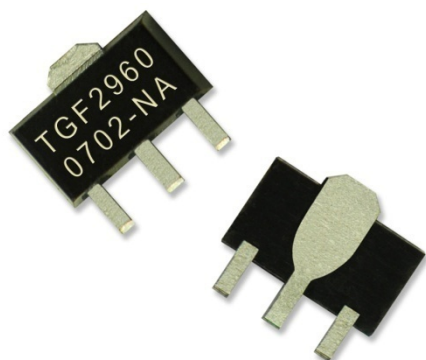
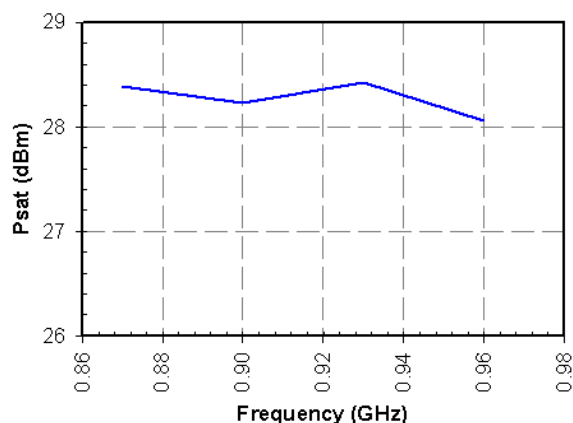
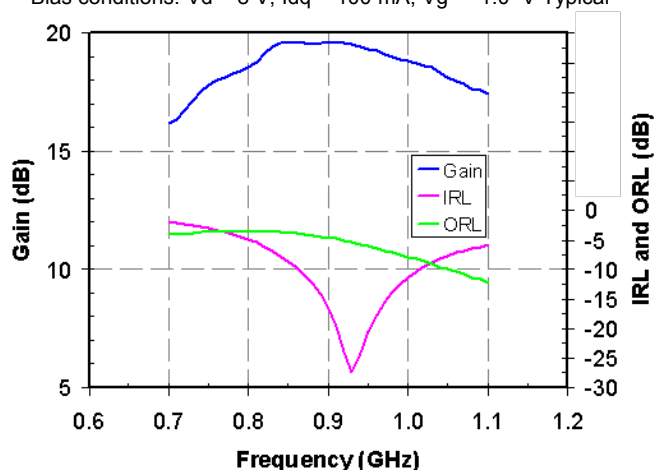


## 0.5 Watt DC-5 GHz Packaged HFET



### 900 MHz Application Board Performance

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



### Key Features

- Frequency Range: DC-5 GHz
- Nominal 900 MHz Application Board Performance:
  - TOI: 40 dBm
  - 28 dBm Psat, 27 dBm P1dB
  - Gain: 19 dB
  - Input Return Loss: -10 dB
  - Output Return Loss: -5 dB
  - Bias:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  (Typical)
  - Package Dimensions: 4.5 x 4 x 1.5 mm

### Primary Applications

- Cellular Base Stations
- WiMAX
- Wireless Infrastructure
- IF & LO Buffer Applications
- RFID

### Product Description

The TGF2960-SD is a high performance 1/2-watt Heterojunction GaAs Field Effect Transistor (HFET) housed in a low cost SOT89 surface mount package.

The device's ideal operating point is at a drain bias of 8 V and 100 mA. At this bias at 900 MHz when matched into 50 ohms using external components, this device is capable of 19 dB of gain, 28 dBm of saturated output power, and 40 dBm of output IP3.

Evaluation boards at 900 MHz, 1900 MHz and 2100 MHz available on request.

RoHS and Lead-Free compliant.

*Datasheet subject to change without notice.*

**Table I**  
**Absolute Maximum Ratings 1/**

| Symbol | Parameter                   | Value           | Notes |
|--------|-----------------------------|-----------------|-------|
| Vd-Vg  | Drain to Gate Voltage       | 17 V            |       |
| Vd     | Drain Voltage               | 9 V             | 2/    |
| Vg     | Gate Voltage Range          | -5 to 0 V       |       |
| Id     | Drain Current               | 390 mA          | 2/    |
| Ig     | Gate Current Range          | -2.4 to 17.8 mA |       |
| Pin    | Input Continuous Wave Power | 26 dBm          | 2/    |

- 1/ These ratings represent the maximum operable values for this device. Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device and / or affect device lifetime. These are stress ratings only, and functional operation of the device at these conditions is not implied.
- 2/ Combinations of supply voltage, supply current, input power, and output power shall not exceed the maximum power dissipation listed in Table IV.

**Table II**  
**Recommended Operating Conditions**

| Symbol | Parameter 1/          | Typical Value |
|--------|-----------------------|---------------|
| Vd     | Drain Voltage         | 8 V           |
| Idq    | Drain Current         | 100 mA        |
| Id     | Drain Current at Psat | 130 mA        |
| Vg     | Gate Voltage          | -1.0 V        |

- 1/ See assembly diagram for bias instructions.

**Table III**  
**Electrical Performance**

**Test conditions unless otherwise specified:**  $f_{in} = 900$  MHz, 25°C;  $V_d = 8V$ ,  $I_{dq} = 100$  mA,  $V_g = -1.0$  Typical; See test circuit for 900 MHz operation

| SYMBOL | PARAMETER                                       | MIn  | Nom | UNIT |
|--------|-------------------------------------------------|------|-----|------|
| Gain   | Small Signal Gain                               | 18   | 19  | dB   |
| P1dB   | Output Power @ 1dB Compression                  | 25.5 | 27  | dBm  |
| OTOI   | 3 <sup>rd</sup> Order Output Intercept Point 1/ | 37   | 40  | dBm  |

1/ 900 and 910 MHz, 16 dBm output power per tone

**Table IIIa**  
**RF Characterization Table**

**Bias: Vd = 8 V, Idq = 100 mA, Vg = -1.0 V, typical**

| SYMBOL | PARAMETER                      | TEST CONDITIONS | NOMINAL | UNITS | NOTES |
|--------|--------------------------------|-----------------|---------|-------|-------|
| Gain   | Small Signal Gain              | 900 MHz         | 19      | dB    | 1/    |
|        |                                | 1900 MHz        | 16      |       | 2/    |
|        |                                | 2100 MHz        | 15      |       | 3/    |
| IRL    | Input Return Loss              | 900 MHz         | -10     | dB    | 1/    |
|        |                                | 1900 MHz        | -10     |       | 2/    |
|        |                                | 2100 MHz        | -10     |       | 3/    |
| ORL    | Output Return Loss             | 900 MHz         | -5      | dB    | 1/    |
|        |                                | 1900 MHz        | -6      |       | 2/    |
|        |                                | 2100 MHz        | -6      |       | 3/    |
| Psat   | Saturated Output Power         | 900 MHz         | 28      | dBm   | 1/    |
|        |                                | 1900 MHz        | 28      |       | 2/    |
|        |                                | 2100 MHz        | 28      |       | 3/    |
| P1dB   | Output Power @ 1dB Compression | 900 MHz         | 27      | dBm   | 1/    |
|        |                                | 1900 MHz        | 27      |       | 2/    |
|        |                                | 2100 MHz        | 27      |       | 3/    |
| TOI    | Output TOI                     | 900 MHz         | 40      | dBm   | 1/    |
|        |                                | 1900 MHz        | 39      |       | 4/    |
|        |                                | 2100 MHz        | 39      |       | 5/    |
| NF     | Noise Figure                   | 900 MHz         | 3.7     | dB    | 1/    |
|        |                                | 1900 MHz        | 4.3     |       | 2/    |
|        |                                | 2100 MHz        | 4.3     |       | 3/    |

