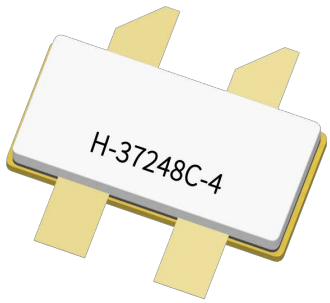
# GTRB226002FC

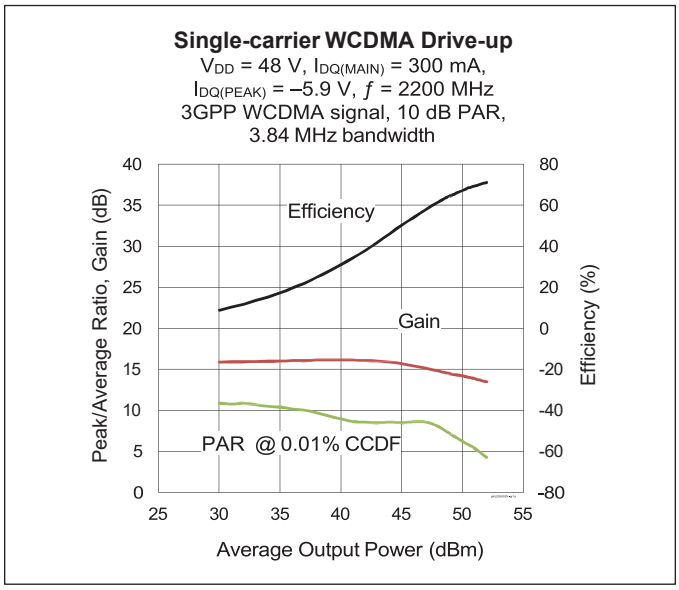
## Thermally-Enhanced High Power RF GaN on SiC HEMT
## 450 W, 48 V, 2110 – 2200 MHz




Package Types: H-37248C-4
PN: GTRB226002FC

### Description

The GTRB226002FC is a 450-watt ($P_{3dB}$) GaN on SiC high electron mobility transistor (HEMT) for use in multi-standard cellular power amplifier applications. It features high efficiency, and a thermally-enhanced package with earless flange.




### Features

- GaN on SiC HEMT technology
- Typical pulsed CW performance: 10 µs pulse width, 10% duty cycle, 2200 MHz, 48 V, Doherty fixture
  - Efficiency = 65%
  - Gain = 14 dB
  - Output power at $P_{3dB}$ = 450 W
- Human Body Model Class 1B (per ANSI/ESDA/JEDEC JS-001)
- Low thermal resistance
- Pb-free and RoHS compliant

## Typical RF Characteristics

**Single-carrier WCDMA Speci ications** (tested in the evaluation board for 2110 – 2200 MHz)
$V_{DD}$ = 48 V, $I_{DQ}$ = 300 mA, $V_{GS(PEAK)}$ = –5.9 V, $P_{OUT}$ = 80 W avg, 3GPP signal, channel bandwidth = 3.84 MHz, input PAR = 10 dB @ 0.01% CCDF

| | $P_{OUT}$ (dBM) | Gain (dB) | Efficiency (%) | OPAR (dB) | –ALT1 (dBc) | ALT1 (dBc) |
|---|---|---|---|---|---|---|
| 2110 | 49.0 | 14.9 | 60.9 | 8 | –27.1 | –27.0 |
| 2155 | 49.0 | 14.9 | 62.4 | 8 | –27.4 | –27.3 |
| 2200 | 49.0 | 14.4 | 65.7 | 7 | –27.0 | –27.1 |

