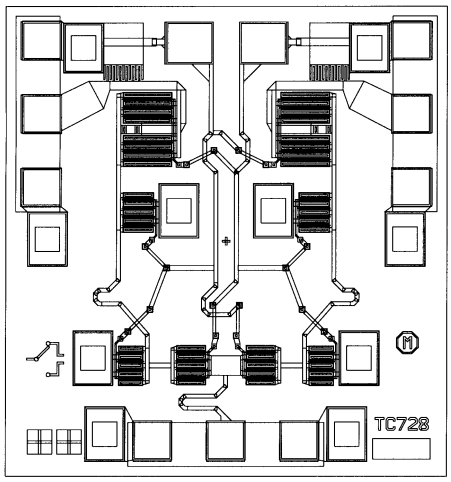
# HMMC-2027
## DC–26.5 GHz SPDT GaAs MMIC Switch

AVAGO TECHNOLOGIES

# Data Sheet

### Description
The HMMC-2027 is a GaAs monolithic microwave integrated circuit (MMIC) designed for low insertion loss and high isolation from DC to 26.5 GHz. It is intended for use as a general-purpose, single-pole, double-throw (SPDT), absorptive switch. Two series and two shunt MESFETs per throw provide 3 dB maximum insertion loss and 30 dB typical isolation at 26.5 GHz. HMMC-2027 chips use through-substrate vias to provide ground connections to the chip backside and minimize the number of wire bonds required.




| | |
|---|---|
| Chip Size: | 900 x 960 µm (35.4 x 37.8 mils) |
| Chip Size Tolerance: | ± 10 µm (±0.4 mils) |
| Chip Thickness: | 127 ± 15 µm (5.0 ± 0.6 mils) |
| Pad Dimensions: | 80 x 80 µm (3.2 x 3.2 mils), or larger |

### Features
- **Outputs terminated in 50Ω when off**
- **Frequency range: DC–26.5 GHz**
- **Insertion loss: 2.5 dB @ 26.5 GHz**
- **Isolation:**
  >70 dB @ 45 MHz
  >30 dB @ 26.5 GHz
- **Return loss:**
  15 dB (both input & selected output)
  12 dB unselected output
- **Switching speed:**
  <1 ns (10%–90% RF)
- **$P_{-1dB}$:**
  18 dBm @ 10 MHz
  27dBm @ 2 GHz
- **Harmonics (DC coupled):**
  <-45 dBc @ 10 MHz & 10 dBm
  <-65 dBc @ 2 GHz & 5 dBm

### Absolute Maximum Ratings[1]

| Symbol | Parameters/Conditions | Units | Min. | Max. |
|---|---|---|---|---|
| $V_{sel}$ | Select Voltages 1 & 2 | V | -10.5 | +3 |
| $P_{in}$ | RF Input Power | dBm | | 25 |
| $T_{op}$ | Operating Temperature | °C | -55 | +125 |
| $T_{stg}$ | Storage Temperature | °C | -65 | +165 |
| $T_{max}$ | Max. Assembly Temperature | °C | | +200 |
| $P_{unsel}$[2] | Power into Unselected Output | dBm | | 15 |

**Notes:**
1. Operation in excess of any one of these may result in permanent damage to this device. $T_A$ = 25°C except for $T_{op}$, $T_{stg}$, and $T_{max}$.
2. Operation in excess of these @ $T_{op\text{-}max}$ may result in permanent damage.

**HMMC-2027 DC Specifications/Physical Properties** ($T_A$= 25°C)

| Symbol | Parameters and Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| $I_1$ | Leakage Current @ -10 V | µA | | | 200 |
| $V_p$ | Pinch-Off Voltage ($V_{SEL2} = V_p$, $V_{RFout2}$ = +2V, $I_{RFout2}$ = 2 mA, $V_{SEL1}$ = -10 V, $V_{RFout1}$ = open circuit, $V_{RFin}$ = GND | V | -6.75 | | -3.00 |
| $BV_{gss}$ | Breakdown Voltage (Test FET w/ $V_D = V_S$ = GND, $I_G$ = -50 µA) | V | | | -13.0 |

