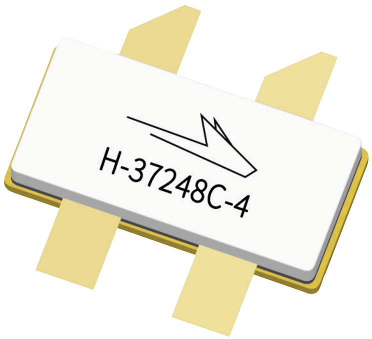
# GTRA364002FC

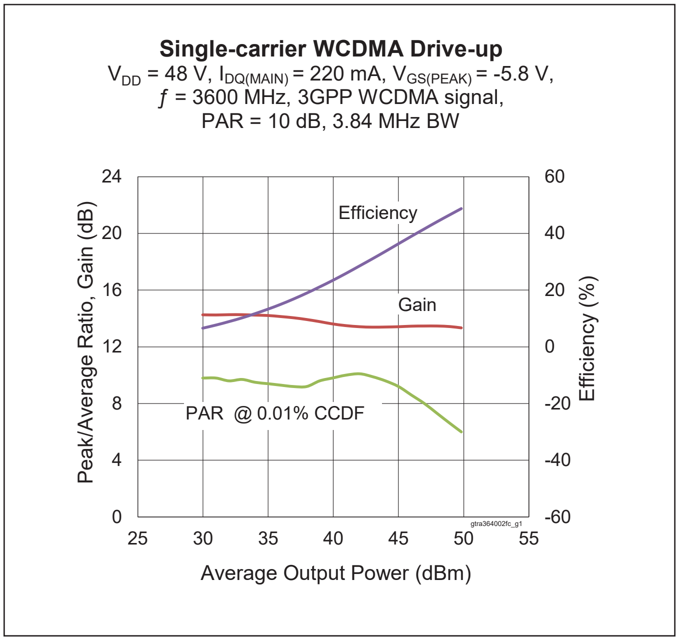
## Thermally-Enhanced High Power RF GaN on SiC HEMT
## 400 W, 48 V, 3400 – 3600 MHz




Package Types: H-37248C-4

### Description

The GTRA364002FC is a 400-watt ($P_{3dB}$) GaN on SiC high electron mobility transistor (HEMT) designed for use in multi-standard cellular power amplifier applications. It features input matching, high efficency, and a thermally-enhanced package with earless flange.




### Features

- GaN on SiC HEMT technology
- Input matched
- Asymmetrical Doherty design
  - Main: $P_{3dB}$ = 170 W Typ
  - Peak: $P_{3dB}$ = 230 W Typ
- Typical Pulsed CW performance, 3400 to 3600 MHz, 48 V, combined outputs, Doherty @ $P_{3dB}$, 10 µs, 10% duty cycle
  - Output power = 400 W
  - Efficiency = 60 %
  - Gain = 14 dB
- Capable of handling 10:1 VSWR @ 48 V, 50 W (WCDMA) output power
- Human Body Model Class 1A, (per ANSI/ESDA/ JEDEC JS-001)
- Low thermal resistance
- Pb-free and RoHS compliant

## RF Characteristics

**Single-carrier WCDMA Specifications** (tested in Wolfspeed Doherty production test fixture)
$V_{DD}$ = 48 V, $I_{DQ}$ = 220 mA, $P_{OUT}$ = 50 W avg, $V_{GS(PEAK)}$ = $V_{GS}$ @ $I_{DQ}$ = 200 mA – 2.7 V, $f$ = 3600 MHz, 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

| Characteristic | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Gain | $G_{ps}$ | 12 | 13 | — | dB |
| Drain Efficiency | $\eta_D$ | 36 | 40 | — | % |
| Adjacent Channel Power Ratio | ACPR | — | –30 | –27 | dBc |
| Output PAR @ 0.01% CCDF | OPAR | 6.4 | 7.7 | — | dB |

Note:
All published data at $T_{CASE}$ = 25°C unless otherwise indicated
ESD: Electrostatic discharge sensitive device—observe handling precautions!

