

## Thermally-Enhanced High Power RF LDMOS FETs 220 W, 920 – 960 MHz

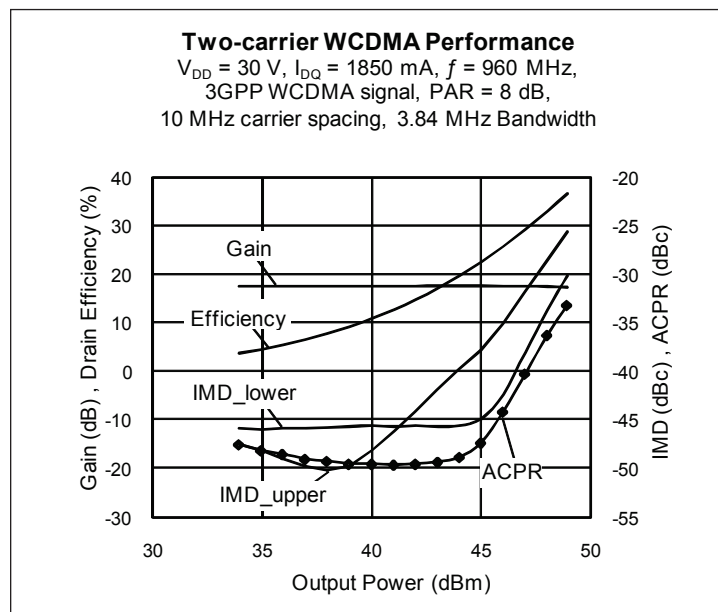
### Description

The PTFA092213EL and PTFA092213FL are 220-watt, internally-matched LDMOS FETs designed for use in cellular power amplifier applications in the 920 to 960 MHz band. These devices feature internal I/O matching and thermally-enhanced open-cavity ceramic packages with slotted or earless flanges. Manufactured with Infineon's advanced LDMOS process, these devices provide excellent thermal performance and superior reliability.

PTFA092213EL  
Package H-33288-6



PTFA092213FL  
Package H-34288-4/2



### Features

- Broadband internal matching
- Typical two-carrier WCDMA performance at 960 MHz, 30 V
  - Average output power = 50 W
  - Linear Gain = 17.5 dB
  - Efficiency = 29%
  - Intermodulation distortion = -32 dBc
  - Adjacent channel power = -42.5 dBc
- Typical CW performance, 960 MHz, 30 V
  - Output power at  $P_{1dB} = 250\text{ W}$
  - Linear Gain = 17.5 dB
  - Efficiency = 52%
- Integrated ESD protection: Human Body Model, Class 2 (minimum)
- Excellent thermal stability, low HCI drift
- Capable of handling 10:1 VSWR @ 30 V, 220 W (CW) output power
- Pb-free, RoHS-compliant

### RF Characteristics

**Two-carrier WCDMA Measurements** (not subject to production test—verified by design/characterization in Infineon test fixture)  
 $V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1850\text{ mA}$ ,  $P_{OUT} = 50\text{ W}$  average,  $f_1 = 950\text{ MHz}$ ,  $f_2 = 960\text{ MHz}$ , 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 8 dB @ 0.01% CCDF

| Characteristic             | Symbol   | Min | Typ  | Max | Unit |
|----------------------------|----------|-----|------|-----|------|
| Gain                       | $G_{ps}$ | —   | 17.5 | —   | dB   |
| Drain Efficiency           | $\eta_D$ | —   | 29   | —   | %    |
| Intermodulation Distortion | IMD      | —   | -32  | —   | dBc  |

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

**ESD:** Electrostatic discharge sensitive device—observe handling precautions!

## RF Characteristics (cont.)

### Two-tone Measurements (tested in Infineon test fixture)

 $V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1850\text{ mA}$ ,  $P_{OUT} = 200\text{ W PEP}$ ,  $f = 960\text{ MHz}$ , tone spacing = 1 MHz

| Characteristic             | Symbol   | Min | Typ  | Max | Unit |
|----------------------------|----------|-----|------|-----|------|
| Gain                       | $G_{ps}$ | 17  | 17.5 | —   | dB   |
| Drain Efficiency           | $\eta_D$ | 40  | 42   | —   | %    |
| Intermodulation Distortion | IMD      | —   | −30  | −28 | dBc  |

