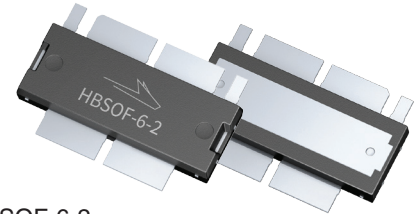


# PTRA094808NF

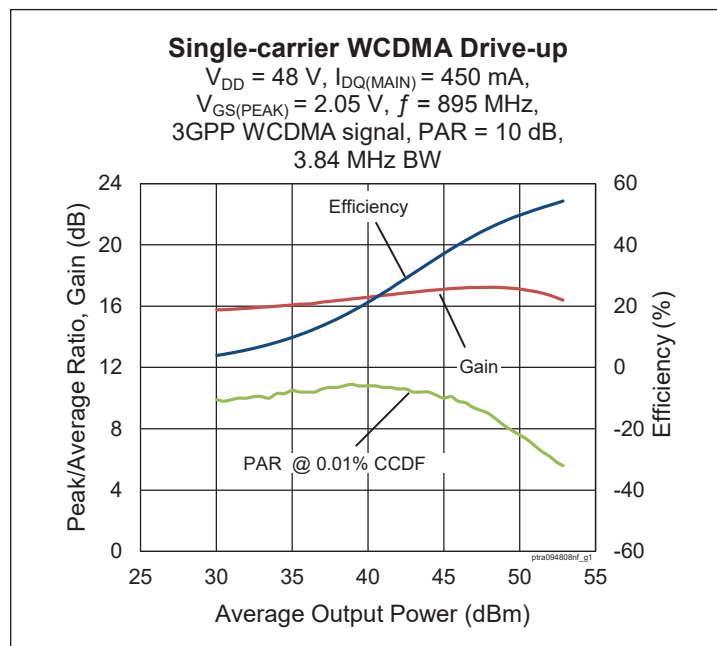
## Thermally-Enhanced High Power RF LDMOS FET 480 W, 48 V, 859 – 960 MHz

### Description

The PTRA094808NF is a 480-watt LDMOS FET intended for use in multi-standard cellular power amplifier applications in the 859 to 960 MHz frequency band. Features include input and output matching, high gain and thermally-enhanced package with earless flange. Manufactured with Wolfspeed's advanced LDMOS process, this device provides excellent thermal performance and superior reliability.



PTRA094808NF  
Package PG-HBSOF-6-2



### Features

- Broadband internal input and output matching
- Asymmetrical design
  - Main:  $P_{1dB} = 210\text{ W Typ}$
  - Peak:  $P_{1dB} = 340\text{ W Typ}$
- Typical Pulsed CW performance, 896 MHz, 48 V, Doherty configuration
  - Output power at  $P_{1dB} = 300\text{ W}$
  - Output power at  $P_{3dB} = 420\text{ W}$
  - Efficiency = 53%
  - Gain = 17.5 dB
- Capable of handling 10:1 VSWR @ 48 V, 100 W (CW) output power
- Integrated ESD protection
- Human Body Model class 1C (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)

$V_{DD} = 48\text{ V}$ ,  $I_{DQ} = 450\text{ mA}$ ,  $V_{GS(PEAK)} = 2.05\text{ V}$ ,  $P_{OUT} = 87\text{ W avg}$ ,  $f = 895\text{ MHz}$ , 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

| Characteristic               | Symbol   | Min  | Typ   | Max   | Unit |
|------------------------------|----------|------|-------|-------|------|
| Linear Gain                  | $G_{ps}$ | 16.5 | 17.5  | —     | dB   |
| Drain Efficiency             | $\eta_D$ | 48.5 | 52.5  | —     | %    |
| Adjacent Channel Power Ratio | ACPR     | —    | -30.5 | -26.5 | dBc  |
| Output PAR@0.01% CCDF        | OPAR     | 7.1  | 7.5   | —     | dB   |

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

ESD: Electrostatic discharge sensitive device—observe handling precautions!