**RF Specifications** ($T_A$ = 25 °C, $Z_o$= 50Ω, $V_{sel\text{-}high}$ = 0V, $V_{sel\text{-}low}$ = -10V)

| Symbol | Parameters and Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| BW | Guaranteed Operating Bandwidth | GHz | DC | | 26.5 |
| IL | Insertion Loss, $RF_{in}$ to Selected $RF_{out}$ (ON throw), 26.5 GHz | dB | | 2.5 | 3.0 |
| ISO | Isolation, $RF_{in}$ to Unselected $RF_{out}$ (OFF throw), 26.5 GHz | dB | 27 | 30 | |
| ISO | Isolation, $RF_{in}$ to Unselected $RF_{out}$ (OFF throw), 18 GHz | dB | 40 | 43 | |
| $RL_{in}$ | Input Return Loss | dB | 12 | 15 | |
| $RL_{out\text{-}ON}$ | Output Return Loss, ON throw | dB | 13 | 16 | |
| $RL_{out\text{-}OFF}$ | Output Return Loss, OFF throw | dB | 9 | 12 | |
| $P_{\text{-}1dB}$ | Input Power where IL increases by 1 dB, $f_{in}$ = 2 GHz | dBm | | 27 | |
| $t_s$ | Switching Speed, 10% – 90% RF Envelope, $f_{in}$ = 2 GHz | ns | | 1 | |

### Applications

The HMMC-2027 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.

Avago application note #54, "GaAs MMIC ESD, Die Attach and Bonding Guidelines" provides basic information on these subjects.

**HMMC-2027 Scattering Parameters**[1]

($T_A$ = 25°C, $Z_o$ = 50Ω, $V_{sel}$ high = 0V, $V_{sel}$ low = -10V)

| Freq. 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 | -18.28 | 0.12 | -7.04 | -1.33 | 0.86 | -8.52 | -71.40 | -18.44 | 0.12 | -9.89 | -16.79 | 0.14 | 173.87 |
| 1.5 | -18.53 | 0.12 | -13.70 | -1.35 | 0.86 | -14.62 | -61.02 | -18.46 | 0.12 | -19.75 | -16.47 | 0.15 | 171.75 |
| 4.0 | -18.92 | 0.11 | -27.64 | -1.41 | 0.85 | -24.53 | -51.67 | -18.75 | 0.12 | -38.78 | -15.36 | 0.17 | 168.03 |
| 6.5 | -19.43 | 0.11 | -45.02 | -1.47 | 0.84 | -39.56 | -49.50 | -19.10 | 0.11 | -63.22 | -14.55 | 0.19 | 152.55 |
| 9.0 | -20.57 | 0.09 | -64.07 | -1.56 | 0.84 | -55.13 | -46.87 | -19.72 | 0.10 | 15.79 | -14.28 | 0.19 | 136.68 |
| 11.5 | -21.85 | 0.08 | -2.59 | -1.62 | 0.83 | -71.03 | -44.71 | -20.91 | 0.09 | 243.63 | -13.84 | 0.20 | 121.81 |
| 14.0 | -23.10 | 0.07 | 258.44 | -1.74 | 0.82 | -29.63 | -42.30 | -22.41 | 0.08 | 217.48 | -13.53 | 0.21 | 106.44 |
| 16.5 | -24.05 | 0.06 | 235.82 | -1.88 | 0.81 | 258.60 | -41.74 | -24.17 | 0.06 | 179.74 | -12.95 | 0.23 | 92.94 |
| 19.0 | -24.59 | 0.06 | 224.56 | -1.99 | 0.80 | 242.13 | -37.07 | -27.09 | 0.04 | 133.20 | -12.76 | 0.23 | 74.01 |
| 21.5 | -25.42 | 0.05 | 206.39 | -2.10 | 0.79 | 227.84 | -40.39 | -28.85 | 0.04 | 68.10 | -13.12 | 0.22 | 68.84 |
| 24.0 | -24.66 | 0.06 | 209.77 | -2.10 | 0.78 | 209.72 | -34.46 | -24.31 | 0.06 | 6.26 | -12.11 | 0.25 | 54.32 |
| 26.5 | -21.90 | 0.08 | 223.86 | -2.39 | 0.76 | 191.82 | -31.38 | -19.43 | 0.11 | -33.31 | -12.03 | 0.25 | 38.26 |

**Note:**

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).

