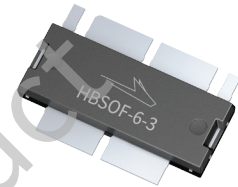


# PTRA094858NF

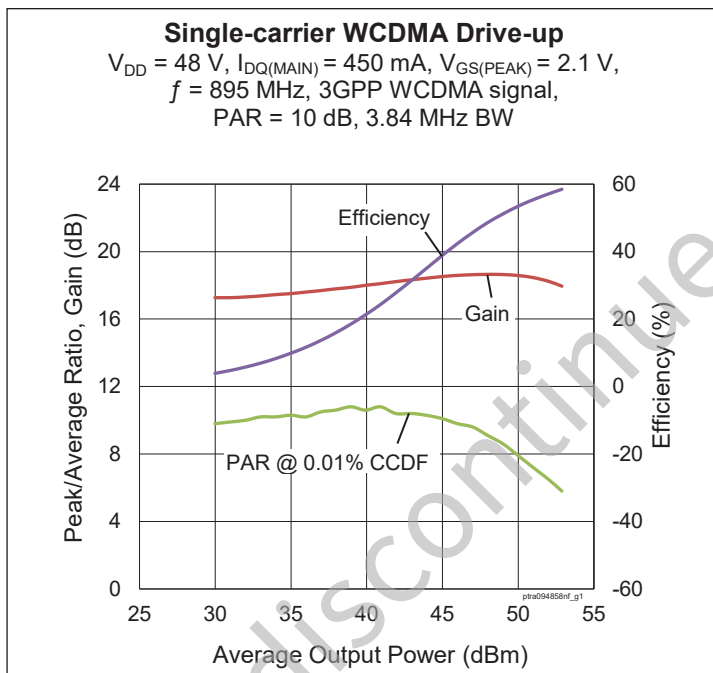
## Thermally-Enhanced High Power RF LDMOS FET 400 W, 48 V, 859 – 960 MHz

### Description

The PTRA094858NF is a 400-watt Doherty LDMOS transistor 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.



PTRA094858NF  
Package PG-HBSOF-6-3



### Features

- Broadband internal input and output matching
- Asymmetrical Doherty design
  - Main :  $P_{1dB} = 150\text{ W Typ}$
  - Peak :  $P_{1dB} = 250\text{ W Typ}$
- Typical Pulsed CW performance, 895 MHz, 48 V, Doherty configuration, 10  $\mu\text{sec}$  pulse width, 10% duty cycle, class AB
  - Output power at  $P_{1dB} = 400\text{ W}$
  - Output power at  $P_{3dB} = 500\text{ W}$
  - Efficiency = 63%
  - Gain = 18.5 dB
- Capable of handling 10:1 VSWR @ 48 V, 87 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 test fixture)

$V_{DD} = 48\text{ V}$ ,  $I_{DQ} = 450\text{ mA}$ ,  $P_{OUT} = 87\text{ W avg}$ ,  $V_{GS(PEAK)} = 2.1\text{ V}$ ,  $f = 895\text{ MHz}$ , 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 10 dB @ 0.01% CCDF

| Characteristic               | Symbol   | Min  | Typ   | Max   | Unit |
|------------------------------|----------|------|-------|-------|------|
| Gain                         | $G_{ps}$ | 16.8 | 17.75 | —     | dB   |
| Drain Efficiency             | $\eta_D$ | 48   | 52    | —     | %    |
| Adjacent Channel Power Ratio | ACPR     | —    | -29   | -26.5 | dBc  |
| Output PAR @ 0.01% CCDF      | OPAR     | 6.5  | 7.2   | —     | dB   |

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

ESD: Electrostatic discharge sensitive device—observe handling precautions!