**DC Characteristics** (each side)

| Characteristic                 | Conditions                                               | Symbol        | Min | Typ  | Max | Unit          |
|--------------------------------|----------------------------------------------------------|---------------|-----|------|-----|---------------|
| Drain-Source Breakdown Voltage | $V_{GS} = 0\text{ V}$ , $I_{DS} = 10\text{ mA}$          | $V_{(BR)DSS}$ | 105 | —    | —   | V             |
| Drain Leakage Current          | $V_{DS} = 48\text{ V}$ , $V_{GS} = 0\text{ V}$           | $I_{DSS}$     | —   | —    | 1   | $\mu\text{A}$ |
|                                | $V_{DS} = 105\text{ V}$ , $V_{GS} = 0\text{ V}$          | $I_{DSS}$     | —   | —    | 10  | $\mu\text{A}$ |
| Gate Leakage Current           | $V_{GS} = 14\text{ V}$ , $V_{DS} = 0\text{ V}$           | $I_{GSS}$     | —   | —    | 1   | $\mu\text{A}$ |
| On-State Resistance            | (Main) $V_{GS} = 10\text{ V}$ , $V_{DS} = 0.1\text{ V}$  | $R_{DS(on)}$  | —   | 0.08 | —   | $\Omega$      |
|                                | (Peak) $V_{GS} = 10\text{ V}$ , $V_{DS} = 0.1\text{ V}$  | $R_{DS(on)}$  | —   | 0.05 | —   | $\Omega$      |
| Operating Gate Voltage         | (Main) $V_{DS} = 48\text{ V}$ , $I_{DQ} = 0.45\text{ A}$ | $V_{GS}$      | 3   | 3.5  | 4   | V             |
|                                | (Peak) $V_{DS} = 48\text{ V}$ , $I_{DQ} = 0\text{ A}$    | $V_{GS}$      | —   | 2.05 | —   | V             |

**Maximum Ratings**

| Parameter                 | Symbol    | Value       | Unit               |
|---------------------------|-----------|-------------|--------------------|
| Drain-Source Voltage      | $V_{DSS}$ | 105         | V                  |
| Gate-Source Voltage       | $V_{GS}$  | −6 to +12   | V                  |
| Operating Voltage         | $V_{DD}$  | 0 to +55    | V                  |
| Junction Temperature      | $T_J$     | 225         | $^{\circ}\text{C}$ |
| Storage Temperature Range | $T_{STG}$ | −65 to +150 | $^{\circ}\text{C}$ |

**Thermal Characteristics**

| Parameter                                                              | Symbol          | Value | Unit                 |
|------------------------------------------------------------------------|-----------------|-------|----------------------|
| Thermal Resistance (Main, $T_{CASE} = 70^{\circ}\text{C}$ , 87.1 W CW) | $R_{\theta JC}$ | 0.51  | $^{\circ}\text{C/W}$ |

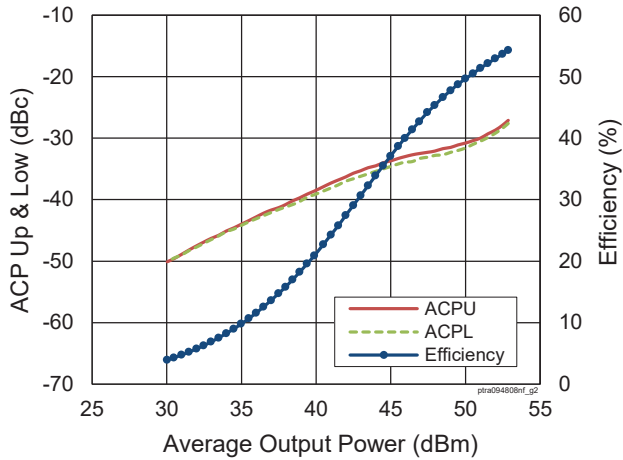
**Ordering Information**

| Type and Version   | Order Code         | Package Description | Shipping             |
|--------------------|--------------------|---------------------|----------------------|
| PTRA094808NF V1 R5 | PTRA094808NF-V1-R5 | PG-HBSOF-6-2        | Tape & Reel, 500 pcs |

# Typical RF Performance (data taken in production test fixture)

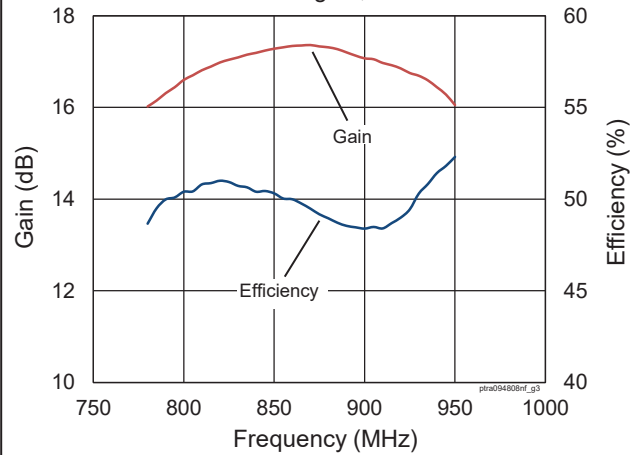
## Single-carrier WCDMA Drive-up

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(MAIN)} = 450\text{ mA}$ ,  
 $V_{GS(PEAK)} = 2.05\text{ V}$ ,  $f = 895\text{ MHz}$ ,  
 3GPP WCDMA signal, PAR = 10 dB,  
 BW = 3.84 MHz