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

RoHS compliant





Rev. 05, 2022-03-18

## DC Characteristics

| Characteristic | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Drain-source Breakdown Voltage (main) | $V_{(BR)DSS}$ | 150 | — | — | V | $V_{GS}$ = –8 V, $I_D$ = 10 mA |
| Drain-source Breakdown Voltage (peak) | | | | | | |
| Drain-source Leakage Current (main) | $I_{DSS}$ | — | — | 4.4 | mA | $V_{GS}$ = –8 V, $V_{DS}$ = 10 V |
| Drain-source Leakage Current (peak) | | | | 8.8 | | |
| Gate-source Leakage Current (main) | $I_{GSX}$ | — | — | -7.0 | | $V_{GS}$ = –8 V, $V_{DS}$ = 50 V |
| Gate-source Leakage Current (peak) | | | | -15 | | |
| Gate Threshold Voltage (main) | $V_{GS(th)}$ | –3.8 | –3.05 | -2.3 | V | $V_{DS}$ = 10 V, $I_D$ = 25 mA |
| Gate Threshold Voltage (peak) | | | | | | $V_{DS}$ = 10 V, $I_D$ = 50 mA |

## Recommended Operating Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | 0 | — | 50 | V | |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | -3.6 | -2.9 | -2.1 | | $V_{DS}$ = 48 V, $I_D$ = 300 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) | $I_G$ | 25 | mA |
| Gate Current (peak) | | 50 | |
| Drain Current (main) | $I_D$ | 9.5 | A |
| Drain Current (peak) | | 19 | |
| Junction Temperature | $T_J$ | 275 | ˚C |
| Storage Temperature Range | $T_{STG}$ | –65 to +150 | |

[1] 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.
[2] Product's qualifications were performed at 225˚C. Operation at $T_j$ = 275 ˚C reduces mean time to failure.

## Thermal Characteristics

Thermal resistance, junction to case ($T_{CASE}$ = 85˚C)

| Parameter | Symbol | Value | Unit | Conditions |
|---|---|---|---|---|
| Thermal Resistance (main) | $R_{\theta JC}$ | 1.4 | ˚C/W | $T_{CASE}$ = 85 ˚C, $P_{DISS}$ = 100 W DC |
| Thermal Resistance (peak) | | 1.0 | | $T_{CASE}$ = 85 ˚C, $P_{DISS}$ = 143 W DC |

## Ordering Information

| Type and Version | Order Code | Package Description | Shipping |
|---|---|---|---|
| GTRB226002FC V1 R0 | GTRB226002FC-V1-R0 | H-37248C-4, earless flange | Tape & Reel, 50 pcs |
| GTRB226002FC V1 R2 | GTRB226002FC-V1-R2 | H-37248C-4, earless flange | Tape & Reel, 250 pcs |

## RF Characteristics

**Single-carrier WCDMA Speci ications** (tested in the Doherty production test fixture) $V_{DD}$ = 48 V, $I_{DQ}$ = 300 mA, $V_{GS(PEAK)}$ = $V_{GS}$ @ $I_{DQ}$ = 600 mA –2.4 V, $P_{OUT}$ = 80 W avg, $f$ = 2200 MHz 3GPP signal, channel bandwidth = 3.84 MHz, input PAR = 10 dB @ 0.01% CCDF

| Characteristic | Symbol | Min. | Typ | Max | Unit |
|---|---|---|---|---|---|
| Gain | $G_{ps}$ | 13.5 | 15 | — | dB |
| Drain Efficiency | $\eta_D$ | 53 | 60 | — | % |
| Adjacent Channel Power Ratio | ACPR | — | –26.7 | –24.5 | dBc |
| Output PAR @ 0.01% CCDF | OPAR | 6.5 | 7.1 | — | dB |