## DC Characteristics

| Characteristic                 | Conditions                                         | Symbol        | Min | Typ  | Max  | Unit          |
|--------------------------------|----------------------------------------------------|---------------|-----|------|------|---------------|
| Drain-Source Breakdown Voltage | $V_{GS} = 0\text{ V}$ , $I_{DS} = 10\text{ mA}$    | $V_{(BR)DSS}$ | 65  | —    | —    | V             |
| Drain Leakage Current          | $V_{DS} = 28\text{ V}$ , $V_{GS} = 0\text{ V}$     | $I_{DSS}$     | —   | —    | 1.0  | $\mu\text{A}$ |
|                                | $V_{DS} = 63\text{ V}$ , $V_{GS} = 0\text{ V}$     | $I_{DSS}$     | —   | —    | 10.0 | $\mu\text{A}$ |
| On-State Resistance            | $V_{GS} = 10\text{ V}$ , $V_{DS} = 0.1\text{ V}$   | $R_{DS(on)}$  | —   | 0.04 | —    | $\Omega$      |
| Operating Gate Voltage         | $V_{DS} = 30\text{ V}$ , $I_{DQ} = 1850\text{ mA}$ | $V_{GS}$      | 2.0 | 2.5  | 3.0  | V             |
| Gate Leakage Current           | $V_{GS} = 10\text{ V}$ , $V_{DS} = 0\text{ V}$     | $I_{GSS}$     | —   | —    | 1.0  | $\mu\text{A}$ |

## Maximum Ratings

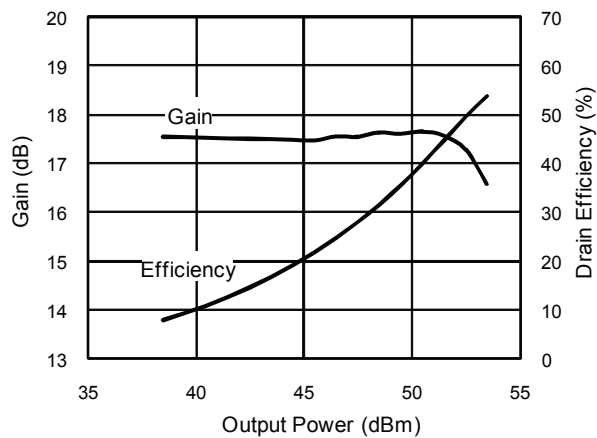
| Parameter                                                  | Symbol          | Value       | Unit |
|------------------------------------------------------------|-----------------|-------------|------|
| Drain-Source Voltage                                       | $V_{DSS}$       | 65          | V    |
| Gate-Source Voltage                                        | $V_{GS}$        | −0.5 to +12 | V    |
| Junction Temperature                                       | $T_J$           | 200         | °C   |
| Storage Temperature Range                                  | $T_{STG}$       | −40 to +150 | °C   |
| Thermal Resistance ( $T_{CASE} = 70\text{ °C}$ , 220 W CW) | $R_{\theta JC}$ | 0.23        | °C/W |

## Ordering Information

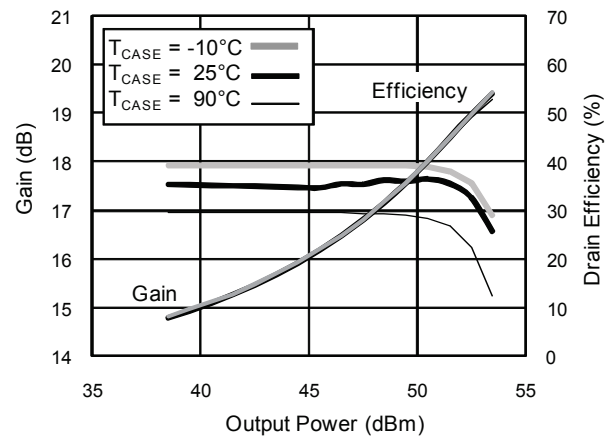
| Type and Version     | Package Outline | Package Description                              | Shipping             |
|----------------------|-----------------|--------------------------------------------------|----------------------|
| PTFA092213EL V4      | H-33288-6       | Thermally-enhanced, slotted flange, single-ended | Tray                 |
| PTFA092213EL V4 R250 | H-33288-6       | Thermally-enhanced, slotted flange, single-ended | Tape & Reel, 250 pcs |
| PTFA092213FL V5      | H-34288-4/2     | Thermally-enhanced, earless flange, single-ended | Tray                 |
| PTFA092213FL V5 R250 | H-34288-4/2     | Thermally-enhanced, earless flange, single-ended | Tape & Reel, 250 pcs |

## Typical Performance

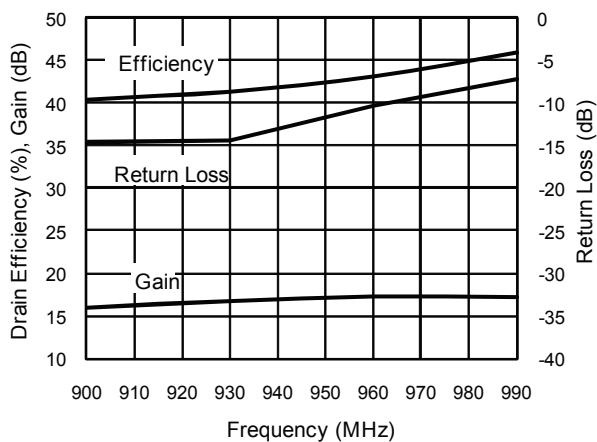
**CW Performance**  
**Gain & Efficiency vs. Output Power**  
 $V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1.85\text{ A}$ ,  $f = 960\text{ MHz}$