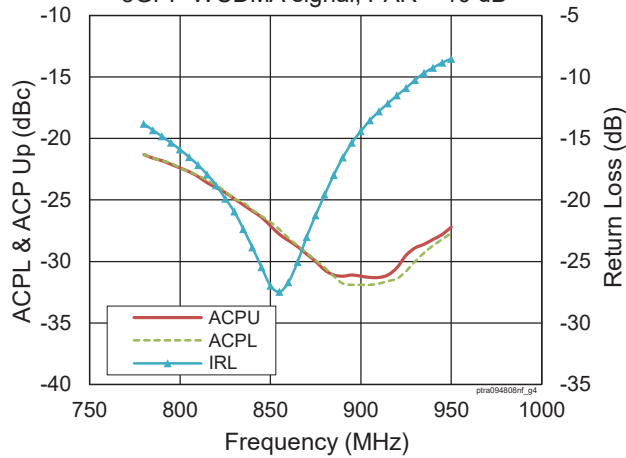
## Single-carrier WCDMA Broadband Performance

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(MAIN)} = 450\text{ mA}$ ,  
 $V_{GS(PEAK)} = 2.05\text{ V}$ ,  $P_{OUT} = 49.4\text{ dBm}$ ,  
 3GPP WCDMA signal, PAR = 10 dB



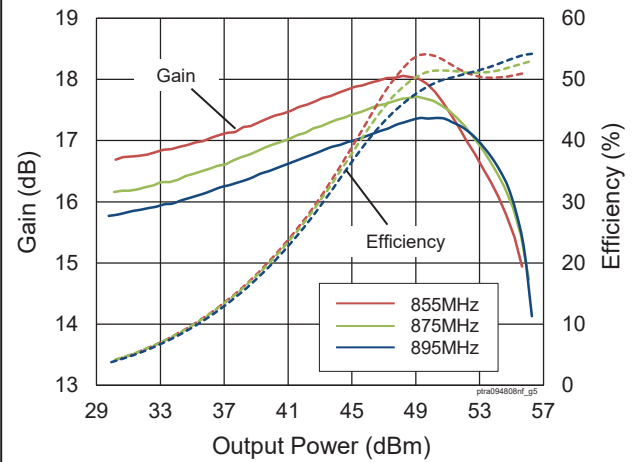
## Single-carrier WCDMA Broadband Performance

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(MAIN)} = 450\text{ mA}$ ,  
 $V_{GS(PEAK)} = 2.05\text{ V}$ ,  $P_{OUT} = 49.4\text{ dBm}$ ,  
 3GPP WCDMA signal, PAR = 10 dB

