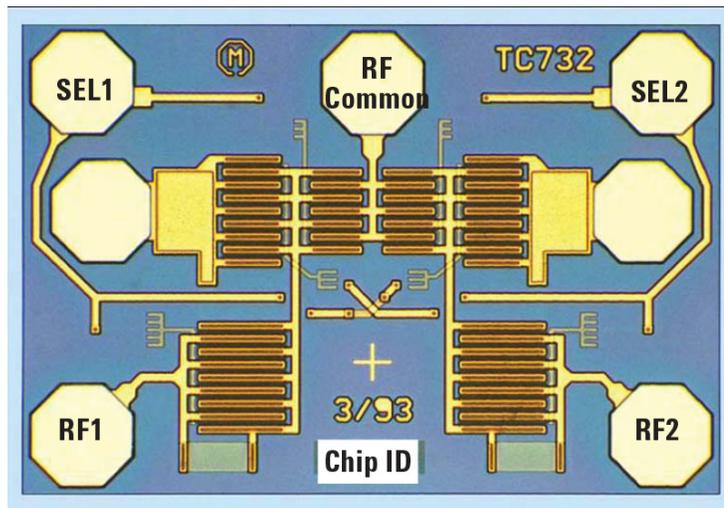


# Keysight HMMC-2007

## DC–8 GHz Terminated SPDT Switch

1GG7-8004

Data Sheet

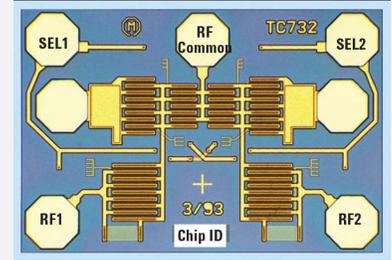


### Features

- Outputs terminated in  $50\ \Omega$  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  $\mu$ 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  $\mu\text{m}$  (25.9 x 37.8 mils)

Chip size tolerance:

$\pm 10 \mu\text{m}$  ( $\pm 0.4$  mils)

Chip thickness:

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

Pad dimensions:

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

## Absolute Maximum Ratings<sup>1</sup>

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

- 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  $T_{\text{op}}$ ,  $T_{\text{st}}$ , and  $T_{\text{max}}$ .

## DC Specifications/Physical Properties

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

Symbol	Parameters/conditions	Typ	Min	Max	Units
$I_{SEL -10V}$	Leakage current @ -10 V			200	$\mu\text{A}$
$I_{SEL +10V}$	Leakage current @ +10 V			20	$\mu\text{A}$
$V_P$	Pinch-off voltage ( $V_{SEL2} = V_P$ , $V_{RFout2} = +2\text{ V}$ , $I_{RFout2} = 4\text{ mA}$ , $V_{SEL1} = -10\text{ V}$ , $V_{RFout1} = \text{open circuit}$ , $V_{RFin} = \text{GND}$ )		-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

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

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
$RL_{out ON}$	Output return loss, on throw @ 6 GHz	25			dB
$RL_{out OFF}$	Output return loss, off throw @ 6 GHz	18			dB
P-1 dB	Input power where IL increases by 1 dB, $f_{in} = 2\text{ GHz}$	27			dBm
$t_s$	Switching speed, 10%-90% RF envelope, $f_{in} = 2\text{ GHz}$	20			$\mu\text{s}$

## 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-Parameters<sup>1</sup>

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

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)