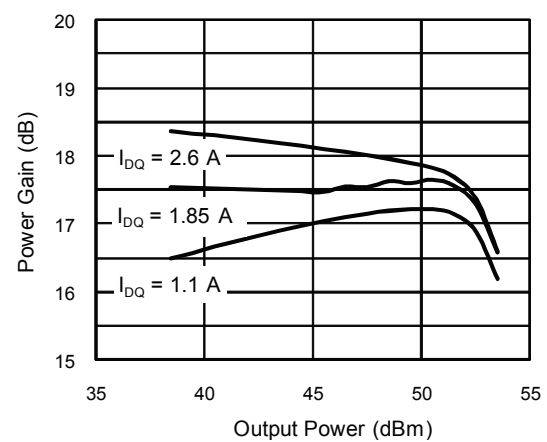
**CW Performance**  
**Gain & Efficiency vs. Output Power**  
 $V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1.85\text{ A}$ ,  $f = 960\text{ MHz}$



**Broadband Two-tone**  
**Gain, Efficiency & Return Loss**  
**vs. Frequency**  
 $V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1.85\text{ A}$ ,  $P_{OUT} = 110\text{ W}$



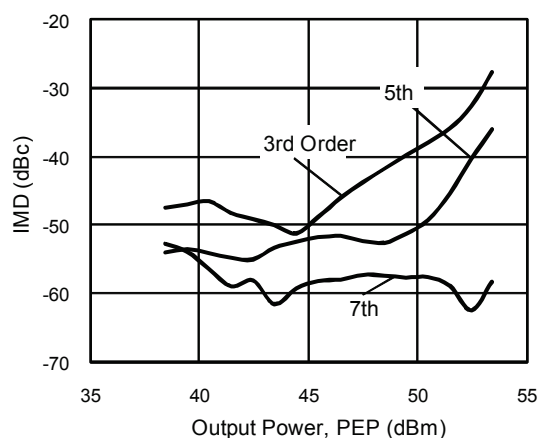
**Power Sweep, CW**  
 $V_{DD} = 30\text{ V}$ ,  $f = 960\text{ MHz}$



## Typical Performance (cont.)

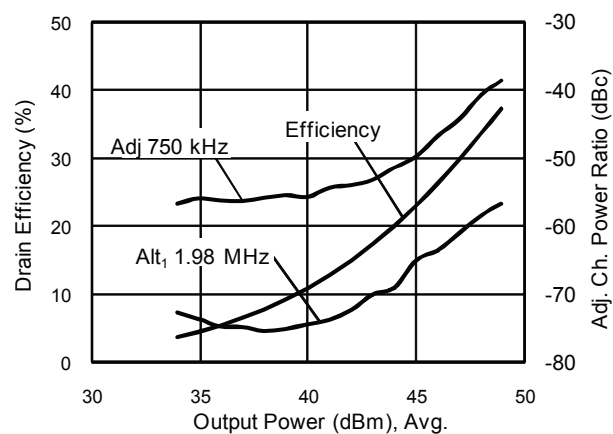
### Intermodulation Distortion vs. Output Power

$V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1.85\text{ A}$ ,  
 $f_1 = 960\text{ MHz}$ ,  $f_2 = 959\text{ MHz}$



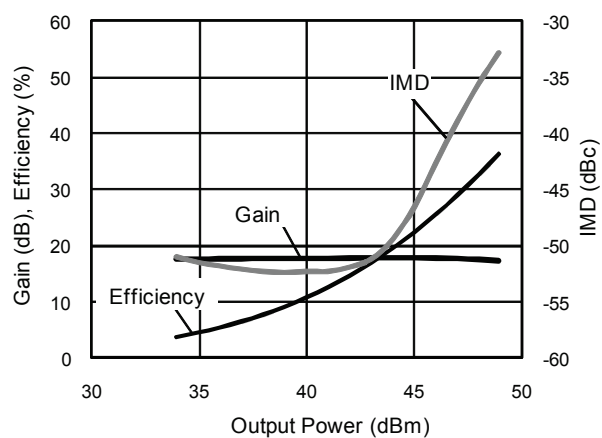
### IS-95 CDMA Performance

$V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1.85\text{ A}$ ,  $f = 960\text{ MHz}$

