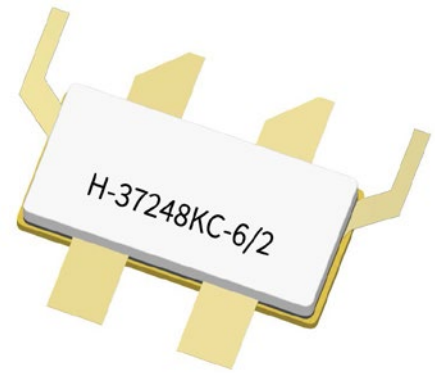


# GTRB424908FC/1

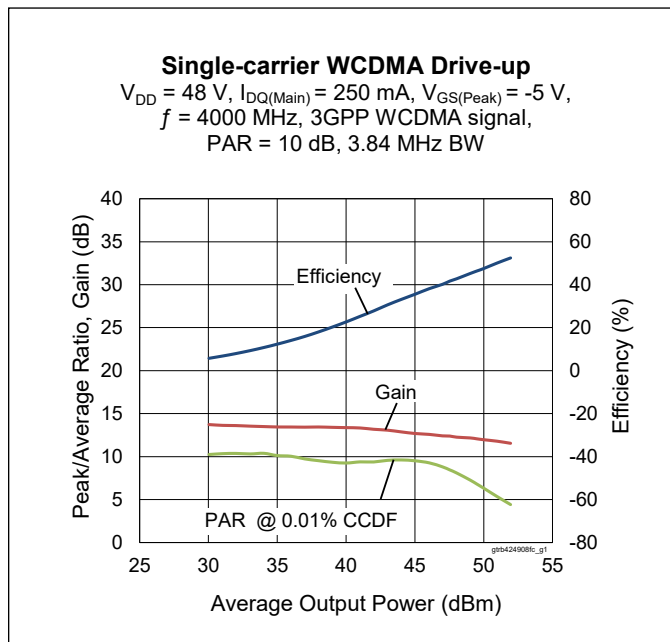
Thermally-Enhanced High Power RF GaN on SiC Amplifier, 450 W, 48 V, 3700 – 4000 MHz



Package Types: H-37248KC-6/2

## Description

The GTRB424908FC/1 is a 450-watt ( $P_{3dB}$ ) GaN on SiC HEMT D-mode amplifier designed 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, 3800 MHz, 48 V, 100  $\mu\text{s}$  pulse width, 10% duty cycle, combined outputs
  - Output power at  $P_{3dB} = 450\text{ W}$
  - Efficiency at  $P_{3dB} = 61\%$
- Human Body Model Class 1C (per ANSI/ESDA/ JEDEC JS-001)
- Pb-free and RoHS compliant

## Typical RF Characteristics

**Single-carrier WCDMA Specifications** (tested in the Doherty evaluation board for 3700 – 4000 MHz)

$V_{DD} = 48\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$ ,  $P_{OUT} = 56.2\text{ W}$ ,  $V_{GS(PEAK)} = -5\text{ V}$ , channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

|          | $P_{OUT}$<br>(dBm) | Gain<br>(dB) | Efficiency<br>(%) | ACPR +<br>(dBc) | ACPR -<br>(dBc) | OPAR<br>(dB) |
|----------|--------------------|--------------|-------------------|-----------------|-----------------|--------------|
| 3700 MHz | 47.5               | 12.4         | 42.4              | -33.7           | -33.8           | 8.2          |
| 3800 MHz | 47.5               | 12.7         | 40.4              | -38.0           | -38.2           | 8.5          |
| 3900 MHz | 47.5               | 12.8         | 40.7              | -35.8           | -35.7           | 8.6          |
| 4000 MHz | 47.5               | 12.4         | 41.7              | -32.5           | -35.5           | 8.5          |

Note:

All published data at  $T_{CASE} = 25^\circ\text{C}$  unless otherwise indicated

ESD: Electrostatic discharge sensitive device—observe handling precautions!