## DC Characteristics

| 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           | $V_{GS} = 10\text{ V}, V_{DS} = 0\text{ V}$          | $I_{GSS}$     | —   | —    | 1   | $\mu\text{A}$ |
| On-State Resistance (Main)     | $V_{GS} = 10\text{ V}, V_{DS} = 0.1\text{ V}$        | $R_{DS(on)}$  | —   | 0.2  | —   | $\Omega$      |
|                                | (Peak) $V_{GS} = 10\text{ V}, V_{DS} = 0.1\text{ V}$ | $R_{DS(on)}$  | —   | 0.13 | —   | $\Omega$      |
| Operating Gate Voltage (Main)  | $V_{DS} = 48\text{ V}, I_{DQ} = 450\text{ mA}$       | $V_{GS}$      | 3.4 | 3.6  | 3.9 | V             |
|                                | (Peak) $V_{DS} = 48\text{ V}, I_{DQ} = 0\text{ mA}$  | $V_{GS}$      | —   | 2.1  | —   | 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 | $^{\circ}\text{C}$ |

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. Parameters values can be affected by end application and product usage. Values may change over time.

## Thermal Characteristics

| Parameter  | Symbol          | Value | Unit                        |
|--|-----------------|-------|-----------------------------|
| Thermal Resistance (main, $T_{CASE} = 70^{\circ}\text{C}$ , 87.1 W CW) | $R_{\theta JC}$ | 0.41  | $^{\circ}\text{C}/\text{W}$ |

