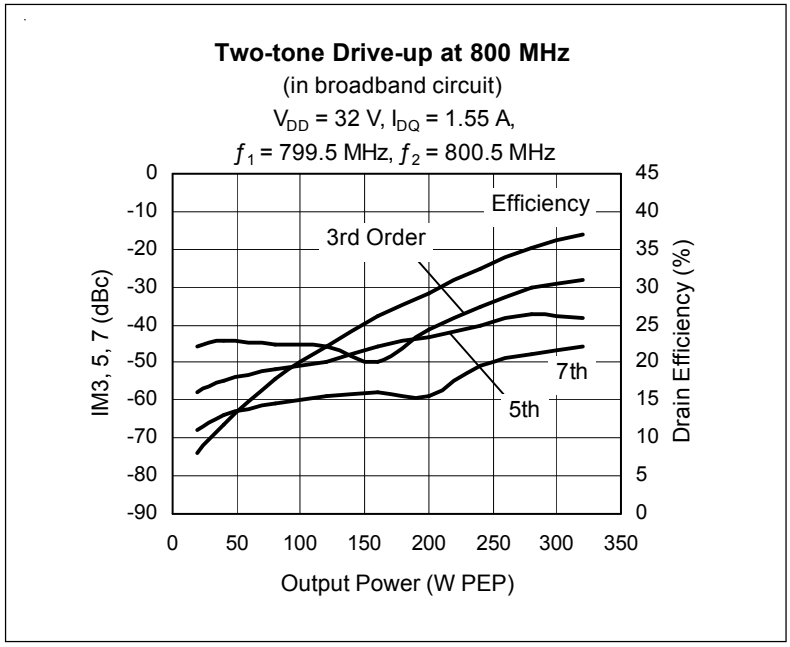
# Thermally-Enhanced High Power RF LDMOS FET
# 300 W, 470 – 860 MHz

## Description

The PTFA043002 is a 300-watt, internally-matched, laterally-diffused, *GOLDMOS*® push-pull FET intended for analog and digital broadcast, including 8VSB and COFDM applications from 470 to 860 MHz. The thermally-enhanced package provides the coolest operation available. Full gold metallization ensures excellent device lifetime and reliability.




PTFA043002E
Package H-30275-4




## Features

- Thermally-enhanced package
- Broadband internal matching
- Typical 8VSB performance
  - Average output power = 100 W
  - Gain = 16 dB
  - Adjacent < –33 dBc
- Integrated ESD protection: Human Body Model, Class 2 (minimum)
- Excellent thermal stability
- Low HCI drift
- Pb-free and RoHS compliant
- Capable of handling 5:1 VSWR at 32 V, 300 W (CW) output power

## RF Characteristics

**ATSC 8VSB Characteristics** (broadband fixture, push-pull configuration)

($V_{DD}$ = 32 V, $P_{OUT}$ = 100 $W_{AVG}$, $I_{DQ}$ = 1.55 A, $f$ = 800 MHz)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Common Source Power Gain | $G_{ps}$ | — | 16 | — | dB |
| Drain Efficiency | $\eta_D$ | — | 28 | — | % |
| FIrst Adjacent | IMD | — | –33 | — | dBc |

*All published data at $T_{CASE}$ = 25°C unless otherwise indicated*

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

## RF Characteristics (cont.)

**Two-tone Measurements** (tested in narrowband test fixture)
$V_{DD}$ = 32 V, $I_{DQ}$ = 1.55 A, $P_{OUT}$ = 300 $W_{PEP}$, $f$ = 860 MHz, tone spacing = 1 MHz

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Gain | $G_{ps}$ | 16 | 17.5 | — | dB |
| Drain Efficiency | $\eta_D$ | 38 | 41 | — | % |
| Intermodulation Distortion | IMD | — | –29 | –28 | dBc |