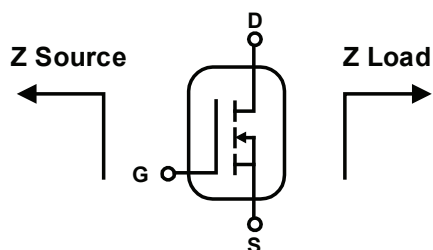


### Single-carrier WCDMA Performance

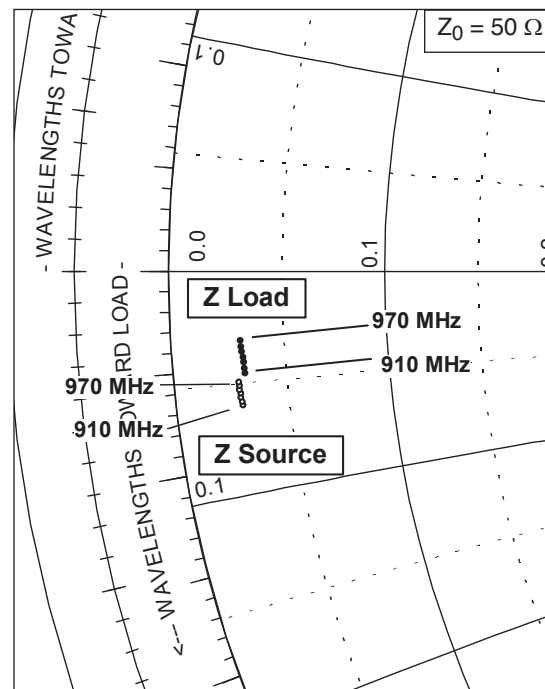
$V_{DD} = 30\text{ V}$ ,  $I_{DQ} = 1850\text{ mA}$ ,  $f = 960\text{ MHz}$ ,  
3GPP WCDMA signal, PAR = 8.5 dB,  
3.84 MHz Bandwidth



