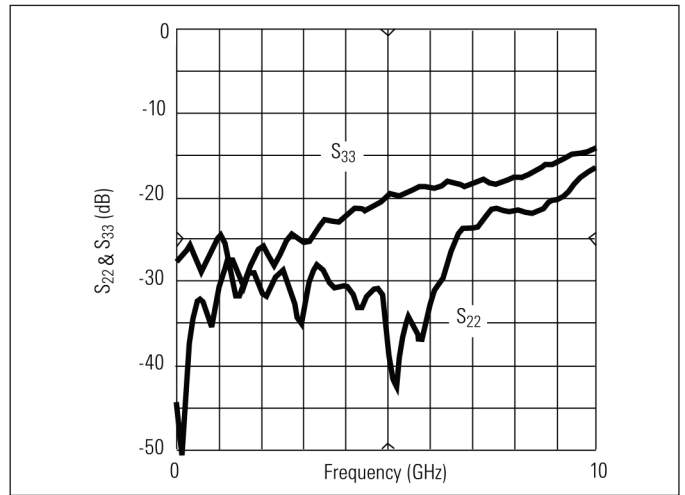


Figure 6. Output return loss¹

1. Data taken with the device mounted in modular breadboard package

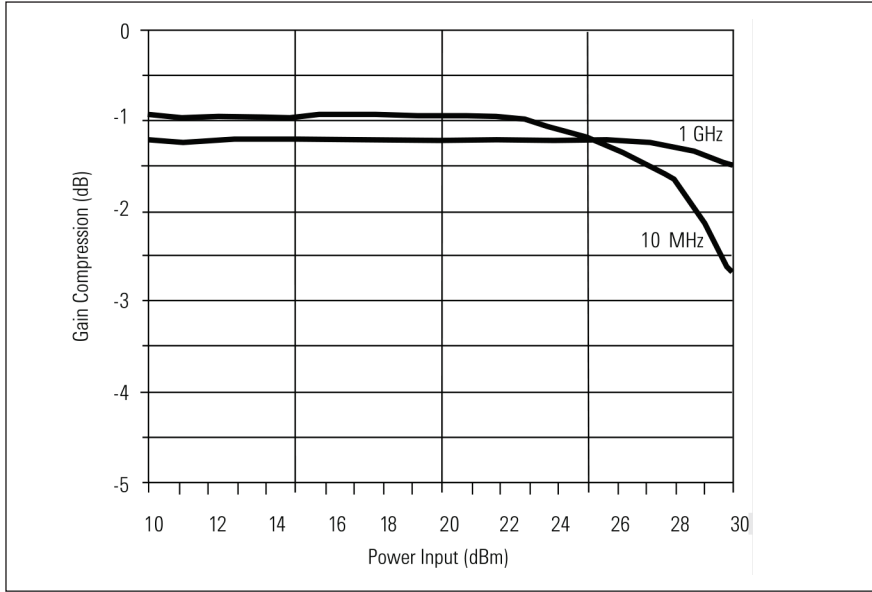


Figure 7. Gain compression

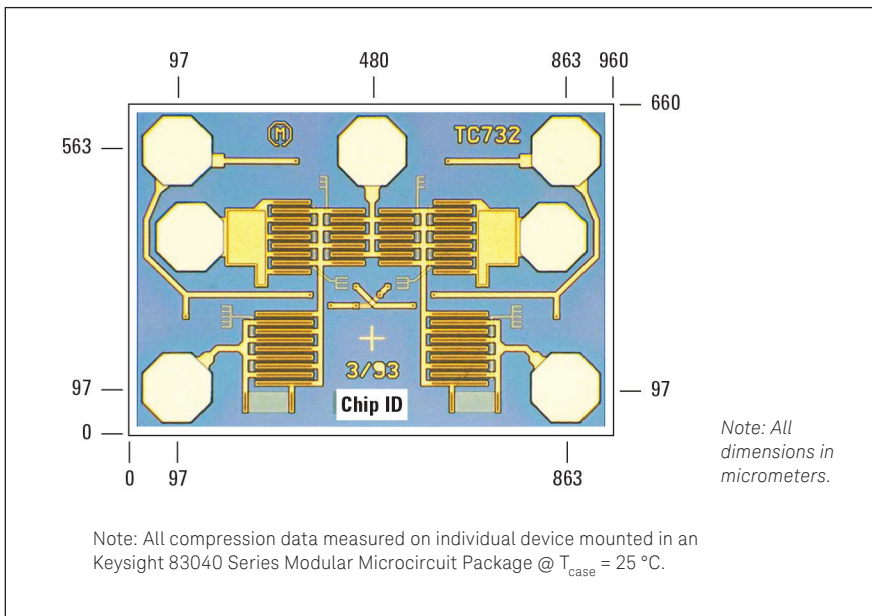


Figure 8. Bonding pad locations

This data sheet contains a variety of typical and guaranteed performance data. The information supplied should not be interpreted as a complete list of circuit specifications. Customers considering the use of this, or other Keysight Technologies, Inc GaAs ICs, for their design should obtain the current production specifications from Keysight. In this data sheet the term typical refers to the 50th percentile performance. For additional information contact Keysight MMIC_Helpline@keysight.com.

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