## DC Characteristics (one side)

| Characteristic | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_{DS}$ = 10 mA/side | $V_{(BR)DSS}$ | 65 | — | — | V |
| Drain Leakage Current | $V_{DS}$ = 28 V, $V_{GS}$ = 0 V | $I_{DSS}$ | — | — | 1.0 | µA |
| | $V_{DS}$ = 63 V, $V_{GS}$ = 0 V | $I_{DSS}$ | — | — | 10.0 | µA |
| On-State Resistance | $V_{GS}$ = 10 V, $V_{DS}$ = 0.1 V | $R_{DS(on)}$ | — | 0.08 | — | W |
| Operating Gate Voltage | $V_{DS}$ = 28 V, $I_{DQ}$ = 0.75 A/side | $V_{GS}$ | 2.0 | 2.5 | 3.0 | V |
| Gate Leakage Current | $V_{GS}$ = 10 V, $V_{DS}$ = 0 V | $I_{GSS}$ | — | — | 1.0 | µA |

## 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 |
| Total Device Dissipation | $P_D$ | 761 | W |
| Above 25°C derate by | | 4.35 | W/°C |
| Storage Temperature Range | $T_{STG}$ | –40 to +150 | °C |
| Thermal Resistance ($T_{CASE}$ = 70°C, 300 W CW) | $R_{\theta JC}$ | 0.23 | °C/W |

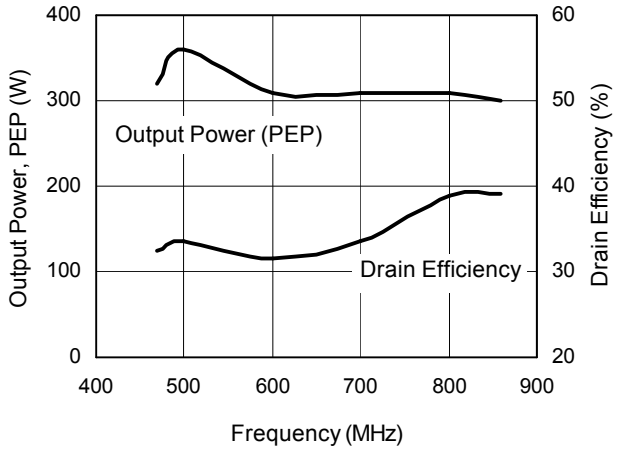
## Ordering Information

| Type | Package Outline | Package Description | Marking |
|---|---|---|---|
| PTFA043002E | H-30275-4 | Thermally-enhanced, flange mount | PTFA043002E |