## Broadband Circuit Impedance

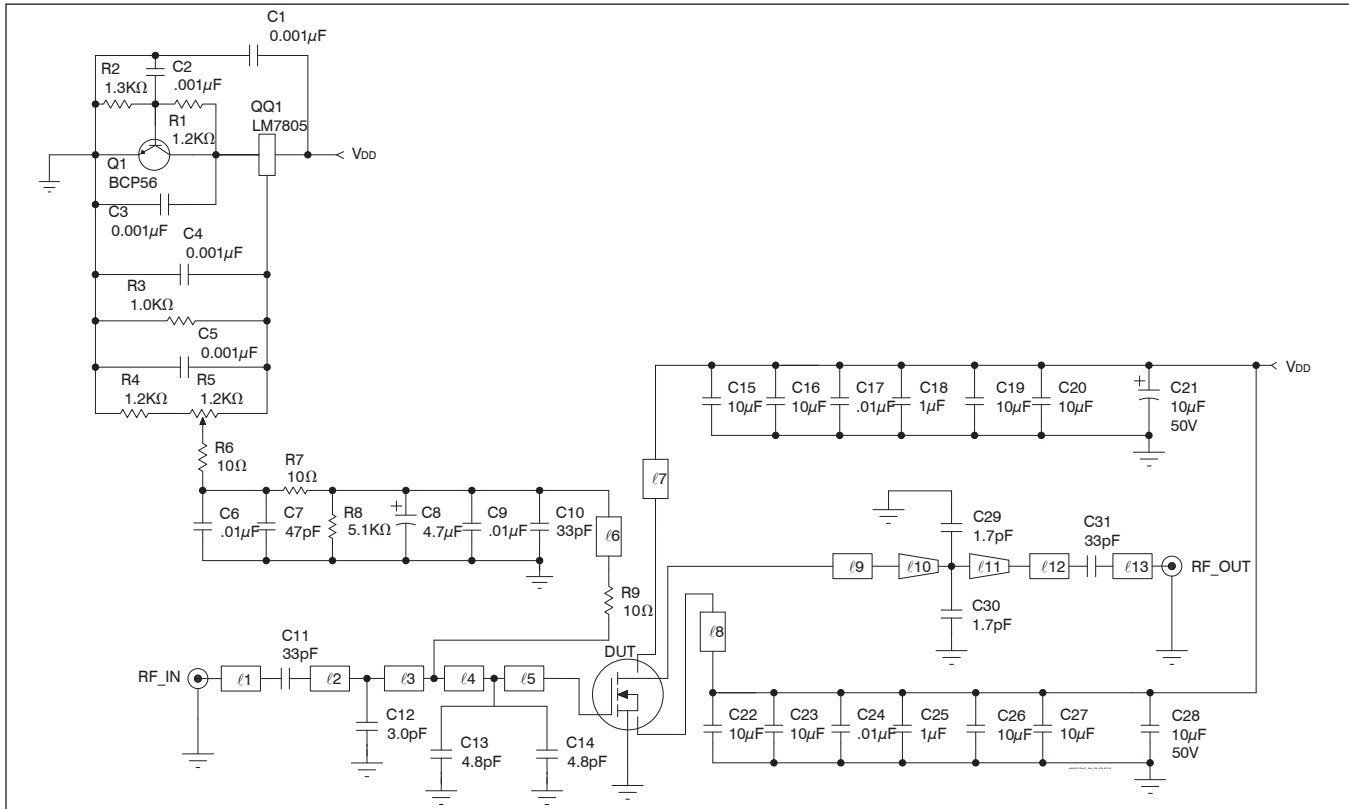


| Frequency<br>MHz | Z Source $\Omega$ |       | Z Load $\Omega$ |       |
|------------------|-------------------|-------|-----------------|-------|
|                  | R                 | jX    | R               | jX    |
| 910              | 1.44              | -3.01 | 1.57            | -2.30 |
| 920              | 1.43              | -2.92 | 1.56            | -2.18 |
| 930              | 1.42              | -2.83 | 1.55            | -2.05 |
| 940              | 1.42              | -2.74 | 1.54            | -1.93 |
| 950              | 1.41              | -2.66 | 1.53            | -1.81 |
| 960              | 1.41              | -2.57 | 1.52            | -1.69 |
| 970              | 1.41              | -2.48 | 1.51            | -1.56 |



See next page for reference circuit information

## Reference Circuit



Reference circuit block diagram for  $f = 960$  MHz

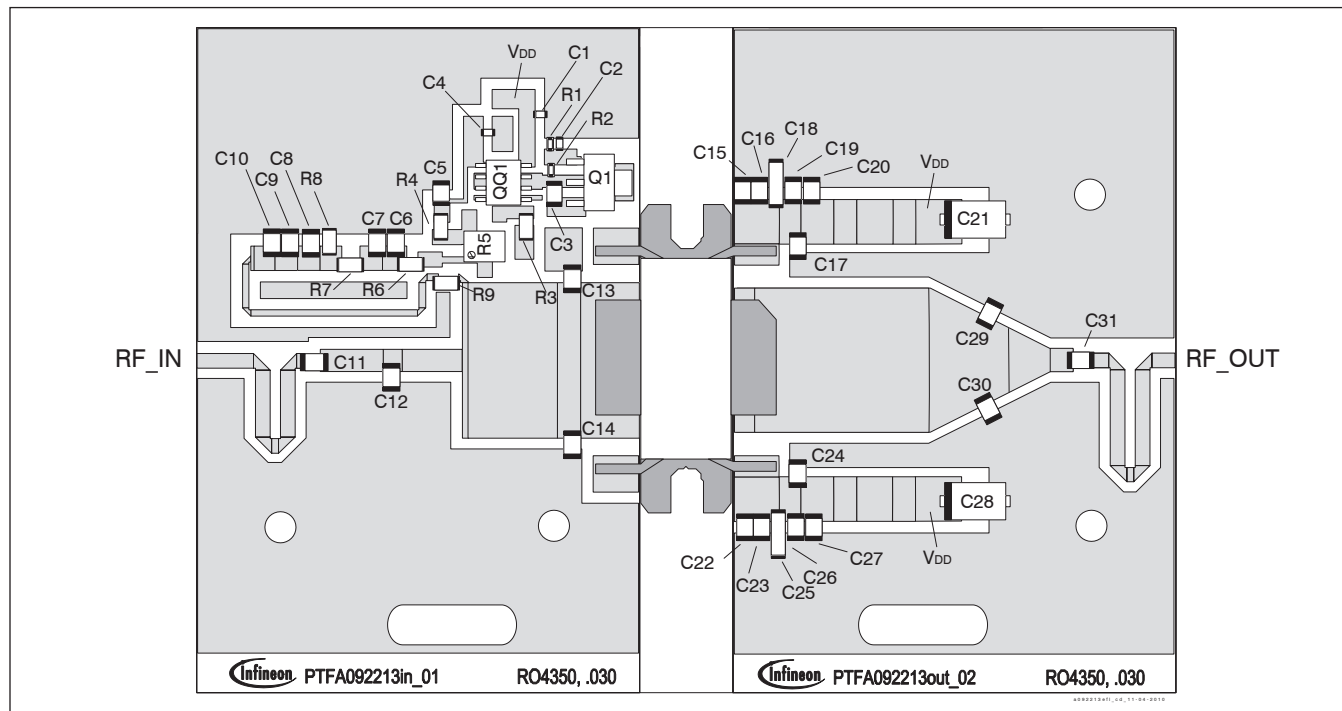
## Circuit Assembly Information

|     |                              |                                                                          |
|-----|------------------------------|--------------------------------------------------------------------------|
| DUT | PTFA092213EL or PTFA092213FL |                                                                          |
| PCB | LTN/PTFA092213EF             | 0.76 mm [.030"] thick, $\epsilon_r = 3.48$ , Rogers RO4350, 1 oz. copper |