RoHS compliant



4600 Silicon Drive | Durham, NC 27703 | Tel: +1.919.313.5300

## DC Characteristics

| Characteristic | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Drain-source Breakdown Voltage (Main) | $V_{BR(DSS)}$ | 150 | — | — | V | $V_{GS}$ = -8 V, $I_D$ = 3 mA |
| Drain-source Breakdown Voltage (Peak) | | | | | | $V_{GS}$ = -8 V, $I_D$ = 4 mA |
| Drain-source Leakage Current | $I_{DSS}$ | — | — | 5 | mA | $V_{GS}$ = -8 V, $V_{DS}$ = 10 V |
| Gate Threshold Voltage (main) | $V_{GS(th)}$ | −3.8 | −3.0 | −2.3 | V | $V_{DS}$ = 10 V, $I_D$ = 21.6 mA |
| Gate Threshold Voltage (peak) | | | | | | $V_{DS}$ = 10 V, $I_D$ = 28.8 mA |

## Recommended Operating Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | 0 | — | 50 | V | |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | -3.7 | −2.9 | -2.1 | | $V_{DS}$ =48 V, $I_D$ = 220 mA |

## Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-source Voltage | $V_{DSS}$ | 125 | V |
| Gate-source Voltage | $V_{GS}$ | −10 to +2 | |
| Operating Voltage | $V_{DD}$ | 55 | |
| Gate Current (main) | $I_G$ | 21.6 | mA |
| Gate Current (peak) | | 28.8 | |
| Drain Current (main) | $I_D$ | 8.1 | A |
| Drain Current (peak) | | 10.8 | |
| Junction Temperature | $T_J$ | 225 | °C |
| Storage Temperature Range | $T_{STG}$ | −65 to +150 | |

Operation above the maximum values listed here may cause permanent damage. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the component. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. For reliable continuous operation, the device should be operated within the operating voltage range ($V_{DD}$) specified above.

## Thermal Characteristics

| Characteristics | Symbol | Value | Unit | Conditions |
|---|---|---|---|---|
| Thermal Resistance (main) | $R_{\theta JC}$ | 1.55 | °C/W | $T_{CASE}$ = 70 °C, 101 W DC |
| Thermal Resistance (peak) | | 1.20 | | $T_{CASE}$ = 70 °C, 130 W DC |

## Ordering Information

| Type and Version | Order Code | Package | Shipping |
|---|---|---|---|
| GTRA364002FC V1 R0 | GTRA364002FC-V1-R0 | H-37248C-4 | Tape & Reel, 50 pcs |
| GTRA364002FC V1 R2 | GTRA364002FC-V1-R2 | H-37248C-4 | Tape & Reel, 250 pcs |


4600 Silicon Drive | Durham, NC 27703 | Tel: +1.919.313.5300

## Typical Performance (data taken in test fixture)

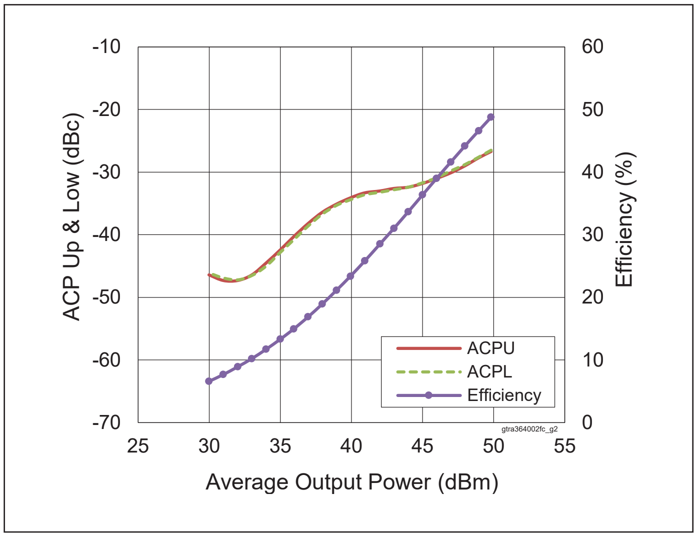



**Figure 1.** Single-carrier WCDMA Drive-up

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 220 mA, $V_{GS(PEAK)}$ = -5.8 V,
*f* = 3600 MHz, 3GPP WCDMA signal,
PAR = 10 dB, BW = 3.84 MHz

