

Agilent HMMC-2027

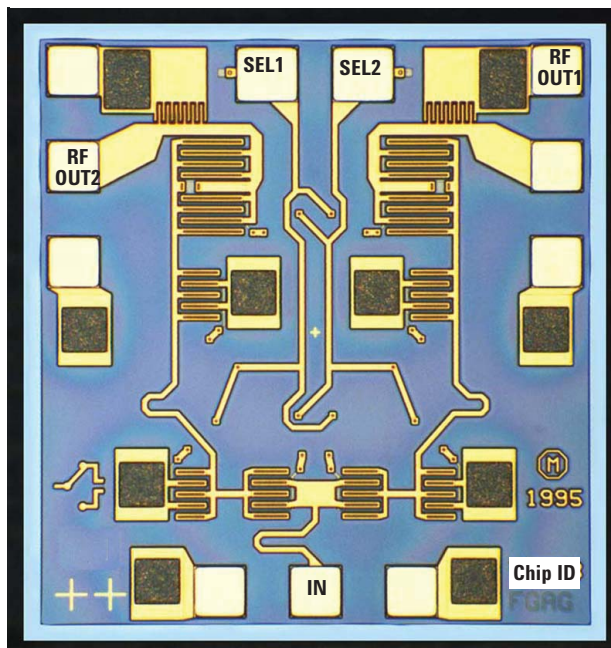
DC–26.5 GHz SPDT GaAs MMIC Switch

1GG7-8005

Data Sheet

Features

- Outputs terminated in 50 Ω when off
- Frequency range: DC to 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 and selected output)
12 dB unselected output
- Switching speed:
< 1 ns (10%–90% RF)
- $P_{-1\text{ dB}}$: 18 dBm @ 10 MHz
27 dBm @ 2 GHz
- Harmonics (DC coupled):
< –45 dBc @ 10 MHz and 5 dBm
< –65 dBc @ 2 GHz and 5 dBm



Chip size: 900 x 960 μm (35.4 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: 80 x 80 μm (3.2 x 3.2 mils) or larger

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 (SP-DT), absorptive switch. Two series and two shunt MESFETs per throw provide 3 dB maximum insertion loss and 30 dB minimum 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 ratings¹

Symbol	Parameters/conditions	Minimum	Maximum	Units
V_{sel}	Select voltages 1 & 2	–10.5	+3	Volts
P_{in}	RF input power		25	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	$^{\circ}\text{C}$
P_{unsel}^2	Power into unselected output		15	dBm

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

² Operation in excess of these @ $T_{\text{op-max}}$ may result in permanent damage.



DC specifications/physical properties

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

Symbol	Parameters/conditions	Minimum	Typical	Maximum	Units
I_l	Leakage current @ -10 V			200	μA
V_p	Pinch-off voltage ($V_{\text{SEL}2} = V_p$, $V_{\text{RFout}2} = +2\text{V}$, $I_{\text{RFout}2} = 2 \text{ mA}$, $V_{\text{SEL}1} = -10 \text{ V}$, $V_{\text{RFout}1} = \text{open circuit}$, $V_{\text{RFin}} = \text{GND}$)	-6.75		-3.00	Volts
BV_{gss}	Breakdown voltage (Test FET w/ $V_D = V_S = \text{GND}$, $I_G = -50 \mu\text{A}$)			-13.0	Volts

RF specifications

($T_A = 25^\circ\text{C}$, $Z_0 = 50 \Omega$, $V_{\text{sel-high}} = 0 \text{ V}$, $V_{\text{sel-low}} = -10 \text{ V}$)

Symbol	Parameters/conditions	Minimum	Typical	Maximum	Units
BW	Guaranteed operating bandwidth	DC		26.5	GHz
IL	Insertion loss, RF_{in} to selected RF_{out} (ON throw), 26.5 GHz		2.5	3.0	dB
ISO	Isolation, RF_{in} to unselected RF_{out} (OFF throw), 26.5 GHz	27	30		dB
ISO	Isolation, RF_{in} to unselected RF_{out} (OFF throw), 18 GHz	40	43		dB
RL_{in}	Input return loss	12	15		dB
$RL_{\text{out-ON}}$	Output return loss, ON throw	13	16		dB
$RL_{\text{out-OFF}}$	Output return loss, OFF throw	9	12		dB
$P_{-1 \text{ dB}}$	Input power where IL increases by 1 dB, $f_{\text{in}} = 2 \text{ GHz}$		27		dBm
t_s	Switching speed, 10%-90% RF envelope, $f_{\text{in}} = 2 \text{ GHz}$		1		ns

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.

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

Additional references

AN #57, "FET Switch Speed and Settling Time."

S-Parameters¹ ($T_A = 25^\circ\text{C}$, $Z_0 = 50 \Omega$, $V_{\text{sel high}} = 0 \text{ V}$, $V_{\text{sel low}} = -10 \text{ V}$)

Frequency (GHz)	S ₁₁			S ₂₁ (insertion loss)			S ₃₁ (isolation)	S ₂₂ (ON throw)			S ₃₃ (OFF throw)		
	dB	M	ang	dB	M	ang	dB	dB	M	ang	dB	M	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	3

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).

