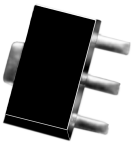
Preliminary

SHF-0189

DC-3 GHz, 0.5 Watt GaAs HFET



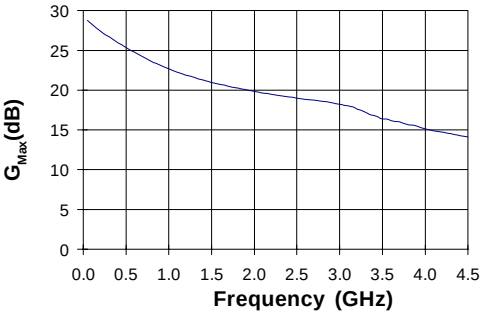
Product Description

Stanford Microdevices' SHF-0189 series is a high performance GaAs Heterostructure FET housed in a low-cost surface-mount plastic package. HFET technology improves breakdown voltage while minimizing Schottky leakage current for higher power added efficiency and improved linearity.

Output power at 1dB compression for the SHF-0189 is +27 dBm when biased for Class AB operation at 8V and 100mA. The +39 dBm third order intercept makes it ideal for high dynamic range, high intercept point requirements. They are well suited for use in both analog and digital wireless communication infrastructure and subscriber equipment including cellular PCS, CDPD, wireless data, and pagers.

Adequate heat sinking must be provided for this part to avoid exceeding the maximum junction temperature. Refer to "Mounting and Thermal Considerations" section on page 7 for more information.

Maximum Available Gain vs. Frequency
Vds = 8.0 volts, Idq = 100 mA



Product Features

- **Patented GaAs Heterostructure FET Technology**
- **+27 dBm Output Power at 1dB Compression**
- **+39 dBm Output IP3**
- **High Drain Efficiency: Up to 46% at Class AB**
- **15 dB Gain at 900 MHz (Application circuit)**
- **17 dB Gain at 1900 MHz (Application circuit)**

Applications

- **Analog and Digital Wireless System**
- **Cellular PCS, CDPD, Wireless Data, Pagers**

Electrical Specifications at Ta = 25°C

Symbol	Parameters: Test Conditions		Units	Min.	Typ.	Max.
$\|S_{21}\|^2$	Insertion Power Gain Vds = 8.0V, I dq= 100mA, Z_S=Z_L= 50 Ohms	f = 0.9 GHz f = 1.9 GHz	dB		17.4 14.4	
G_{max}	Maximum Available Gain Vds = 8.0V, I dq= 100mA, Z_S=$Z_{S\ OPT}$, Z_L=$Z_{L\ OPT}$	f = 0.9 GHz f = 1.9 GHz	dB		23.1 20.0	
TOIP	Output Third Order Intercept Point (Device is tuned for Maximum P_{1dB})	f = 0.9 GHz f = 1.9 GHz	dBm dBm		39 40.2	
I_{Dss}	Saturated Drain Current Vds = 3.0V, Vgs= 0V		mA		300	
G_m	Tranconductance: Vds = 3.0V, Vgs = 0V		mS		175	
Vp	Pinch-Off Voltage: Vds = 2.0V, I d = 0.6mA		V	-2.7	-1.9	-1.0
V_{bgs}	Gate-to-Source Breakdown Voltage, Igs = 1.2mA		V		-20	-17
V_{bgd}	Gate-to-Drain Breakdown Voltage, Igd = 1.2mA		V		-20	-17
Rth	Thermal Resistance, junction-to-lead		°C/W		66	