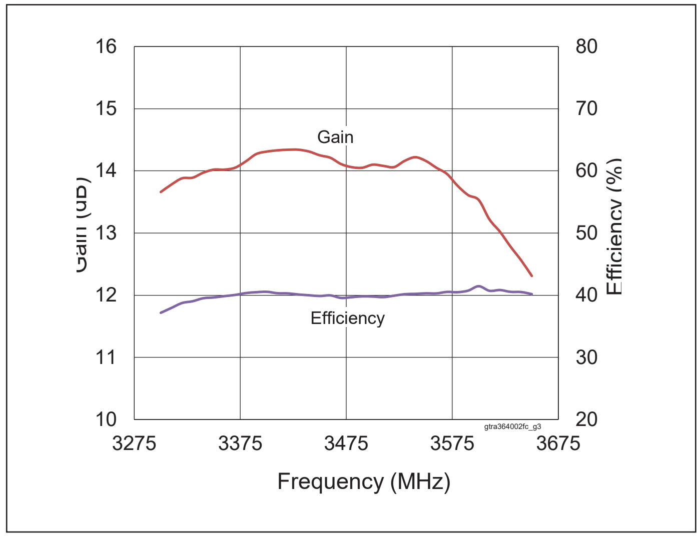



**Figure 2.** Single-carrier WCDMA Broadband Performance

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 220 mA, $V_{GS(PEAK)}$ =- 5.8 V,
$P_{OUT}$ = 47 dBm, 3GPP WCDMA signal,
PAR = 10 dB

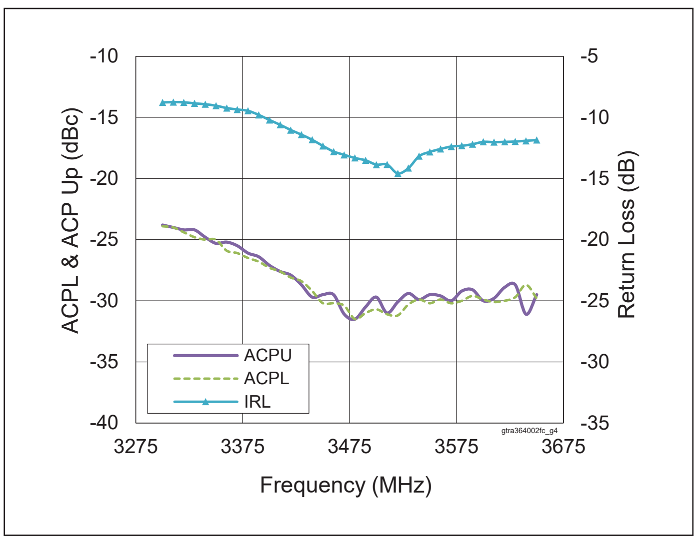



**Figure 3.** Single-carrier WCDMA Broadband Performance

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 220 mA, $V_{GS(PEAK)}$ = -5.8 V,
$P_{OUT}$ = 47 dBm, 3GPP WCDMA signal,
PAR = 10 dB

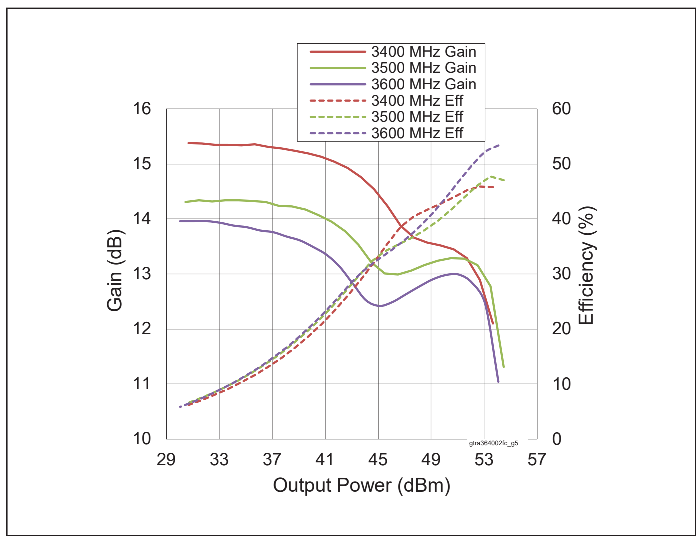



**Figure 4.** CW Performance

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 220 mA,
$V_{GS(PEAK)}$ = -5.8 V