1/ Using 900 MHz Application Board

2/ Using 1900 MHz Application Board tuned for maximum output power

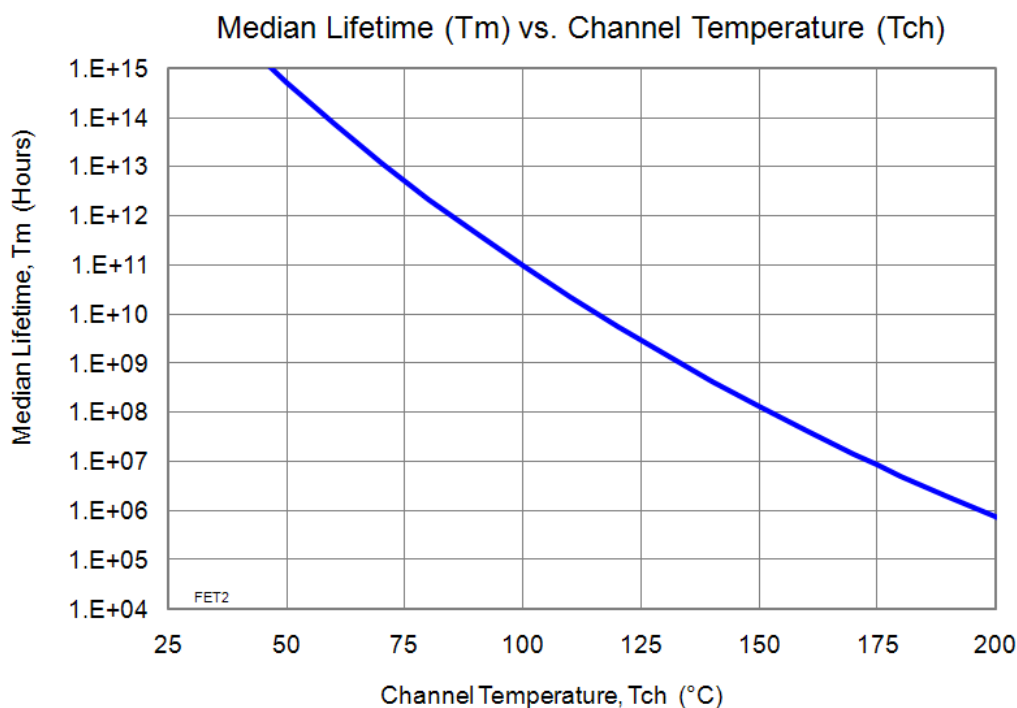
3/ Using 2100 MHz Application Board tuned for maximum output power

4/ Using 1900 MHz Application Board tuned for maximum TOI (reduces output power reduced by 1 dB)

5/ Using 2100 MHz Application Board tuned for maximum TOI (reduces output power reduced by 1 dB)

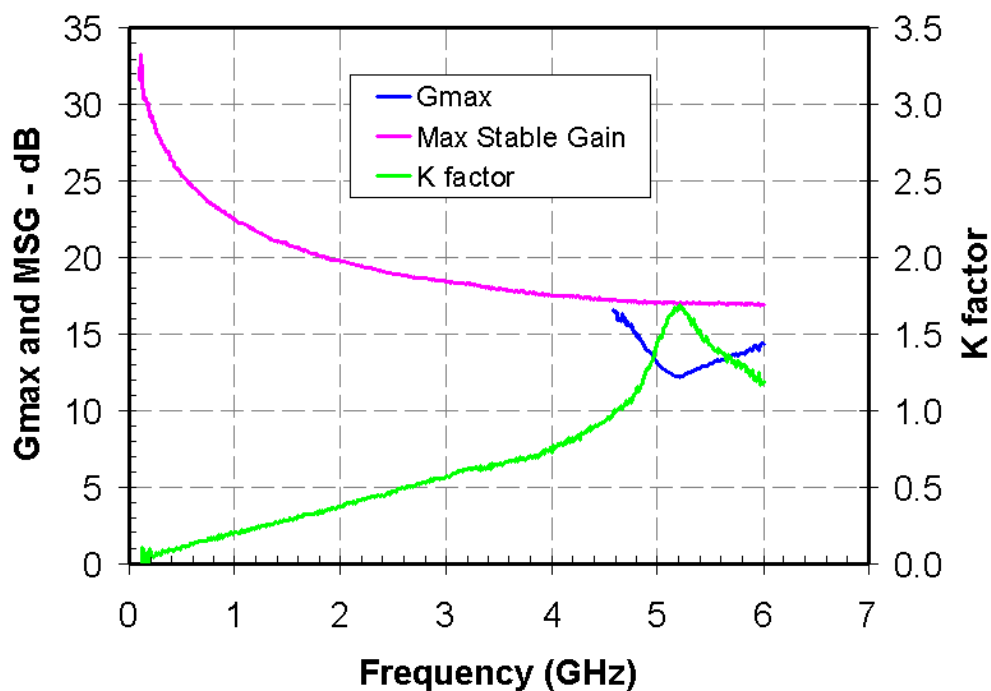
**Table IV**  
**Power Dissipation and Thermal Properties**

| Parameter                                    | Test Conditions                                                              | Value                                                                |
|----------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Maximum Power Dissipation                    | Tbaseplate = 70°C                                                            | Pd = 1.37 W<br>Tchannel = 175°C<br>Tm = 8.77E+06 Hrs                 |
| Thermal Resistance, $\theta_{jc}$            | Vd = 8 V<br>Id = 100 mA<br>Pd = 0.8 W<br>Tbaseplate = 85°C                   | $\theta_{jc} = 77$ (°C/W)<br>Tchannel = 146.5°C<br>Tm = 2.06E+08 Hrs |
| Thermal Resistance, $\theta_{jc}$<br>at Psat | Vd = 8 V<br>Id = 130 mA<br>Pout = 27 dBm<br>Pd = 0.54 W<br>Tbaseplate = 85°C | $\theta_{jc} = 77$ (°C/W)<br>Tchannel = 126°C<br>Tm = 2.48E+09 Hrs   |
| Mounting Temperature                         | See 'Typical Solder Reflow Profiles' Table                                   |                                                                      |
| Storage Temperature                          |                                                                              | -65 to 150°C                                                         |