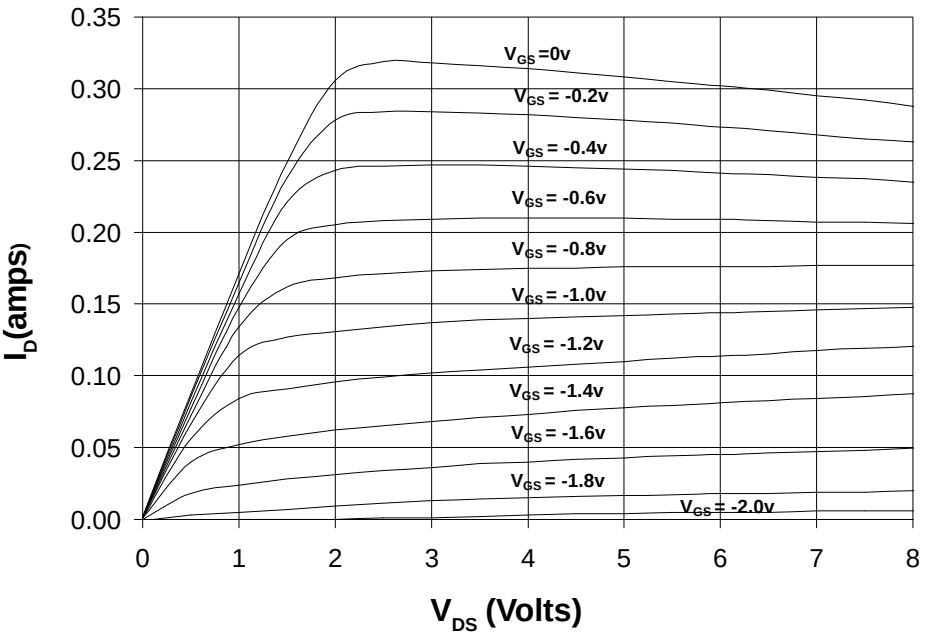
Absolute Maximum Ratings

Notes:

1. Operation of this device above any one of these parameters may cause permanent damage.

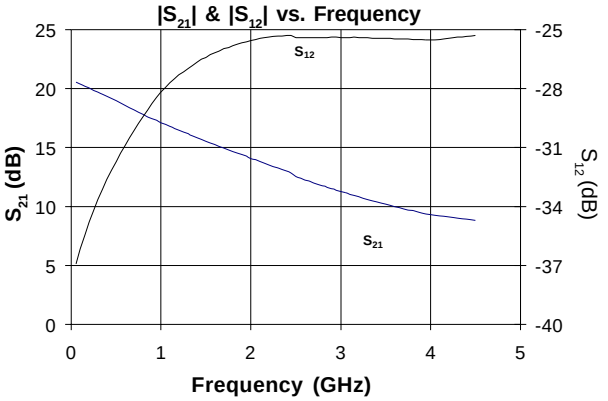
Parameter	Symbol	Absolute Maximum
Drain-to-Source Voltage	V_{DS}	+12V
Gate-to-Source Voltage	V_{GS}	-5V to 0V
Operating Temperature	T_{OP}	-45 C to +85° C
RF Input Power	P_{IN}	200 mW
Channel Temperature	T_{CH}	+175° C
Storage Temperature	T_{STG}	-65 to +175° C

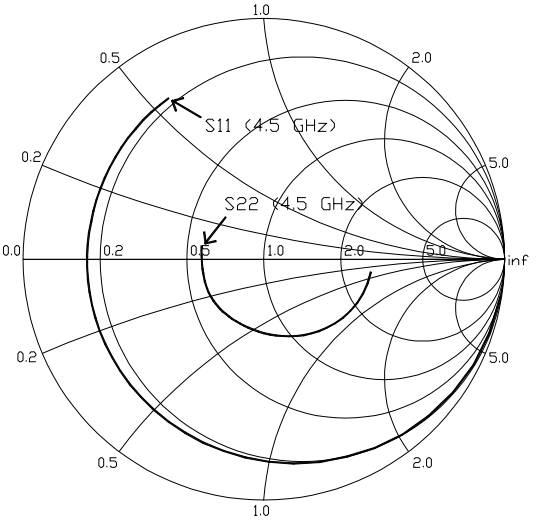
Plot of I_D vs. V_{DS} for V_{GS}= -2.2V to 0V



NOTE: I/V curves were taken using pulse sampling techniques. This results in low duty cycle currents through the device and therefore very low power levels. It is not recommended that these measurements be taken in d.c. mode, as excessive current could result in damage to the device.