## Typical Performance (data taken in a Worlfspeed production test fixture)

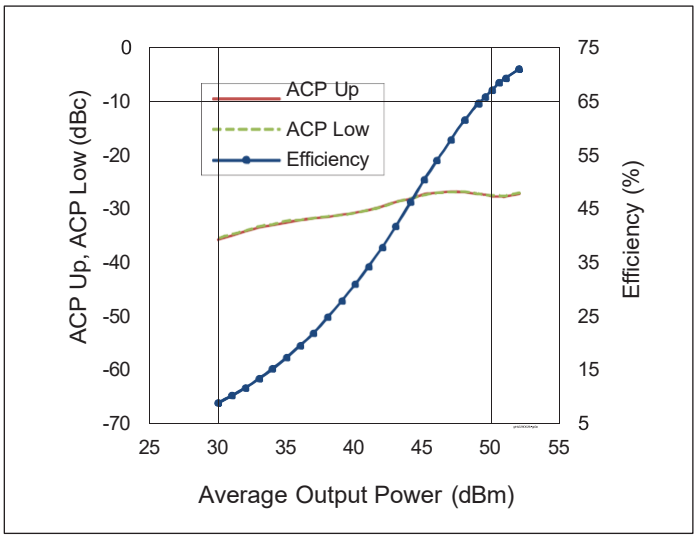



**Figure 1.** Single-carrier WCDMA Drive-up

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 300 mA,
$V_{GS(PEAK)}$ = –5.9 V, $f$ = 2200 MHz
3GPP WCDMA signal, 10 dB PAR,
3.84 MHz bandwidth

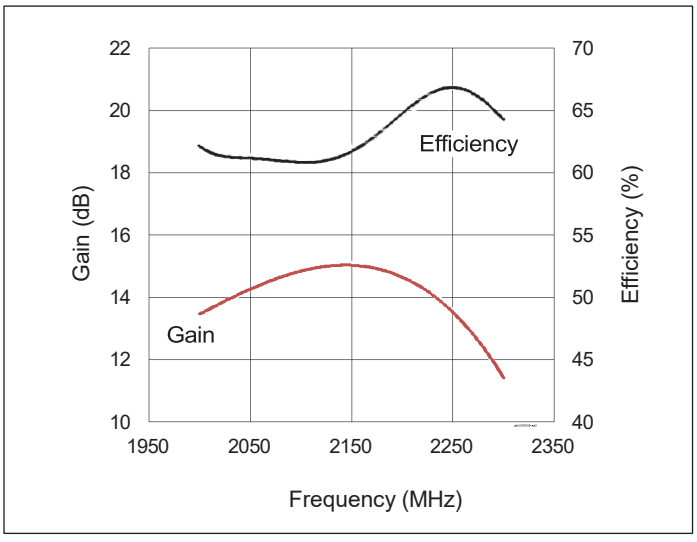



**Figure 2.** Single-carrier WCDMA Broadband

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 300 mA,
$V_{GS(PEAK)}$ = –5.9 V, $P_{OUT}$ = 49.03 dBm,
3GPP WCDMA signal, 10 dB PAR,
3.84 MHz bandwidth

## Typical Performance (cont.)

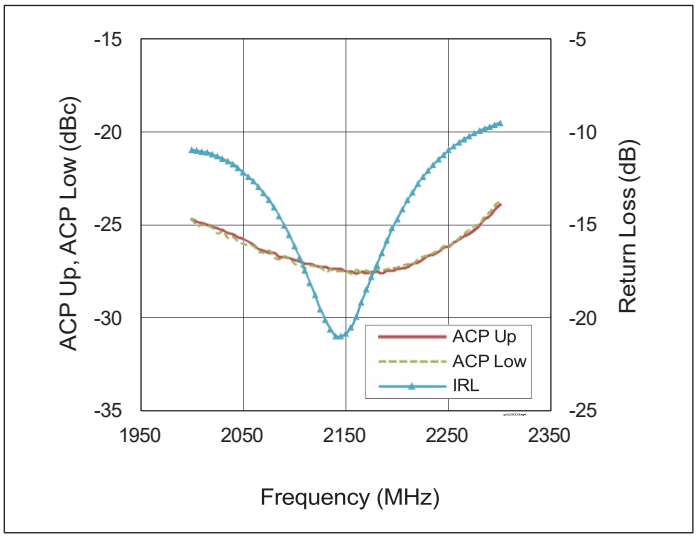



**Figure 3.** Single-carrier WCDMA Broadband

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 300 mA,
$V_{GS(PEAK)}$ = –5.9, $P_{OUT}$ = 49.03 dBm,
3GPP WCDMA signal, 10 dB PAR,
3.84 MHz bandwidth