## Typical Performance (data taken in a broadband test fixture)

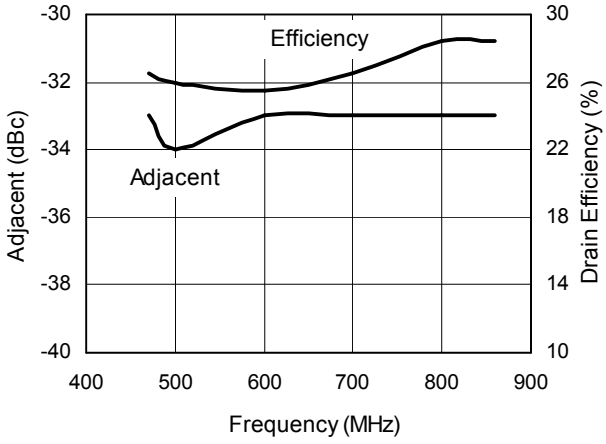
**Two-tone IMD Performance**

$V_{DD}$ = 32 V, $I_{DQ}$ = 1.55 A, IMD = –28 dBc



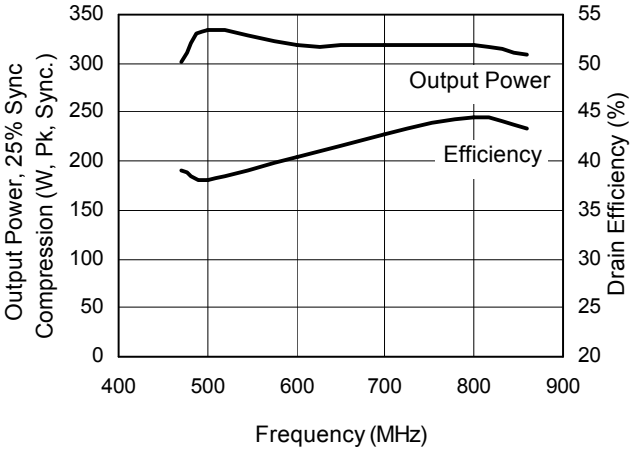

**8VSB Performance vs. Frequency @ 100 W Average Power**

$V_{DD}$ = 32 V, $I_{DQ}$ = 1.55 A, IMD = –28 dBc



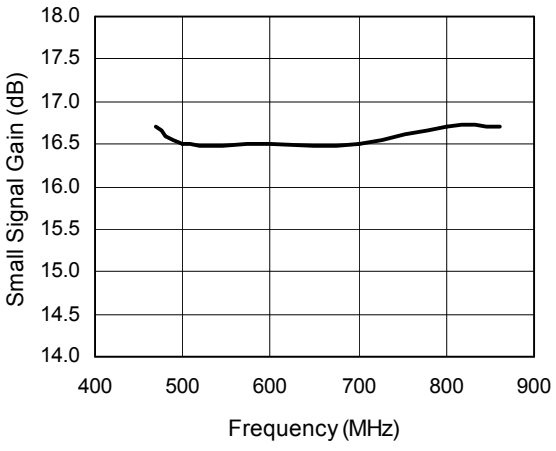

**Analog NTSC Performance**

$V_{DD}$ = 32 V, $I_{DQ}$ = 1.55 A




**Gain vs. Frequency**

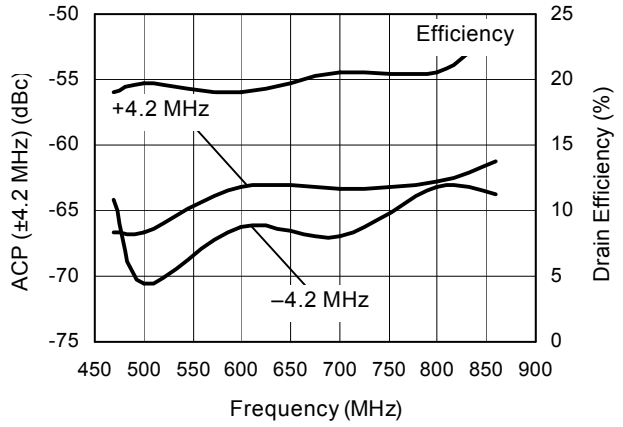
$V_{DD}$ = 32 V, $I_{DQ}$ = 1.55 A



## Typical Performance (cont.)

**DVB Adjacent Channel Power**

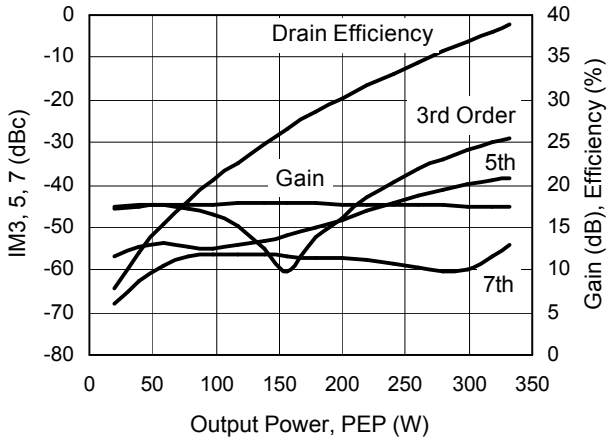
$V_{DD}$ = 32 V, $I_{DQ}$ = 1.55 A,
63 W DVB signal




**Two-tone Drive-up at 800 MHz**

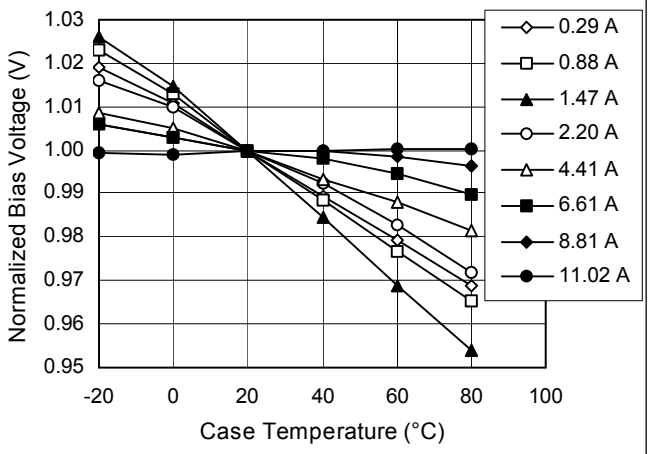
(in narrowband circuit)

