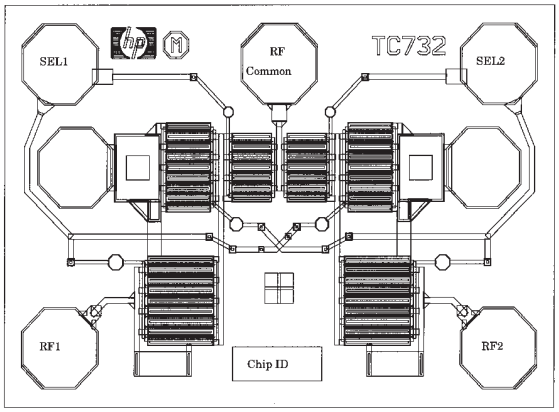
HMMC-2007
DC–8 GHz Terminated SPDT Switch

Data Sheet

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 (SPDT), 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.

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



Chip Size:	660 x 960 μm (25.9 x 37.8 mils)
Chip Size Tolerance:	±10 μm (±0.4 mils)
Chip Thickness:	127 ± 15 μm (5.0 ± 0.6 mils)
Pad Dimensions:	120 x 120 μm (4.7 x 4.7 mils)

Absolute Maximum Ratings[1]

Symbol	Parameters/Conditions	Units	Min.	Max.
V_{sel}	Select Voltages 1 & 2	V	-10.5	+10.5
P_{in}	RF Input Power	dBm		27
T_{op}	Operating Temperature	°C	-55	+125
T_{stg}	Storage Temperature	°C	-65	+165
T_{max}	Max. Assembly Temperature	°C		+200
P_{unsel}	Power into Unselected Output	dBm		27

Notes:

1. Operation in excess of any one of these conditions may result in permanent damage to this device. T_A = 25°C except for T_{ch}, T_{stg}, and T_{max}.

HMMC-2007 DC Specifications/Physical Properties (T_A= 25°C)

Symbol	Parameters and Test Conditions	Units	Min.	Typ.	Max.
$I_{SEL-10V}$	Leakage Current @ -10 V	µA			200
$I_{SEL+10V}$	Leakage Current @ +10V	µA			20
V_p	Pinchoff Voltage (V_{SEL2} = V_p, V_{RFout2} = +2V, I_{RFout2} = 4 mA, V_{SEL1} = -10 V, V_{RFout1} = open circuit, V_{RFin} = GND	V	-6.75		-3.00
BV	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, $V_{sel-high}$ = +10V, $V_{sel-low}$ = -10V)

Symbol	Parameters and Test Conditions	Units	Min.	Typ.	Max.
BW	Guaranteed Operating Bandwidth	GHz	DC		8.0
IL	Insertion Loss, RF_{in} to Selected RF_{out} (ON throw), 6 GHz	dB		1.1	1.4
ISO	Isolation, RF_{in} to Unselected RF_{out} (OFF throw), 6 GHz	dB		38	
RL_{in}	Input Return Loss @ 6 GHz	dB		25	
RL_{out-ON}	Output Return Loss, ON throw @ 6 GHz	dB		25	
$RL_{out-OFF}$	Output Return Loss, OFF throw @ 6 GHz	dB		18	
P_{-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	µs		20	

Applications

The HMMC-2007 can be used in instrumentation, communica-tions, 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-2007 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	-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

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).