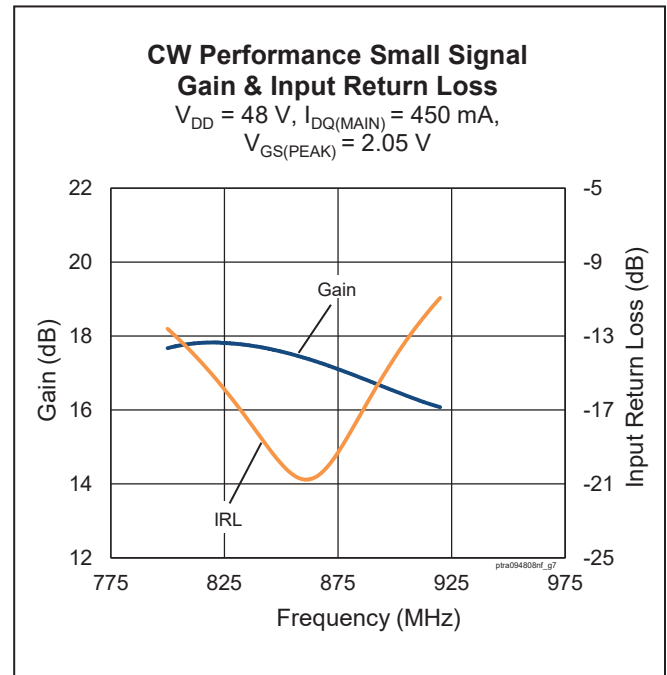
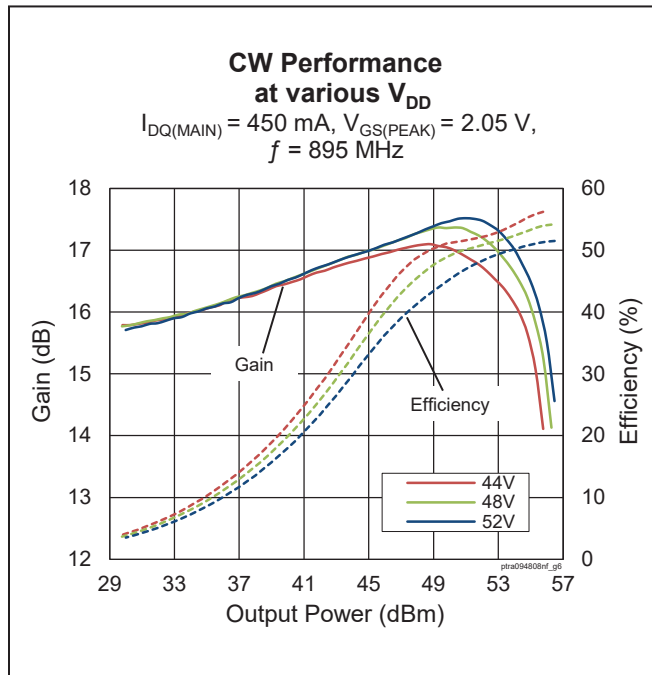


## CW Performance

$V_{DD} = 48\text{ V}$ ,  $I_{DQ(MAIN)} = 450\text{ mA}$ ,  
 $V_{GS(PEAK)} = 2.05\text{ V}$



## Typical RF Performance (cont.)



## Load Pull Performance

**Main Side Load Pull Performance** – Pulsed CW signal: 10  $\mu$ sec, 10% duty cycle,  $V_{DD} = 48$  V,  $I_{DQ} = 350$  mA, class AB

|                   |                                            | <b>P<sub>1dB</sub></b>                     |                  |                              |                            |                                |                                            |                  |                              |                            |                                |
|-------------------|--------------------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|
|                   |                                            | <b>Max Output Power</b>                    |                  |                              |                            |                                | <b>Max Drain Efficiency</b>                |                  |                              |                            |                                |
| <b>Freq [MHz]</b> | <b>Z<sub>s</sub> [<math>\Omega</math>]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>1dB</sub> [dBm]</b> | <b>P<sub>1dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>1dB</sub> [dBm]</b> | <b>P<sub>1dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> |
| 865               | 1.4-j4.1                                   | 1.93-j1.35                                 | 20.25            | 53.40                        | 219                        | 57.4                           | 4.16-j0.34                                 | 22.1             | 51.50                        | 141                        | 67.2                           |
| 880               | 1.6-j4.65                                  | 1.67-j1.24                                 | 19.8             | 53.40                        | 219                        | 54.6                           | 4.0-j0.5                                   | 22.1             | 51.50                        | 141                        | 67.7                           |
| 895               | 2.0-j4.33                                  | 1.87-j1.62                                 | 20               | 53.37                        | 217                        | 56.7                           | 4.08-j0.33                                 | 22               | 51.37                        | 137                        | 67.6                           |

|                   |                                            | <b>P<sub>3dB</sub></b>                     |                  |                              |                            |                                |                                            |                  |                              |                            |                                |
|-------------------|--------------------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|
|                   |                                            | <b>Max Output Power</b>                    |                  |                              |                            |                                | <b>Max Drain Efficiency</b>                |                  |                              |                            |                                |
| <b>Freq [MHz]</b> | <b>Z<sub>s</sub> [<math>\Omega</math>]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>3dB</sub> [dBm]</b> | <b>P<sub>3dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>3dB</sub> [dBm]</b> | <b>P<sub>3dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> |
| 865               | 1.4-j4.1                                   | 2.09-1.87                                  | 18.4             | 54.30                        | 270                        | 61.8                           | 3.8+0                                      | 20               | 52.62                        | 182                        | 69.1                           |
| 880               | 1.6-j4.65                                  | 1.87-1.73                                  | 18               | 54.20                        | 263                        | 58.7                           | 3.56+0.05                                  | 19.85            | 52.67                        | 184                        | 69.5                           |
| 895               | 2.0-j4.33                                  | 1.81-1.78                                  | 17.9             | 54.20                        | 263                        | 59.1                           | 3.33+0.04                                  | 19.73            | 52.65                        | 184                        | 69.43                          |