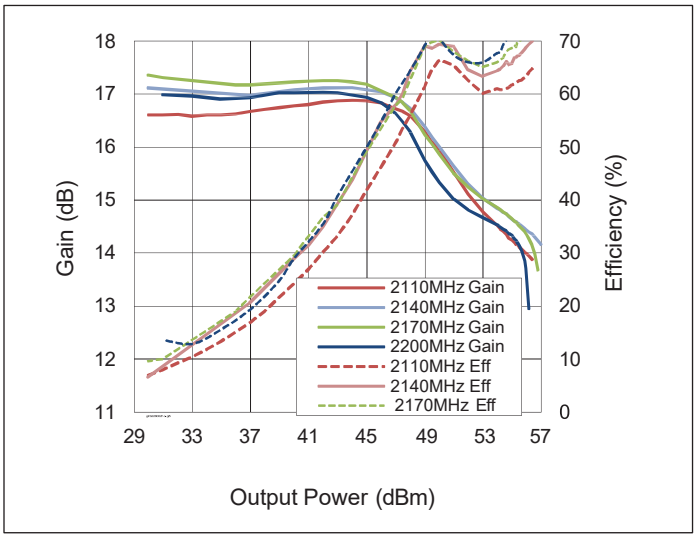



**Figure 4.** Pulsed CW Performance

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$= 300 mA, $V_{GS(PEAK)}$= –5.9V