$V_{DD}$ = 32 V, $I_{DQ}$ = 1.55 A, $f_1$ = 799.5 MHz, $f_2$ = 800.5 MHz

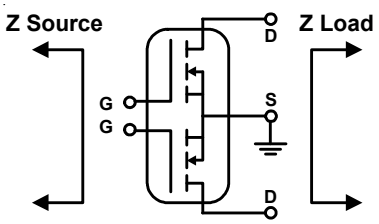



**Bias Voltage vs. Temperature**

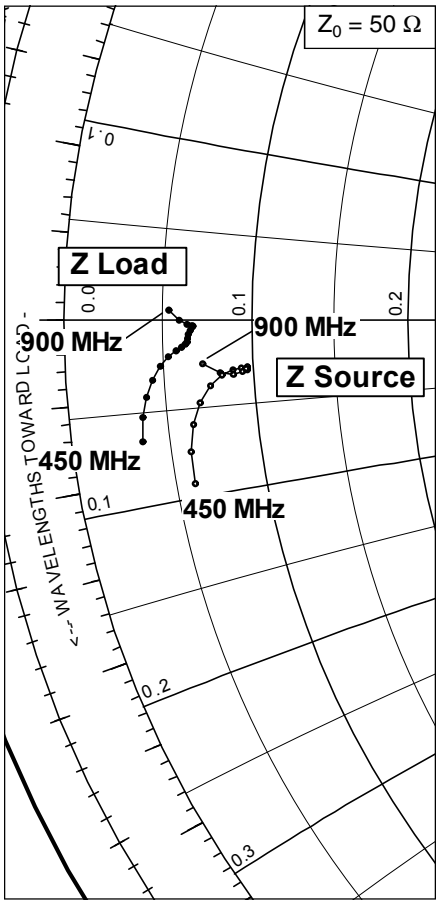
Voltage normalized to typical gate voltage,
series show current



