SIRENZA MICRODEVICES®

OBSOLETE

# SHF-0589

## 0.05-3 GHz, 2 Watt GaAs HFET

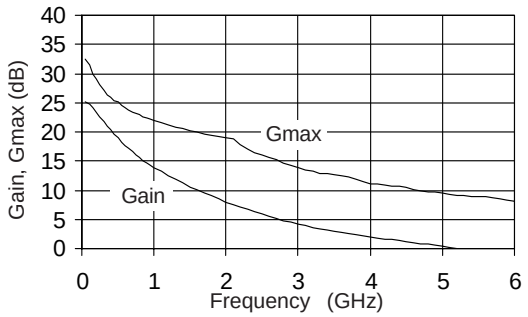
## Product Description

Sirenza Microdevices' SHF-0589 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 is +33.4 dBm when biased for Class AB operation at 7V,345mA at 1.96 GHz. The +46.5 dBm 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.

**OBSOLETE**
**Last Time Buy Date: 14-Dec-2007**
**Final Shipment Date: 13-June-2008**

**Typical Gain Performance (7V,345mA)**




## Applications

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

| Symbol | Device Characteristics | Test Conditions, 25C $V_{DS}$=7V, $I_{DQ}$=345mA (unless otherwise noted) | Test Frequency | Units | Min | Typ | Max |
|---|---|---|---|---|---|---|---|
| Gmax | Maximum Available Gain | $Z_S=Z_S^*$, $Z_L=Z_L^*$ | 0.90 GHz<br>1.96 GHz<br>2.14 GHz | dB<br>dB<br>dB | -<br>-<br>- | 22.9<br>17.4<br>16.6 | -<br>-<br>- |
| $S_{21}$ | Insertion Gain [1] | $Z_S=Z_L$=50 Ohms | 0.90 GHz | dB | 14.1 | 15.7 | 17.3 |
| Gain | Power Gain [2] | Application Circuit | 1.96 GHz | dBm | 10.3 | 11.5 | 12.7 |
| OIP3 | Output Third Order Intercept Point [2] | Application Circuit | 1.96 GHz | dBm | 44 | 46.5 | - |
| P1dB | Output 1dB Compression Point [2] | Application Circuit | 1.96 GHz | dBm | 31.9 | 33.4 | - |
| $P_{CHAN}$ | IS-95 Channel Power (-45dBc ACPR) | Application Circuit | 1.96 GHz | dBm | - | 26.2 | - |
| NF | Noise Figure [2] | Application Circuit | 1.96 GHz | dB | - | 3.7 | - |
| $I_{DSS}$ | Saturated Drain Current | $V_{DS}$= $V_{DSP}$, $V_{GS}$= 0V | | mA | 816 | 1176 | 1536 |
| $g_m$ | Tranconductance | $V_{DS}$= $V_{DSP}$, $V_{GS}$= -0.25V | | mS | 576 | 792 | 1008 |
| $V_P$ | Pinch-Off Voltage [1] | $V_{DS}$= 2.0V, $I_{DS}$= 2.4mA | | V | -3.0 | -1.9 | -1.0 |
| $BV_{GS}$ | Gate-Source Breakdown Voltage [1] | $I_{GS}$= 4.8mA, drain open | | V | - | -17 | -15 |
| $BV_{GD}$ | Gate-Drain Breakdown Voltage [1] | $I_{GD}$= 4.8mA, $V_{GS}$= -5.0V | | V | - | -22 | -17 |
| Rth | Thermal Resistance | junction-to-lead | | °C/W | - | 23 | - |
| $V_{DS}$ | Operating Voltage [3] | drain-source | | V | - | - | 8.0 |
| $I_{DQ}$ | Operating Current [3] | drain-source, quiescent | | mA | - | - | 480 |
| $P_{DISS}$ | Power Dissipation [3] | | | C | - | - | 2.4 |



[1] 100% tested - Insertion gain tested using a 50 ohm 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, P1dB, and VSWR.
[3] Maximum recommended power dissipation is specified to maintain $T_J$<140C at $T_L$=85C. $V_{DS}$ * $I_{DQ}$ < 2.4W is recommended for continuous reliable operation.



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## Absolute Maximum Ratings

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

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

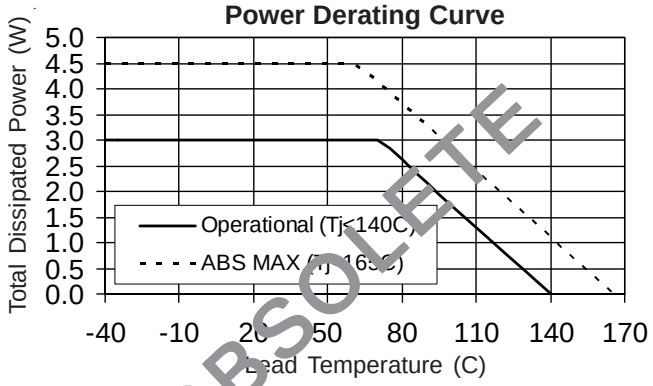
where:

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

MTTF @ $T_J$=150C exceeds 1E7 hours

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain Current | $I_{DS}$ | 640 | mA |
| Forward Gate Current | $I_{GSF}$ | 4.8 | mA |
| Reverse Gate Current | $I_{GSR}$ | 4.8 | mA |
| Drain-to-Source Voltage | $V_{DS}$ | 9.0 | V |
| Gate-to-Source Voltage | $V_{GS}$ | <-5 or >0 | V |
| RF Input Power | $P_{IN}$ | 800 | 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 1.