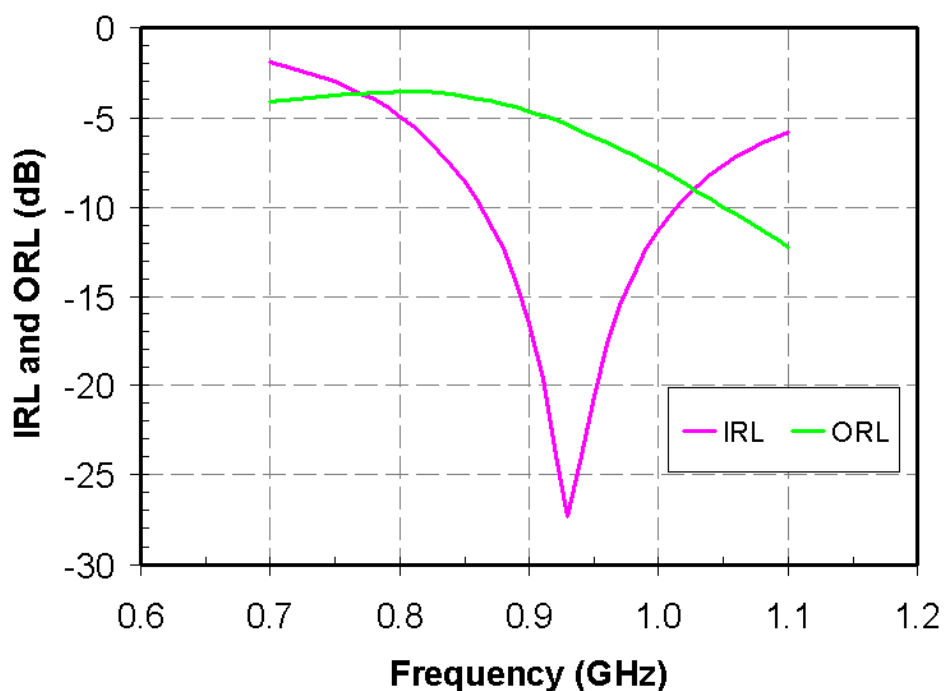
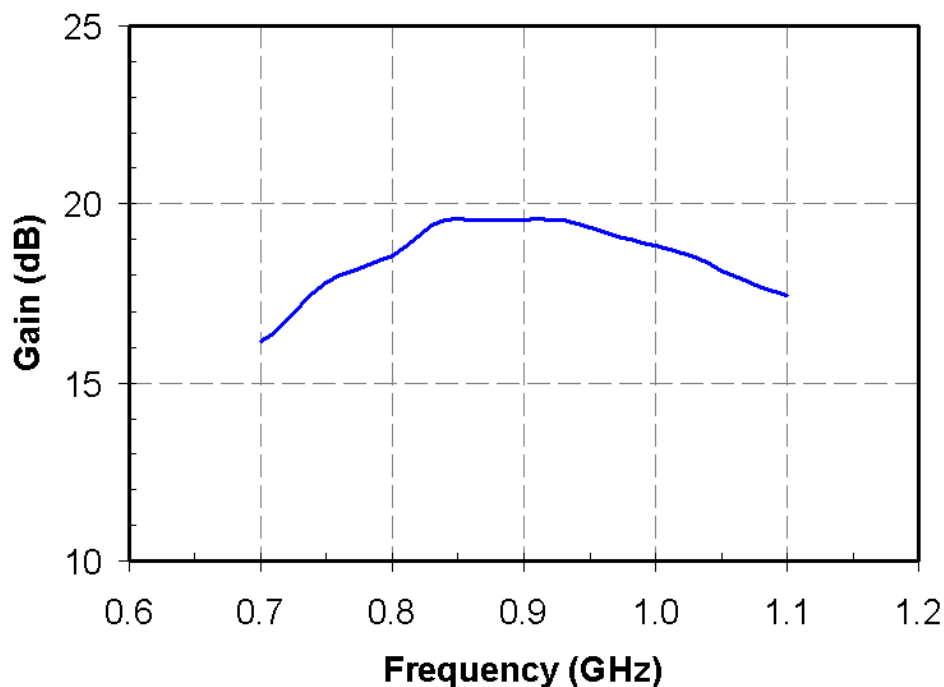
## Gmax, Max Stable Gain, K factor

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



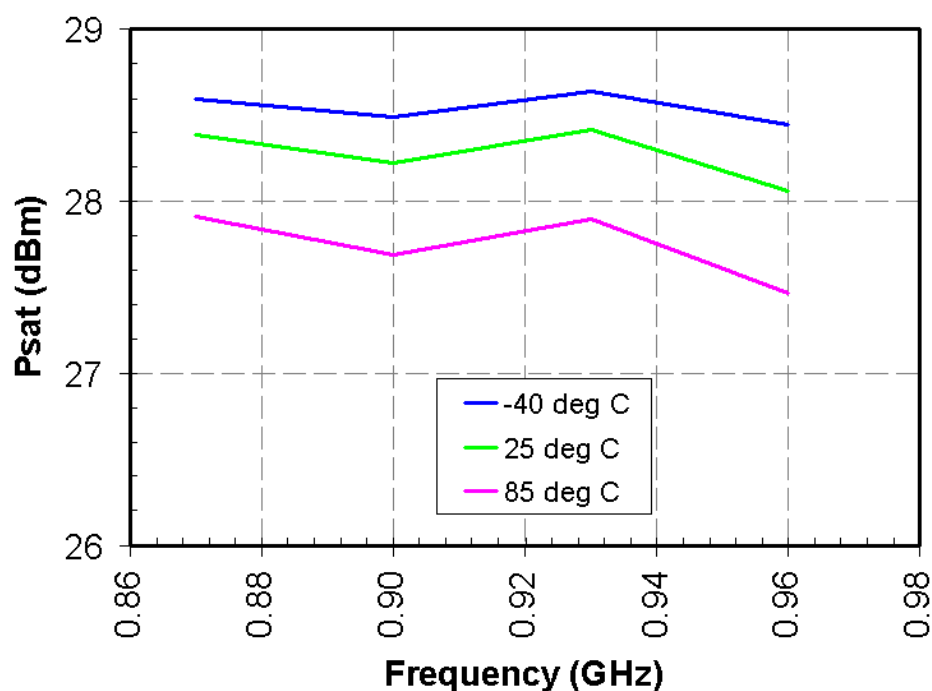
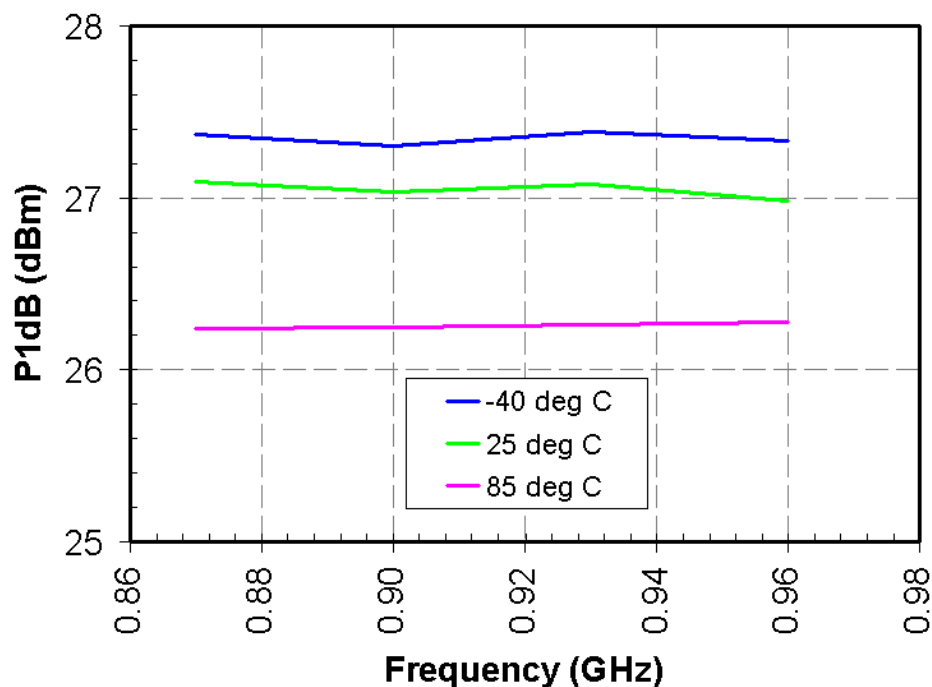
## Measured Data 900 MHz Application Board