## DC Characteristics

| Characteristic                        | Symbol        | Min. | Typ. | Max. | Unit | Conditions                                   |
|---------------------------------------|---------------|------|------|------|------|--|
| Drain-source Breakdown Voltage (main) | $V_{BR(DSS)}$ | 150  | —    | —    | V    | $V_{GS} = -8\text{ V}, I_D = 10\text{ mA}$   |
| Drain-source Breakdown Voltage (peak) |               |      |      |      |      |  |
| Drain-source Leakage Current (main)   | $I_{DSS}$     | —    | —    | 4.4  | mA   | $V_{GS} = -8\text{ V}, V_{DS} = 10\text{ V}$ |
| Drain-source Leakage Current (peak)   |               |      |      | 6.3  |      |  |
| Gate-source Leakage Current (main)    | $I_{GSX}$     | —    | —    | -6.9 | V    | $V_{GS} = -8\text{ V}, V_{DD} = 50\text{ V}$ |
| Gate-source Leakage Current (peak)    |               |      |      | -9.9 |      |  |
| Gate Threshold Voltage (main)         | $V_{GS(th)}$  | -3.8 | -3.1 | -2.3 | V    | $V_{DS} = 10\text{ V}, I_D = 25\text{ mA}$   |
| Gate Threshold Voltage (peak)         |               |      |      |      |      | $V_{DS} = 10\text{ V}, I_D = 36\text{ mA}$   |

## Recommended Operating Conditions

| Parameter              | Symbol      | Min. | Typ. | Max. | Unit | Conditions                                  |
|------------------------|-------------|------|------|------|------|---|
| Operating Voltage      | $V_{DD}$    | 0    | —    | 50   | V    | $V_{DS} = 48\text{ V}, I_D = 250\text{ mA}$ |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | -3.6 | -2.9 | -2.1 |      |   |

## 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)       | $I_G$     | 25.2        | mA   |
| Gate Current (peak)       |           | 36          |      |
| Drain Current (main)      | $I_D$     | 9.45        | A    |
| Drain Current (peak)      |           | 13.5        |      |
| 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 qualification were performed at 225 °C. Operation at  $T_J$  (275 °C) reduces median time to failure.

## Thermal Characteristics

| Characteristic            | Symbol          | Value | Unit | Conditions                                 |
|---------------------------|-----------------|-------|------|--|
| Thermal Resistance (main) | $R_{\theta JC}$ | 1.4   | °C/W | $T_{CASE} = 85\text{ °C}, 100\text{ W DC}$ |
| Thermal Resistance (peak) |                 | 1.05  |      | $T_{CASE} = 85\text{ °C}, 134\text{ W DC}$ |

## RF Characteristics

### Single-carrier WCDMA Specifications (tested in the Doherty test fixture)

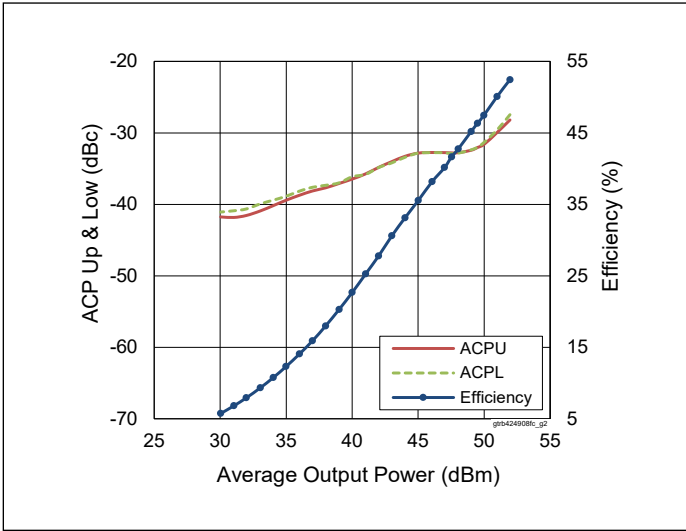
$V_{DD} = 48\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$ ,  $P_{OUT} = 56.2\text{ W avg}$ ,  $V_{GS(PEAK)} = -5\text{ V}$ ,  $f = 4000\text{ MHz}$ , 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

| Characteristic               | Symbol   | Min. | Typ. | Max. | Unit |
|------------------------------|----------|------|------|------|------|
| Gain                         | $G_{ps}$ | 11   | 12   | —    | dB   |
| Drain Efficiency             | $\eta_D$ | 35   | 42   | —    | %    |
| Adjacent Channel Power Ratio | ACPR     | —    | -25  | -20  | dBc  |
| Output PAR @ 0.01% CCDF      | OPAR     | 7.2  | 8    | —    | dB   |