## Design Considerations and Trade-offs

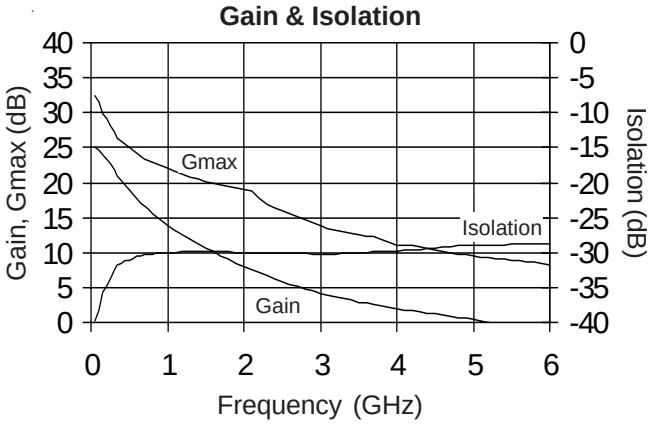
1. The SHF-0x89 is a depletion mode FET and requires a negative gate voltage. Normal pinchoff variation from part-to-part precludes the use of a fixed gate voltage for all devices. Active bias circuitry or manual gate bias alignment is recommended to maintain acceptable performance (RF and thermal).

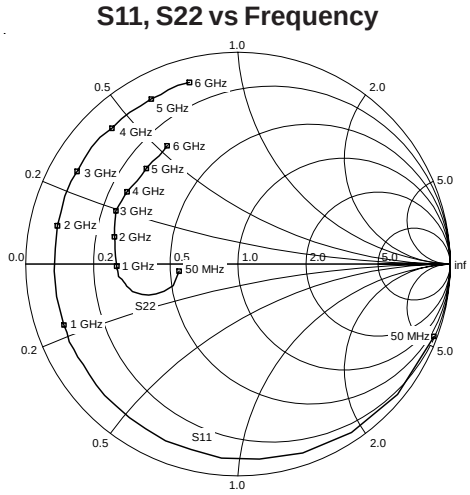
2. Active bias circuitry is strongly recommended for class A operation (backoff >6dB).

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 with temperature compensation. Per item 1 above the gate voltage should be aligned for each device to eliminate the effects of pinchoff process variation.

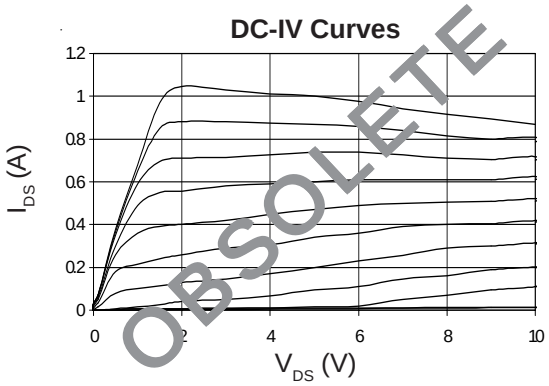
4. Choose the operating voltage based on the amount of backoff. For large signal operation the drain-source voltage should be increased to 8V to maximize P1dB. For small signal operation OIP3 may be improved by reducing the voltage and increasing the current. The recommended application circuit should 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 (shown on page 1).

## De-embedded S-Parameters ($Z_S$=$Z_L$=50 Ohms, $V_{DS}$=7V, $I_{DS}$=345mA, 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 (www.sirenza.com).




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



## Typical Performance - Engineering Application Circuits

| Freq (MHz) | $V_{DS}$ (V) | $I_{DQ}$ (mA) | P1dB (dBm) | -45dBc Channel Power (dBm) | -55dBc Channel Power (dBm) | OIP3[6] (dBm) | Gain (dB) | S11 (dB) | S22 (dB) | NF (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 900 | 7 | 345 | 32.0 | 25.7 [4] | 23.2 [4] | 45.0 | 16.3 | -20 | -10 | 3.6 |
| 1960 | 7 | 345 | 33.4 | 26.2 [4] | 23.2 [4] | 46.5 | 11.5 | -15 | -12 | 3.7 |
| 2140 | 7 | 345 | 32.7 | 23.7 [5] | 20.5 [5] | 46.4 | 11.1 | -15 | -12 | 4.4 |

[4] IS-95 CDMA Channel Power (9 Fwd Channels, 885kHz offset, 30kHz Adj Chan BW)
[5] W-CDMA Channel Power (64 DPCH, 5MHz offset, 3.84MHz Adj Chan BW)
[6] $P_{OUT}$= +15dBm per tone, 1MHz tone spacing

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

## Pin Description

| 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. [CRITICAL]
5. Thermal transfer paste should be used between the PCB and the mounting plate to improve heat spreading capability. [RECOMMENDED]

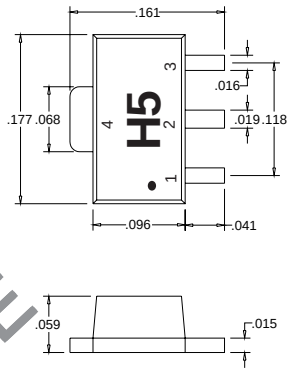
### Part Number Ordering Information

| Part Number | Reel Size | Devices/Reel |
|---|---|---|
| SHF-0589 | 7" | 1000 |

### Part Symbolization

The part will be symbolized with the "H5" designator and a dot signifying pin 1 on the top surface of the package.

### Package Dimensions




DIMENSIONS ARE IN INCHES

### Recommended Mounting Configuration for Optimum RF and Thermal Performance