## Electrical Characteristics at 960 MHz

| Transmission Line | Electrical Characteristics                      | Dimensions: L x W (mm) | Dimensions: L x W (in.) |
|-------------------|-------------------------------------------------|------------------------|-------------------------|
| l1                | $0.167 \lambda$ , $50.1 \Omega$                 | 31.75 x 1.65           | 1.250 x 0.065           |
| l2                | $0.047 \lambda$ , $38.0 \Omega$                 | 8.38 x 2.54            | 0.330 x 0.100           |
| l3                | $0.039 \lambda$ , $38.0 \Omega$                 | 7.37 x 2.54            | 0.290 x 0.100           |
| l4                | $0.072 \lambda$ , $7.8 \Omega$                  | 12.45 x 17.78          | 0.490 x 0.700           |
| l5                | $0.046 \lambda$ , $7.8 \Omega$                  | 7.87 x 17.78           | 0.310 x 0.700           |
| l6                | $0.163 \lambda$ , $78.3 \Omega$                 | 31.75 x 0.74           | 1.250 x 0.029           |
| l7, l8            | $0.043 \lambda$ , $23.5 \Omega$                 | 7.75 x 4.95            | 0.305 x 0.195           |
| l9                | $0.130 \lambda$ , $8.3 \Omega$                  | 22.61 x 16.51          | 0.890 x 0.650           |
| l10 (taper)       | $0.032 \lambda$ , $8.3 \Omega$ / $11.7 \Omega$  | 5.72 x 16.51 / 11.30   | 0.225 x 0.650 / 0.445   |
| l11 (taper)       | $0.053 \lambda$ , $11.7 \Omega$ / $37.0 \Omega$ | 9.78 x 11.30 / 2.64    | 0.385 x 0.445 / 0.104   |
| l12               | $0.009 \lambda$ , $37.0 \Omega$                 | 16.51 x 2.64           | 0.650 x 0.104           |
| l13               | $0.167 \lambda$ , $50.1 \Omega$                 | 31.75 x 1.65           | 1.250 x 0.065           |

## Reference Circuit (cont.)



Reference circuit assembly diagram (not to scale)\*

| Component                              | Description                          | Suggested Manufacturer | P/N              |
|----------------------------------------|--------------------------------------|------------------------|------------------|
| C1, C2, C3, C4, C5                     | Capacitor, 0.001 $\mu$ F             | Digi-Key               | PCC1772CT-ND     |
| C18, C25                               | Capacitor, 1 $\mu$ F                 | ATC                    | 920C105          |
| C8                                     | Capacitor, 4.7 $\mu$ F, 16 V         | Digi-Key               | PCS3475CT-ND     |
| C6, C9, C17, C24                       | Capacitor, 0.01 $\mu$ F              | ATC                    | 200B 103         |
| C15, C16, C19, C20, C22, C23, C26, C27 | Tantalum Capacitor, 10 $\mu$ F, 50 V | Garrett Electronics    | TPSE106K050R0400 |
| C21, C28                               | Tantalum Capacitor, 10 $\mu$ F, 50 V | Digi-Key               | P5571-ND         |
| C29, C30                               | Ceramic Capacitor, 1.7 pF            | ATC                    | 100B 1R7         |
| C13, C14                               | Ceramic Capacitor, 4.8 pF            | ATC                    | 100B 4R8         |
| C12                                    | Ceramic Capacitor, 3.0 pF            | ATC                    | 100B 3R0         |
| C10, C11, C31                          | Ceramic Capacitor, 33 pF             | ATC                    | 100B 330         |
| C7                                     | Ceramic Capacitor, 47 pF             | ATC                    | 100B 470         |
| Q1                                     | Transistor                           | Infineon Technologies  | BCP56            |
| QQ1                                    | Voltage Regulator                    | National Semiconductor | LM7805           |
| R1, R4                                 | Chip Resistor, 1.2 k $\Omega$        | Digi-Key               | P1.2KGCT-ND      |
| R2                                     | Chip Resistor, 1.3 k $\Omega$        | Digi-Key               | P1.3KGCT-ND      |
| R3                                     | Chip Resistor, 2 k $\Omega$          | Digi-Key               | P2KECT-ND        |
| R5                                     | Potentiometer, 2 k $\Omega$          | Digi-Key               | 3224W-202ETR-ND  |
| R8                                     | Chip Resistor, 5.1 k $\Omega$        | Digi-Key               | P5.1KECT-ND      |
| R6, R7, R9                             | Chip Resistor, 10 $\Omega$           | Digi-Key               | P10ECT-ND        |