SHF-0189 DC-3GHz, 0.5 Watt GaAs HFET





S_{11} & S_{22} vs. Frequency (.05 to 4.5 GHz)

Typical s-parameters at 25° C (V_{ds} = 8V, I_{dq} = 100mA)

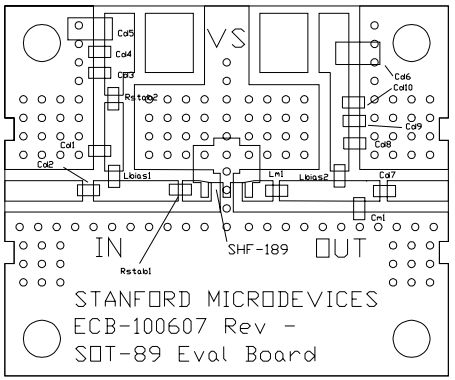
Freq GHz	$\|S_{11}\|$	S_{11} Ang	S_{21} dB	$\|S_{21}\|$	S_{21} Ang	S_{12} dB	$\|S_{12}\|$	S_{12} Ang	$\|S_{22}\|$	S_{22} Ang
0.05	0.98	-15.6	20.5	10.6	168.7	-36.9	0.01	72.2	0.44	-15.2
0.1	0.97	-19.3	20.4	10.4	165.8	-36.1	0.02	70.2	0.44	-17.7
0.3	0.97	-33.8	19.7	9.7	154.5	-33.6	0.02	61.8	0.42	-28.1
0.5	0.93	-48.4	19.0	8.9	143.2	-31.7	0.03	53.4	0.40	-38.4
0.7	0.90	-62.9	18.2	8.1	131.9	-30.1	0.03	45.1	0.37	-48.7
0.9	0.86	-77.7	17.4	7.5	120.7	-28.8	0.04	36.0	0.35	-59.3
1.1	0.83	-91.8	16.8	6.9	110.2	-27.7	0.04	27.0	0.34	-69.8
1.3	0.80	-105.0	16.2	6.4	100.5	-27.0	0.04	18.7	0.32	-79.4
1.5	0.77	-117.6	15.5	6.0	91.3	-26.4	0.05	10.9	0.31	-88.6
1.7	0.76	-129.7	15.0	5.6	82.6	-26.0	0.05	3.5	0.30	-97.4
1.9	0.74	-141.6	14.4	5.2	74.2	-25.7	0.05	-3.6	0.29	-106.4
2.1	0.73	-153.4	13.8	4.9	65.8	-25.4	0.05	-10.5	0.28	-114.9
2.3	0.73	-165.0	13.3	4.6	57.6	-25.3	0.05	-17.1	0.27	-123.2
2.5	0.73	-174.1	12.5	4.2	49.8	-25.4	0.05	-23.5	0.27	-136.1
3.0	0.74	164.3	11.3	3.7	32.1	-25.4	0.05	-37.4	0.27	-153.2
3.5	0.75	144.9	10.2	3.2	15.4	-25.4	0.05	-50.3	0.27	-166.9
4.0	0.77	127.0	9.3	2.9	-1.0	-25.5	0.05	-63.0	0.26	178.4
4.5	0.86	109.1	9.3	2.9	-21.0	-25.3	0.05	-76.3	0.26	166.5

No external matching, scattering parameters de-embedded on test fixture to device lead at package edge.

Preliminary

SHF-0189 DC-3GHz, 0.5 Watt GaAs HFET

900 MHz Application Circuit at 25° C (Vds=8V, Idq=100mA)



Ref. desig.	Value	Part Number /Style
Cd1,8	18 pF	ROHM MCH18 series
Cd2	5.6 pF	ROHM MCH18 series
Cd3,7,9	68 pF	ROHM MCH18 series
Cd4,10	1000 pF	ROHM MCH18 series
Cd5,6	0.1 uF	TANTALUM, size"A", 35 volt
CM1	2.2 pF	ROHM MCH18 series
LM1	6.8 nH	TOKO LL1608-FH6N8K
Lbias1	6.8 nH	TOKO LL1608-FH6N8K
Lbias2	82 nH	TOKO LL1608-FH82NT
Rstab1,2	20 ohms	size 0603