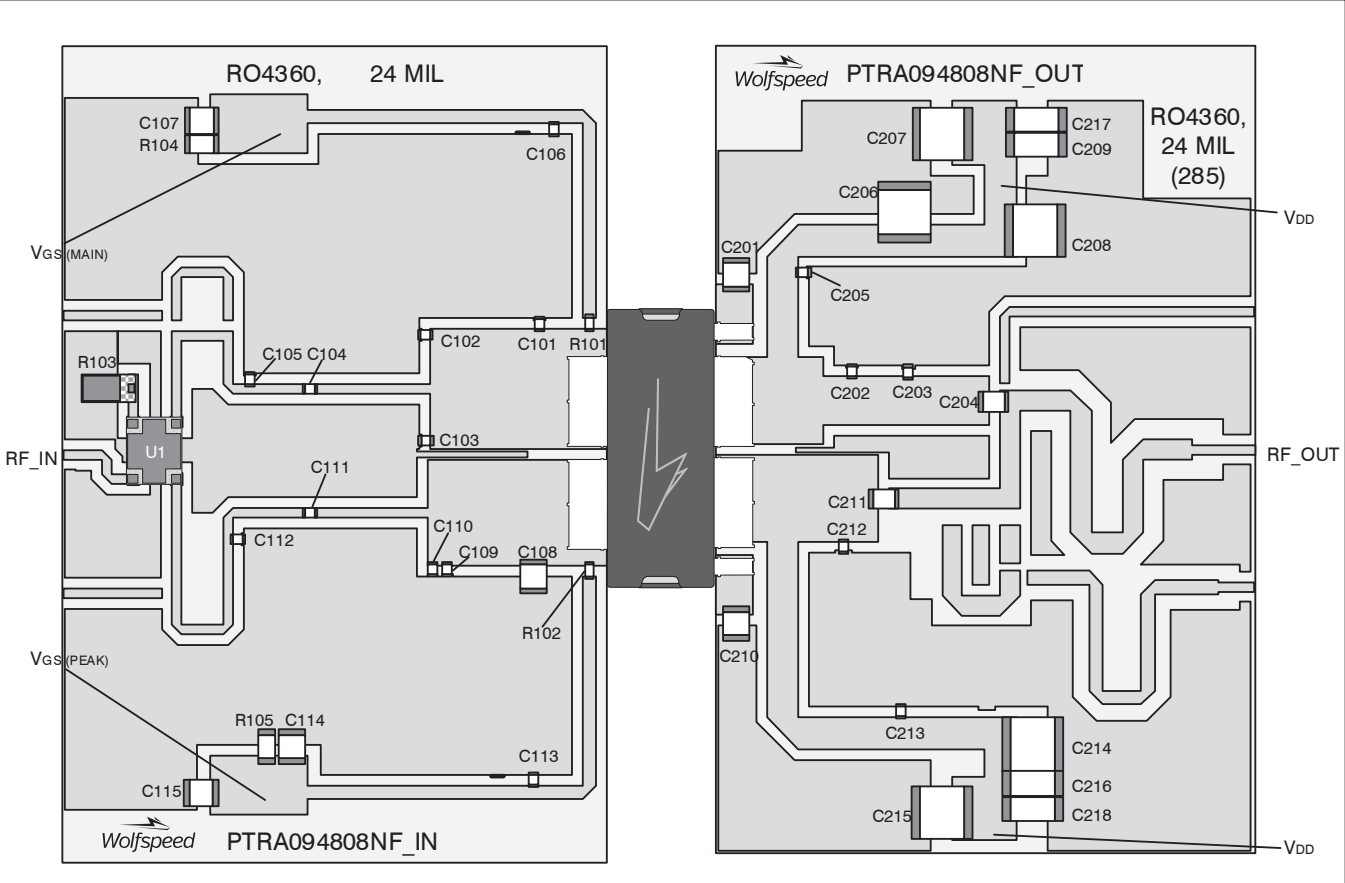
**Peak Side Load Pull Performance** – Pulsed CW signal: 10  $\mu$ sec, 10% duty cycle,  $V_{DD} = 48$  V,  $V_{GS(PEAK)} = 2$  V, class C