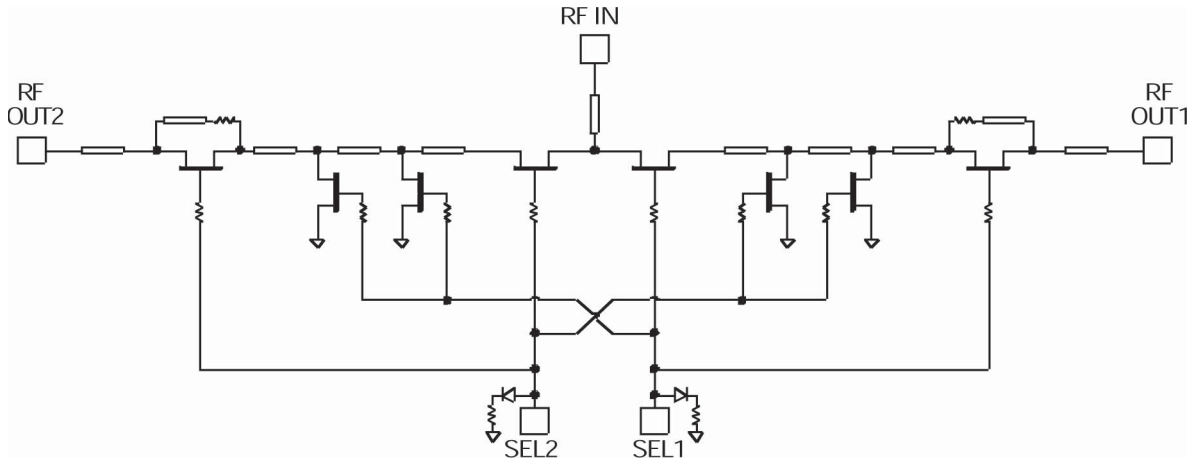


Figure 1. Schematic

Select line		RF path	
SEL1	SEL2	RF IN to RF OUT1	RF IN to RF OUT2
-10 V	0 V	Isolated	Low loss
0 V	-10 V	Low loss	Isolated