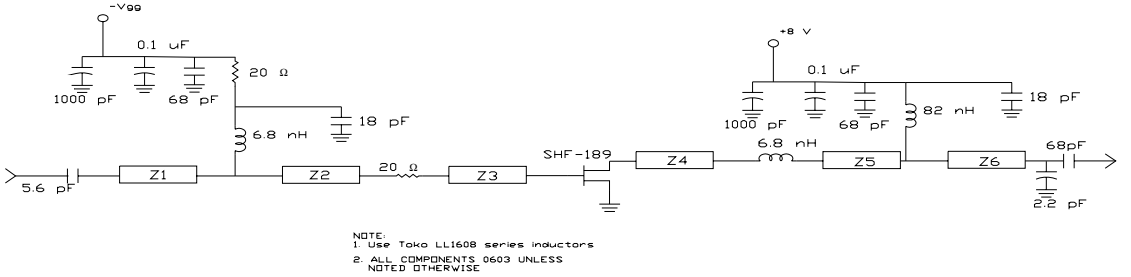
Microstrip Segment Specifications

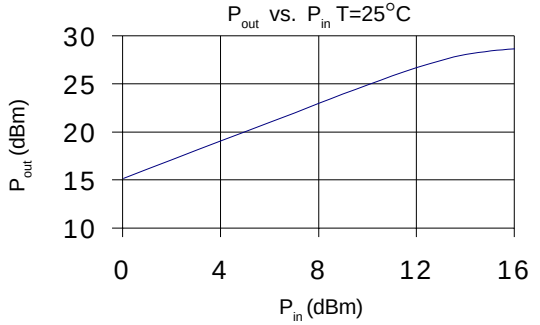
Ref. desig.	Value
Z1	50 ohms, 2.4 deg. @ 900 MHz
Z2	50 ohms, 8.4 deg. @ 900 MHz
Z3	50 ohms, 4.0 deg. @ 900 MHz
Z4	50 ohms, 4.0 deg. @ 900 MHz
Z5	50 ohms, 8.0 deg. @ 900 MHz
Z6	50 ohms, 2.4 deg. @ 900 MHz

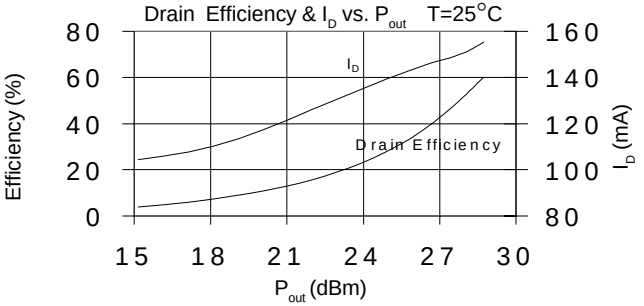
Phase shift functional block between components are calculated based on wavelength of 900 MHz signal on FR4 board material with dielectric constant of 4.1, microstrip width and height dimensions of W=.054 inch and h= .031 inch.

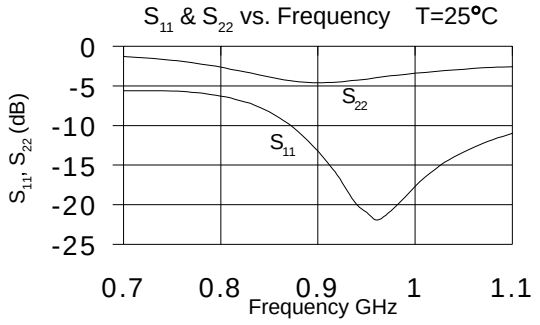
Test Data @ 0.9 GHz

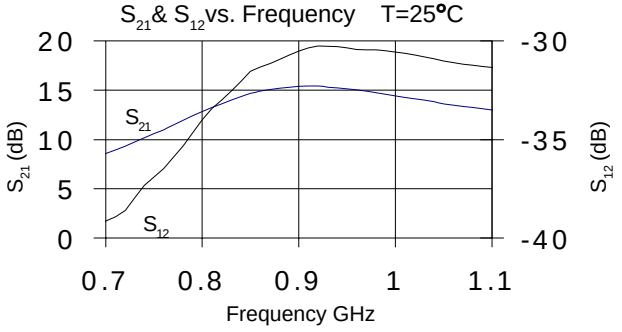
P_{1dB}(dBm)	IP3(dBm)	Output tone Level (dBm)
27.0	39.0	11