|                   |                                            | <b>P<sub>1dB</sub></b>                     |                  |                              |                            |                                |                                            |                  |                              |                            |                                |
|-------------------|--------------------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|
|                   |                                            | <b>Max Output Power</b>                    |                  |                              |                            |                                | <b>Max Drain Efficiency</b>                |                  |                              |                            |                                |
| <b>Freq [MHz]</b> | <b>Z<sub>s</sub> [<math>\Omega</math>]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>1dB</sub> [dBm]</b> | <b>P<sub>1dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>1dB</sub> [dBm]</b> | <b>P<sub>1dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> |
| 865               | 1.57-j3.71                                 | 1.17-j1.97                                 | 16               | 55.80                        | 380                        | 58.8                           | 1.01-j0.55                                 | 17.1             | 53.17                        | 207                        | 71.1                           |
| 880               | 1.58-j3.55                                 | 1.15-j3.55                                 | 16               | 55.70                        | 372                        | 59.0                           | 1.08-j0.83                                 | 17               | 53.70                        | 234                        | 70.9                           |
| 895               | 1.82-3.82                                  | 1.14-j2.05                                 | 16               | 55.84                        | 384                        | 60.9                           | 1.11-j1.04                                 | 16.9             | 54.10                        | 257                        | 71.1                           |

|                   |                                            | <b>P<sub>3dB</sub></b>                     |                  |                              |                            |                                |                                            |                  |                              |                            |                                |
|-------------------|--------------------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|--------------------------------------------|------------------|------------------------------|----------------------------|--------------------------------|
|                   |                                            | <b>Max Output Power</b>                    |                  |                              |                            |                                | <b>Max Drain Efficiency</b>                |                  |                              |                            |                                |
| <b>Freq [MHz]</b> | <b>Z<sub>s</sub> [<math>\Omega</math>]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>3dB</sub> [dBm]</b> | <b>P<sub>3dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> | <b>Z<sub>l</sub> [<math>\Omega</math>]</b> | <b>Gain [dB]</b> | <b>P<sub>3dB</sub> [dBm]</b> | <b>P<sub>3dB</sub> [W]</b> | <b><math>\eta_D</math> [%]</b> |
| 865               | 1.57-j3.71                                 | 1.2-1.97                                   | 14               | 56.68                        | 466                        | 61.9                           | 1.17-0.93                                  | 15.1             | 55.12                        | 325                        | 71.2                           |
| 880               | 1.58-j3.55                                 | 1.32-2.11                                  | 13.8             | 56.46                        | 443                        | 60.6                           | 1.15-1.05                                  | 15               | 55.00                        | 316                        | 70.7                           |
| 895               | 1.82-3.82                                  | 1.19-2.09                                  | 13.9             | 56.59                        | 456                        | 62.4                           | 1.05-1.04                                  | 14.8             | 54.72                        | 296                        | 71.0                           |

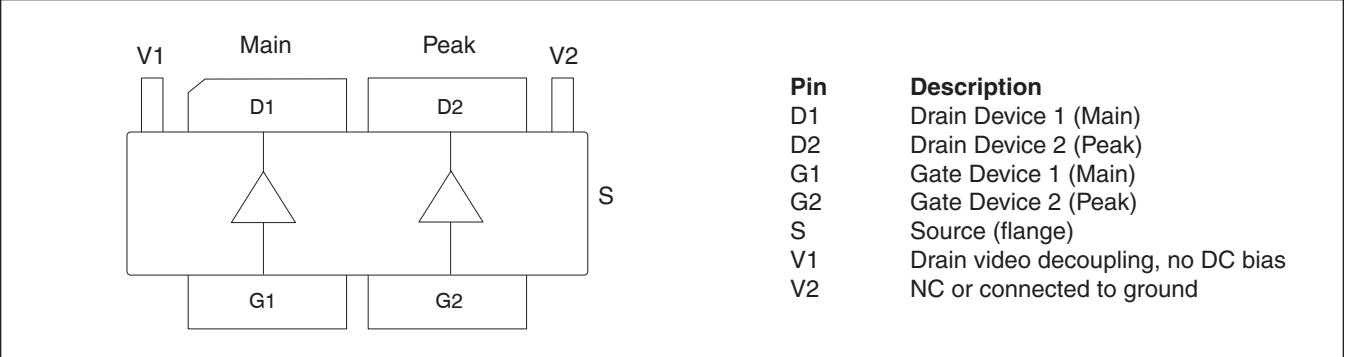


Reference Circuit, 869 – 894 MHz



Reference circuit assembly diagram (not to scale)