## Ordering Information

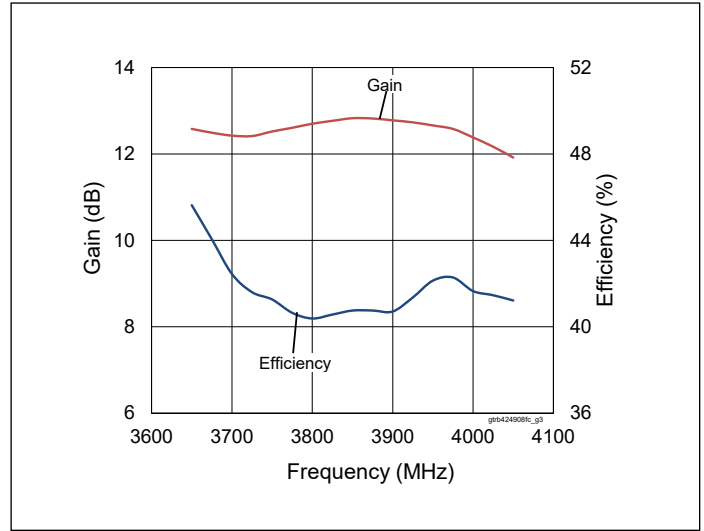
| Type and Version     | Order Code         | Package       | Shipping             |
|----------------------|--------------------|---------------|----------------------|
| GTRB424908FC/1 V1 R0 | GTRB424908FC1V1-R0 | H-37248KC-6/2 | Tape & Reel, 50 pcs  |
| GTRB424908FC/1 V1 R2 | GTRB424908FC1V1-R2 | H-37248KC-6/2 | Tape & Reel, 250 pcs |

**Typical Performance** (data taken in Doherty evaluation board)



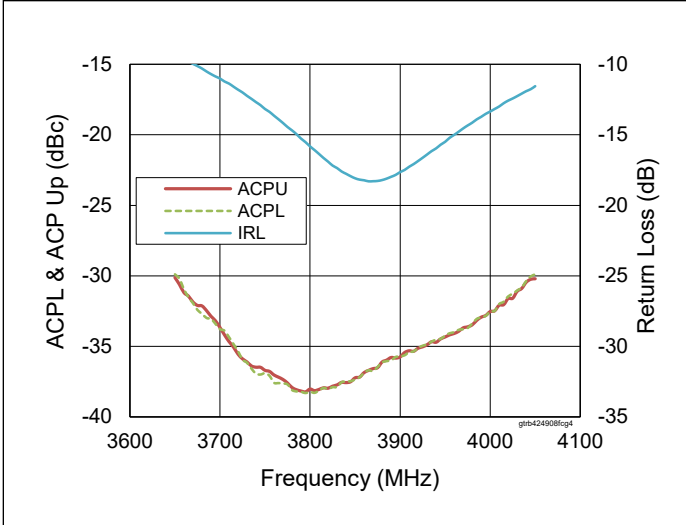
**Figure 1.** Single-carrier WCDMA Drive-up

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(Main)} = 250\text{ mA}$ ,  $V_{GS(Peak)} = -5\text{ V}$ ,  
 $f = 4000\text{ MHz}$ , 3GPP WCDMA signal,  
 PAR = 10 dB, BW = 3.84 MHz



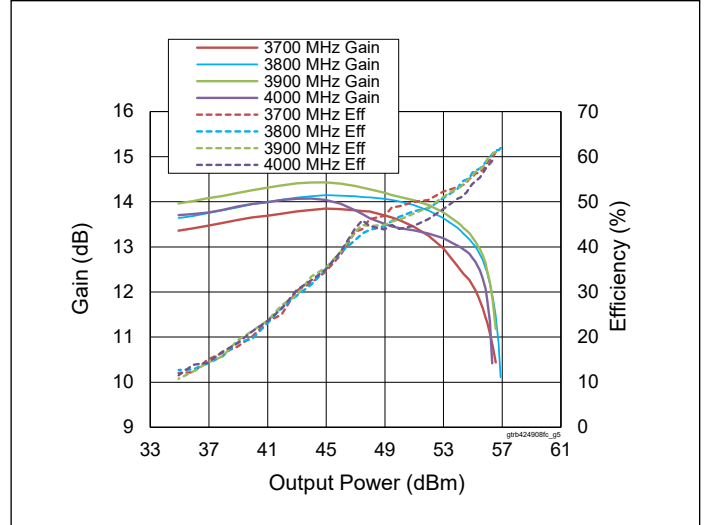
**Figure 2.** Single-carrier WCDMA Broadband Performance