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



## Measured Data 900 MHz Application Board

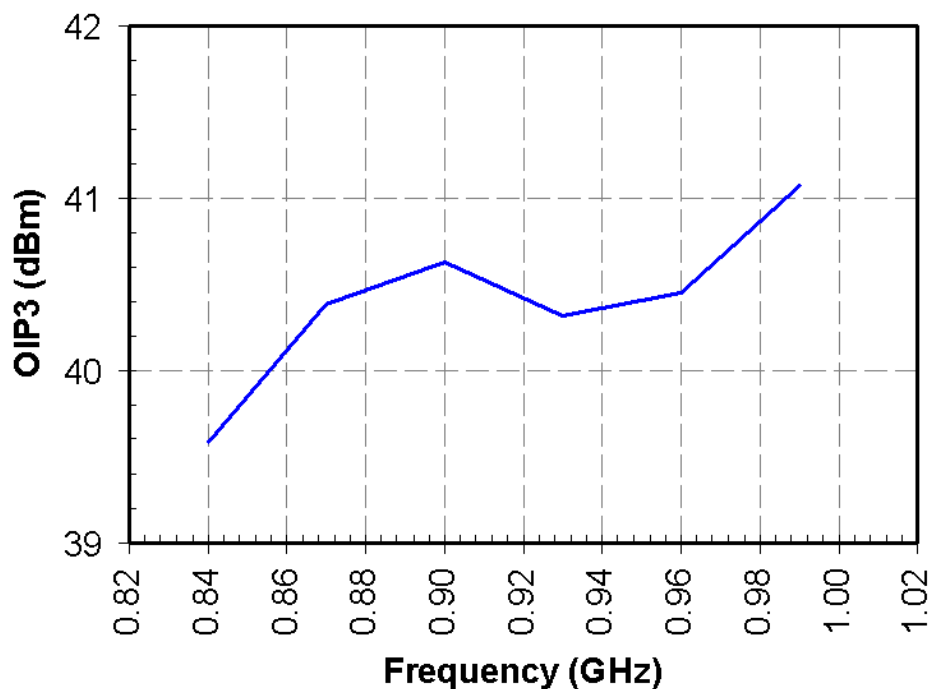
Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical





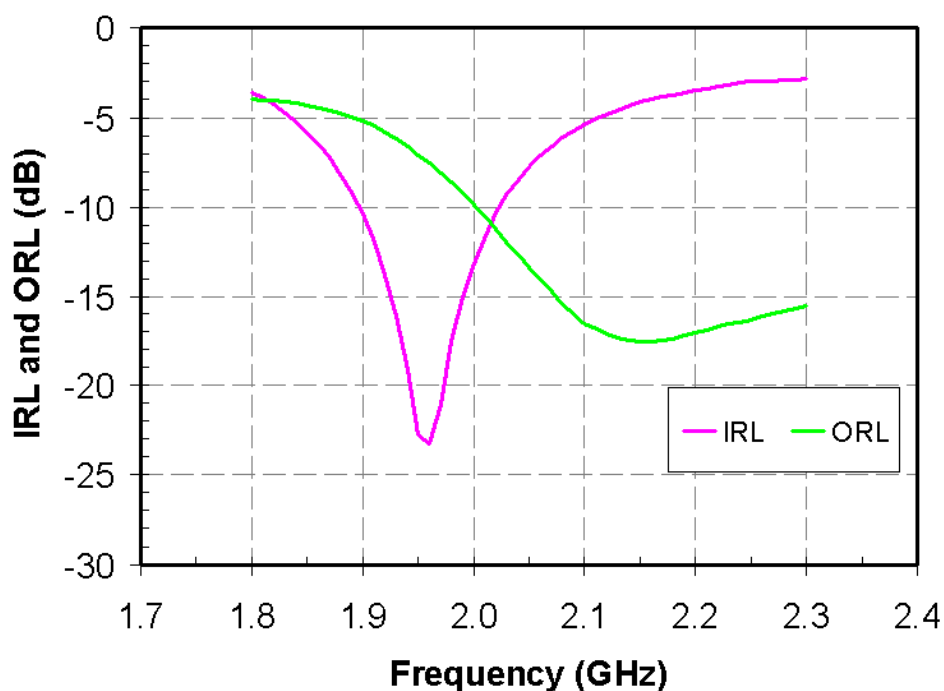
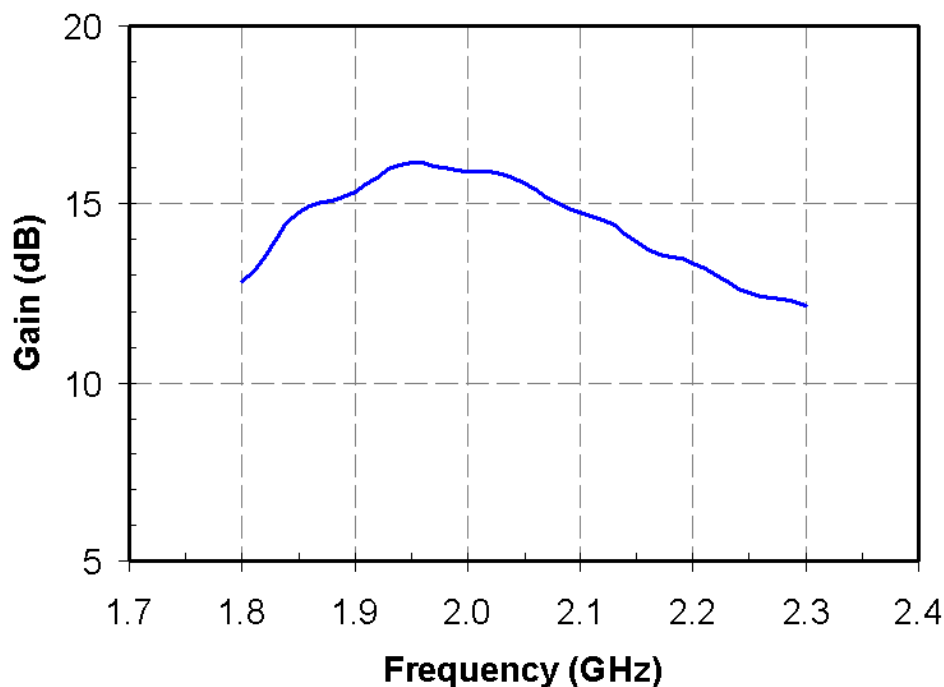
**Measured Data 900 MHz Application Board**

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



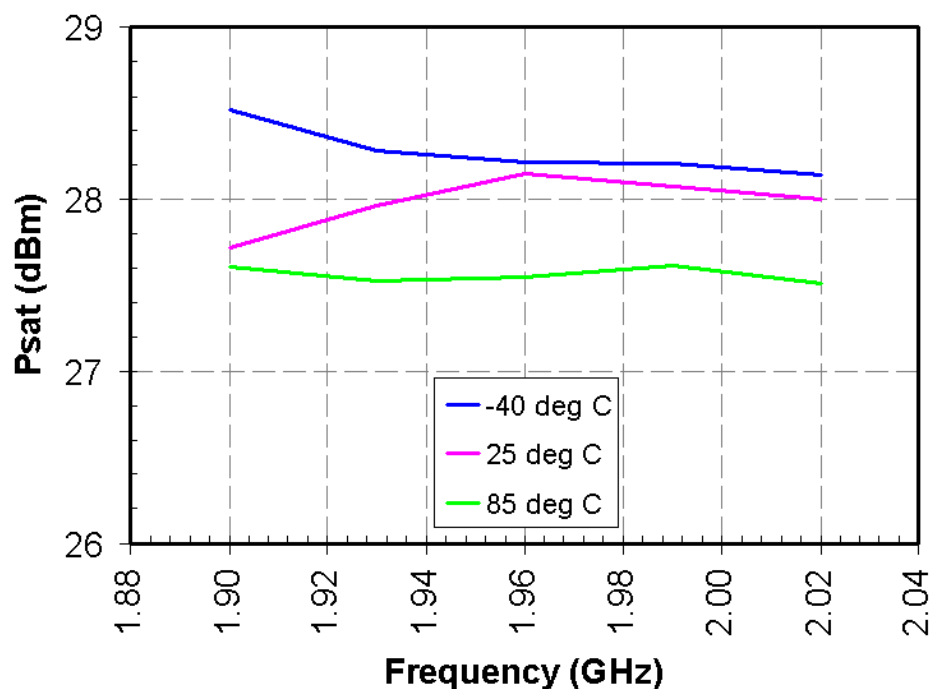
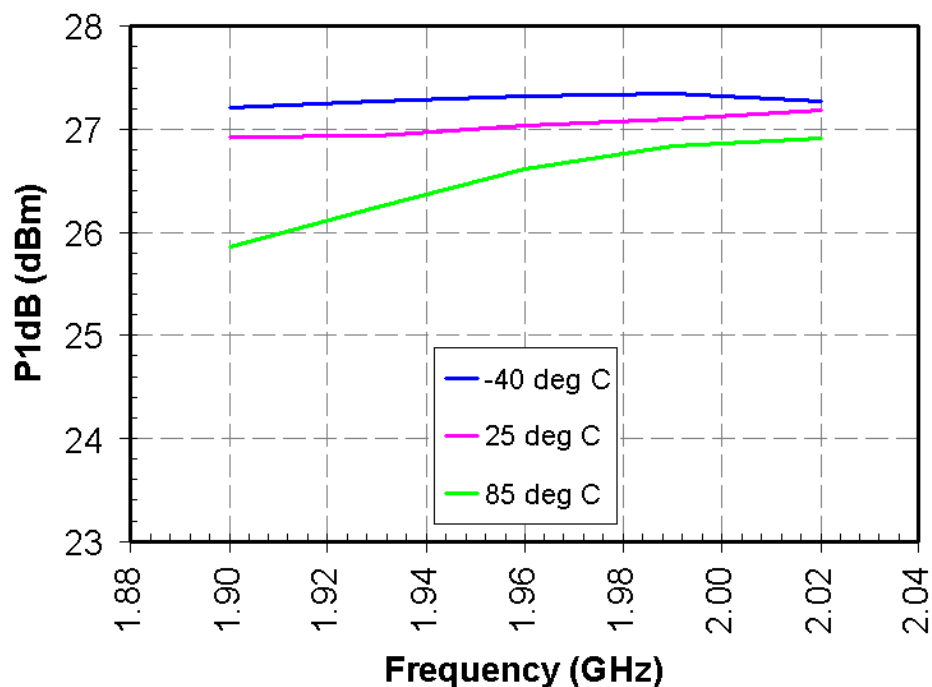
# Measured Data 1900 MHz Application Board