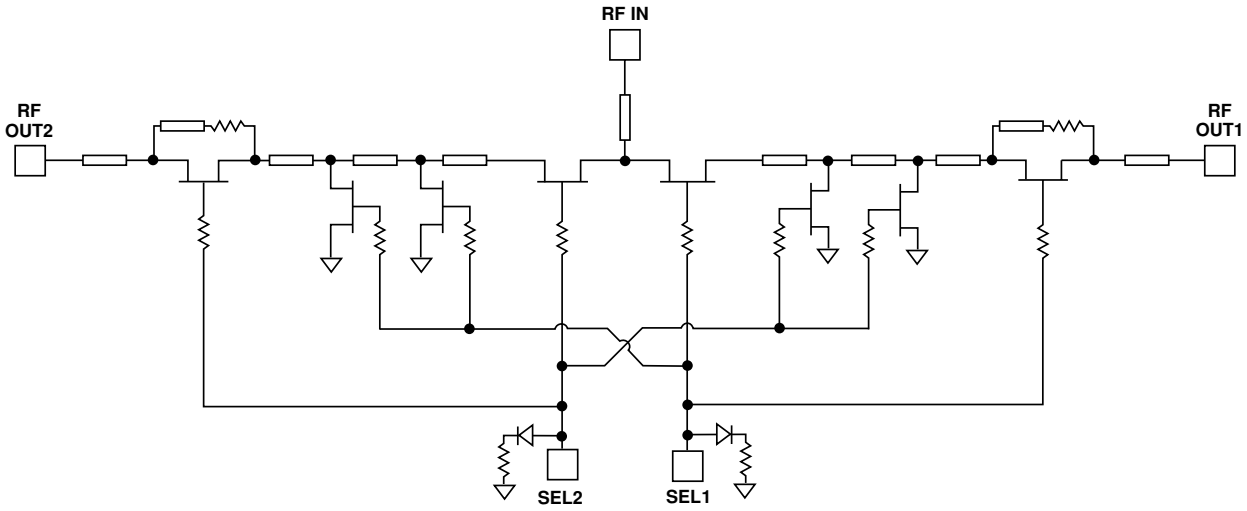



**Figure 1. Schematic.**

**Recommended Operating Conditions** ($T_A$ = 25°C)

| Select Line | | RF Path | |
|---|---|---|---|
| **SEL1** | **SEL2** | **RF IN to RF OUT1** | **RF IN to RF OUT2** |
| -10V | 0V | Isolated | Low Loss |
| 0V | -10V | Low Loss | Isolated |