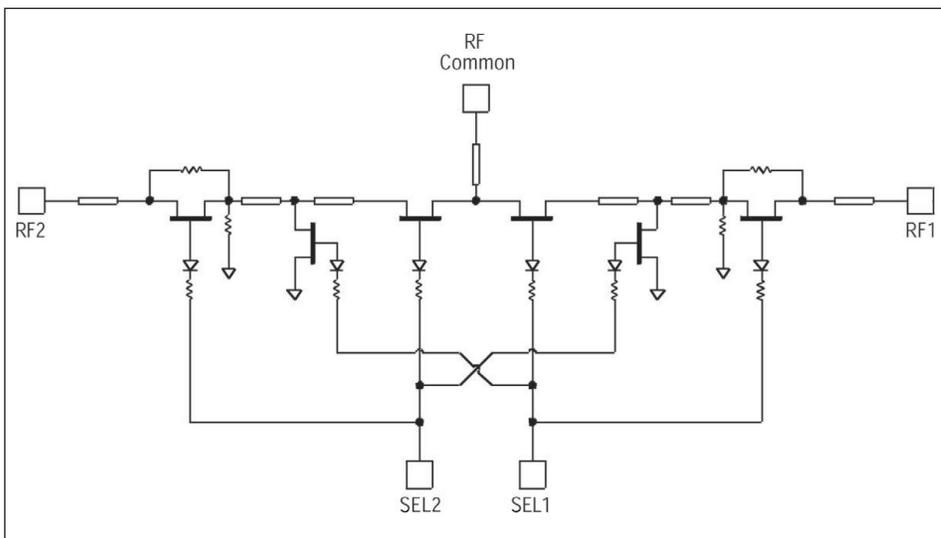


Figure 1. Schematic

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

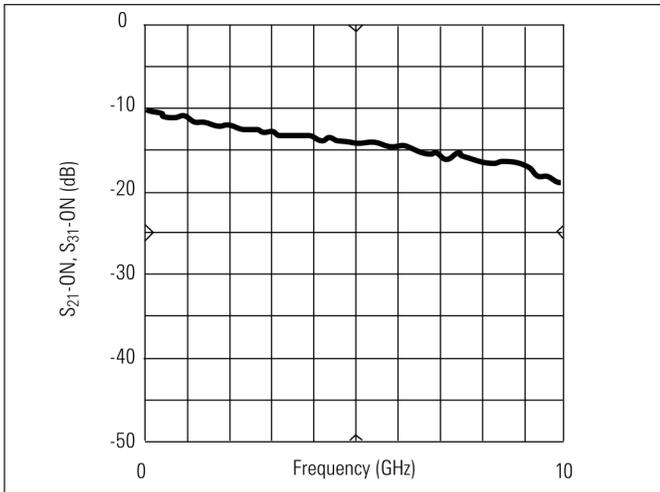


Figure 3. Insertion loss<sup>1</sup>

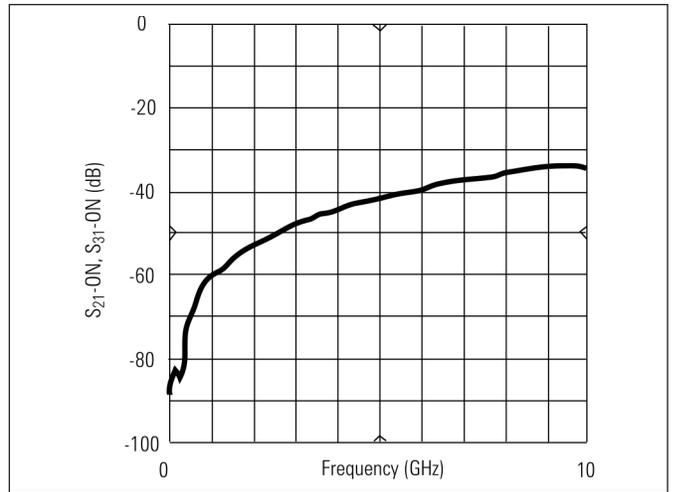


Figure 4. Input-to-output isolation<sup>1</sup>

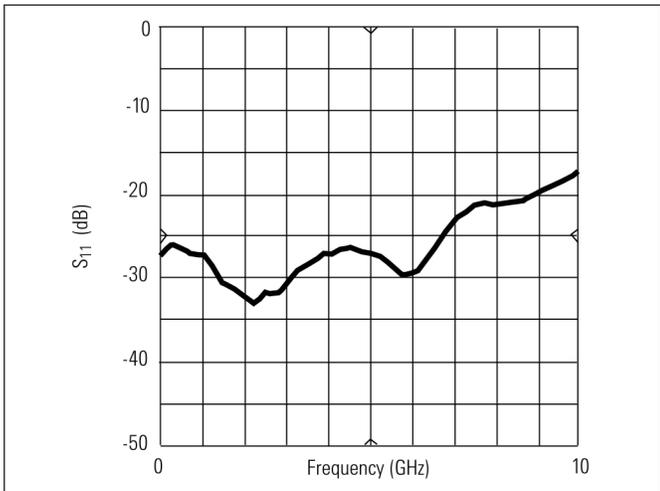


Figure 5. Input return loss<sup>1</sup>

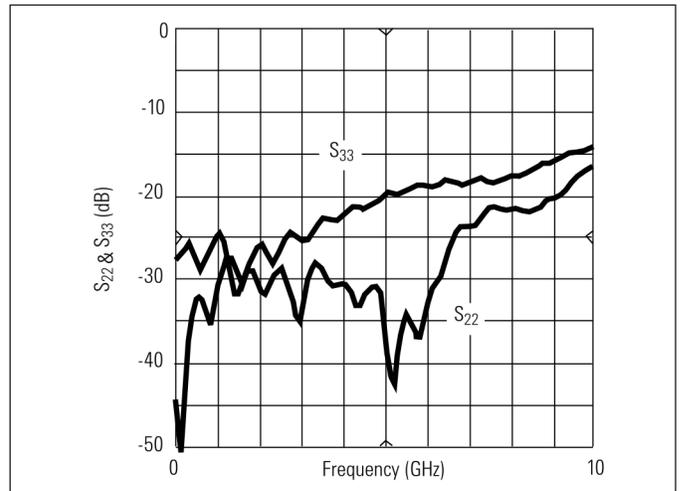


