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RFMD
SHF-0289

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SHF-0289(Z)

0.05GHz to 6GHz, 1.0WATT GaAs HFET

RFMD Green, RoHS Compliant, Pb-Free (Z Part Number)
Package: SOT-89

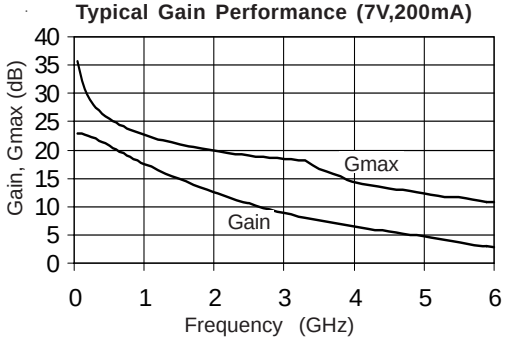
Product Description

RFMD's SHF-0289 is a high performance AlGaAs/GaAs Heterostructure FET (HFET) housed in a low-cost surface-mount plastic package. The HFET technology improves breakdown voltage while minimizing Schottky leakage current resulting in higher PAE and improved linearity. Output power at 1dB compression for the SHF-0289 is +30dBm when biased for Class AB operation at 7V, 200mA. The +43dBm third order intercept makes it ideal for high dynamic range, high intercept point requirements. It is well suited for use in both analog and digital wireless communication infrastructure and subscriber equipment including 3G, cellular, PCS, fixed wireless, and pager systems.

Optimum Technology Matching® Applied

- ☐ GaAs HBT
- ☐ GaAs MESFET
- ☐ InGaP HBT
- ☐ SiGe BiCMOS
- ☐ Si BiCMOS
- ☐ SiGe HBT
- ☐ GaAs pHEMT
- ☐ Si CMOS
- ☐ Si BJT
- ☐ GaN HEMT
- ☐ RF MEMS

Typical Gain Performance (7V,200mA)



Features

- High Linearity Performance at 1.96GHz
  +30dBm P_{1dB}
  +43dBm OIP_3
  +23.7dBm IS-95 Channel Power
  +14.6dB Gain
- +21.7dBm W-CDMA Channel Power
- High Drain Efficiency (>50% at P_{1dB})

Applications

- Analog and Digital Wireless Systems
- 3G, Cellular, PCS
- Fixed Wireless, Pager Systems

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Maximum Available Gain		23		dB	0.90GHz, $Z_S=Z_S^*$, $Z_L=Z_L^*$
		20		dB	1.96GHz, $Z_S=Z_S^*$, $Z_L=Z_L^*$
		19.5		dB	2.14GHz, $Z_S=Z_S^*$, $Z_L=Z_L^*$
Insertion Gain [1]	16.7	18.5	20.3	dB	0.90GHz, $Z_S=Z_L=50\Omega$
Power Gain [2]	13.1	14.6	16.1	dBm	1.96GHz, Application Circuit
Output Power at 1dB Compression[2]	28.7	30.2		dBm	1.96GHz, Application Circuit
Output Third Order Intercept Point[2]	40.5	43.0		dBm	1.96GHz, Application Circuit
IS-95 Channel Power (-45dBc ACPR)		23.7		dBm	1.96GHz, Application Circuit
Noise Figure [2]		4.0		dB	1.96GHz, Application Circuit
Saturated Drain Current	408	588	768	mA	$V_{DS}=V_{DSP}$, $V_{GS}=0V$
Transconductance	288	396	504	mS	$V_{DS}=V_{DSP}$, $V_{GS}=-0.25V$
Pinch-Off Voltage [1]	-3.0	-1.9	-1.0	V	$V_{DS}=2.0V$, $I_{DS}=1.2mA$
Gate-Source Breakdown Voltage [1]		-17	-15	V	$I_{GS}=2.4mA$, drain open
Gate-Drain Breakdown Voltage [1]		-22	-17	V	$I_{GD}=2.4mA$, $V_{GS}=-5.0V$
Thermal Resistance, (Junction - Lead)		41		°C/W	
Operating Voltage [3]			8.0	V	drain-source
Operating Current [3]			280	mA	drain-source, quiescent
Power Dissipation [3]			1.4	W	