## HMMC-2027 Typical Performance

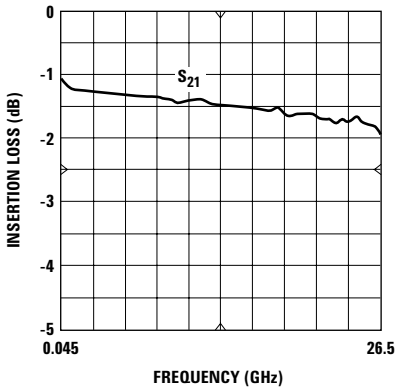



**Figure 2. Insertion Loss[1] vs. Frequency.**

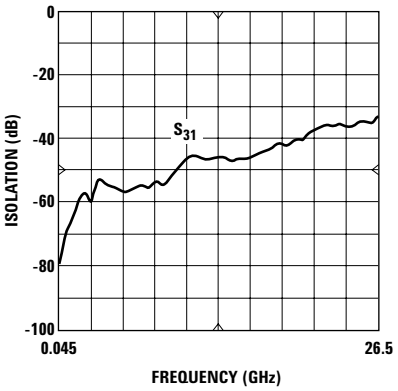



**Figure 3. Input-to-Output Isolation[1] vs. Frequency.**

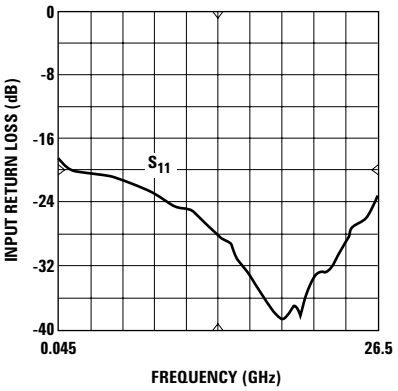



**Figure 4. Input Return Loss[1] vs. Frequency.**

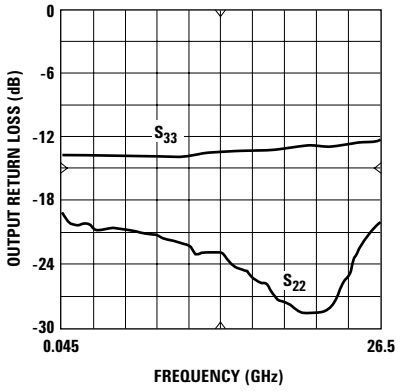



**Figure 5. Output Return Loss[1] vs. Frequency.**

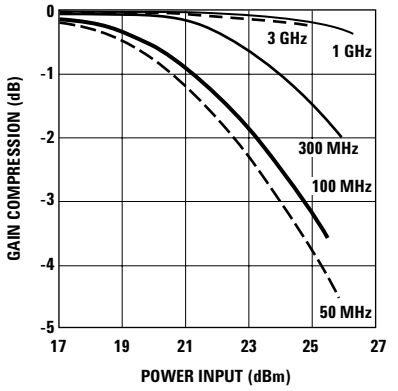



**Figure 6. Gain Compression[2] vs. Power Input.**

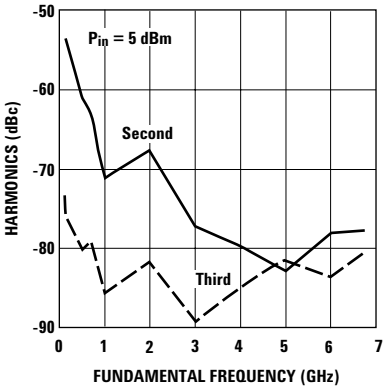



**Figure 7. Harmonics vs. Fundamental Frequency[2,3].**

**Notes:**

1. Data obtained from wafer-probed measurements.
2. All compression and harmonic data measured on individual device mounted in an HP83040 Series Modular Microcircuit Package @ $T_{case}$ = 25°C.
3. Harmonic data points below -80 dBc are at or near the noise floor of the measurement system.

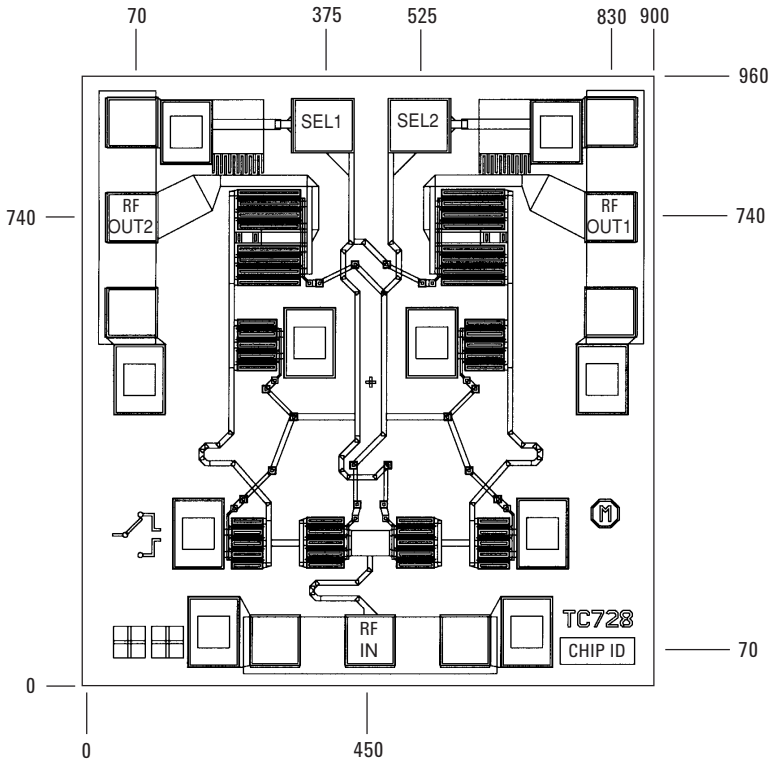



**Figure 7. HMMC-2027 Bonding Pad Positions. (Shown in micrometers)**

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. In this data sheet the term *typical* refers to the 50th percentile performance. For additional information contact your local Avago Technologies' sales representative.

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Obsoletes 5988-3197EN
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