Figure 6. Output return loss<sup>1</sup>

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

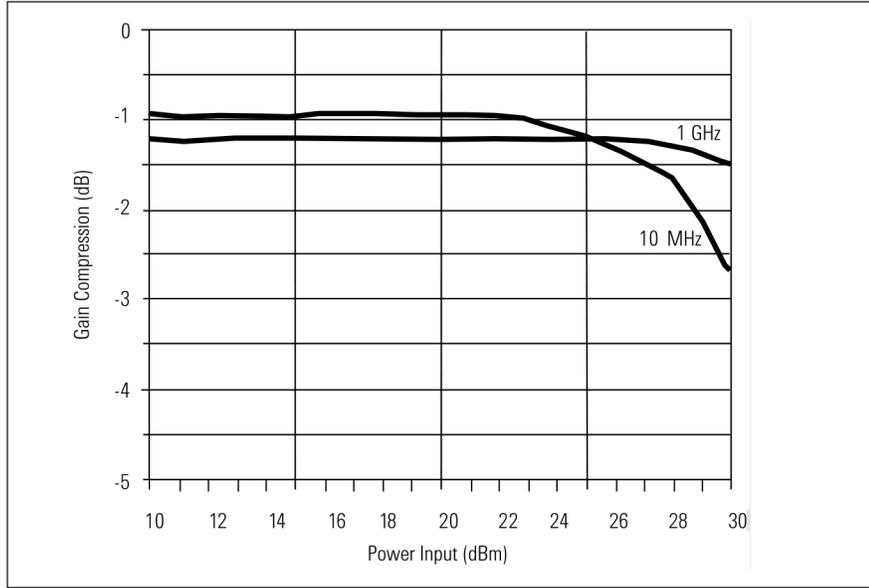


Figure 7. Gain compression

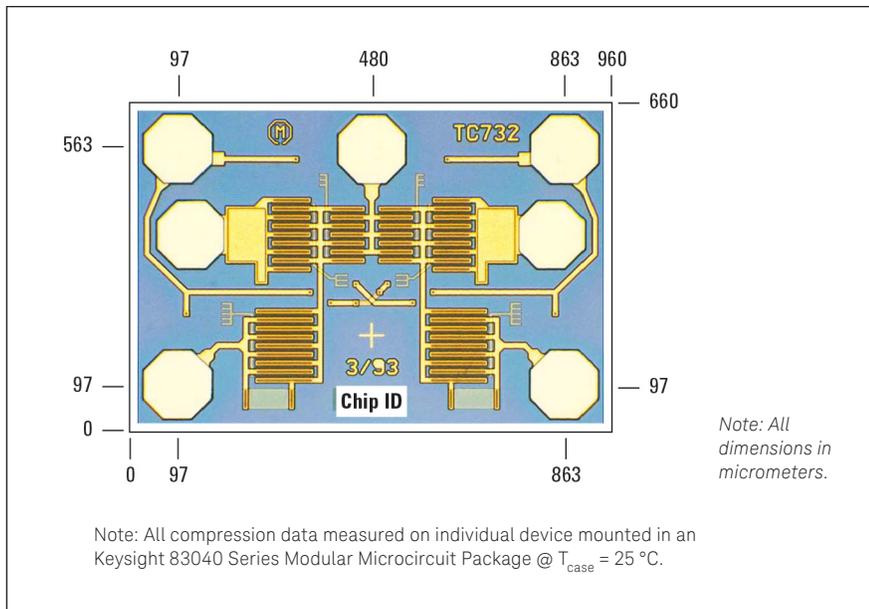


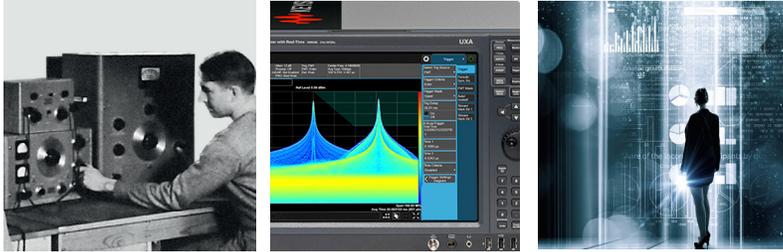
Figure 8. Bonding pad locations

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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