Test Conditions: $V_{DS}=7V$, $I_{DQ}=200mA$ (unless otherwise noted) [1] 100% Tested - Insertion gain tested using a 50Ω contact board (no matching circuitry) during final production test. [2] Sample Tested - Samples pulled from each wafer/package lot. Sample test specifications are based on statistical data from sample test measurements. The test fixture is an engineering application circuit board. The application circuit was designed for the optimum combination of linearity, P_{1dB} and VSWR. [3] Maximum recommended power dissipation is specified to maintain $T_J<140°C$ at $T_L=85°C$. $V_{DS}*I_{DQ}<1.4W$ is recommended for continuous reliable operation.

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Absolute Maximum Ratings

Parameter	Rating	Unit
Drain Current (I_{DS})	400	mA
Forward Gate Current (I_{GSF})	2.4	mA
Reverse Gate Current (I_{GSR})	2.4	mA
Drain-to-Source Voltage (V_{DS})	+9.0	V
Gate-to-Source Voltage (V_{GS})	<-5 or >0	V
RF Input Power (P_{IN})	400	mW
Operating Lead Temperature (T_L)	See Graph	°C
Storage Temperature Range (T_{STOR})	-40 to +165	°C
Power Dissipation (P_{DISS})	See Graph	W
Channel Temperature (T_J)	+165	°C

Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation, the device voltage and current must not exceed the maximum operating values specified in the table on page one.

Caution! ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EUDirective2002/95/EC (at time of this document revision).

Typical Performance with Engineering Application Circuits

Freq (MHz)	VDS (V)	IDQ (mA)	P1dB (dBm)	-45dBc Channel Power (dBm)	-55dBc Channel Power (dBm)	OIP3* (dBm)	Gain (dB)	S11 (dB)	S22 (dB)	NF (dB)
900	7	200	30.2	23.5[1]	21.1[1]	43.0	19.2	-15	-12	3.2
1960	7	200	30.2	23.7[1]	21.3[1]	43.0	14.6	-18	-10	4.0
2140	7	200	30.3	21.7[2]	20.4[2]	43.0	13.8	-18	-7	4.1

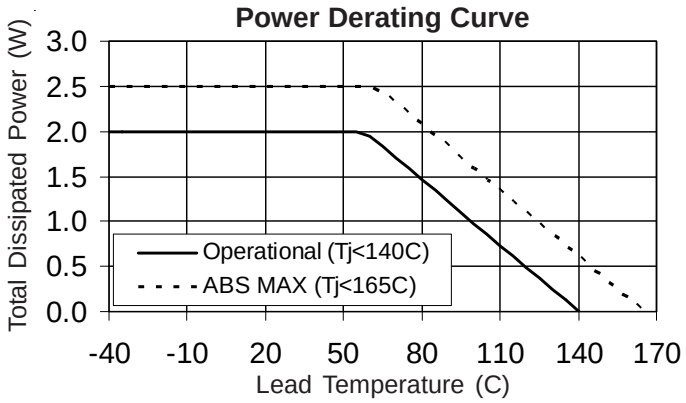
[1] IS-95 CDMA Channel Power (9 Fwd Channels, 885kHz offset, 30kHz Adj Chan BW)
[2] W-CDMA Channel Power (64 DPCH, 5MHz offset, 3.84MHz Adj Chan BW)
*P_{OUT}=+13dBm per tone, 1MHz tone spacing

MTTF is inversely proportional to the device junction temperature. For junction temperature and MTTF considerations the bias condition should also satisfy the following expression:

$P_{DC} < (T_J - T_L) / R_{TH}$

Where $P_{DC}=I_{DS}*V_{DS}$ (W), T_J=Junction Temperature (°C), T_L=Lead Temperature (pin 4) (°C), R_{TH}=Thermal Resistance (°C/W)

MTTF at T_J=150°C exceeds 1E7 hours



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Design Considerations and Trade Off