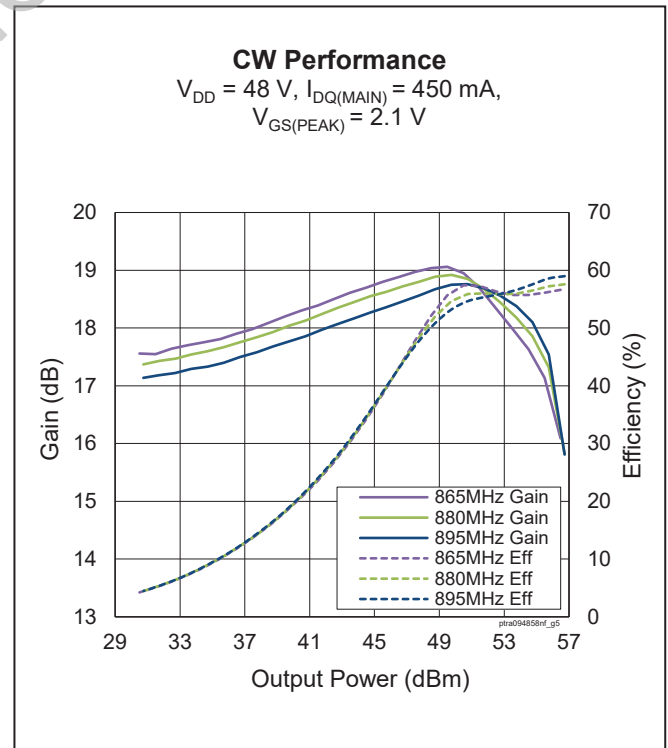
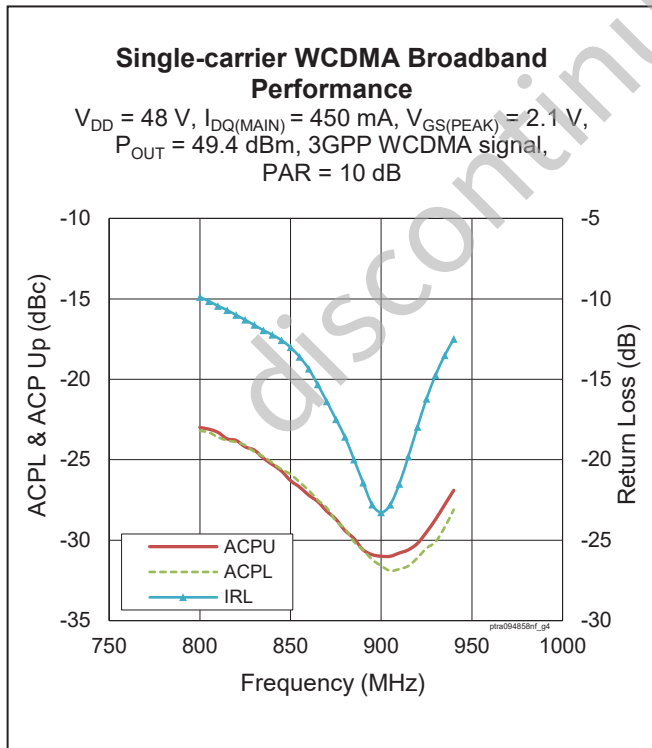
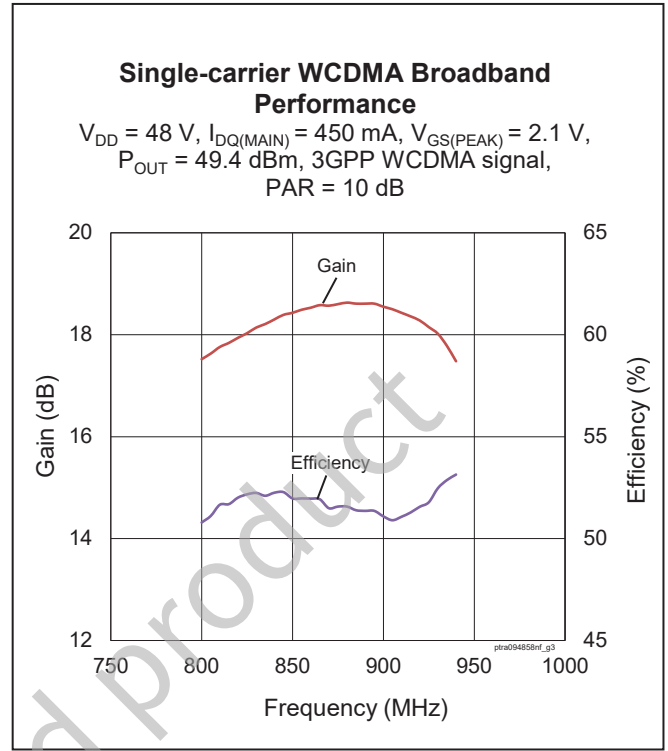
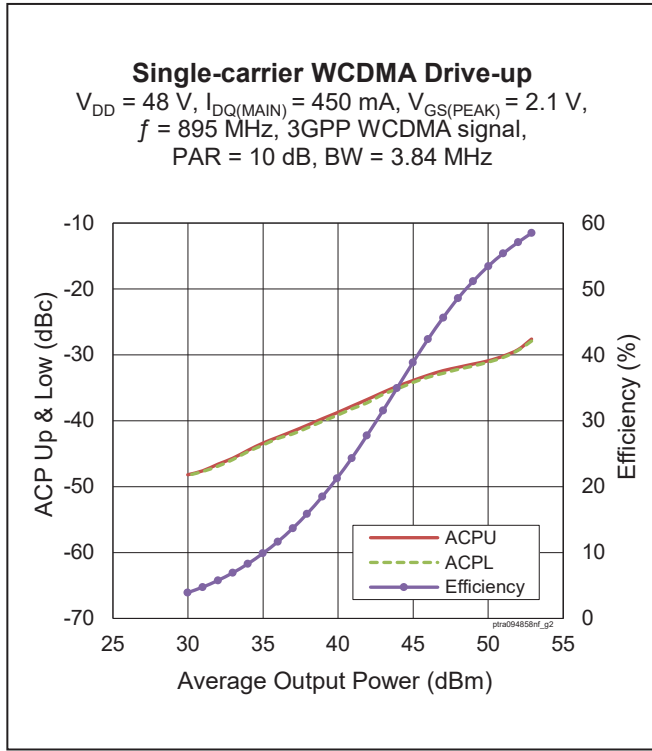
## Moisture Sensitivity Level

| Level | Test Signal         | Package Temperature | Unit               |
|-------|---------------------|---------------------|--------------------|
| 3     | IPC/JEDEC J-STD-020 | 260                 | $^{\circ}\text{C}$ |