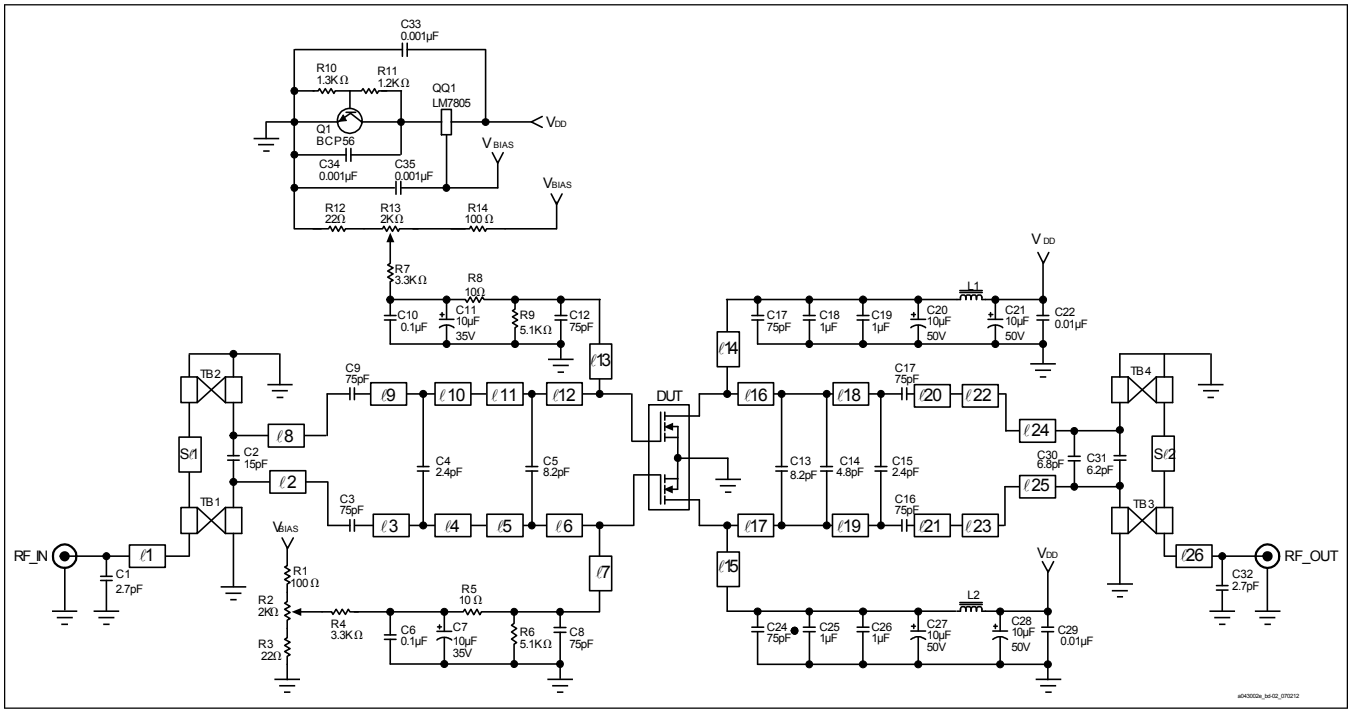
## Broadband Circuit Impedance Data




| Frequency | Z Source Ω | | Z Load Ω | |
|---|---|---|---|---|
| MHz | R | jX | R | jX |
| 450 | 3.00 | –4.61 | 1.78 | –3.26 |
| 475 | 3.02 | –3.71 | 1.85 | –2.63 |
| 500 | 3.18 | –2.96 | 1.99 | –2.09 |
| 525 | 3.43 | –2.36 | 2.18 | –1.64 |
| 550 | 3.75 | –1.90 | 2.41 | –1.28 |
| 575 | 4.10 | –1.61 | 2.64 | –1.03 |
| 600 | 4.42 | –1.47 | 2.85 | –0.87 |
| 625 | 4.66 | –1.44 | 3.01 | –0.77 |
| 650 | 4.79 | –1.47 | 3.10 | –0.70 |
| 675 | 4.84 | –1.50 | 3.15 | –0.63 |
| 700 | 4.84 | –1.50 | 3.17 | –0.53 |
| 725 | 4.82 | –1.46 | 3.20 | –0.42 |
| 750 | 4.82 | –1.42 | 3.24 | –0.31 |
| 775 | 4.83 | –1.41 | 3.30 | –0.22 |
| 800 | 4.80 | –1.46 | 3.33 | –0.18 |
| 825 | 4.69 | –1.54 | 3.30 | –0.16 |
| 850 | 4.43 | –1.61 | 3.17 | –0.13 |
| 875 | 4.04 | –1.54 | 2.95 | –0.01 |
| 900 | 3.57 | –1.27 | 2.67 | 0.27 |



