## Thermally-Enhanced High Power RF LDMOS FETs <br> 150 W, 2110 - 2170 MHz

## Description

The PTFB211503EL and PTFB211503FL are thermally-enhanced, 150-watt, LDMOS FETs designed for cellular power amplifier applications in the 2110 to 2170 frequency band. Features include I/O matching, high gain, and thermally-enhanced ceramic open-cavity packages with slotted and earless flanges. Manufactured with Infineon's advanced LDMOS process, these devices provide excellent thermal performance and superior reliability.

PTFB211503EL H-33288-6

PTFB211503FL H-34288-4/2



## Features

- Broadband internal matching
- Enhanced for use in DPD error correction systems
- Typical two-carrier WCDMA performance at 2170 MHz, 30 V
- Average output power $=32 \mathrm{~W}$
- Linear Gain $=18 \mathrm{~dB}$
- Efficiency = 29\%
- Intermodulation distortion $=-34 \mathrm{dBc}$
- Adjacent channel power $=-37 \mathrm{dBc}$
- Typical CW performance, $2170 \mathrm{MHz}, 30 \mathrm{~V}$
- Output power at $\mathrm{P}_{1 \mathrm{~dB}}=150 \mathrm{~W}$
- Efficiency = 55\%
- Increased negative gate-source voltage range for improved performance in Doherty peaking amplifiers
- Integrated ESD protection
- Capable of handling 10:1 VSWR @ 30 V, 150 W (CW) output power
- Pb-Free and RoHS compliant


## RF Characteristics

Two-carrier WCDMA Measurements (not subject to production test-verified by design/characterization in Infineon test fixture) $\mathrm{V}_{\mathrm{DD}}=30 \mathrm{~V}, \mathrm{I}_{\mathrm{DQ}}=1.2 \mathrm{~A}, \mathrm{P}_{\mathrm{OUT}}=32 \mathrm{~W}$ AVG, $f_{1}=2135 \mathrm{MHz}, f_{2}=2145 \mathrm{MHz}, 3 \mathrm{GPP}$ signal, channel bandwidth $=3.84 \mathrm{MHz}$, peak/average = 8 dB @ 0.01\% CCDF

| Characteristic | Symbol | Min | Typ | Max | Unit |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Gain | $\mathrm{G}_{\mathrm{ps}}$ | - | 18 | - | dB |
| Drain Efficiency | $\eta \mathrm{D}$ | - | 29 | - | $\%$ |
| Adjacent Channel Power Ratio | ACPR | - | -36 | - | dBc |

All published data at $T_{\text {CASE }}=25^{\circ} \mathrm{C}$ unless otherwise indicated
ESD: Electrostatic discharge sensitive device-observe handling precautions!

PTFB211503EL PTFB211503FL

## RF Characteristics (cont.)

Two-tone Measurement (tested in Infineon test fixture)
$\mathrm{V}_{\mathrm{DD}}=30 \mathrm{~V}, \mathrm{I}_{\mathrm{DQ}}=1.2 \mathrm{~A}, \mathrm{P}_{\text {OUT }}=150 \mathrm{~W}$ PEP, $f=2170 \mathrm{MHz}$, tone spacing $=1 \mathrm{MHz}$

| Characteristic | Symbol | Min | Typ | Max | Unit |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Gain | Gps | 16.5 | 18 | - | dB |
| Drain Efficiency | $\eta \mathrm{D}$ | 39 | 40 | - | $\%$ |
| Intermodulation Distortion | IMD | - | -30 | -28 | dBc |