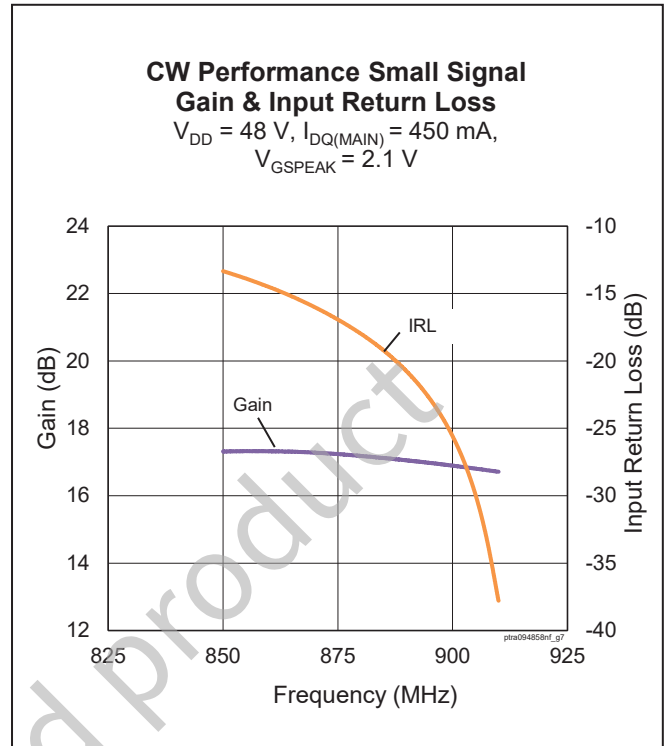
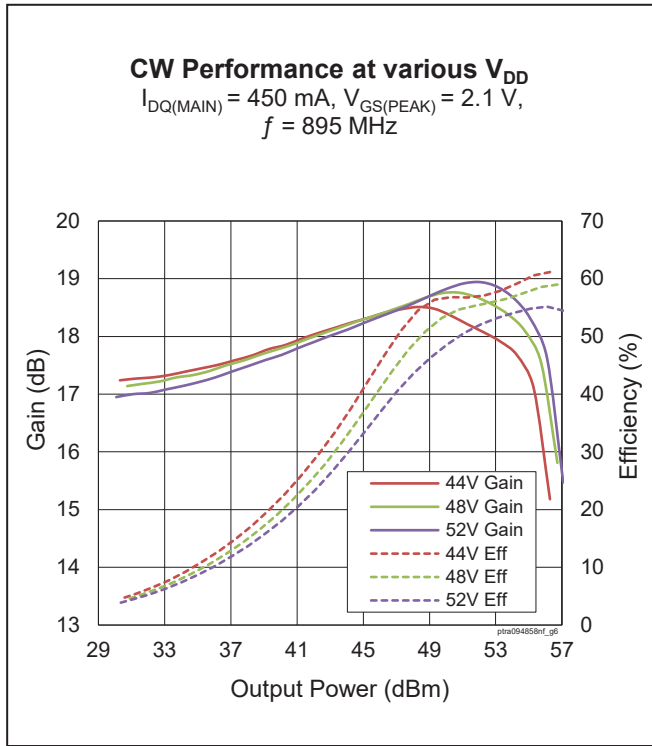
## Ordering Information

| Type and Version   | Order Code         | Package      | Shipping             |
|--------------------|--------------------|--------------|----------------------|
| PTRA094858NF V1 R5 | PTRA094858NF-V1-R5 | PG-HBSOF-6-3 | Tape & Reel, 500 pcs |

Typical Performance (data taken in test fixture)



Typical Performance (cont.)



discontinued Product

### Load Pull Performance

**Main Side Load Pull Performance** – Pulsed CW signal: 10  $\mu$ sec, 10% duty cycle,  $V_{DD} = 48$  V,  $I_{DQ} = 450$  mA, class AB

|            |                             | P <sub>1dB</sub>            |           |                        |                      |              |                             |           |                        |                      |              |
|------------|-----------------------------|-----------------------------|-----------|------------------------|----------------------|--------------|-----------------------------|-----------|------------------------|----------------------|--------------|
|            |                             | Max Output Power            |           |                        |                      |              | Max Drain Efficiency        |           |                        |                      |              |
| Freq [MHz] | Z <sub>s</sub> [ $\Omega$ ] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>1dB</sub> [dBm] | P <sub>1dB</sub> [W] | $\eta_D$ [%] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>1dB</sub> [dBm] | P <sub>1dB</sub> [W] | $\eta_D$ [%] |
| 865        | 1.43 - j5.04                | 2.29 - j0.67                | 21.06     | 53.32                  | 214.78               | 54.9         | 4.77 + j1.31                | 22.83     | 51.65                  | 146.22               | 66.0         |
| 895        | 2.31 - j6.58                | 2.26 - j0.24                | 21.03     | 53.47                  | 222.33               | 57.0         | 4.26 + j1.68                | 22.7      | 51.84                  | 152.76               | 68.1         |