## Reference Circuit




*Reference circuit schematic for 470 to 860 MHz—rated for 300 W (PEP) only*

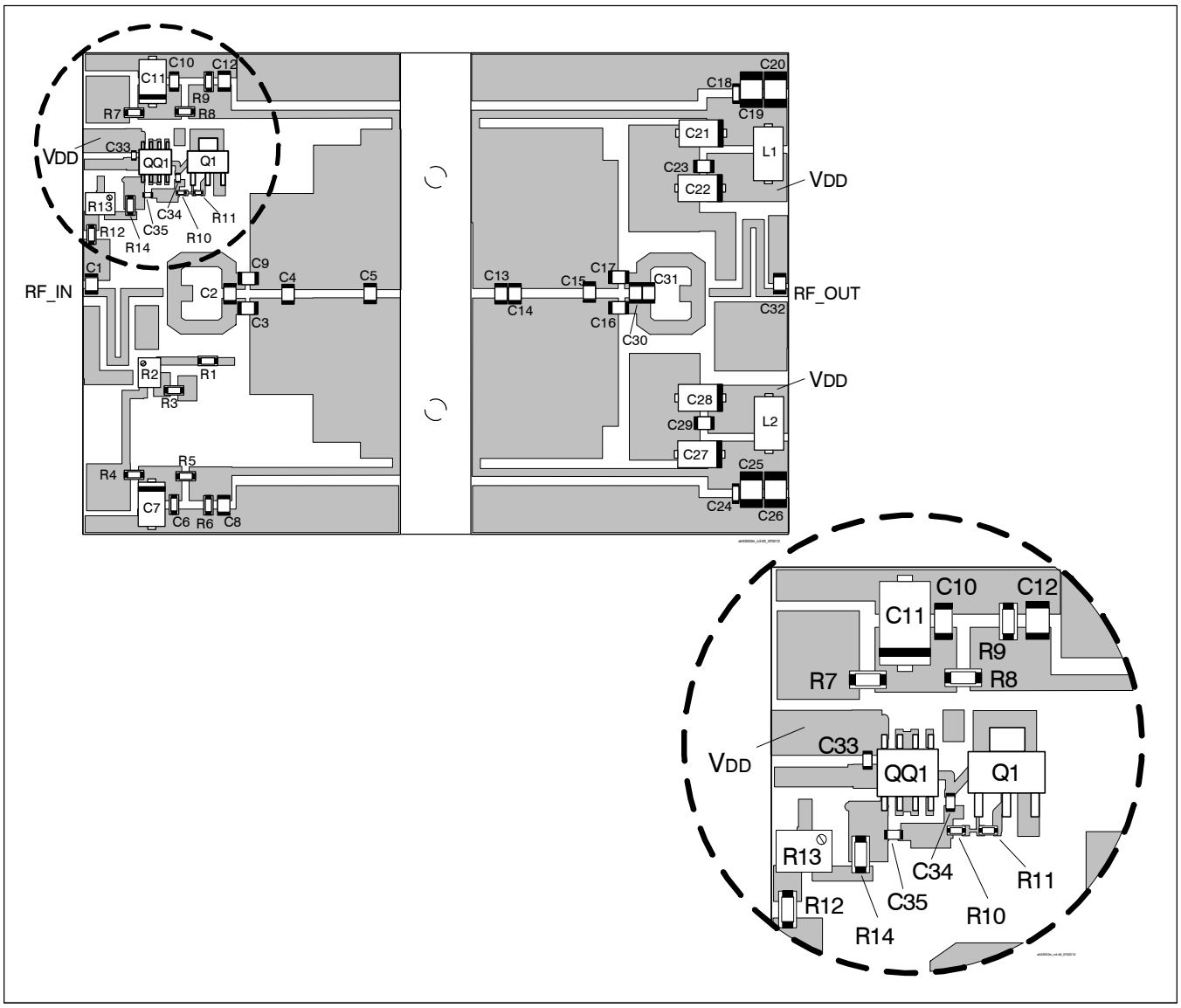
### Circuit Assembly Information

| | | |
|---|---|---|
| DUT | PTFA043002E | LDMOS transistor |
| Circuit board | 0.25 mm [.010"] over .635 mm [.025"] thick, $\varepsilon_r$ = 10.2<br>copper: 10 mils top 25 mils bottom | Rogers 3010, multilayer |

| Microstrip | Electrical Characteristics at 860 MHz[1] | Dimensions: L x W (mm) | Dimensions: L x W (in.) |
|---|---|---|---|
| TB1, TB2, TB3, TB4 | Broadside coupled striplines | 14.63 x 1.70 | 0.576 x 0.067 |
| S$\ell$1, S$\ell$2 | 0.017 λ, 15.6 Ω | 33.02 x 1.32 | 0.075 x 0.067 |
| $\ell$1, $\ell$26 | 0.250 λ, 39.0 Ω | 0.51 x 2.54 | 1.300 x 0.052 |
| $\ell$2, $\ell$8, $\ell$24, $\ell$25 | 0.004 λ, 26.0 Ω | 5.59 x 15.24 | 0.020 x 0.100 |
| $\ell$3, $\ell$9 | 0.049 λ, 6.1 Ω | 4.45 x 15.24 | 0.220 x 0.600 |
| $\ell$4, $\ell$10 | 0.038 λ, 6.1 Ω | 7.62 x 22.86 | 0.175 x 0.600 |
| $\ell$5, $\ell$11 | 0.067 λ, 4.2 Ω | 6.25 x 25.40 | 0.300 x 0.900 |
| $\ell$6, $\ell$12 | 0.055 λ, 3.8 Ω | 28.45 x 1.22 | 0.246 x 1.000 |
| $\ell$7, $\ell$13 | 0.216 λ, 41.0 Ω | 40.39 x 1.22 | 1.120 x 0.048 |
| $\ell$14, $\ell$15 | 0.307 λ, 41.0 Ω | 5.08 x 25.40 | 1.590 x 0.048 |
| $\ell$16, $\ell$17 | 0.045 λ, 3.8 Ω | 12.70 x 25.40 | 0.200 x 1.000 |
| $\ell$18, $\ell$19 | 0.112 λ, 3.8 Ω | 2.74 x 25.40 | 0.500 x 1.000 |
| $\ell$20, $\ell$21 | 0.024 λ, 3.8 Ω | 2.54 x 20.32 | 0.108 x 1.000 |
| $\ell$22, $\ell$23 | 0.022 λ, 4.7 Ω | 2.54 x 20.32 | 0.100 **x** 0.800 |