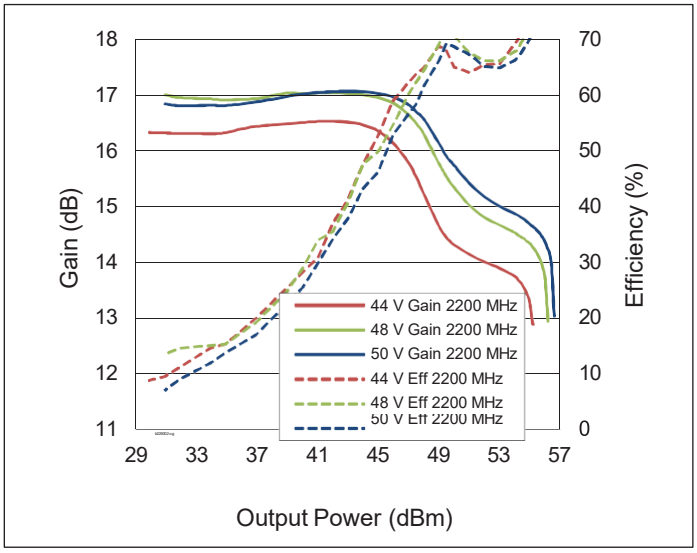



**Figure 5.** Pulsed CW Performance at various $V_{DD}$

$I_{DQ(MAIN)}$ = 300 mA, $V_{GS(PEAK)}$ = –5.9V
$f$ = 2200 MHz

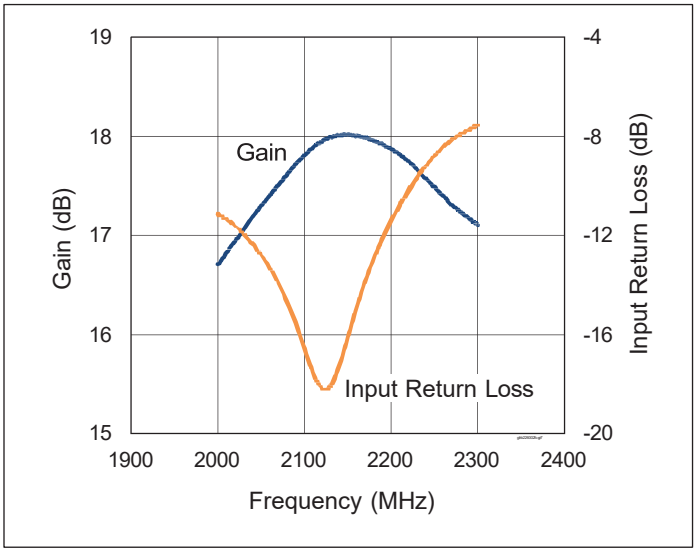



**Figure 6.** CW Performance Small Signal Gain & Input Return Loss

$V_{DD}$ = 48 V, $I_{DQ(MAIN)}$ = 300 mA,
$V_{GS(PEAK)}$ = –5.9V

## Load Pull

**Main Side Load Pull Performance** – Pulsed CW signal – 10 µsec pulse width, 10% duty cycle, 48 V, $I_{DQ}$ = 200 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] | $\eta_D$ [%] | Zl [Ω] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | ηD [%] |
| 2110 | 9.0 – j12.2 | 3.0 – j3.4 | 15.8 | 54.70 | 295 | 70.7 | 1.8 – j0.3 | 17.8 | 50.90 | 123 | 82.5 |
| 2170 | 9.0 – j12.8 | 2.7 – j3.2 | 16.1 | 54.50 | 281 | 70.5 | 2.3 – j1.2 | 17.6 | 53.10 | 204 | 82.7 |
| 2200 | 8.8 – j12.7 | 2.6 – j3.2 | 16.1 | 54.40 | 275 | 69.8 | 2.3 – j1.2 | 17.7 | 52.90 | 195 | 82.1 |

**Peak Side Load Pull Performance** – Pulsed CW signal – 10 µsec pulse width, 10% duty cycle, 48 V, $V_{GS(PEAK)}$ = –4 V, class C

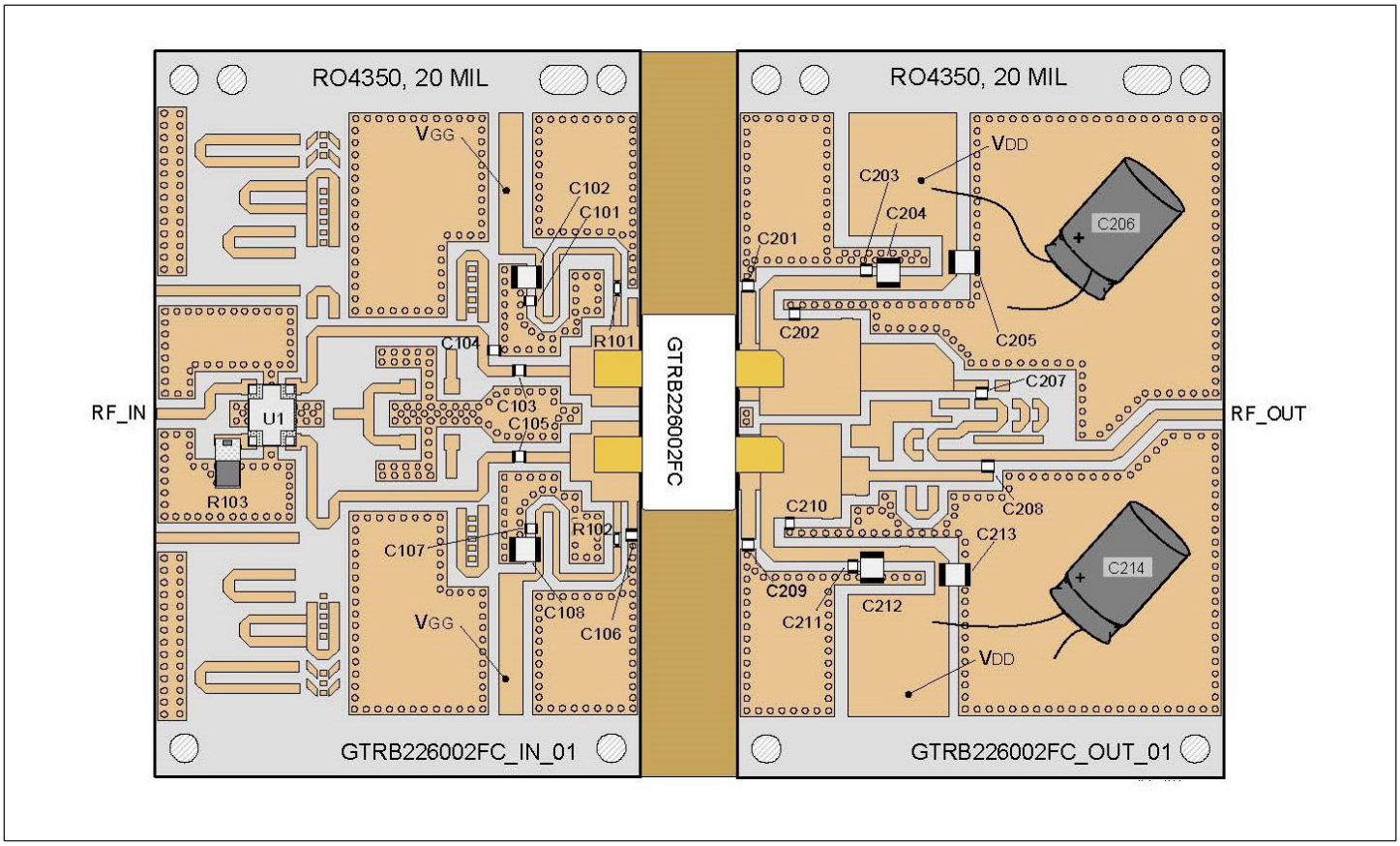
| | | $P_{3dB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max Output Power | | | | | Max Drain Efficiency | | | | |
| Freq [MHz] | Zs [Ω] | Zl [Ω] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | $\eta_D$ [%] | Zl [Ω] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | ηD [%] |
| 2110 | 3.2 – j8.6 | 1.4 – j3.9 | 13.6 | 56.90 | 489 | 61.1 | 1.7 – j2.5 | 15.4 | 55.90 | 389 | 78.0 |
| 2170 | 3.6 – j8.4 | 1.9 – j3.8 | 14 | 56.70 | 467 | 62.4 | 1.9 – j2.3 | 15.4 | 55.40 | 346 | 75.5 |
| 2200 | 4.0 – j8.3 | 1.8 – j3.8 | 14 | 56.60 | 457 | 61.1 | 1.5 – j2.0 | 15.4 | 54.40 | 275 | 73.4 |