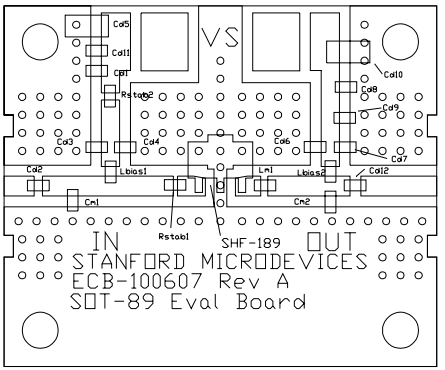




Note: s-parameters determined using applications circuit shown above

SHF-0189 DC-3GHz, 0.5 Watt GaAs HFET

1900 MHz Application Circuit at 25° C (Vds=8V, Idq=100mA)



Ref. desig.	Value	Part Number /Style
Cd1,9	1000 pF	ROHM MCH18 series
Cd2,3,6,12	33 pF	ROHM MCH18 series
Cd4,7	8.2 pF	ROHM MCH18 series
Cd5,10	0.1 uF	TANTALUM, size"A", 35 volt
Cd8,11	100 pF	ROHM MCH18 series
CM1	2.7 pF	ROHM MCH18 series
CM2	1.0 pF	ROHM MCH18 series
LM1	2.2 nH	TOKO LL1608-FH2N2K
Lbias1	10 nH	TOKO LL1608-FH10NT
Lbias2	22 nH	TOKO LL1608-FH22NT
Rstab1	5.1 ohms	size 0603
Rstab2	10 ohms	size 0603

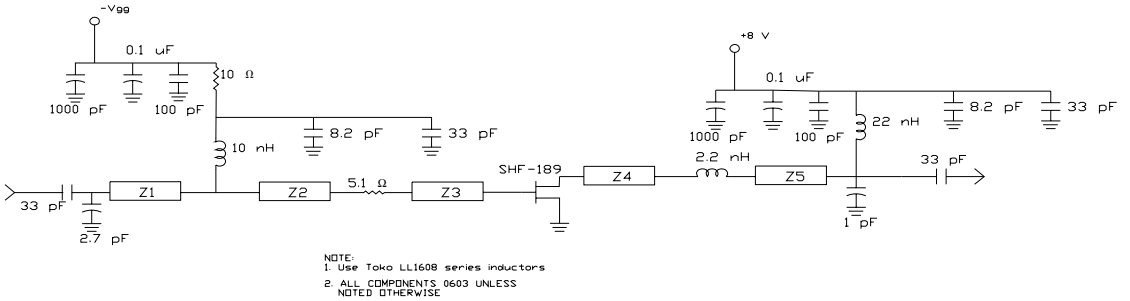
Microstrip Segment Specifications

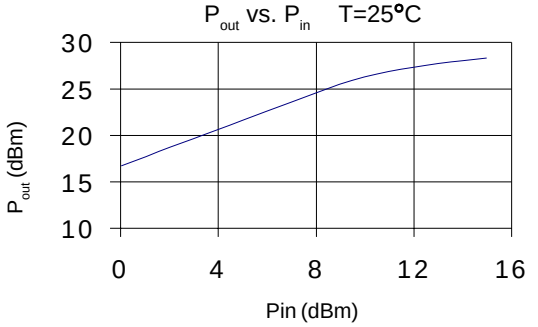
Ref. desig.	Value
Z1	50 ohms, 5.0 deg. @ 1900 MHz
Z2	50 ohms, 8.4 deg. @ 1900 MHz
Z3	50 ohms, 3.8 deg. @ 1900 MHz
Z4	50 ohms, 3.8 deg. @ 1900 MHz
Z5	50 ohms, 8.6 deg. @ 1900 MHz

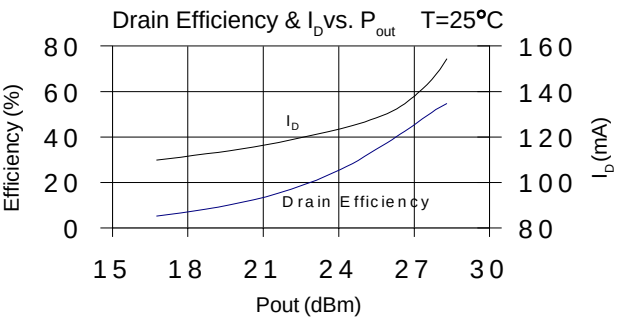
Phase shift functional block between components are calculated based on wavelength of 1900 MHz signal on FR4 board material with dielectric constant of 4.1, microstrip width and height dimensions of W=.054 inch and h= .031 inch.