Pinout Diagram (top view)



**Reference Circuit** (cont.)**Reference Circuit Assembly**

|                                                                                                                                     |                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| DUT                                                                                                                                 | PTRA094808NF V1                                                         |
| Test Fixture Part No.                                                                                                               | LTA/PTRA094808NF V1                                                     |
| PCB                                                                                                                                 | Rogers 4360, 0.609 mm [0.024"] thick, 2 oz. copper, $\epsilon_r = 6.15$ |
| Find Gerber files for this test fixture on the Wolfspeed Web site at <a href="http://www.wolfspeed.com/RF">www.wolfspeed.com/RF</a> |                                                                         |

**Components Information**

| Component                                            | Description                  | Manufacturer                    | P/N                 |
|------------------------------------------------------|------------------------------|---------------------------------|---------------------|
| <b>Input</b>                                         |                              |                                 |                     |
| C101                                                 | Capacitor, 6.8 pF            | ATC                             | ATC600F6R8BT250T    |
| C102                                                 | Capacitor, 2.7 pF            | ATC                             | ATC600F2R7BT250T    |
| C103, C105                                           | Capacitor, 1.8 pF            | ATC                             | ATC600F1R8BT250T    |
| C104, C111                                           | Capacitor, 33 pF             | ATC                             | ATC600F330JT250T    |
| C106, C113                                           | Capacitor, 68 pF             | ATC                             | ATC600F680JT250T    |
| C107, C114, C115                                     | Capacitor, 10 $\mu$ F        | Taiyo Yuden                     | UMK325C7106MM-T     |
| C108                                                 | Capacitor, 8.2 pF            | ATC                             | ATC100B8R2BT500XB   |
| C109                                                 | Capacitor, 2.0 pF            | ATC                             | ATC600F2R0BT250T    |
| C110                                                 | Capacitor, 1.0 pF            | ATC                             | ATC600F1R0BT250T    |
| C112                                                 | Capacitor, 3.3 pF            | ATC                             | ATC600F3R3BT250T    |
| R101, R102                                           | Resistor, 5.6 $\Omega$       | Panasonic Electronic Components | ERJ-8RQJ5R6V        |
| R103                                                 | Resistor, 50 $\Omega$        | Anaren                          | C16A50Z4            |
| R104, R105                                           | Resistor, 1,000 $\Omega$     | Panasonic Electronic Components | ERJ-8GEYJ102V       |
| U1                                                   | Hybrid coupler               | CEMAX                           | CMX09Q02            |
| <b>Output</b>                                        |                              |                                 |                     |
| C201, C210                                           | Capacitor, 10 $\mu$ F        | Taiyo Yuden                     | UMK325C7106MM-      |
| C202                                                 | Capacitor, 10 pF             | ATC                             | ATC600F100JT250T    |
| C203                                                 | Capacitor, 1.5 pF            | ATC                             | ATC600F1R5CT250T    |
| C204                                                 | Capacitor, 20 pF             | ATC                             | ATC100B200JT500XB   |
| C205                                                 | Capacitor, 68 pF             | ATC                             | ATC600F680JT250T    |
| C206, C207, C208, C209, C214, C215, C216, C217, C218 | Capacitor, 10 $\mu$ F, 100 V | TDK Corporation                 | C5750X7S2A106M230KB |
| C211                                                 | Capacitor, 47 pF             | ATC                             | ATC100B470JT500XB   |
| C212                                                 | Capacitor, 12 pF             | ATC                             | ATC600F120JT250T    |
| C213                                                 | Capacitor, 47 pF             | ATC                             | ATC600F470JT250T    |