**See next page for reference circuit information**

## Reference Circuit, 2110 – 2200 MHz

### Reference Circuit Assembly

| | |
|---|---|
| DUT | GTRB226002FC V1 |
| Test Fixture Part No. | LTA/GTRB226002FC-V1 |
| PCB | Rogers 4350, 0.508 mm [0.020”] thick, 2 oz. copper, $\varepsilon_r$ = 3.66 |




*Reference circuit assembly diagram (not to scale)*

## Reference Circuit (cont.)

### Components Table

| Component | Description | Manufacturer | P/N |
|---|---|---|---|
| Input | | | |
| C101, C107 | Capacitor, 18 pF | ATC | ATC600F180JT250XT |
| C102, C108 | Capacitor, 10 µF, 50 V | Taiyo Yuden | UMK325C7106MM-T |
| C103, C105 | Capacitor, 15 pF | ATC | ATC600F150JT250XT |
| C104 | Capacitor, 0.7 pF | ATC | ATC600F0R7BT250XT |
| C106 | Capacitor, 1.3 pF | ATC | ATC600F1R3BT250XT |
| R101, R102 | Resistor, 9.1 ohms | Panasonic Electronic Components | ERJ-8RQJ9R1V |
| R103 | Resistor, 50 ohms | Anaren | C16A50Z4 |
| U1 | Hybrid coupler | Anaren | X3C21P1-03S |
| Output | | | |
| C201, C209 | Capacitor, 1.6 pF | ATC | ATC600F1R6BT250XT |
| C202 | Capacitor, 1.0 pF | ATC | ATC600F1R0BT250XT |
| C203, C211 | Capacitor, 18 pF | ATC | ATC600F180JT250XT |
| C204, C205, C212, C213 | Capacitor, 10 µF, 100 V | Murata Electronics | GRM32EC72A106KE05L |
| C206, C214 | Capacitor, 470 µF, 100 V | Cornell Dubilier Electronics (CDE) | SEK471M050ST |
| C207, C208 | Capacitor, 15 pF | ATC | ATC600F150JT250XT |
| C210 | Capacitor, 0.3 µF | ATC | ATC600F0R3BT250XT |

## Bias Sequencing

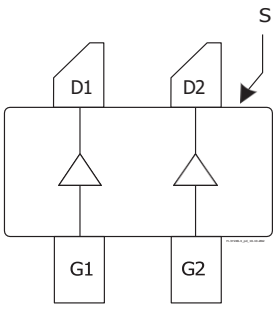
**Bias ON**

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. Appliy 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