## DC Characteristics

| Characteristic | Conditions | Symbol | Min | Typ | Max | Unit |
| :--- | :--- | :---: | :---: | :---: | :---: | :---: |
| Drain-Source Breakdown Voltage | $\mathrm{V}_{\mathrm{GS}}=0 \mathrm{~V}, \mathrm{I}_{\mathrm{DS}}=10 \mu \mathrm{~A}$ | $\mathrm{~V}_{(\mathrm{BR}) \mathrm{DSS}}$ | 65 | - | - | V |
| Drain Leakage Current | $\mathrm{V}_{\mathrm{DS}}=28 \mathrm{~V}, \mathrm{~V}_{\mathrm{GS}}=0 \mathrm{~V}$ | $\mathrm{I}_{\mathrm{DSS}}$ | - | - | 1.0 | $\mu \mathrm{~A}$ |
|  | $\mathrm{~V}_{\mathrm{DS}}=63 \mathrm{~V}, \mathrm{~V}_{\mathrm{GS}}=0 \mathrm{~V}$ | $\mathrm{I}_{\mathrm{DSS}}$ | - | - | 10.0 | $\mu \mathrm{~A}$ |
| On-State Resistance | $\mathrm{V}_{\mathrm{GS}}=10 \mathrm{~V}, \mathrm{~V}_{\mathrm{DS}}=0.1 \mathrm{~V}$ | $\mathrm{R}_{\mathrm{DS}(\mathrm{on})}$ | - | 0.08 | - | $\Omega$ |
| Operating Gate Voltage | $\mathrm{V}_{\mathrm{DS}}=30 \mathrm{~V}, \mathrm{I}_{\mathrm{DQ}}=1.2 \mathrm{~A}$ | $\mathrm{~V}_{\mathrm{GS}}$ | 1.6 | 2.1 | 3.0 | V |
| Gate Leakage Current | $\mathrm{V}_{\mathrm{GS}}=10 \mathrm{~V}, \mathrm{~V}_{\mathrm{DS}}=0 \mathrm{~V}$ | $\mathrm{I}_{\mathrm{GSS}}$ | - | - | 1.0 | $\mu \mathrm{~A}$ |

## Maximum Ratings

| Parameter | Symbol | Value | Unit |
| :--- | :---: | :---: | :---: |
| Drain-Source Voltage | $\mathrm{V}_{\mathrm{DSS}}$ | 65 | V |
| Gate-Source Voltage | $\mathrm{V}_{\mathrm{GS}}$ | -6 to +10 | V |
| Junction Temperature | $\mathrm{T}_{\mathrm{J}}$ | 200 | ${ }^{\circ} \mathrm{C}$ |
| Storage Temperature Range | $\mathrm{T}_{\text {STG }}$ | -40 to +150 | ${ }^{\circ} \mathrm{C}$ |
| Thermal Resistance $\left(\mathrm{T}_{\text {CASE }}=70^{\circ} \mathrm{C}, 150 \mathrm{~W} \mathrm{CW}\right)$ | $\mathrm{R}_{\theta \mathrm{JC}}$ | 0.27 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |

## Ordering Information

| Type and Version | Package Outline | Package Description | Shipping |
| :--- | :--- | :--- | :--- |
| PTFB211503EL V1 | H-33288-6 | Slotted flange, single-ended | Tray |
| PTFB211503EL V1 R250 | H-33288-6 | Slotted flange, single-ended | Tape \& Reel 250 pcs |
| PTFB211503FL V2 | H-34288-4/2 | Earless flange, single-ended | Tray |
| PTFB211503FL V2 R250 | H-34288-4/2 | Earless flange, single-ended | Tape \& Reel 250 pcs |

## PTFB211503EL PTFB211503FL

Typical Performance (data taken in a production test fixture)



Single-carrier WCDMA Drive-Up
$\mathrm{V}_{\mathrm{DD}}=30 \mathrm{~V}, \mathrm{I}_{\mathrm{DQ}}=1.20 \mathrm{~A}, f=2170 \mathrm{MHz}$ 3GPP WCDMA, PAR = 8 dB, BW 3.84 MHz


Single-carrier WCDMA, 3GPP Broadband
$\mathrm{V}_{\mathrm{DD}}=30 \mathrm{~V}, \mathrm{I}_{\mathrm{DQ}}=1.20 \mathrm{~A}, \mathrm{P}_{\text {OUT }}=40 \mathrm{~W}$


## PTFB211503EL PTFB211503FL

## Typical Performance (cont.)






PTFB211503EL PTFB211503FL

Typical Performance (cont.)