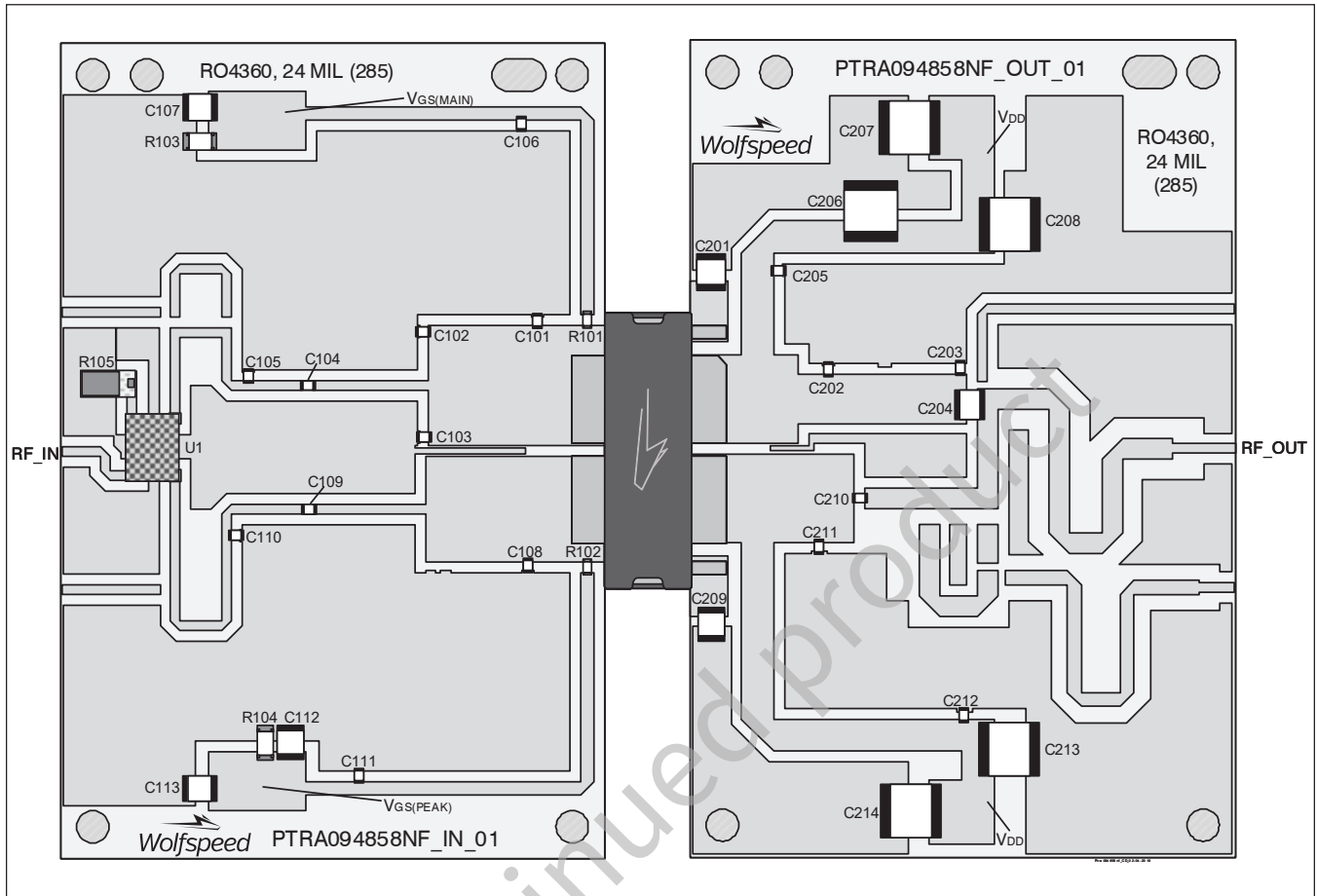
|            |                             | P <sub>3dB</sub>            |           |                        |                      |              |                             |           |                        |                      |              |
|------------|-----------------------------|-----------------------------|-----------|------------------------|----------------------|--------------|-----------------------------|-----------|------------------------|----------------------|--------------|
|            |                             | Max Output Power            |           |                        |                      |              | Max Drain Efficiency        |           |                        |                      |              |
| Freq [MHz] | Z <sub>s</sub> [ $\Omega$ ] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>3dB</sub> [dBm] | P <sub>3dB</sub> [W] | $\eta_D$ [%] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>3dB</sub> [dBm] | P <sub>3dB</sub> [W] | $\eta_D$ [%] |
| 865        | 1.43 - j5.04                | 2.32 - j0.79                | 19.07     | 54.24                  | 265.46               | 58.5         | 4.68 + j1.09                | 20.78     | 52.59                  | 181.55               | 67.3         |
| 895        | 2.31 - j6.58                | 2.29 - j0.32                | 19.03     | 54.35                  | 272.27               | 60.4         | 4.14 + j1.5                 | 20.64     | 52.77                  | 189.23               | 69.3         |