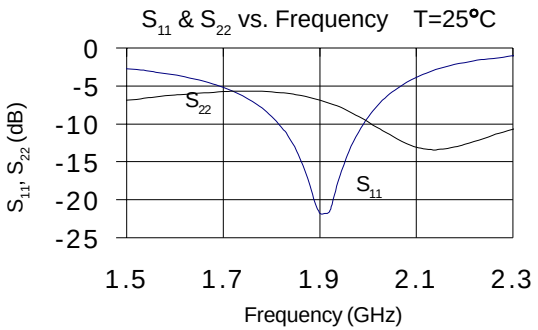
Test Data @ 1.9 GHz

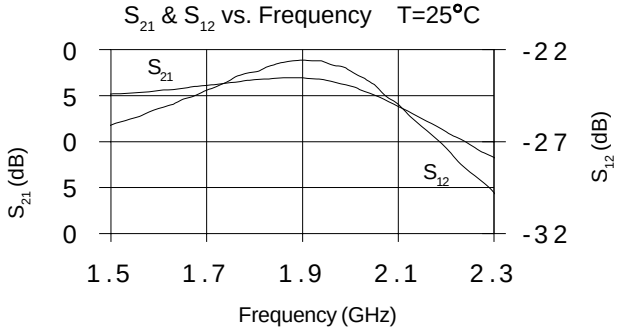
P_{1dB}(dBm)	IP3(dBm)	Output tone Level (dBm)
27.0	40.2	11







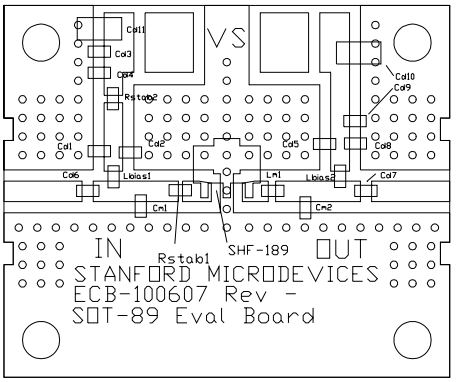




Note: s-parameters determined using applications circuit shown above

SHF-0189 DC-3GHz, 0.5 Watt GaAs HFET

2450 MHz Application Circuit at 25°C (Vds=8V, Idq=100mA)



Ref. desig.	Value	Part Number /Style
Cd1,4,6,7,8	22 pF	ROHM MCH18 series
Cd2,5	5.6 pF	ROHM MCH18 series
Cd3,9	1000 pF	ROHM MCH18 series
Cd10,11	0.1 uF	TANTALUM, size"A", 35 volt
CM1	1.8 pF	ROHM MCH18 series
CM2	1.0 pF	ROHM MCH18 series
LM1	2.2 nH	TOKO LL1608-FH2N2K
Lbias1	6.8 nH	TOKO LL1608-FH6N8K
Lbias2	15 nH	TOKO LL1608-FH15NT
Rstab1	5.1 ohms	size 0603
Rstab2	20 ohms	size 0603

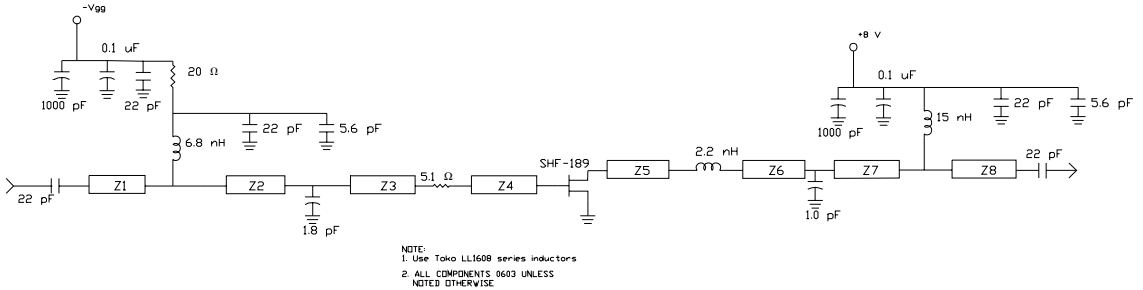
Microstrip Segment Specifications

Ref. Desig.	Value
Z1	50 ohms, 7.4 deg. @ 2450 MHz
Z2	50 ohms, 9.8 deg. @ 2450 MHz
Z3	50 ohms, 13.5 deg. @ 2450 MHz
Z4	50 ohms, 10.3 deg. @ 2450 MHz
Z5	50 ohms, 10.1 deg. @ 2450 MHz
Z6	50 ohms, 10.6 deg. @ 2450 Mhz
Z7	50 ohms, 12.7 deg. @ 2450 Mhz
Z8	50 ohms, 7.4 deg. @ 2450 Mhz