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



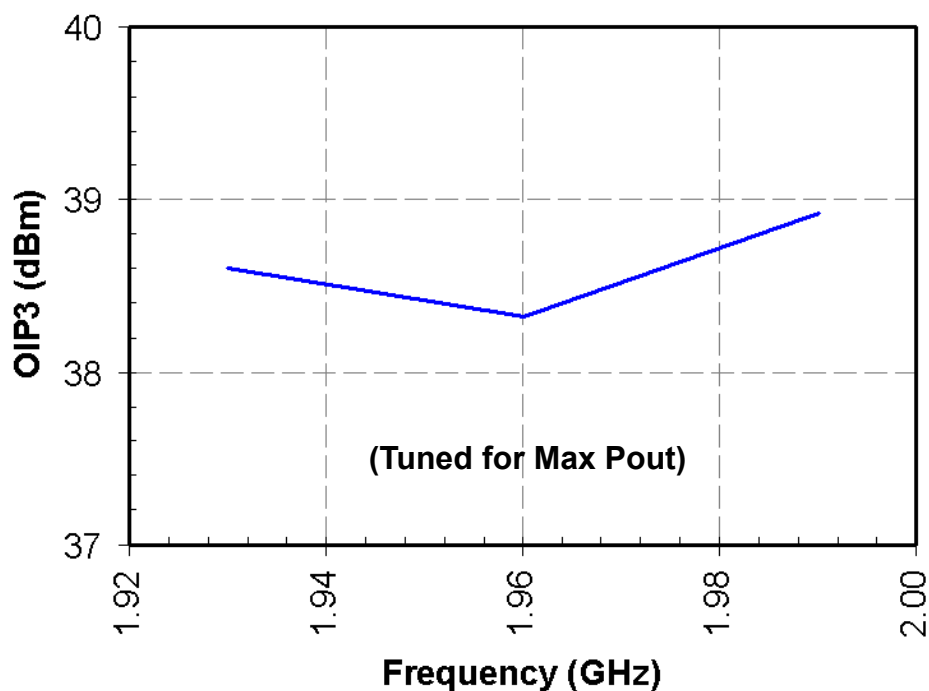
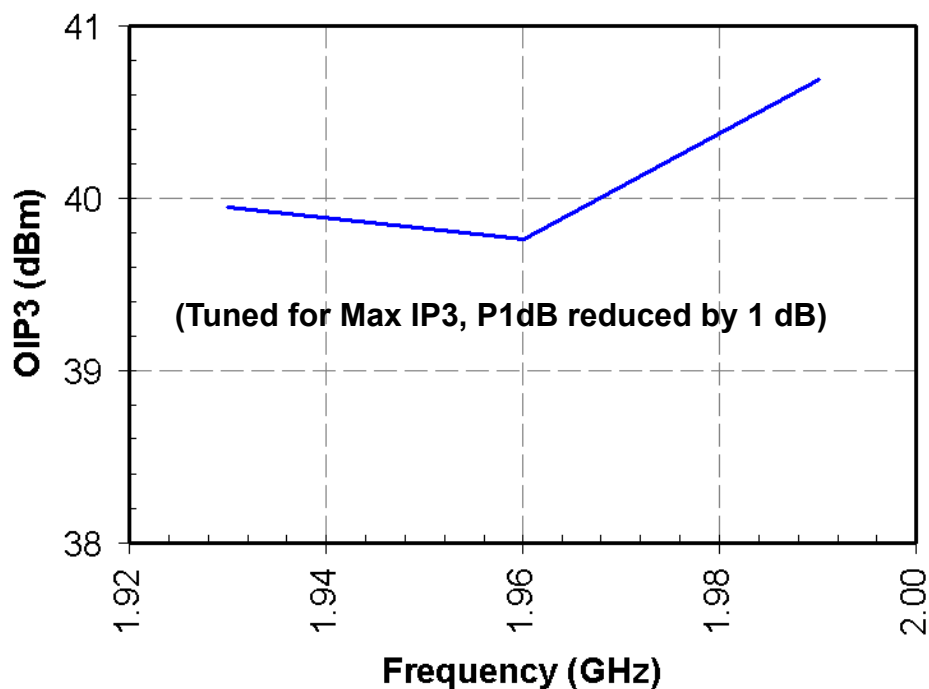
## Measured Data 1900 MHz Application Board