**Peak Side Load Pull Performance** – Pulsed CW signal: 10  $\mu$ sec, 10% duty cycle,  $V_{DD} = 48$  V,  $V_{GS(PEAK)} = 2.1$  V, class C

|            |                             | P <sub>1dB</sub>            |           |                        |                      |              |                             |           |                        |                      |              |
|------------|-----------------------------|-----------------------------|-----------|------------------------|----------------------|--------------|-----------------------------|-----------|------------------------|----------------------|--------------|
|            |                             | Max Output Power            |           |                        |                      |              | Max Drain Efficiency        |           |                        |                      |              |
| Freq [MHz] | Z <sub>s</sub> [ $\Omega$ ] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>1dB</sub> [dBm] | P <sub>1dB</sub> [W] | $\eta_D$ [%] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>1dB</sub> [dBm] | P <sub>1dB</sub> [W] | $\eta_D$ [%] |
| 865        | 1.78 - j4.94                | 1.20 - j0.29                | 16.83     | 55.60                  | 363.08               | 57.9         | 0.97 + j1.36                | 17.44     | 52.28                  | 169.04               | 74.5         |
| 895        | 2.94 - j6.74                | 1.34 - j0.19                | 16.54     | 55.65                  | 367.28               | 58.9         | 0.98 + j1.35                | 17.24     | 52.81                  | 191                  | 74.2         |

|            |                             | P <sub>3dB</sub>            |           |                        |                      |              |                             |           |                        |                      |              |
|------------|-----------------------------|-----------------------------|-----------|------------------------|----------------------|--------------|-----------------------------|-----------|------------------------|----------------------|--------------|
|            |                             | Max Output Power            |           |                        |                      |              | Max Drain Efficiency        |           |                        |                      |              |
| Freq [MHz] | Z <sub>s</sub> [ $\Omega$ ] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>3dB</sub> [dBm] | P <sub>3dB</sub> [W] | $\eta_D$ [%] | Z <sub>l</sub> [ $\Omega$ ] | Gain [dB] | P <sub>3dB</sub> [dBm] | P <sub>3dB</sub> [W] | $\eta_D$ [%] |
| 865        | 1.78 - j4.94                | 1.36 - j0.19                | 15.03     | 56.38                  | 434.51               | 63.4         | 1.17 + j0.98                | 15.72     | 54.31                  | 269.77               | 72.5         |
| 895        | 2.94 - j6.74                | 1.36 - j0.19                | 14.54     | 56.45                  | 441.57               | 61.2         | 1.15 + j1                   | 15.54     | 54.69                  | 294.44               | 74.0         |