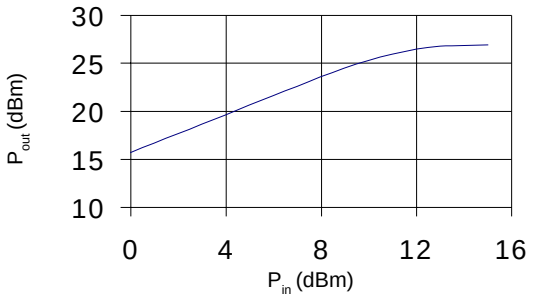
Phase shift functional block between components are calculated based on wavelength of 2450 MHz signal on FR4 board material with dielectric constant of 4.1, microstrip width and height dimensions of W=.054 inch and h= .031 inch.

Test Data @ 2.45 GHz

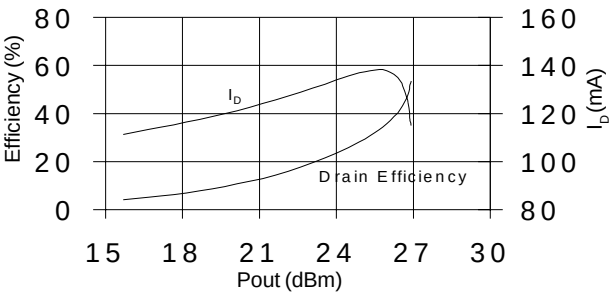
P_{1dB}(dBm)	IP3(dBm)	Output tone Level (dBm)
27.0	40.2	11



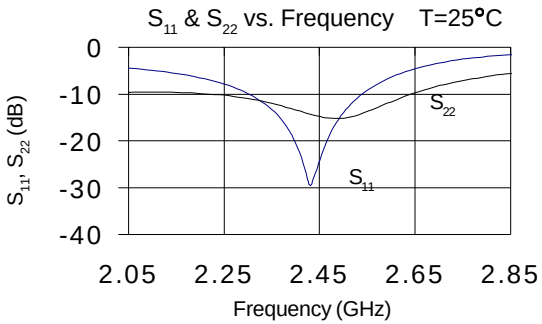
P_{out} vs. P_{in} T=25°C



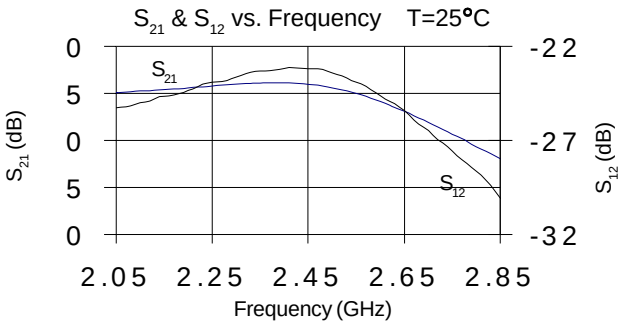
Drain Efficiency & I_D vs. P_{out} T=25°C



S_{11} & S_{22} vs. Frequency T=25°C



S_{21} & S_{12} vs. Frequency T=25°C



Note: s-parameters determined using applications circuit shown above

SHF-0189 DC-3GHz, 0.5 Watt GaAs HFET

Caution: ESD sensitive
Appropriate precautions in handling, packaging and testing devices must be observed.

Part Number Ordering Information

Part Number	Devices Per Reel	Reel Size
SHF-0189	1000	7"

Mounting and Thermal Considerations:

It is important that adequate heat sinking be provided to avoid exceeding the maximum device junction temperature. The following suggestions should be followed to ensure maximum operating life of the device:

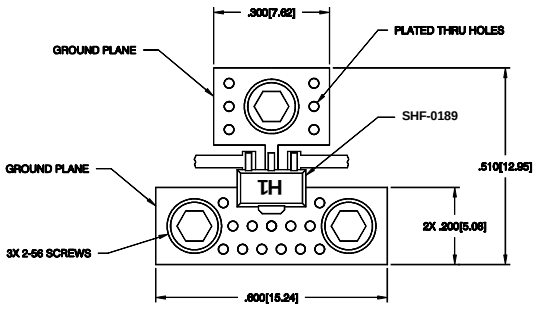
1. Use 2 ounce copper if possible.
2. Use a large ground pad area with many plated through-holes.
3. Multiple vias are required directly below the SOT-89 ground tab.
4. Solder the copper pad on the backside of the device package to the ground plane.
5. Use three point board seating with 2-56 machine screws (no more than 0.2 inch from the device) to provide a low thermal resistance path to the plate. The thermal resistance from ground lead to screws is 2 °C/W.
6. We recommend thermal transfer paste be used between the board and the mounting plate.