[1]Electrical characteristics are rounded.

## Reference Circuit (cont.)




*Reference circuit assembly diagram* (not to scale)—rated for 300 W (PEP) only*

**Gerber Files for this circuit available on request.*

## Reference Circuit (cont.)

| Component | Description | Suggested Manufacturer | P/N or Comment |
|---|---|---|---|
| C1, C32 | Ceramic capacitor, 2.7 pF | ATC | 100B 2R7 |
| C2 | Capacitor, 15 pF | ATC | 100B 150 |
| C3, C8, C9, C12, C16, C17, C18, C24 | Ceramic capacitor, 75 pF | ATC | 100B 750 |
| C4, C15 | Ceramic capacitor, 2.4 pF | ATC | 100B 2R4 |
| C5, C13 | Ceramic capacitor, 8.2 pF | ATC | 100B 8R2 |
| C6, C10 | Capacitor, 0.1 µF | Digi-Key | PCC104BCT-ND |
| C7, C11 | Tantalum capacitor, 10 µF, 35 V | Digi-Key | PCS6106TR-ND |
| C14 | Ceramic capacitor, 4.8 pF | ATC | 100B 4R8 |
| C19, C20, C25, C26 | Capacitor, 1 µF | ATC | 920C105 |
| C21, C22, C27, C28 | Tantalum capacitor, 10 µF, 50 V | Garrett Electronics | TPS106K050R0400 |
| C23, C29 | Ceramic capacitor, 0.01 µF | ATC | 200B 103 |
| C30 | Ceramic capacitor, 6.8 pF | ATC | 100B 6R8 |
| C31 | Ceramic capacitor, 6.2 pF | ATC | 100B 6R2 |
| C33, C34, C35 | Capacitor, 0.001 µF | Digi-Key | PCC1772CT-ND |
| L1, L2 | Ferrite, 8.9 mm | Elna Magnetics | BDS 4.6/3/8.9-4S2 |
| Q1 | Transistor | Infineon Technologies | BCP56 |
| QQ1 | Voltage regulator | National Semiconductor | LM7805 |
| R1, R14 | Chip Resistor 100 ohms | Digi-Key | P100ECT-ND |
| R2, R13 | Potentiometer 2 k-ohms | Digi-Key | 3224W-202ETR-ND |
| R3, R12 | Chip Resistor 22 ohms | Digi-Key | P22KECT-ND |
| R4, R7 | Chip Resistor 3.3 k-ohms | Digi-Key | P3.3KECT-ND |
| R5, R8 | Chip Resistor 10 ohms | Digi-Key | P10ECT-ND |
| R6, R9 | Chip Resistor 5.1 k-ohms | Digi-Key | P5.1KECT-ND |
| R10 | Chip Resistor 1.0 k-ohms | Digi-Key | P1KGCT-ND |
| R11 | Chip Resistor 1.1 k-ohms | Digi-Key | P1.1KGCT-ND |

