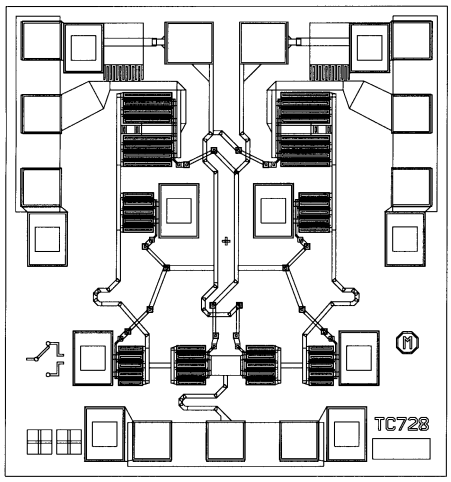
Agilent HMMC-2027 DC–26.5 GHz SPDT GaAs MMIC Switch

Data Sheet



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 & 5 dBm
  <-65 dBc @ 2 GHz & 5 dBm

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.

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.

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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. Agilent 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).

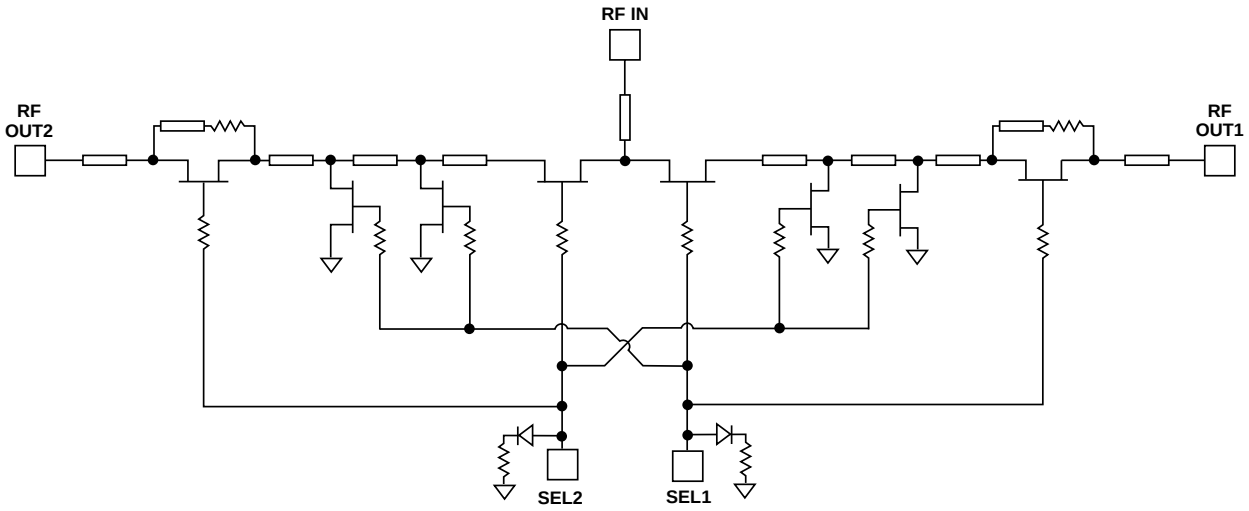

Figure 1. Schematic.

Recommended Operating Conditions (T_A = 25°C)

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

HMMC-2027 Typical Performance

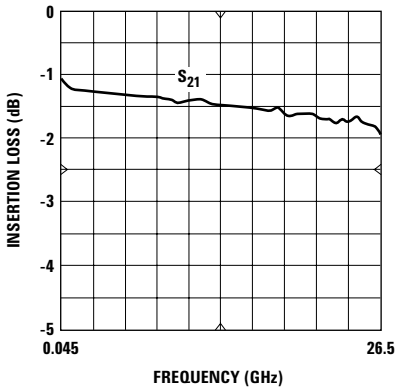

Figure 2. Insertion Loss[1] vs. Frequency.

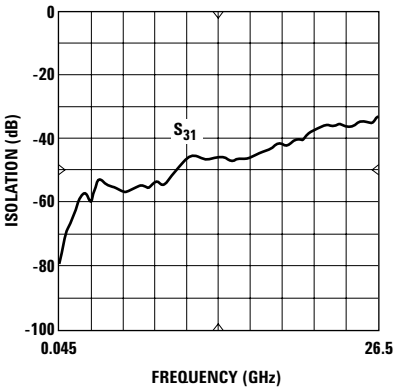

Figure 3. Input-to-Output Isolation[1] vs. Frequency.