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(Main)} = 250\text{ mA}$ ,  $V_{GS(Peak)} = -5\text{ V}$ ,  
 $P_{OUT} = 47.5\text{ dBm}$ , 3GPP WCDMA signal,  
 PAR = 10 dB



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

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(Main)} = 250\text{ mA}$ ,  $V_{GS(Peak)} = -5\text{ V}$ ,  
 $P_{OUT} = 47.5\text{ dBm}$ , 3GPP WCDMA signal,  
 PAR = 10 dB



**Figure 4.** Pulsed CW Performance

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(Main)} = 250\text{ mA}$ ,  $V_{GS(Peak)} = -5\text{ V}$

Typical RF Performance(cont.)

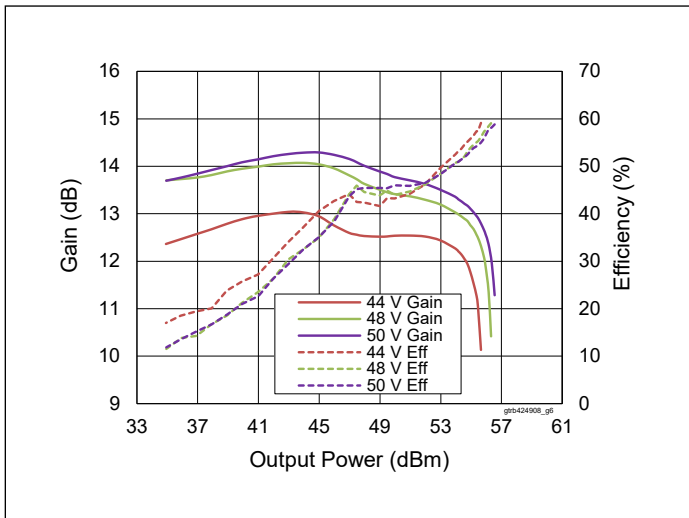


Figure 5. Pulsed CW Performance at Various  $V_{DD}$

$I_{DQ(Main)} = 250 \text{ mA}$ ,  $V_{GS(Peak)} = -5 \text{ V}$ ,  
 $f = 4000 \text{ MHz}$

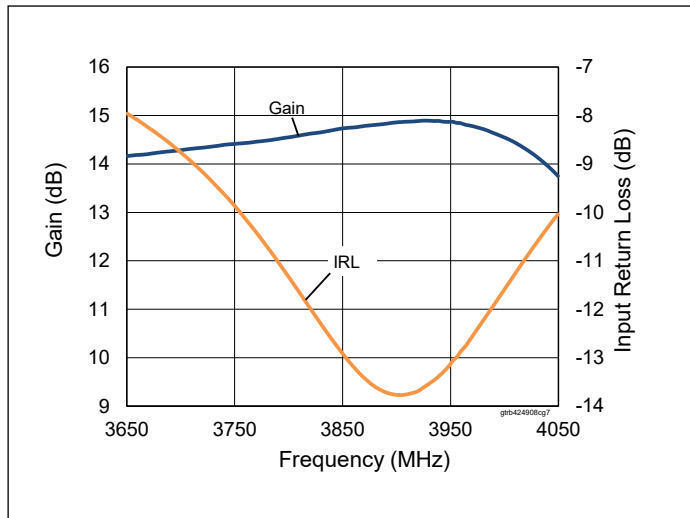


Figure 6. CW Performance Small Signal Gain & Input Return Loss

$V_{DD} = 48 \text{ V}$ ,  $I_{DQ(Main)} = 250 \text{ mA}$ ,  $V_{GS(Peak)} = -5 \text{ V}$