## Typical Performance (cont.)

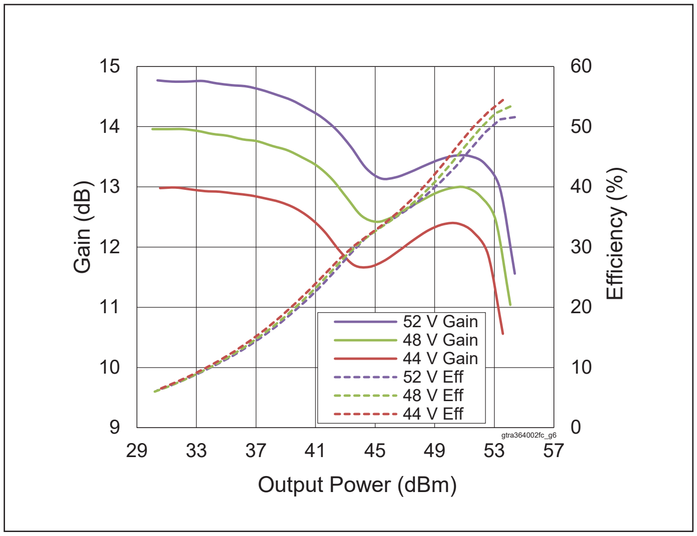



**Figure 5.** CW Performance at various $V_{DD}$

$I_{DQ(MAIN)}$ = 220 mA, $V_{GS(PEAK)}$ = -5.8 V,
$f$ = 3600 MHz

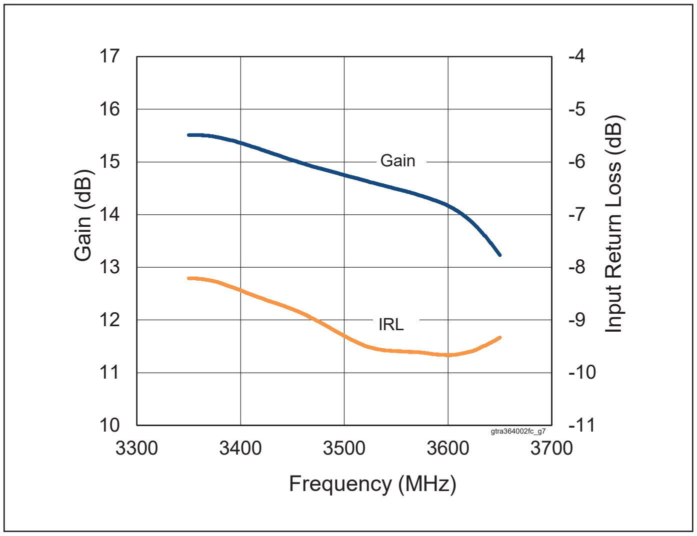



**Figure 6.** CW Performance Small Signal Gain & Input Return Loss

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 220 mA, $V_{GS(PEAK)}$= -5.8 V