Part Symbolization

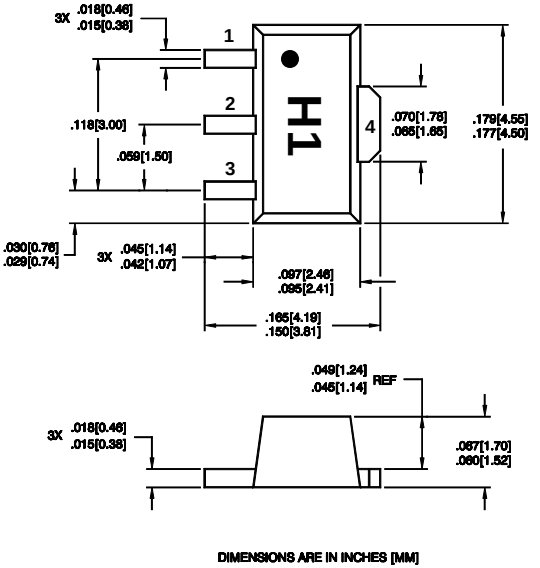
The part will be symbolized with a “H1” designator on the top surface of the package.

Pin Designation	
1	Gate
2	Source
3	Drain
4	Source

Outline Drawing



DIMENSIONS ARE IN INCHES [MM]



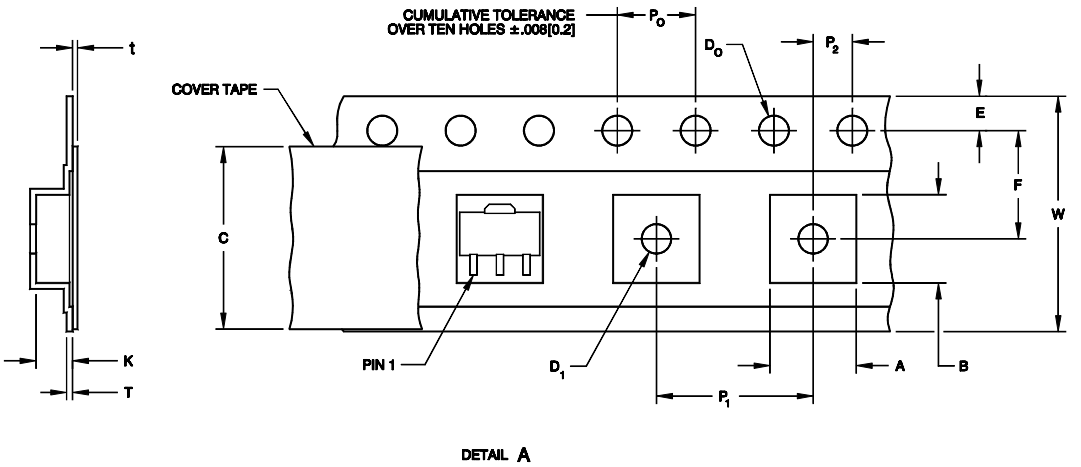
DIMENSIONS ARE IN INCHES [MM]

Pin assignments shown for reference only, not marked on part

Component Tape and Reel Packaging

Tape Dimensions

For 89 Outline



Description		Symbol	Size (mm)
Cavity	Length	A	4.91 +/- 0.01
	Width	B	4.52 +/- 0.01
	Depth	K	1.90 +/- 0.01
	Pitch	P_1	8.00 +/- 0.01
	Bottom Hole Diameter	D_1	1.60 +/- 0.10
Perforation	Diameter	D_0	1.55 +/- 0.05
	Pitch	P_0	4.00 +/- 0.01
	Position	E	1.75 +/- 0.01
Cover Tape	Width	C	9.10 +/- 0.25
	Tape Thickness	t	0.05 +/- 0.01
Carrier Tape	Width	W	12.0 +/- 0.03
	Thickness	T	0.30 +/- 0.05
Distance	Cavity to Perforation (Width Direction)	F	5.50 +/- 0.10
	Cavity to Perforation (Length Direction)	P_2	2.00 +/- 0.10

Note: Drawing not to scale