## Load Pull Performance

**Main Side Load Pull Performance** – Pulsed CW signal – 100  $\mu$ sec, 10% duty cycle, 48 V,  $I_{DQ} = 250$  mA, class AB

| $P_{3dB}$        |                 |                 |           |                 |               |              |                      |           |                 |               |              |
|------------------|-----------------|-----------------|-----------|-----------------|---------------|--------------|----------------------|-----------|-----------------|---------------|--------------|
| Max Output Power |                 |                 |           |                 |               |              | Max Drain Efficiency |           |                 |               |              |
| Freq [MHz]       | Zs [ $\Omega$ ] | Zl [ $\Omega$ ] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | $\eta D$ [%] | Zl [ $\Omega$ ]      | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | $\eta D$ [%] |
| 3700             | 14-j22.8        | 6.7-j13.8       | 16.9      | 54              | 251.2         | 54.7         | 9.8-j4.9             | 19.1      | 51.7            | 147.9         | 64.4         |
| 3800             | 13.4-j21.2      | 6.9-j15.3       | 16.4      | 53.9            | 245.5         | 52.6         | 7.5-j7               | 18.9      | 52.1            | 162.2         | 63           |
| 3900             | 12.4-j22.4      | 7-j15.1         | 16.9      | 53.8            | 239.9         | 54           | 7-j8.8               | 18.7      | 52.3            | 169.8         | 62.4         |
| 4000             | 12.1-j26        | 7.5-j15.6       | 16.9      | 53.7            | 234.4         | 54.3         | 7.2-j9.6             | 18.5      | 52.1            | 162.2         | 62.3         |

**Peak Side Load Pull Performance** – Pulsed CW signal – 100  $\mu$ sec, 10% duty cycle, 48 V,  $V_{GSPK} = -5$  V, class C

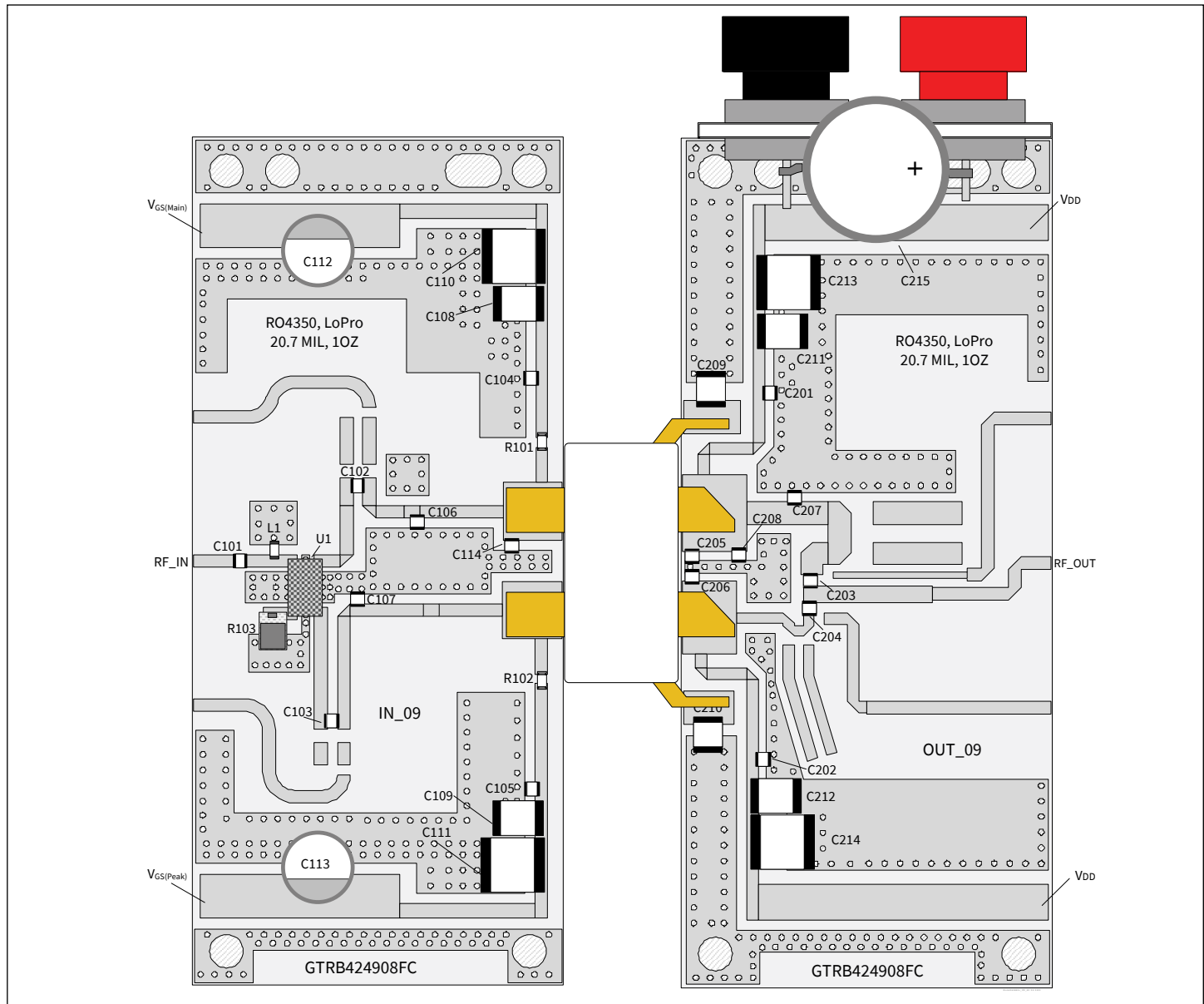
| $P_{3dB}$        |                 |                 |           |                 |               |              |                      |           |                 |               |              |
|------------------|-----------------|-----------------|-----------|-----------------|---------------|--------------|----------------------|-----------|-----------------|---------------|--------------|
| Max Output Power |                 |                 |           |                 |               |              | Max Drain Efficiency |           |                 |               |              |
| Freq [MHz]       | Zs [ $\Omega$ ] | Zl [ $\Omega$ ] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | $\eta D$ [%] | Zl [ $\Omega$ ]      | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | $\eta D$ [%] |
| 3700             | 5.1-j21.3       | 3.8-j7.8        | 11.7      | 55.1            | 323.6         | 72.3         | 4-j7.7               | 11.7      | 55.00           | 316.2         | 72.8         |
| 3800             | 9.4-j21.2       | 2.4-j8.8        | 10.6      | 55.5            | 354.8         | 64.4         | 3.7-j5.7             | 11.7      | 53.80           | 239.9         | 78.1         |
| 3900             | 12.1-j17.5      | 2.7-j8.9        | 10.6      | 55.4            | 346.7         | 64.7         | 3.4-j5.9             | 11.3      | 53.70           | 234.4         | 73.6         |
| 4000             | 11.3-j13.2      | 2.8-j9          | 10.6      | 55.4            | 346.7         | 64.7         | 2.9-j6.1             | 11.5      | 53.50           | 223.9         | 73.8         |