\* Gerber Files for this circuit available on request

## Package Outline Specifications

Package H-33288-6

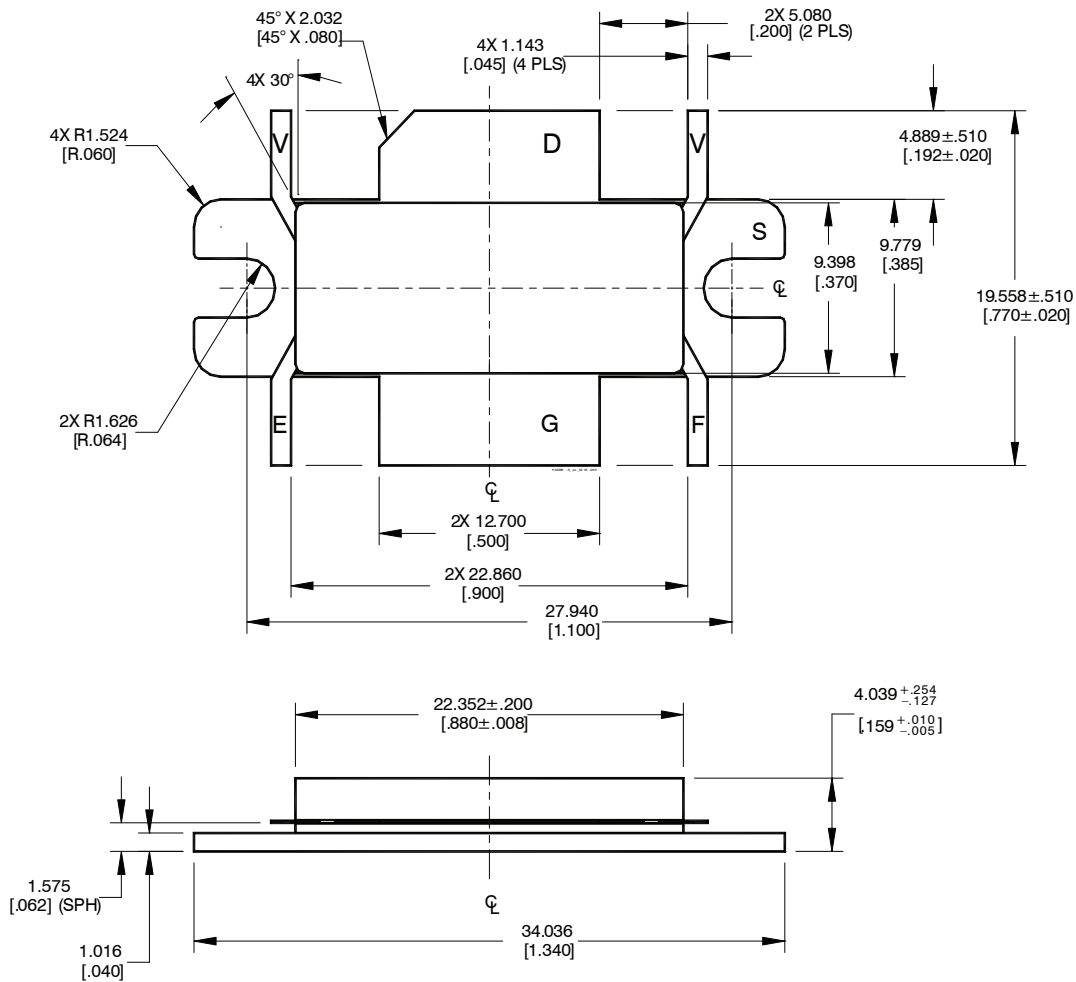
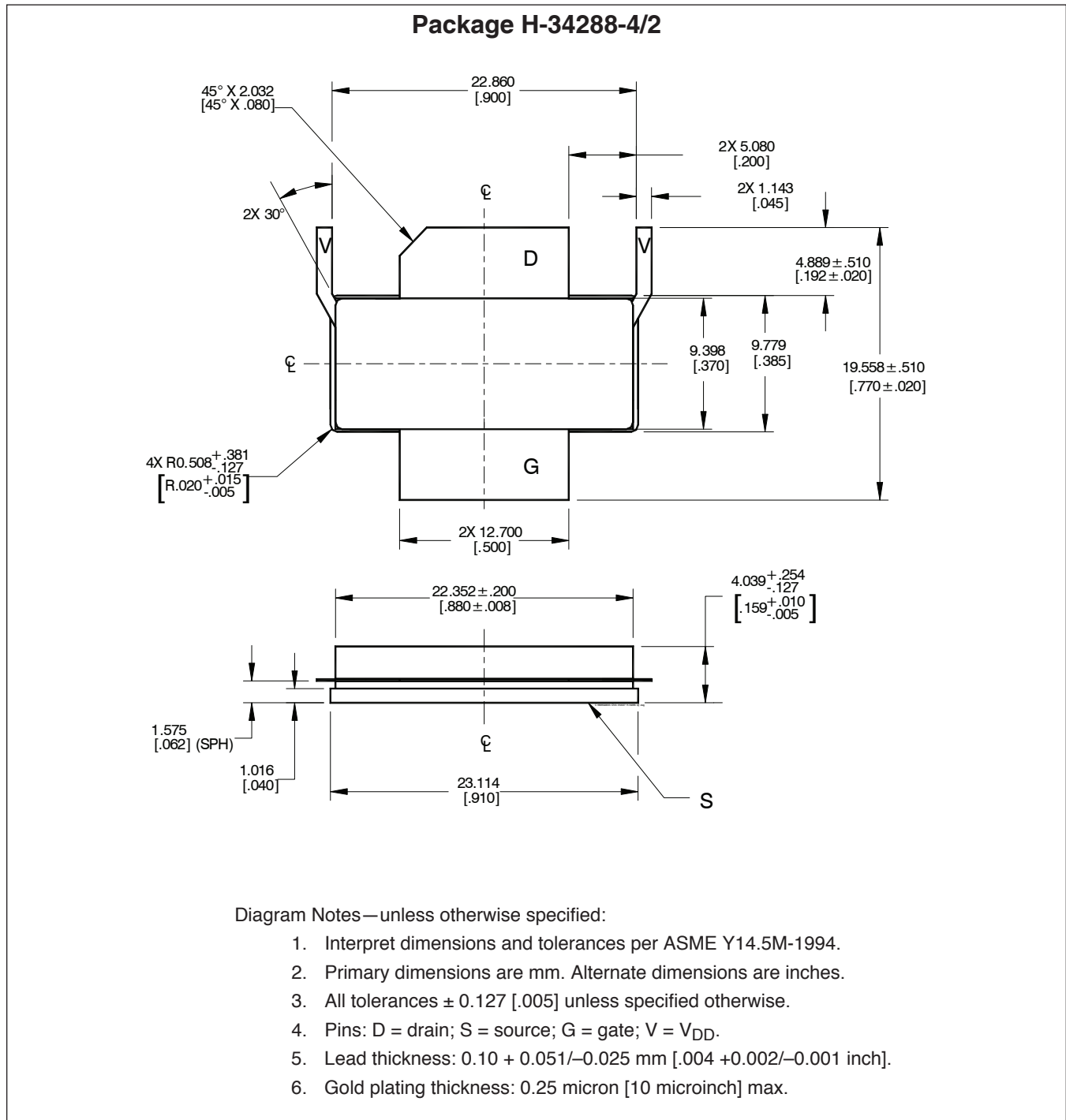