## Load Pull Performance

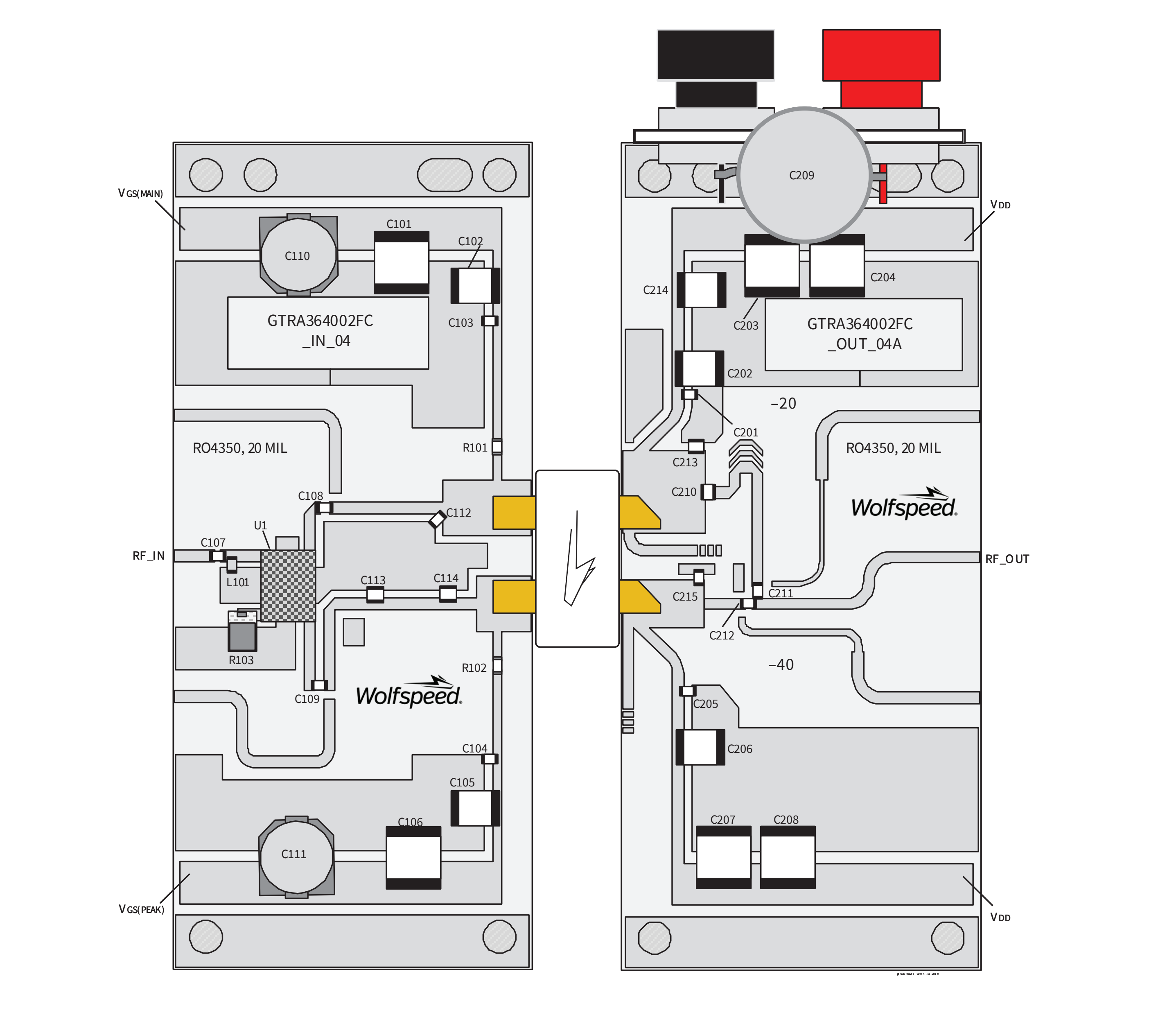
**Main Side Load Pull Performance –** Pulsed CW signal: 10 µs, 10% duty cycle, 48 V, $I_{DQ}$ = 220 mA, class AB

| | | $P_{3dB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Max Output Power** | | | | | **Max Drain Efficiency** | | | | |
| Freq [MHz] | Zs [Ω] | Zl [Ω] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | ηD [%] | Zl [Ω] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | ηD [%] |
| 3400 | 9.0-j3.4 | 4.3-j6.5 | 15.3 | 53.90 | 245 | 62.5 | 1.7-j3.5 | 17.3 | 52.40 | 174 | 74.0 |
| 3500 | 5.0-j5.2 | 3.8-j7.0 | 15.4 | 54.00 | 251 | 63.9 | 2.2-j5.0 | 17.4 | 52.10 | 162 | 76.0 |
| 3600 | 3.5-j7.0 | 4.4-j7.1 | 14.9 | 53.80 | 240 | 61.2 | 2.4-j5.2 | 16.8 | 52.10 | 162 | 74.0 |

**Peak Side Load Pull Performance –** Pulsed CW signal: 10 µs, 10% duty cycle, 48 V, $I_{DQ}$ = 280 mA, class AB

| | | $P_{3dB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Max Output Power** | | | | | **Max Drain Efficiency** | | | | |
| Freq [MHz] | Zs [Ω] | Zl [Ω] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | ηD [%] | Zl [Ω] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | ηD [%] |
| 3400 | 16.5-j22 | 3.1-j6.2 | 15.6 | 55.10 | 324 | 59.0 | 2.1-j4.4 | 17.8 | 53.70 | 234 | 70.0 |
| 3500 | 20-j13 | 2.8-j6.6 | 15.8 | 55.10 | 324 | 59.5 | 1.9-j4.7 | 18.3 | 53.00 | 200 | 69.0 |
| 3600 | 15.7-j7.4 | 3.7-j6.8 | 15.3 | 54.90 | 309 | 56.0 | 2.0-j4.8 | 17.5 | 53.00 | 200 | 66.0 |