**Peak Side Load Pull Performance** – Pulsed CW signal – 100  $\mu$ sec, 10% duty cycle, 48 V,  $I_{DQ} = 360$  mA, class AB

| $P_{3dB}$        |                 |                 |           |                 |               |              |                      |           |                 |               |              |
|------------------|-----------------|-----------------|-----------|-----------------|---------------|--------------|----------------------|-----------|-----------------|---------------|--------------|
| Max Output Power |                 |                 |           |                 |               |              | Max Drain Efficiency |           |                 |               |              |
| Freq [MHz]       | Zs [ $\Omega$ ] | Zl [ $\Omega$ ] | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | $\eta D$ [%] | Zl [ $\Omega$ ]      | Gain [dB] | $P_{3dB}$ [dBm] | $P_{3dB}$ [W] | $\eta D$ [%] |
| 3700             | 5.1-j21.3       | 2.6-j8.8        | 14.7      | 55.8            | 380.2         | 61.0         | 3.8-j6.8             | 16.4      | 54.30           | 269.2         | 67.3         |
| 3800             | 9.4-j21.2       | 2.4-j8.9        | 14.5      | 55.8            | 380.2         | 60.0         | 3.6-j4.1             | 16.9      | 52.20           | 166           | 68.8         |
| 3900             | 12.1-j17.5      | 2.7-j9          | 14.7      | 55.7            | 371.5         | 61.1         | 2.8-j6.5             | 16.6      | 54.10           | 257           | 68.4         |
| 4000             | 10.6-j16.8      | 2.7-j9.3        | 14.9      | 55.6            | 363.1         | 59.4         | 2.9-j6.4             | 17.1      | 53.40           | 218.8         | 67.9         |