Diagram Notes—unless otherwise specified:

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] unless specified otherwise.
4. Pins: A = gate, B = source, C = drain, D =  $V_{DD}$ , E, F = N.C.
5. Lead thickness:  $0.10 + 0.051/-0.025$  mm [.004 +0.002/-0.001 inch].
6. Gold plating thickness: 0.25 micron [10 microinch] max.

Package Outline Specifications (cont.)



Find the latest and most complete information about products and packaging at the Infineon Internet page  
<http://www.infineon.com/rfpower>

Revision History: 2010-11-04

Data Sheet

Previous Version: 2010-09-03, Data Sheet

| Page    | Subjects (major changes since last revision) |
|---------|----------------------------------------------|
| 1, 2, 8 | Updated eared flange package information     |
|         |                                              |
|         |                                              |
|         |                                              |
|         |                                              |

**We Listen to Your Comments**

Any information within this document that you feel is wrong, unclear or missing at all?

Your feedback will help us to continuously improve the quality of this document.

Please send your proposal (including a reference to this document) to:

[highpowerRF@infineon.com](mailto:highpowerRF@infineon.com)

To request other information, contact us at:

+1 877 465 3667 (1-877-GO-LDMOS) USA

or +1 408 776 0600 International



Edition 2010-11-04

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2009 Infineon Technologies AG

All Rights Reserved.

**Legal Disclaimer**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

**Information**

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com/rfpower](http://www.infineon.com/rfpower)).

**Warnings**

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Infineon:](#)

[PTFA092213EL V4](#) [PTFA092213EL V4 R250](#) [PTFA092213FL V4](#) [PTFA092213FL V4 R250](#) [PTFA092213FL V5](#)  
[PTFA092213FL V5 R250](#)