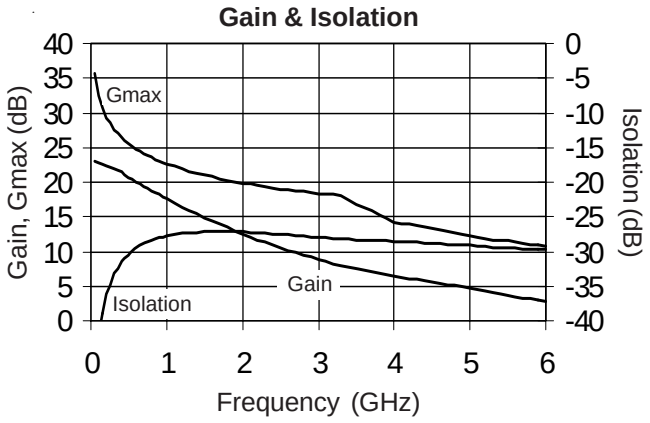
1. The SHF-0289 is a depletion mode FET and requires a negative gate voltage. Normal pinchoff variation from part-to-part precludes the use of a fixed gate voltage for all devices. Active bias circuitry or manual gate bias alignment is recommended to maintain acceptable RF performance (RF and thermal).

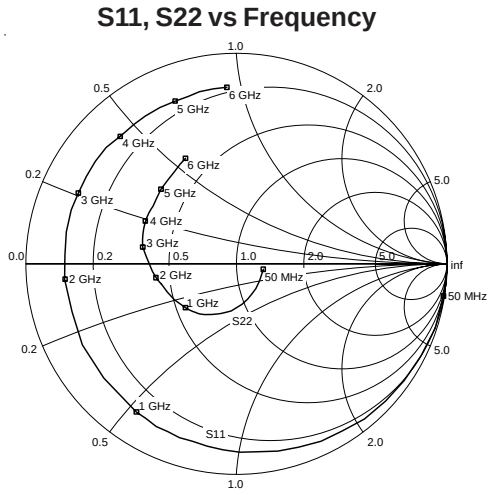
2. Active bias circuitry is strongly recommended for class A operation (backoff > 6dB).

3. For large signal operation (<6dB backoff) class AB operation is required to maximize the FET's performance. Passive gate bias circuitry is generally required to achieve pure class AB performance. This is generally accomplished using a voltage divider wit temperature compensation. Per item one above the gate voltage should be aligned for each device to eliminate the effects of pinchoff process variation.

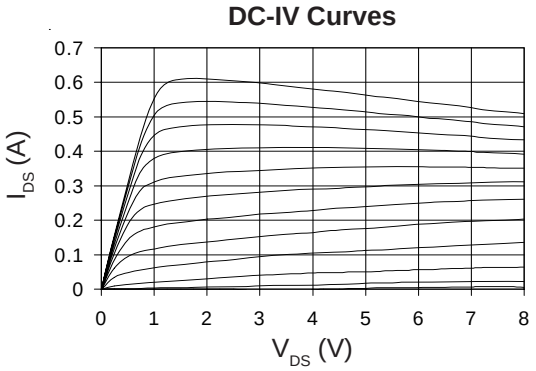
4. Choose the operating voltage based on the amount of backoff. For large signal operation the drain-source voltage should be increased to 8V to maximize P1dB. For small signal operation the OIP3 may be improved by reducing the voltage and increasing the current. The recommended application circuit should be re-optimized if the recommended 7V bias condition is not used. Make sure the quiescent bias condition does not exceed the recommended power dissipation limit.

De-embedded S-Parameters (Z_S=Z_L=50 Ohms, V_{DS}=7V, I_{DS}=200mA, 25°C)





Note: S-parameters are de-embedded to the device leads with Z_S=Z_L=50Ω. The data represents typical performace of the device. De-embedded s-parameters can be downloaded from our website



V_{GS} = -2.0 to 0V, 0.2V steps
T=25°C

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Pin	Function	Description
1	Gate	RF input.
2	Source	Connection to ground. Use via holes to reduce lead inductance. Place vias as close to ground leads as possible.
3	Drain	RF output.
4	Source	Same as pin 2.