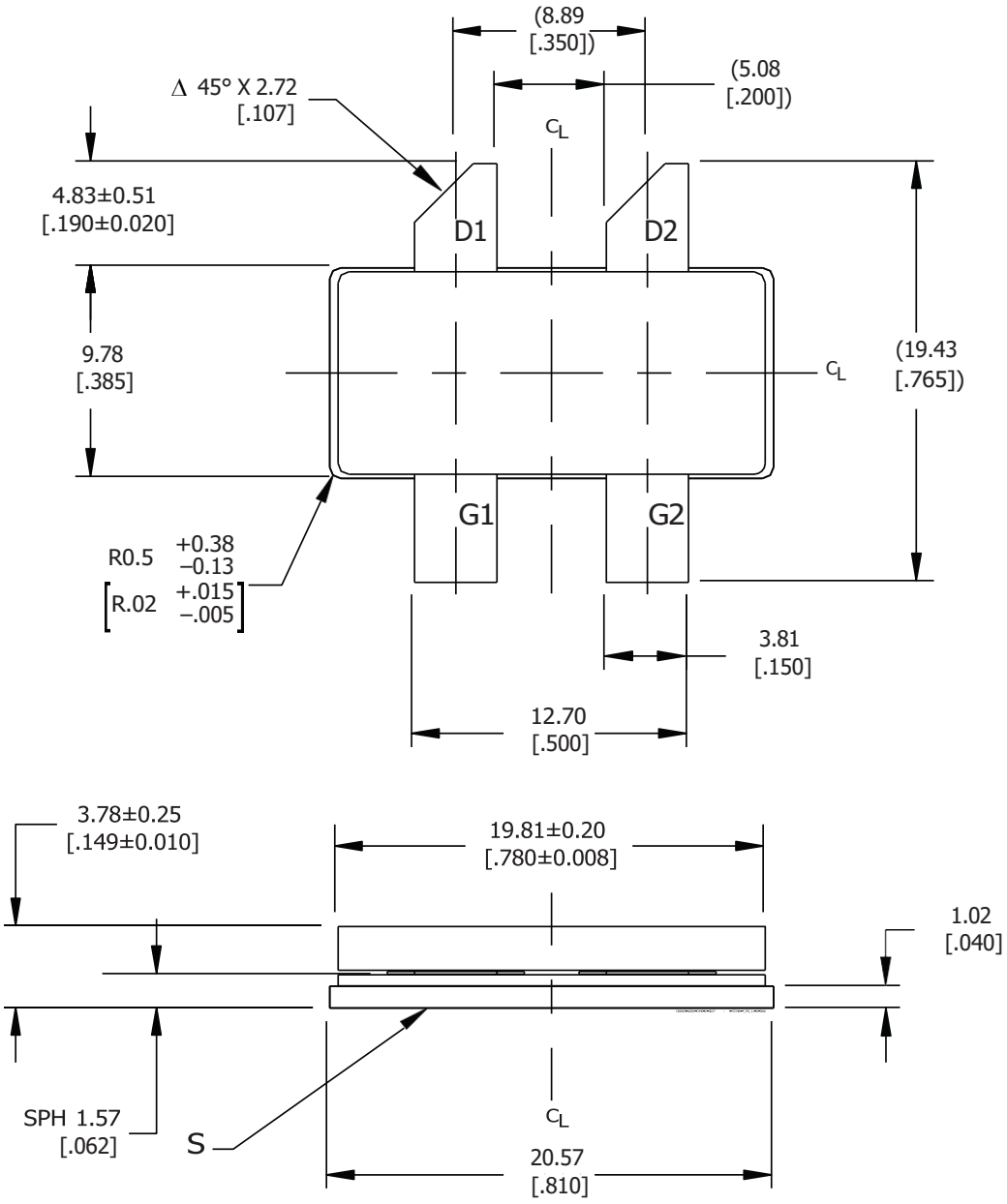



Diagram Notes—unless otherwise specified:

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]

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