## Evaluation Board, 3400 – 3600 MHz




Reference circuit assembly diagram (not to scale)

| | |
|---|---|
| Evaluation Board Part Number | LTA/GTRA364002FC-V1 |
| PCB Information | Rogers 4350, 0.508 mm [0.020”] thick, 2 oz. copper, $\varepsilon_r$ = 3.66, $f$ = 3400 – 3600 MHz |

Find Gerber files for this test fixture on the Wolfspeed Web site at www.wolfspeed.com/RF

## Components Information

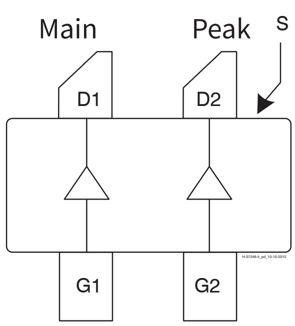
| Component | Description | Manufacturer | P/N |
|---|---|---|---|
| Input | | | |
| C101, C106 | Capacitor, 10 µF, 100 V | TDK Corporation | C5750X7S2A106M230KB |
| C102, C105 | Capacitor, 1 µF | TDK Corporation | C4532X7R2A105M230KA |
| C103, C104, C107, C108, C109 | Capacitor, 10 pF | ATC | ATC800A100JT250T |
| C110, C111 | Capacitor, 100 µF, 35 V | Panasonic Electronic Components | EEE-FT1V101AP |
| C112, C114 | Capacitor, 0.2 pF | ATC | ATC800A0R2BT250T |
| C113 | Capacitor, 0.8 pF | ATC | ATC800A0R8CT250T |
| L101 | Inductor, 4.7 nH | EPCOS (TDK) | B82496C3479J000 |
| R101, R102 | Resistor, 10 ohms | Panasonic Electronic Components | ERJ-3GEYJ100V |
| R103 | Resistor, 50 ohms | Richardson | C8A50Z4A |
| U1 | Hybrid Coupler | Anaren | XC3500P-03S |
| Output | | | |
| C201, C205, C211, C212 | Capacitor, 10 pF | ATC | ATC800A100JT250T |
| C202, C206, C214 | Capacitor, 1 µF | TDK Corporation | C4532X7R2A105M230KA |
| C203, C204, C207, C208 | Capacitor, 10 µF, 100 V | TDK Corporation | C5750X7S2A106M230KB |
| C209 | Capacitor, 220 µF, 100 V | Panasonic Electronic Components | ECA-2AHG221 |
| C210 | Capacitor, 1 pF | ATC | ATC800A1R0CT250T |
| C213 | Capacitor, 0.2 pF | ATC | ATC800A0R2BT250T |
| C215 | Capacitor, 0.6 pF | ATC | ATC800A0R6CT250T |

## Bias Sequencing

**Bias ON**
1. Ensure RF is turned off
2. Apply pinch-off voltage of –5 V to the gate
3. Apply nominal drain voltage
4. Bias gate to desired quiescent drain current
5. Apply RF

**Bias OFF**
1. Turn RF off
2. Apply pinch-off voltage to the gate
3. Turn-off drain voltage
4. Turn-off gate voltage

## Pinout Diagram (top view)




| Pin | Description |
|---|---|
| D1 | Drain Device 1 (Main) |
| D2 | Drain Device 2 (Peak) |
| G1 | Gate Device 1 (Main) |
| G2 | Gate Device 2 (Peak) |
| S | Source (flange) |