Mounting and Thermal Considerations

It is very important that adequate heat sinking be provided to minimize the device junction temperature. The following items should be implemented to maximize MTTF and RF performance.

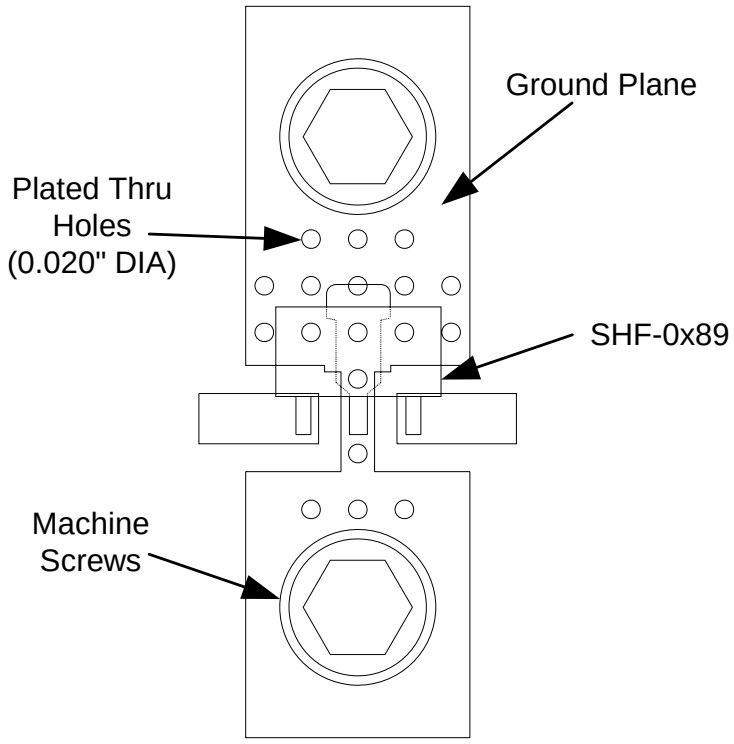
1. Multiple solder-filled vias are required directly below the ground tab (pin 4). [CRITICAL]

2. Incorporate a large ground pad area with multiple plated-through vias around pin 4 of the device. [CRITICAL]

3. Use two point board seating to lower the thermal resistance between the PCB and mounting plate. Place machine screws as close to the ground tab (pin 4) as possible. [CRITICAL]

4. Use 2 ounce copper to improve the PCB's heat spreading capability. [RECOMMENDED]

Recommended Mounting Configuration for Optimum RF and Thermal Performance



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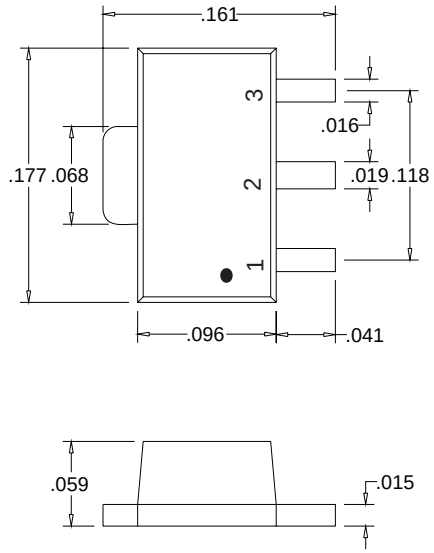
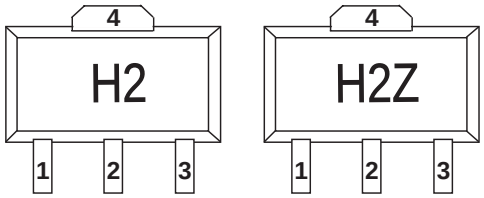
Package Drawing

Dimensions in inches (millimeters)
Refer to drawing posted at www.rfmd.com for tolerances.



Part Symbolization



ALternate marking is SHF0289 or SHF0289Z on line 1 with Trace Code on line 2.

Ordering Information

Part Number	Reel Size	Devices/Reel
SHF-0289	7”	1000
SHF-0289Z	7”	1000

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