Reference Circuit, 865 – 895 MHz



Reference circuit assembly diagram (not to scale)

discontinued product

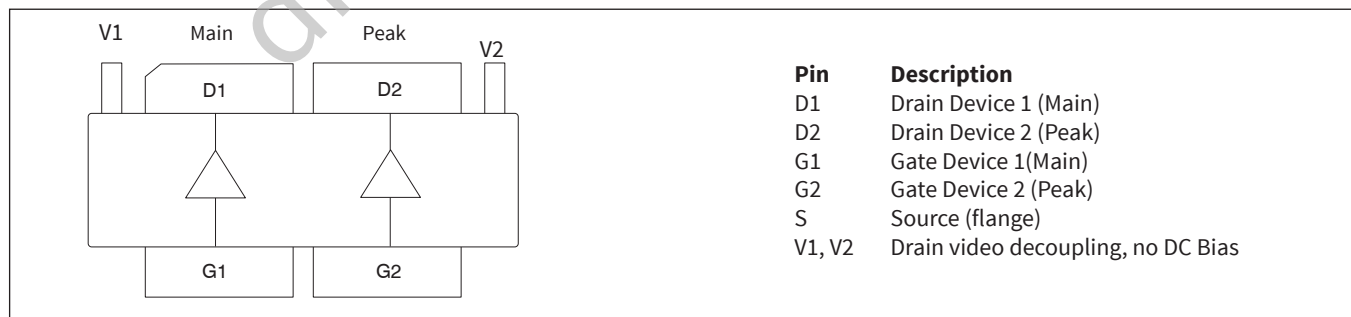
**Reference Circuit Assembly**

|   |   |
|---|---|
| DUT   | PTRA094858NF V1   |
| Test Fixture Part No.   | LTA/PTRA094858NF-V1   |
| PCB   | Rogers 4360, 0.024" thick, 2 oz. copper, $\epsilon_r = 6.4$ , $f = 865 - 895$ MHz |
| 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**