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



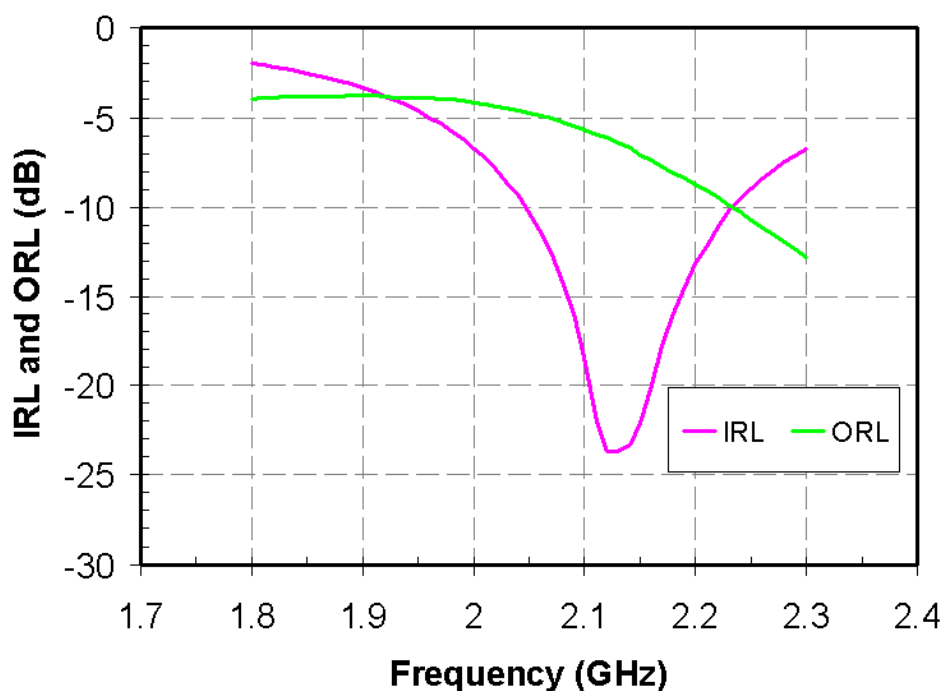
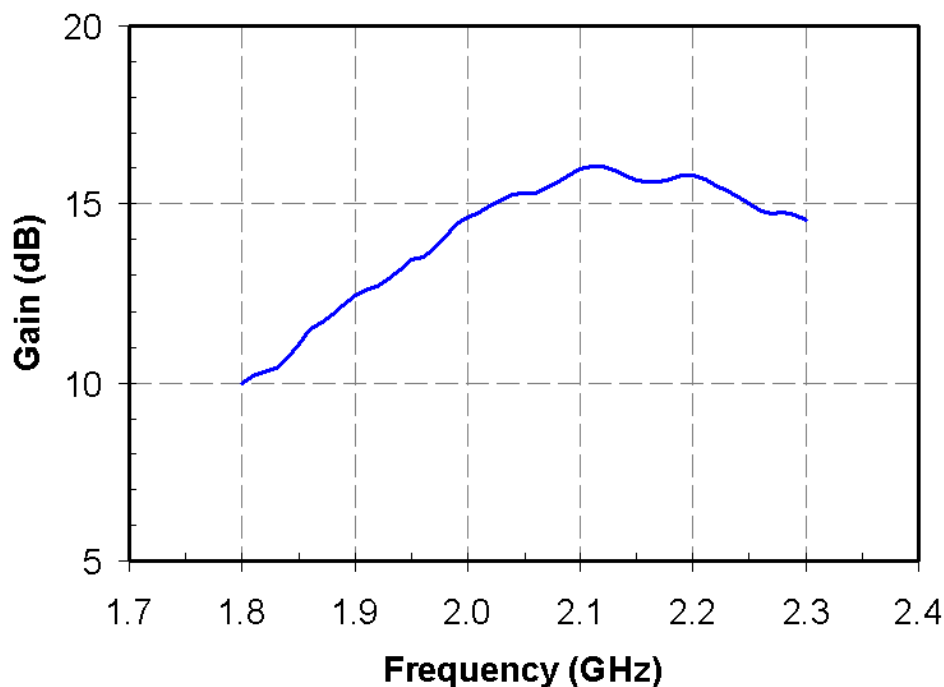
# Measured Data 1900 MHz Application Board

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



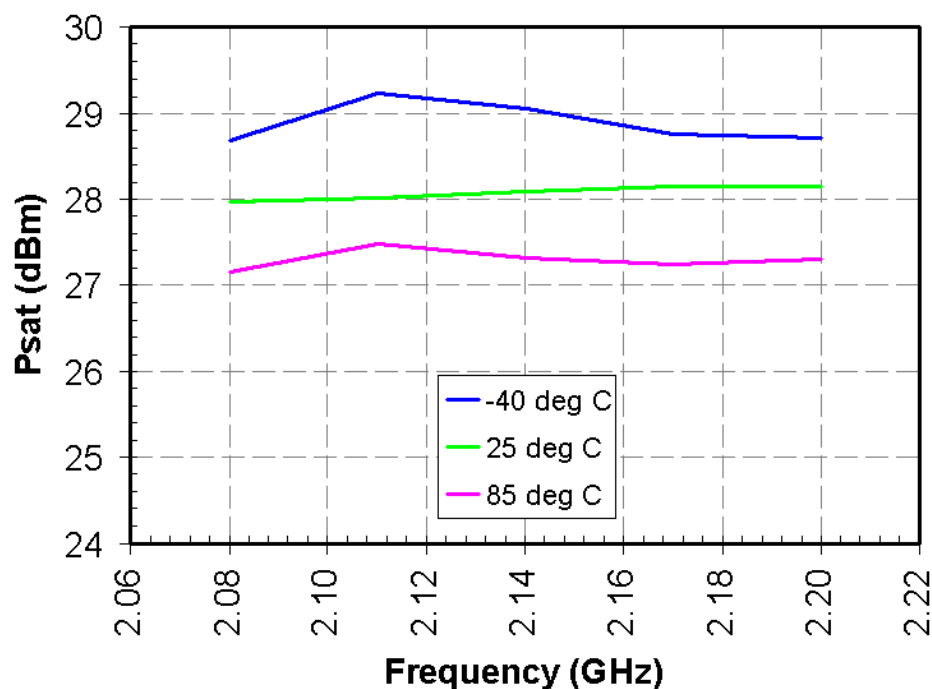
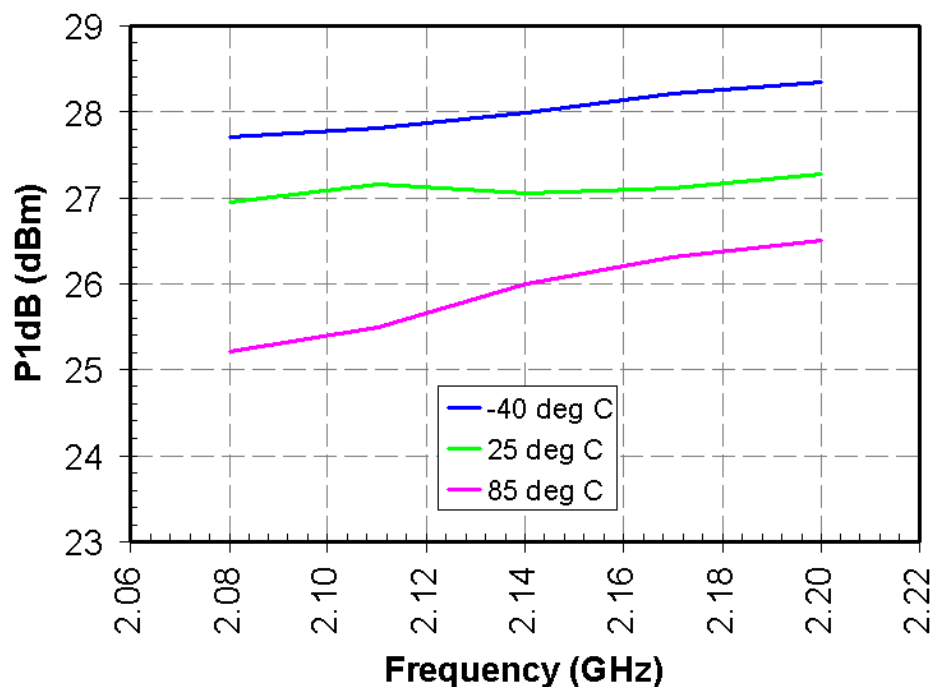
# Measured Data 2100 MHz Application Board