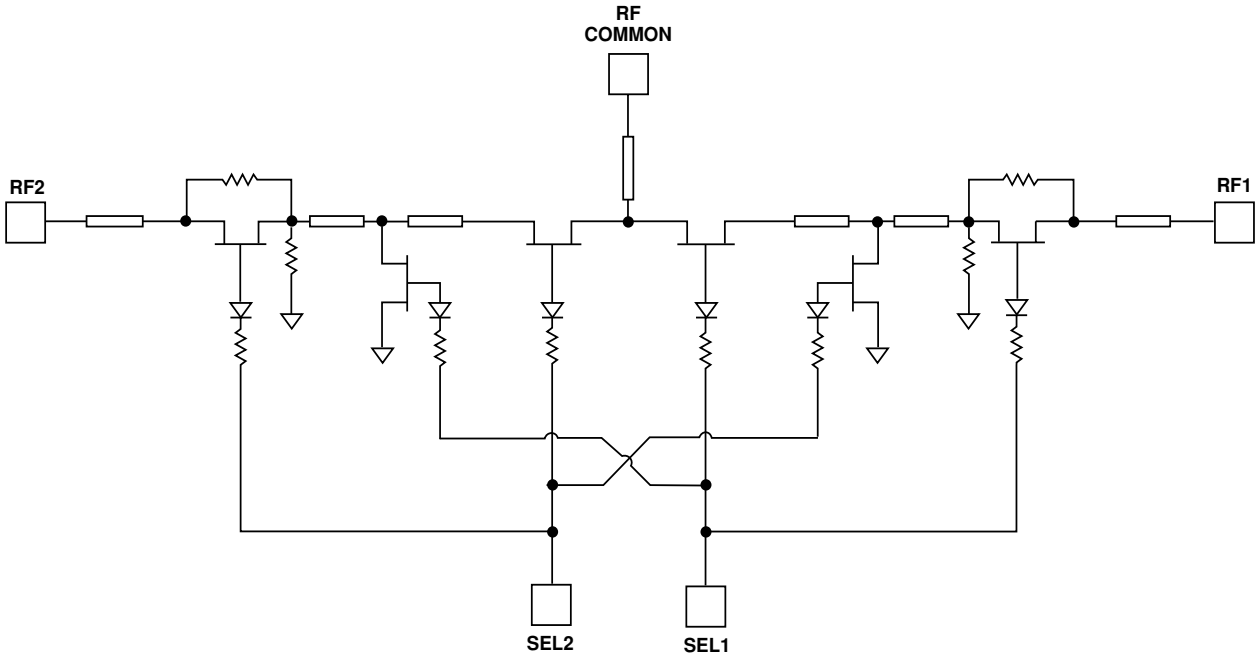


Figure 1. Schematic.

Recommended Operating Conditions (T_A = 25°C)

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

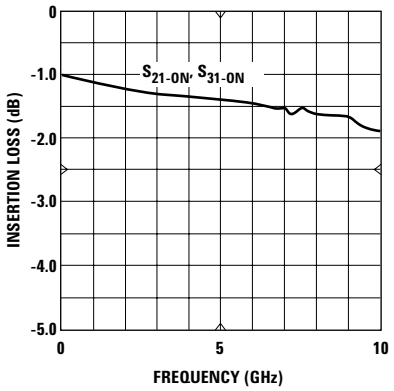


Figure 2. Insertion Loss[1] vs. Frequency.

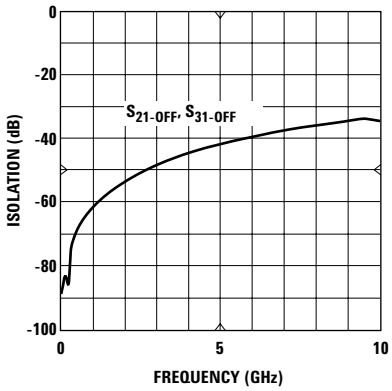


Figure 3. Input-to-Output Isolation[1] vs. Frequency.

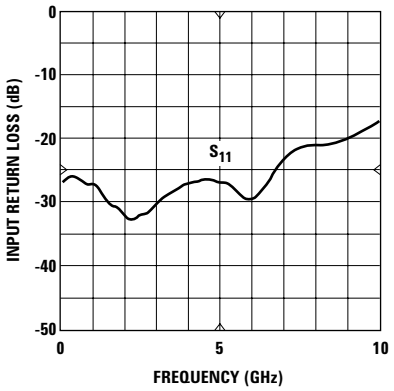


Figure 4. Input Return Loss[1] vs. Frequency.