## Doherty Evaluation Board, 3700 – 4000 MHz

|                              |  |
|------------------------------|--|
| Evaluation Board Part Number | LTAGTRB424908FC1E4   |
| PCB Information              | Rogers 4350 LoPro, 0.526 mm [0.0207"] thick, 1 oz. copper, $\epsilon_r = 3.66$ |



Reference circuit assembly diagram (not to scale)

## Doherty Evaluation Board (cont.)

### Components Information

| Component                    | Description                   | Manufacturer                    | P/N                 |
|------------------------------|-------------------------------|---------------------------------|---------------------|
| <b>Input</b>                 |                               |                                 |                     |
| C101, C102, C103, C104, C105 | Capacitor, 8.2 pF             | ATC                             | ATC800A8R2JT250XT   |
| C106                         | Capacitor, 0.8 pF             | ATC                             | ATC800A0R8CT250XT   |
| C107                         | Capacitor, 0.4 pF             | ATC                             | ATC800A0R4CT250T    |
| C108, C109                   | Capacitor, 100 V, 1 $\mu$ F   | TDK Corporation                 | C4532X7R2A105K230KA |
| C110, C111                   | Capacitor, 100 V, 10 $\mu$ F  | TDK Corporation                 | C5750X7S2A106M230KB |
| C112, C113                   | Capacitor, 35 V, 100 $\mu$ F  | Panasonic Electronic Components | EEE-FT1V101AP       |
| C114                         | Capacitor, 0.1 pF             | ATC                             | ATC800A0R1CT250T    |
| R101, R102                   | Resistor, 5.6 ohms            | Panasonic Electronic Components | ERJ-8RQJ5R6V        |
| R103                         | Resistor, 50 ohms             | Richardson                      | C8A50Z4B            |
| L1                           | Inductor, 6.8 nH              | EPCOS - TDK Electronics         | B82496C3689J000     |
| U1                           | Hybrid Coupler                | Anaren                          | X3C35F1-03S         |
| <b>Output</b>                |                               |                                 |                     |
| C201, C202, C203, C204       | Capacitor, 8.2 pF             | ATC                             | ATC800A8R2JT250XT   |
| C205, C206                   | Capacitor, 0.6 pF             | ATC                             | ATC800A0R6CT250XT   |
| C207                         | Capacitor, 0.9 pF             | ATC                             | ATC800A0R9CT250XT   |
| C208                         | Capacitor, 0.2 pF             | ATC                             | ATC800A0R2CT250XT   |
| C209, C210                   | Capacitor, 100 V, 4.7 $\mu$ F | TDK Corporation                 | C4532X7S2A475M230KB |
| C211, C212                   | Capacitor, 100 V, 1 $\mu$ F   | TDK Corporation                 | C4532X7R2A105K230KA |
| C213, C214                   | Capacitor, 100 V, 10 $\mu$ F  | TDK Corporation                 | C5750X7S2A106M230KB |
| C215                         | Capacitor, 220 $\mu$ F        | Panasonic Electronic Components | ECA-2AHG221         |



## Bias Sequencing

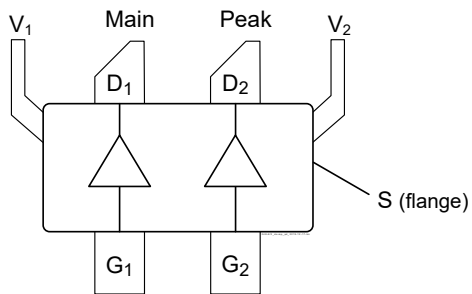
### Bias On

1. Ensure RF is turned off
2. Apply pinch-off voltage of  $-5\text{ V}$  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                        |
| D2  | Drain Device 2                        |
| G1  | Gate Device 1                         |
| G2  | Gate Device 2                         |
| V1  | Drain video decoupling and no DC bias |
| V2  | Drain video decoupling and no DC bias |
| S   | Source (flange)                       |