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



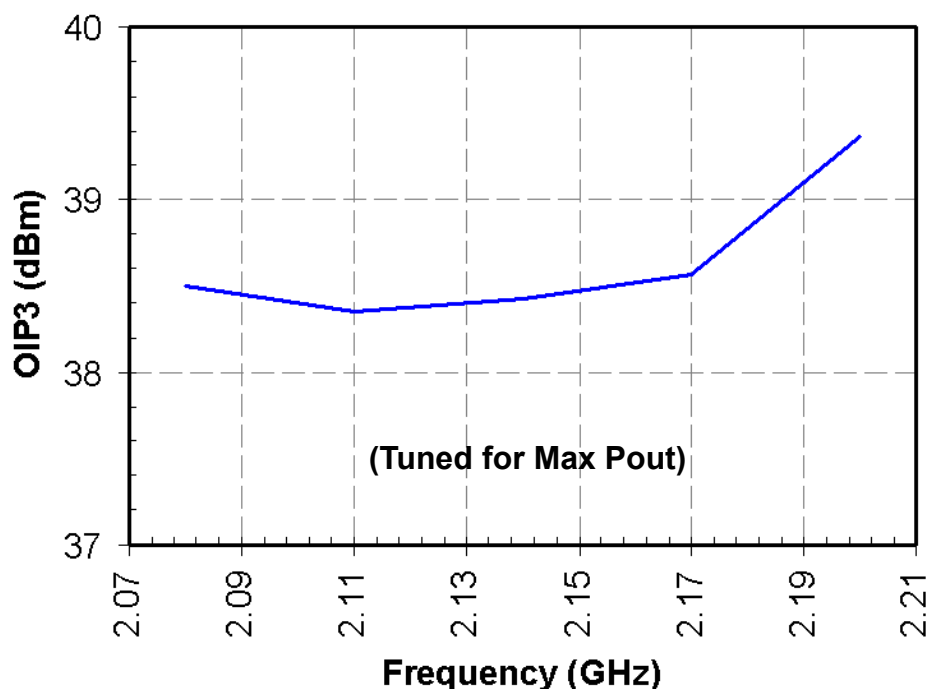
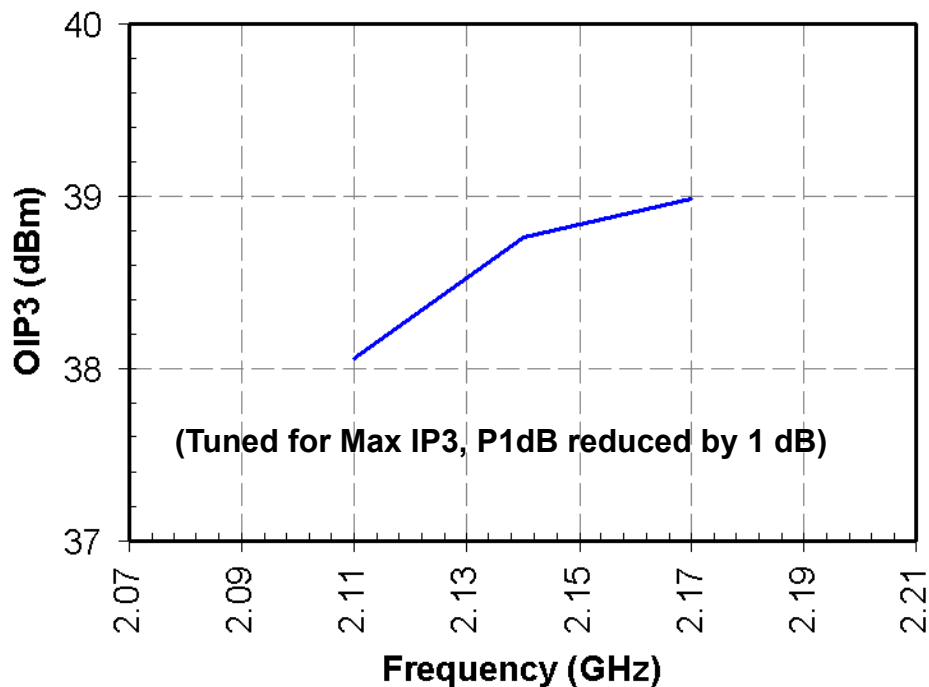
## Measured Data 2100 MHz Application Board

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical

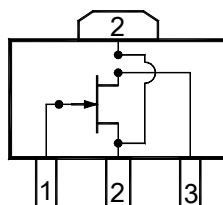


## Measured Data 2100 MHz Application Board

Bias conditions:  $V_d = 8\text{ V}$ ,  $I_{dq} = 100\text{ mA}$ ,  $V_g = -1.0\text{ V}$  Typical



## Electrical Schematic



| Pin | Signal         |
|-----|----------------|
| 1   | RF In (Gate)   |
| 2   | Gnd (Source)   |
| 3   | RF Out (Drain) |

## Bias Procedures

### Bias-up Procedure

- Vg set to -2.5 V
- Vd set to +8 V
- Adjust Vg more positive until Idq is 100 mA. This will be  $\sim Vg = -1.0 V$
- Apply RF signal to input

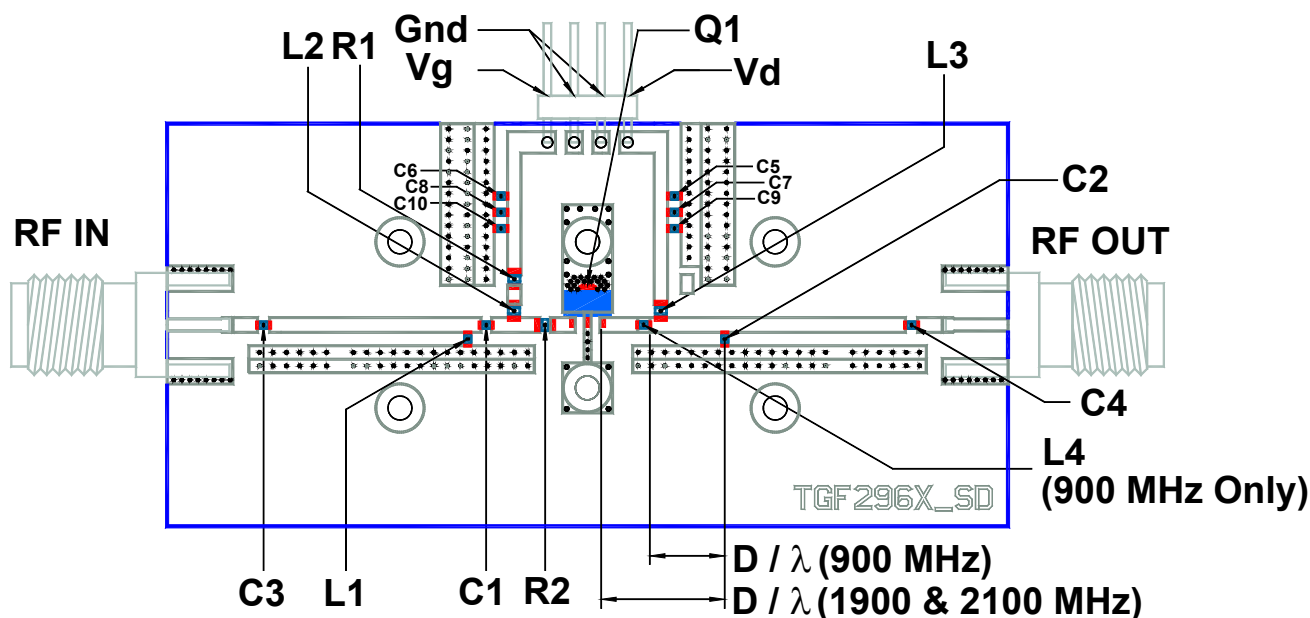
### Bias-down Procedure

- Turn off RF signal at input
- Reduce Vg to -2.5V. Ensure Id  $\sim 0$  mA
- Turn Vd to 0 V
- Turn Vg to 0 V