## Package Outline Specifications

### Package PG-HBSOF-6-2

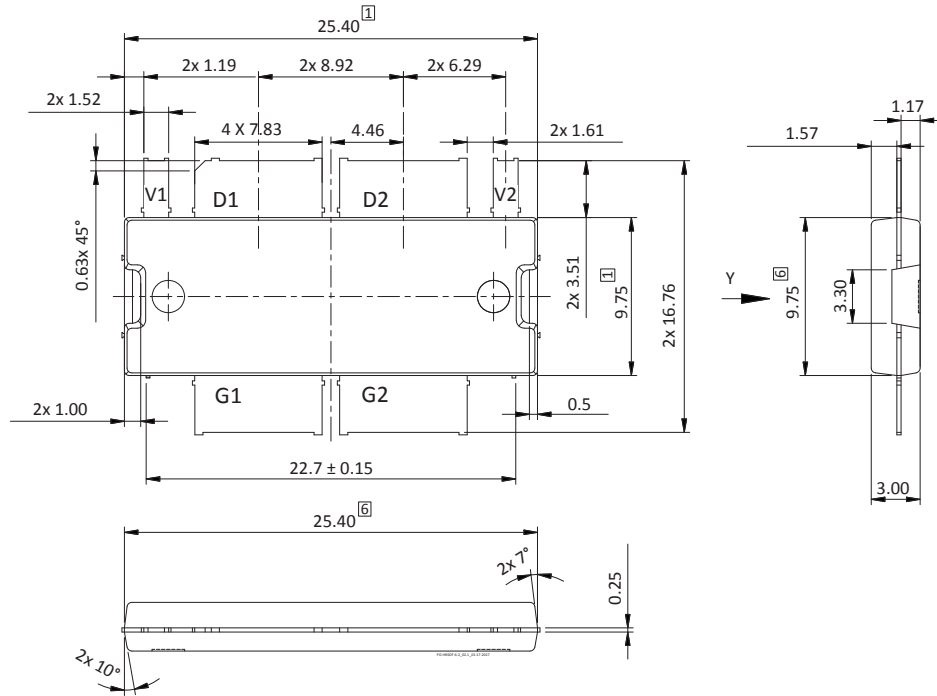


Diagram Notes—unless otherwise specified:

1. Mold/dam bar/metal protrusion of 0.30 mm max per side not included.
2. Metal protrusions are connected to source and shall not exceed 0.10 mm max.
3. Fillets and radii: all radii are 0.3 mm max.
4. Interpret dimensions and tolerances per ISO 8015.
5. Dimensions are mm.
6. Does not include mold/dam bar and metal protrusion.
7. Exposed metal surface is tin-plated, may not be covered by mold compound.
8. All tolerances ± 0.1 mm unless specified otherwise.
9. All metal surfaces are tin-plated, except area of cut.
10. Lead thickness: 0.25 mm.
11. Pins: D1, D2 = drain; G1, G2 = gate; S = source; V1 = drain video decoupling, no DC bias, V2 = NC or connected to ground

## Package Outline Specifications

**Package PG-HBSOF-6-2 (bottom view)**

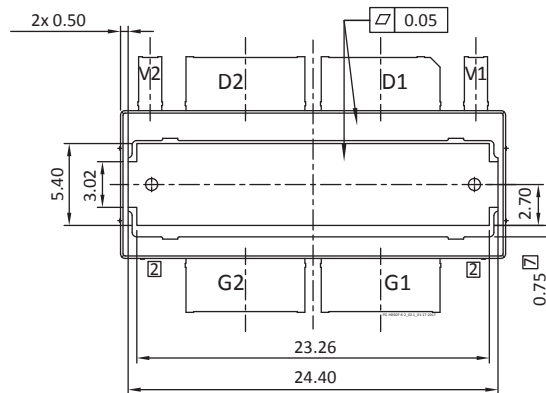


Diagram Notes—unless otherwise specified:

1. Mold/dam bar/metal protrusion of 0.30 mm max per side not included.
2. Metal protrusions are connected to source and shall not exceed 0.10 mm max.
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5. Dimensions are mm.
6. Does not include mold/dam bar and metal protrusion.
7. Exposed metal surface is tin-plated, may not be covered by mold compound.
8. All tolerances  $\pm 0.1$  mm unless specified otherwise.
9. All metal surfaces are tin-plated, except area of cut.
10. Lead thickness: 0.25 mm.
11. Pins: D1, D2 = drain; G1, G2 = gate; S = source; V1 = drain video decoupling, no DC bias, V2 = NC or connected to ground

## Revision History

| Revision | Date       | Data Sheet Type | Page | Subjects (major changes at each revision)                         |
|----------|------------|-----------------|------|-------------------------------------------------------------------|
| 01       | 2016-09-30 | Advance         | All  | Data Sheet reflects advance specification for product development |
| 02       | 2017-04-28 | Production      | All  | Data Sheet reflects released product specification                |
| 03       | 2017-08-21 | Production      | 6, 7 | Updated PCB layout and components information                     |
| 04       | 2017-09-01 | Production      | 7    | Update components information                                     |
| 05       | 2018-06-20 | Production      | All  | Converted to Wolfspeed Data Sheet                                 |

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## Notes

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