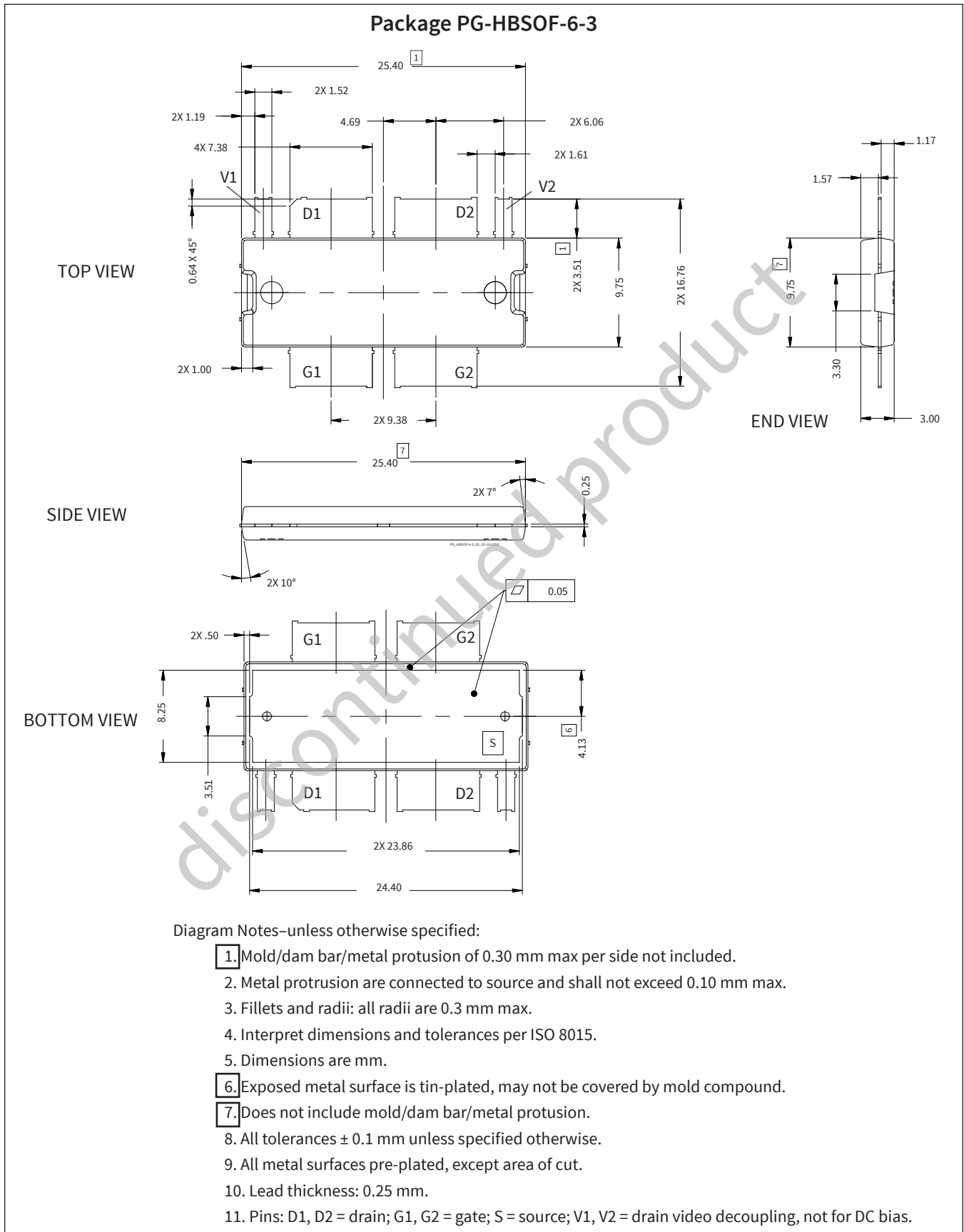
| Component                    | Description                  | Manufacturer                     | P/N                 |
|------------------------------|------------------------------|----------------------------------|---------------------|
| <b>Input</b>                 |                              |                                  |                     |
| C101, C108                   | Capacitor, 6.8 pF            | ATC                              | ATC600F6R8CT250XT   |
| C102                         | Capacitor, 2.7 pF            | ATC                              | ATC600F2R7CT250XT   |
| C103, C105                   | Capacitor, 1.8 pF            | ATC                              | ATC600F1R8CT250XT   |
| C104, C109                   | Capacitor, 33 pF             | ATC                              | ATC600F330JT250XT   |
| C106, C111                   | Capacitor, 68 pF             | ATC                              | ATC600F680JT250XT   |
| C107, C112, C113             | Capacitor, 10 $\mu$ F, 50 V  | Murata Electronics North America | GRM31CR61H106KA12K  |
| C110                         | Capacitor, 3 pF              | ATC                              | ATC600F3R0CT250XT   |
| R101, R102                   | Resistor, 5.6 ohms           | Panasonic Electronic Components  | ERJ-8RQJ5R6V        |
| R103, R104                   | Resistor, 1000 ohms          | Panasonic Electronic Components  | ERJ-8GEYJ102V       |
| R105                         | Resistor, 50 ohms            | Richardson                       | C16A50Z4            |
| U1                           | Hybrid Coupler               | RN2 Tech                         | RN2 CMX09Q02        |
| <b>Output</b>                |                              |                                  |                     |
| C201, C209                   | Capacitor, 10 $\mu$ F, 100 V | TDK Corporation                  | C5750X7S2A106M230KB |
| C202                         | Capacitor, 10 pF             | ATC                              | ATC600F100JT250XT   |
| C203                         | Capacitor, 3.3 pF            | ATC                              | ATC600F3R3CT250XT   |
| C204                         | Capacitor, 20 pF             | ATC                              | ATC100B200KW500XT   |
| C205                         | Capacitor, 68 pF             | ATC                              | ATC600F680JT250XT   |
| C206, C207, C208, C213, C214 | Capacitor, 10 $\mu$ F, 100 V | TDK Corporation                  | C5750X7S2A106M230KB |
| C210, C212                   | Capacitor, 47 pF             | ATC                              | ATC600F470JT250XT   |
| C211                         | Capacitor, 15 pF             | ATC                              | ATC600F150JT250XT   |

**Pinout Diagram (top view)**



Lead connections for PTRA094858NF

Package Outline Specifications





## Revision History

| Revision | Date       | Data Sheet Type | Page | Subjects (major changes since last revision)   |
|----------|------------|-----------------|------|--|
| 01       | 2019-02-06 | Preliminary     | All  | Data Sheet reflects preliminary specification  |
| 02       | 2019-04-03 | Final           | All  | Corrected package throughout, updated HBM classification, Data Sheet reflects released product specification |
| 02.1     | 2020-03-02 | Final           | 8    | Updated package outline  |

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## Notes

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