## Package Outline Specifications – Package H-37248C-4

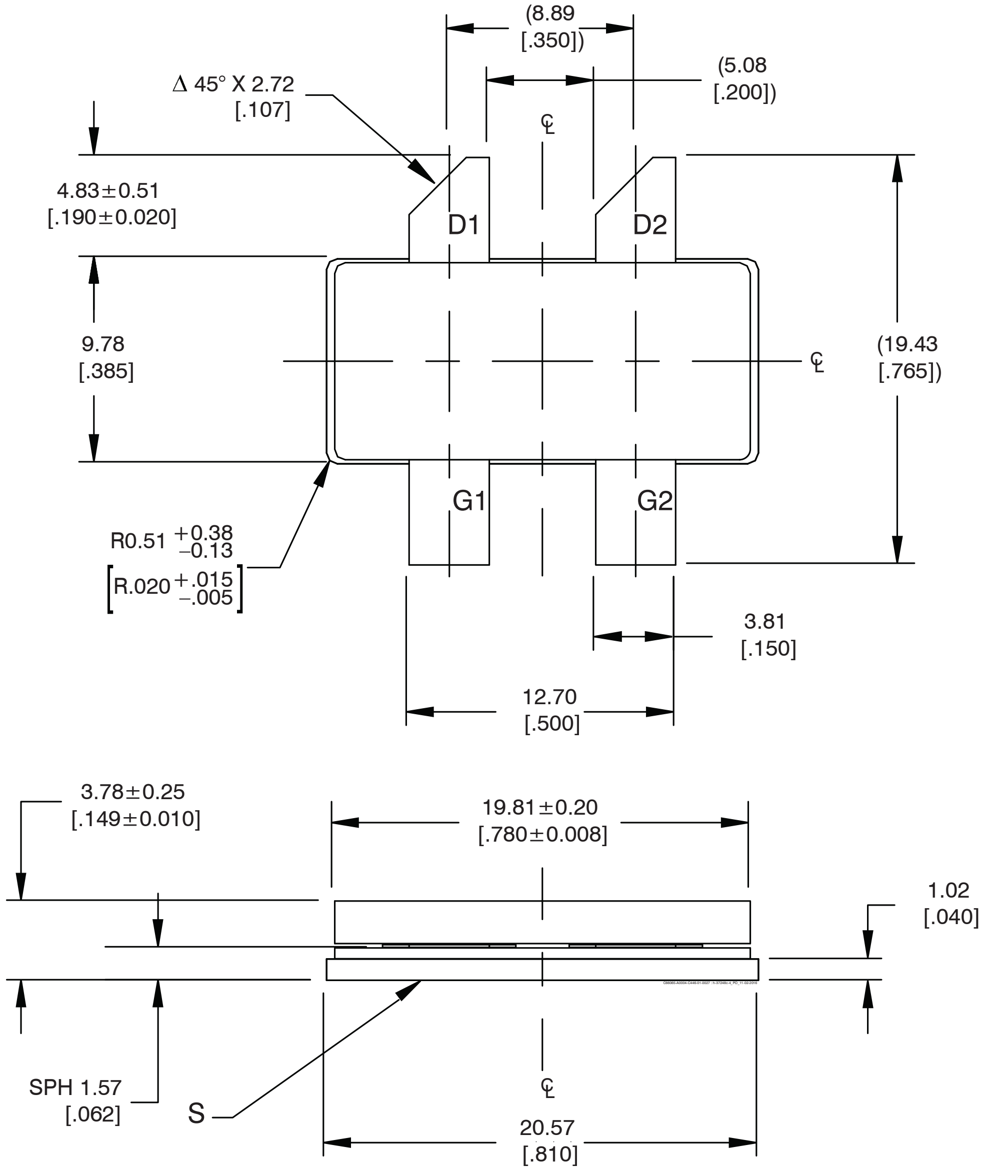



Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994
2. Primary dimensions are mm, alternate dimensions are inches
3. All tolerances ± 0.127 [0.005]
4. Pins: D1, D2 – drain, G1, G2 – gate, S – source (flange)
5. Lead thickness: 0.13 ± 0.05 [0.005 ± 0.002]
6. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch]

**For more information, please contact:**

4600 Silicon Drive
Durham, NC 27703 USA
Tel: +1.919.313.5300
www.wolfspeed.com/RF

Sales Contact
RFSales@wolfspeed.com

RF Product Marketing Contact
RFMarketing@wolfspeed.com

## Notes & Disclaimer

Specifications are subject to change without notice. "Typical" parameters are the average values expected by Wolfspeed in large quantities and are provided for information purposes only. Wolfspeed products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death. No responsibility is assumed by Wolfspeed for any infringement of patents or other rights of third parties which may result from use of the information contained herein. No license is granted by implication or otherwise under any patent or patent rights of Wolfspeed.




© 2022 Wolfspeed, Inc. All rights reserved. Wolfspeed® and the Wolfstreak logo are registered trademarks and the Wolfspeed logo is a trademark of Wolfspeed, Inc.
The information in this document is subject to change without notice.