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

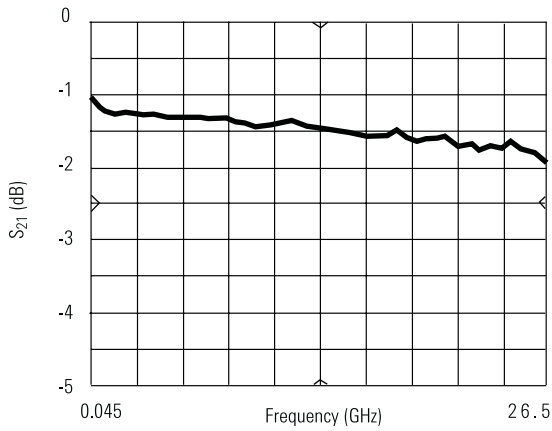


Figure 3. Insertion loss¹

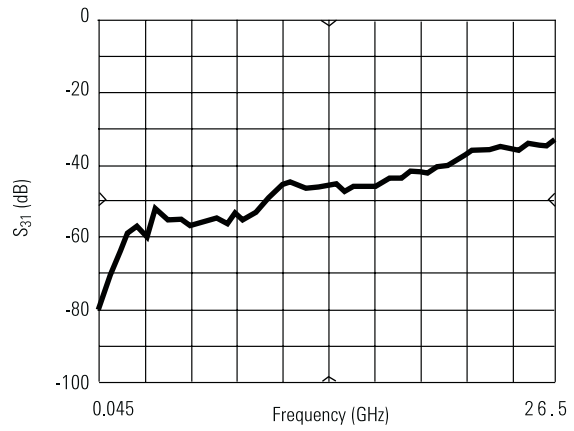


Figure 4. Input-to-output isolation¹

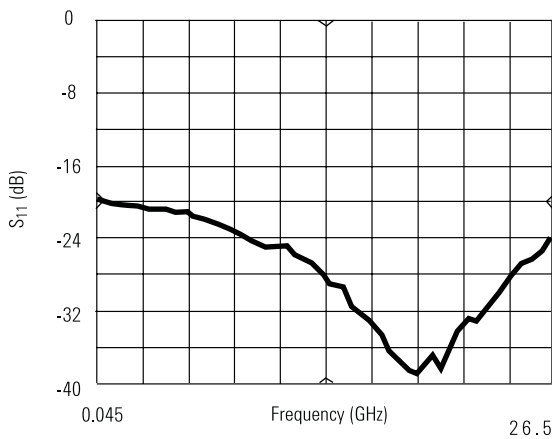


Figure 5. Input return loss¹

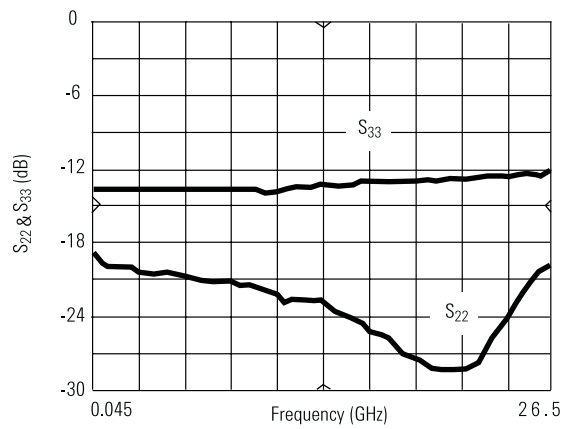


Figure 6. Output return loss¹

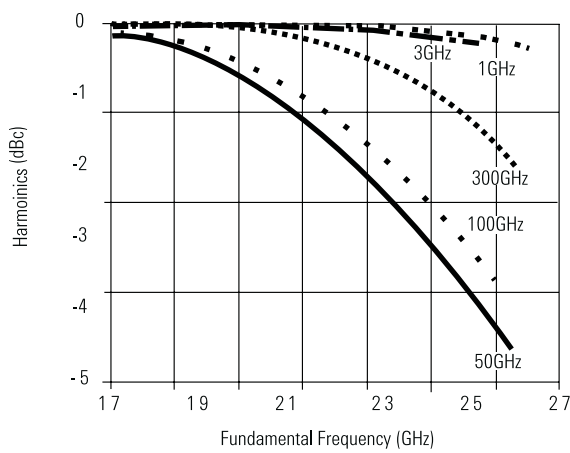


Figure 7. Gain compression²

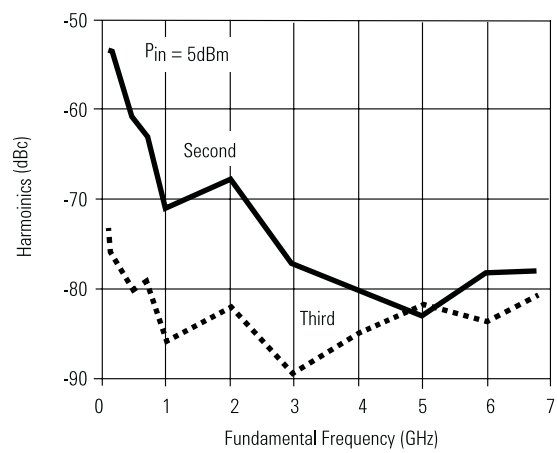


Figure 8. Harmonics^{2, 3}

1 Data obtained from wafer-probed measurements.

2 All compression and harmonic data measured on individual device mounted in an Agilent 83040 Series Modular Microcircuit Package @ $T_{case} = 25^{\circ}C$.

3 Harmonic data points below -80 dBc are at or near the noise floor of the measurement system.

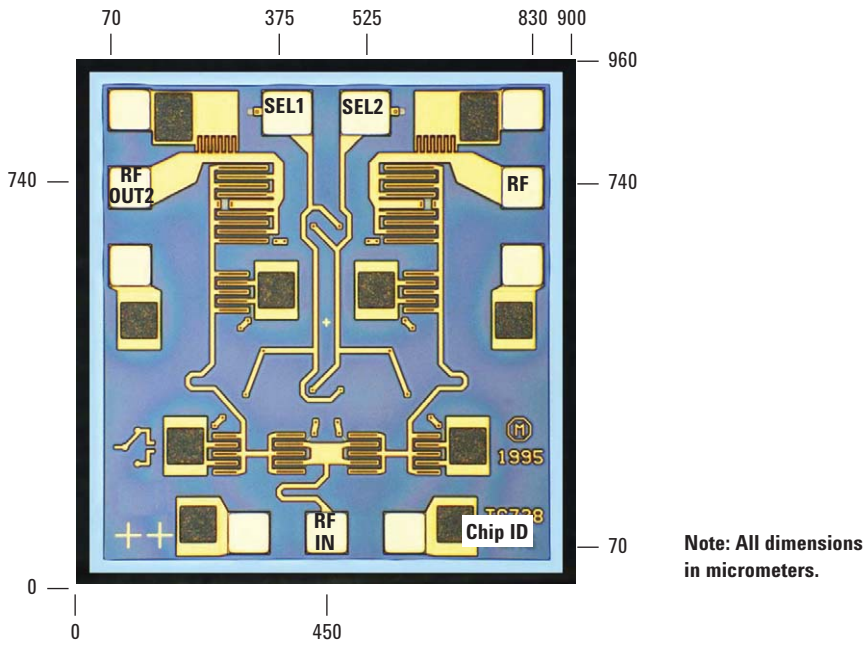


Figure 9. Bonding pad positions

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(fax) (81) 426 56 7840

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(fax) (080) 769 0900

Latin America:

(tel) (305) 269 7500

Taiwan:

(tel) 0800 047 866
(fax) 0800 286 331

Other Asia Pacific Countries:

(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com

Revised: February 5, 2007

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Printed in USA, June 8, 2007
5989-6204EN



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