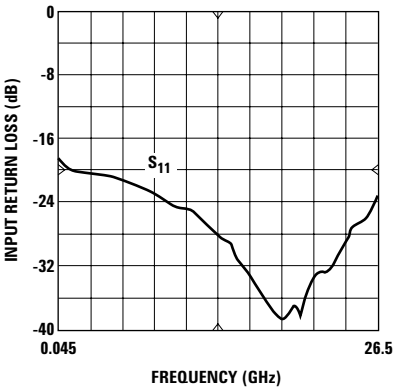

Figure 4. Input Return Loss[1] vs. Frequency.

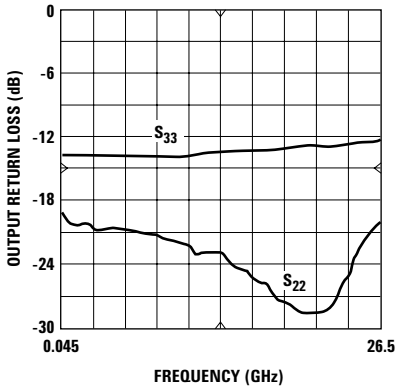

Figure 5. Output Return Loss[1] vs. Frequency.

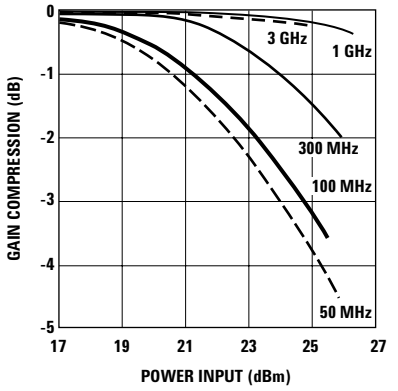

Figure 6. Gain Compression[2] vs. Power Input.

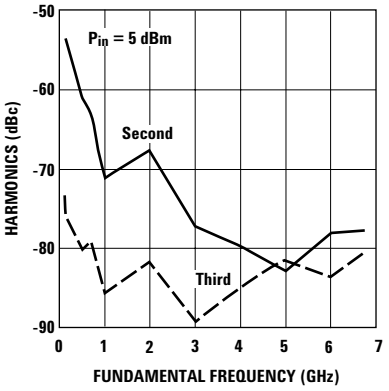

Figure 7. Harmonics vs. Fundamental Frequency[2,3].

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.

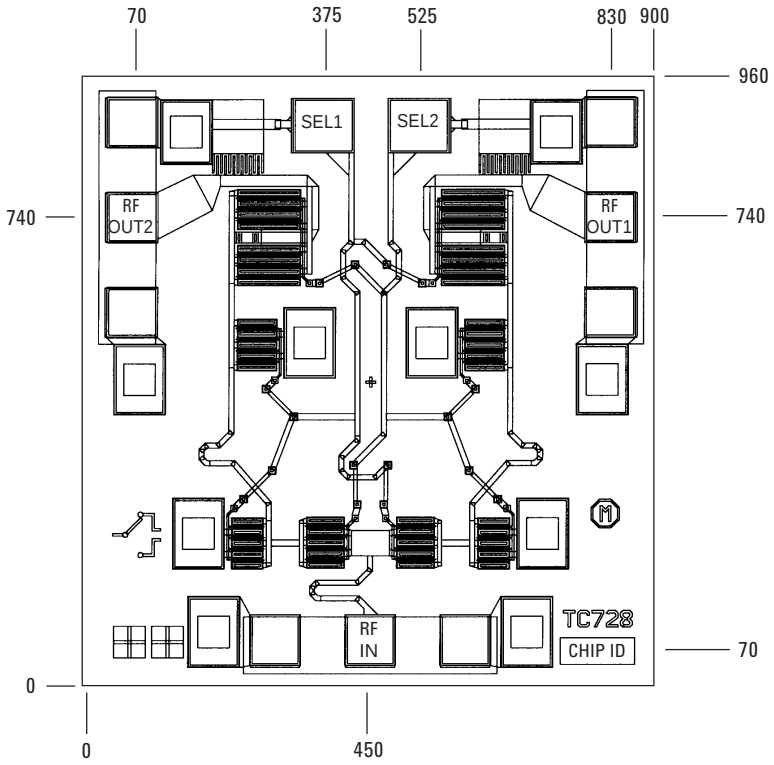

Figure 8. HMMC-2027 Bonding Pad Positions. (Shown in micrometers)

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 Agilent Technologies' sales representative.

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Data subject to change.

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