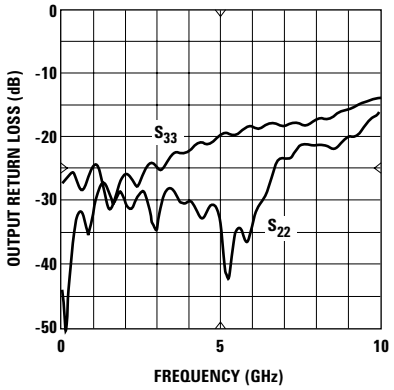


Figure 5. Output Return Loss[1] vs. Frequency.

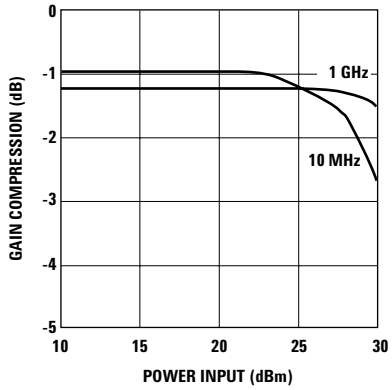


Figure 6. Gain Compression vs. Power Input.

Notes:

1. Data taken with the device mounted in modular breadboard package.
2. All compression data measured on individual device mounted in an Avago 83040 Series Modular Microcircut Package @ T_{case} = 25°C.

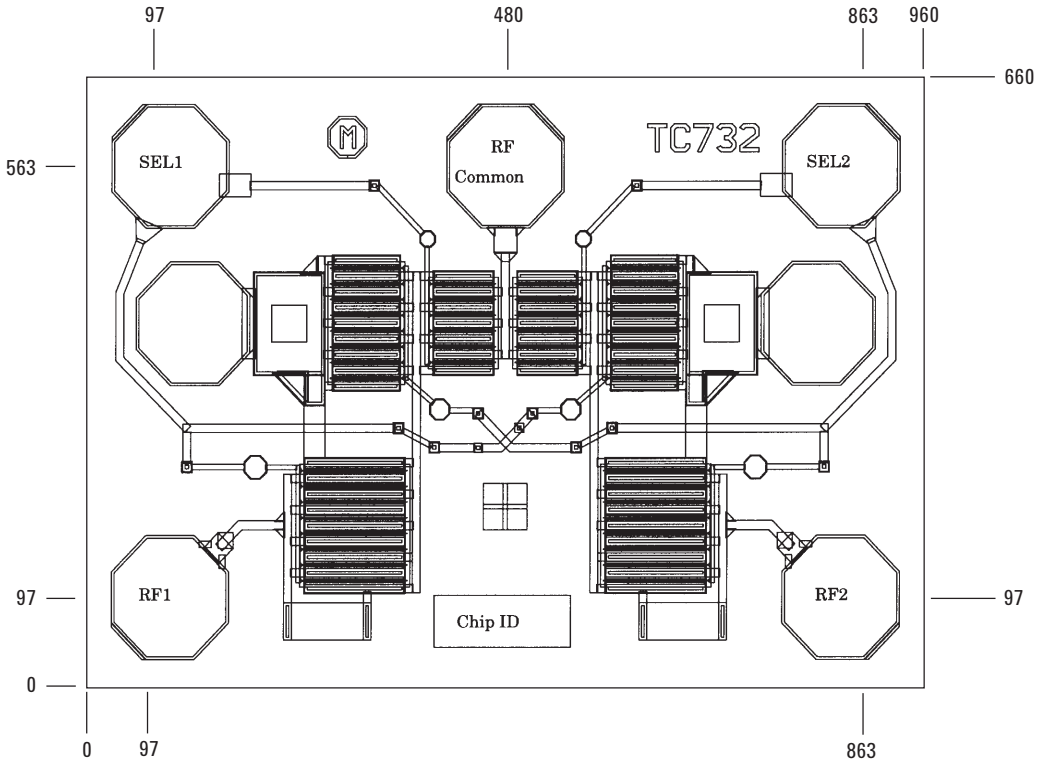


Figure 7. HMMC-2007 Bonding Pad Positions. (Shown in micrometers)

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.

For product information and a complete list of distributors, please go to our web site:
www.avagotech.com

Obsoletes 5965-5451E
5988-3198EN May 11, 2006