**See next page for package information**

## Package Outline Specifications

### Package H-30275-4

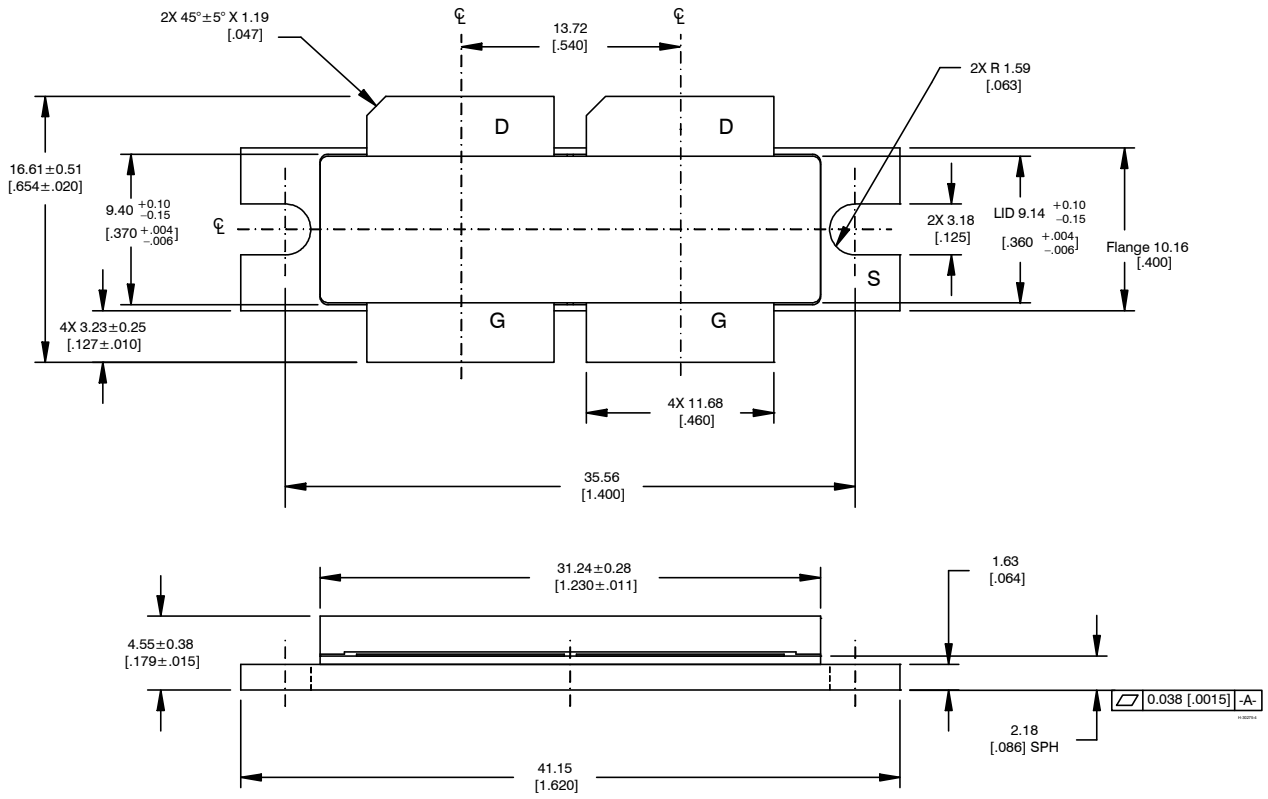



Diagram Notes—unless otherwise specified:

1. Lead thickness: 0.13 +0.051/–0.025 [.005 +.002/–.001].
2. All tolerances ± 0.127 [.005] unless specified otherwise.
3. Pins: D = drain, S = source, G = gate.
4. Interpret dimensions and tolerances per ASME Y14.5M-1994.
5. Primary dimensions are mm. Alternate dimensions are inches.
6. Gold plating thickness:
   S - flange: 2.54 micron [100 microinch] (min)
   D, G - leads: 11.14 micron ± 0.38 micron [45 microinch ± 15 microinch]

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**PTFA043002E**

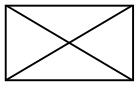
| **Revision History:** | 2009-02-20 | Data Sheet |
|---|---|---|
| Previous Version: | 2005-11-18, Data Sheet | |
| Page | Subjects (major changes since last revision) | |
| 6 | Revise circuit board information. | |
| 1, 2, 9 | Update package designation. | |
| 8 | Fixed typing error | |
| | | |
| | | |

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