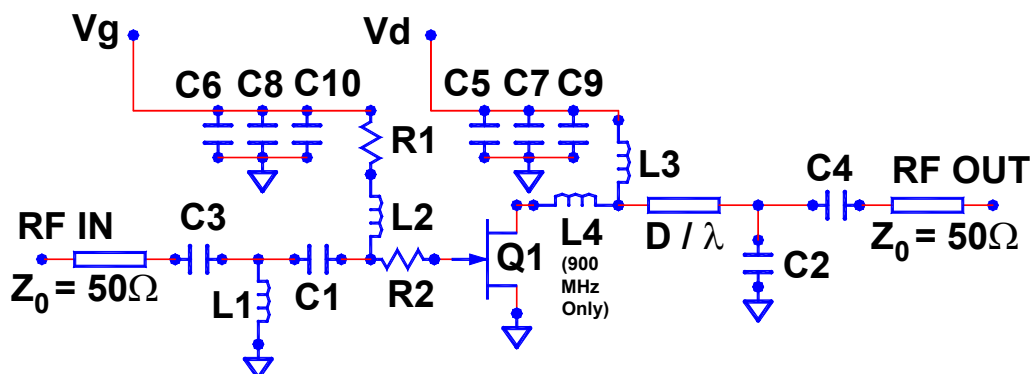




## Evaluation Board



## Evaluation Board Schematic



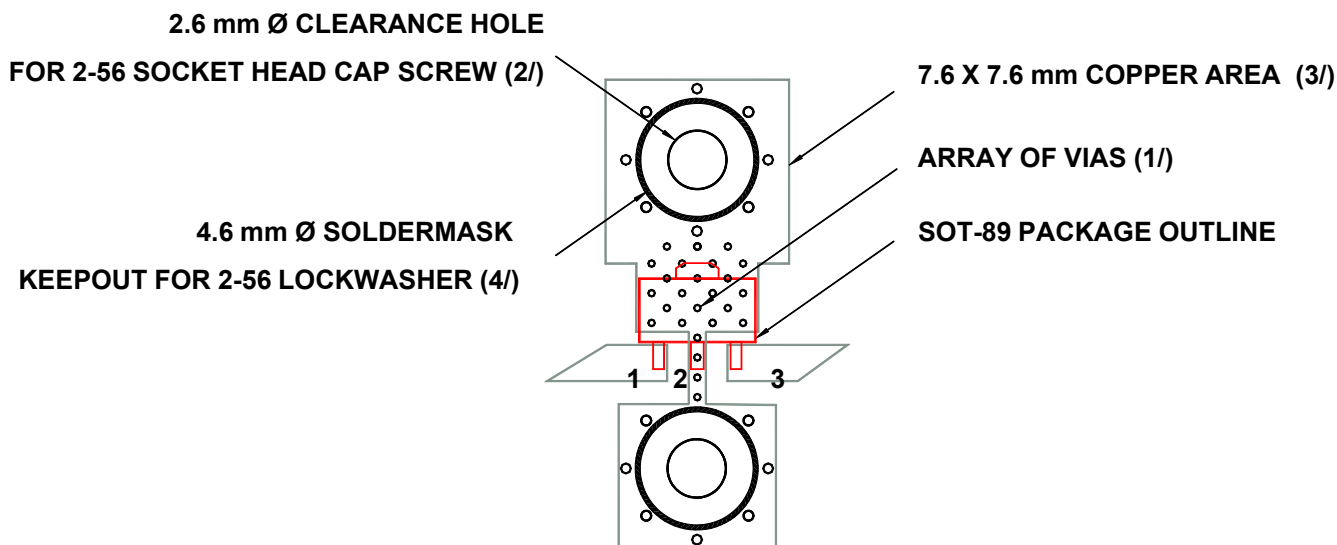
**GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.**

## Evaluation Board Bill of Materials

| Ref Des   | Value for Freq (MHz) |             |             | Description                                         |
|-----------|----------------------|-------------|-------------|-----------------------------------------------------|
|           | 900                  | 1900        | 2100        |                                                     |
| L1        | 4.7 nH               | 1.2 nH      | 1.5 nH      | 0603 ACCU-L AVX Inductor                            |
| C1        | 22 pF                | 1.2 pF      | 1.2 pF      | 0603 ACCU-P AVX Capacitor                           |
| C2        | 0.7 pF               | 0.6 pF      | 0.6 pF      | 0603 ACCU-P AVX Capacitor                           |
| D         | 18.8 mm              | 14.2 mm     | 5.8 mm      | Physical Location for C2                            |
| D         | 18.8 mm              | 14.2 mm     | 5.8 mm      | Physical Location for C2 for maximum power          |
| $\lambda$ | 36°@0.9 GHz          | 58°@1.9 GHz | 26°@2.1 GHz | 50 Ohm Transmission Line Length D for maximum power |
| D         | 18.8 mm              | 17.2 mm     | 9.6 mm      | Physical Location for C2 for maximum TOI            |
| $\lambda$ | 36°@0.9 GHz          | 70°@1.9 GHz | 39°@2.1 GHz | 50 Ohm Transmission Line Length D for maximum TOI   |
| L2, L3    | 50 nH                |             |             | 0805 Inductor                                       |
| L4        | 1.2 nH               | --          | --          | 0603 ACCU-L AVX Inductor                            |
| C3,C4     | 150 pF               |             |             | 0603 Capacitor                                      |
| C5, C6    | 0.1 $\mu$ F          |             |             | 0603 Capacitor                                      |
| C7, C8    | 0.01 $\mu$ F         |             |             | 0603 Capacitor                                      |
| C9, C10   | 1000 pF              |             |             | 0603 Capacitor                                      |
| R1        | 50 Ohms              |             |             | 0805 1/8 Watt Resistor                              |
| R2        | 11 Ohms              | 3 Ohms      | 5.1 Ohms    | 0805 1/8 Watt Resistor                              |
| Q1        | --                   |             |             | TriQuint TGF2960-SD Packaged FET                    |
| (PCB)     | --                   |             |             | 28 mil thick GETEK                                  |

**GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.**

## Recommended Assembly Diagram



## Assembly Notes

1/ The lowest possible thermal and electrical resistance for Pin 2 is critical for optimal performance. The array of vias under Pin 2 should be as small and as dense as the PC board fabrication permits. 0.30 mm diameter vias on 0.60 mm center to center spacing is recommended.

2/ Mounting screws in the vicinity of the package improve heat transfer to the chassis or to a heat spreader located on the backside of the PC board. Shown are clearance holes and solder mask keepout zone for a 2-56 socket head cap screw. Use of a split lockwasher and proper torque on the screw will prevent compression damage to the PC board.

3/ Use of 1 oz copper (min) in the PC board construction is recommended.

4/ For lowest thermal resistance, solder mask must be removed where the copper traces on the PC board contact the heat spreader. In this example, this would be a) front and backsides of the PC board around the 2-56 screw and b) front of the PC board around package pin 2.

***GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.***

## Recommended Surface Mount Package Assembly

Proper ESD precautions must be followed while handling packages.

Clean the board with acetone. Rinse with alcohol. Allow the circuit to fully dry.

TriQuint recommends using a conductive solder paste for attachment. Follow solder paste and reflow oven vendors' recommendations when developing a solder reflow profile. Typical solder reflow profiles are listed in the table below.

Hand soldering is not recommended. Solder paste can be applied using a stencil printer or dot placement. The volume of solder paste depends on PCB and component layout and should be well controlled to ensure consistent mechanical and electrical performance.

Clean the assembly with alcohol.

### Typical Solder Reflow Profiles

| Reflow Profile                       | SnPb                        | Pb Free                     |
|--------------------------------------|-----------------------------|-----------------------------|
| Ramp-up Rate                         | 3 °C/sec                    | 3 °C/sec                    |
| Activation Time and Temperature      | 60 – 120 sec @ 140 – 160 °C | 60 – 180 sec @ 150 – 200 °C |
| Time above Melting Point             | 60 – 150 sec                | 60 – 150 sec                |
| Max Peak Temperature                 | 240 °C                      | 260 °C                      |
| Time within 5 °C of Peak Temperature | 10 – 20 sec                 | 10 – 20 sec                 |
| Ramp-down Rate                       | 4 – 6 °C/sec                | 4 – 6 °C/sec                |

### Ordering Information

| Part                      | Package Style         |
|---------------------------|-----------------------|
| TGF2960-SD, TAPE AND REEL | SOT-89, TAPE AND REEL |