Lead connections for GTRB424908FC/1

## Package Outline Specifications – Package H-37248KC-6/2

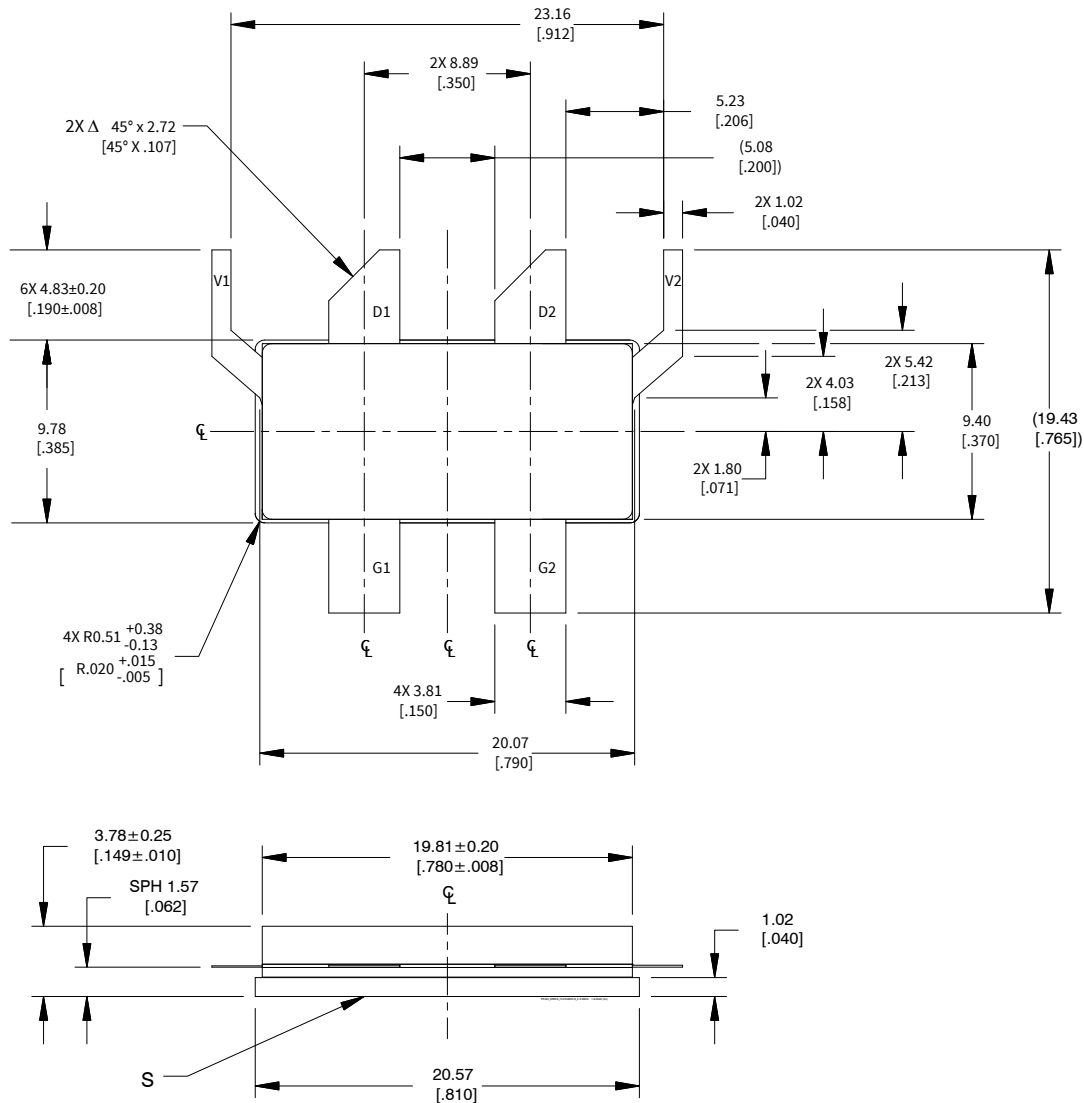


Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994
2. Primary dimensions are mm; alternate dimensions are inches
3. All tolerances  $\pm 0.127$  [.005]
4. Pins: D1, D2 – drain, G1, G2 – gate, V1, V2 – drain video decoupling and no DC bias, S – source (flange)
5. Lead thickness:  $0.127 +0.05/-0.025$  [.005 +.002/-.001]
6. Gold plating thickness:  $1.14 \pm 0.38$  micron [45 ± 15 microinch]

## Notes & Disclaimer

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