## PTFB211503EL PTFB211503FL

Broadband Circuit Impedance


| Frequency | Z Source $\Omega$ |  | Z Load $\Omega$ |  |
| :---: | :---: | :---: | :---: | :---: |
| $\mathbf{M H z}$ | $\mathbf{R}$ | $\mathbf{j X}$ | $\mathbf{R}$ | $\mathbf{j X}$ |
| 2200 | 2.06 | -6.08 | 2.19 | -4.73 |
| 2170 | 2.17 | -6.33 | 2.19 | -4.82 |
| 2140 | 2.30 | -6.59 | 2.20 | -4.91 |
| 2110 | 2.43 | -6.86 | 2.21 | -5.00 |
| 2080 | 2.58 | -7.14 | 2.22 | -5.09 |



See next page for reference circuit information

## Reference Circuit



Reference circuit input schematic for $f=2170 \mathrm{MHz}$


Reference circuit output schematic for $f=2170 \mathrm{MHz}$

## Reference Circuit (cont.)

## Description

| DUT | PTFB211503EL or PTFB211503FL |
| :--- | :--- |
| PCB | $0.508 \mathrm{~mm}[.020 "]$ thick, $\varepsilon$ e $=3.48$, Rogers 4350, 1 oz. copper |

## Electrical Characteristics at 2170 MHz

| Transmission Line | Electrical <br> Characteristics | Dimensions: mm | Dimensions: mils |
| :---: | :---: | :---: | :---: |
| Input |  |  |  |
| TL101, TL129 | $0.095 \lambda, 54.17 \Omega$ | W = 1.016, L = 8.001 | $\mathrm{W}=40, \mathrm{~L}=315$ |
| TL102 | $0.016 \lambda, 31.24 \Omega$ | $\mathrm{W}=2.286, \mathrm{~L}=1.270$ | $\mathrm{W}=90, \mathrm{~L}=50$ |
| TL103 | $0.026 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=2.159$ | W $=40, \mathrm{~L}=85$ |
| TL104 | $0.032 \lambda, 47.12 \Omega$ | $\mathrm{W}=1.270, \mathrm{~L}=2.692$ | $\mathrm{W}=50, \mathrm{~L}=106$ |
| TL105 | $0.005 \lambda, 6.67 \Omega$ | $\mathrm{W}=13.970, \mathrm{~L}=0.381$ | $\mathrm{W}=550, \mathrm{~L}=15$ |
| TL106 |  | $\begin{aligned} & \mathrm{W} 1=13.970, \mathrm{~W} 2=1.016, \mathrm{~W} 3=13.970, \\ & \mathrm{~W} 4=1.016 \end{aligned}$ | $\begin{aligned} & \mathrm{W} 1=550, \mathrm{~W} 2=40, \mathrm{~W} 3=550, \\ & \mathrm{~W} 4=40 \end{aligned}$ |
| TL107, TL108, TL109 |  | W = 1.016 | $\mathrm{W}=40$ |
| TL110, TL139 | $0.012 \lambda, 54.17 \Omega$ | $\mathrm{W} 1=1.016, \mathrm{~W} 2=1.016, \mathrm{~W} 3=1.016$ | $\mathrm{W} 1=40, \mathrm{~W} 2=40, \mathrm{~W} 3=40$ |
| TL111 (taper) | $0.006 \lambda, 6.67 \Omega / 8.37 \Omega$ | $\mathrm{W} 1=13.970, \mathrm{~W} 2=10.922, \mathrm{~L}=0.483$ | $\mathrm{W} 1=550, \mathrm{~W} 2=430, \mathrm{~L}=19$ |
| TL112 |  | $\mathrm{W} 1=17.780, \mathrm{~W} 2=12.700$ | $\mathrm{W} 1=700, \mathrm{~W} 2=500$ |
| TL113 |  | $\mathrm{W} 1=1.270, \mathrm{~W} 2=2.286$ | $\mathrm{W} 1=50, \mathrm{~W} 2=90$ |
| TL114 | $0.031 \lambda, 34.72 \Omega$ | $\mathrm{W}=1.981, \mathrm{~L}=2.540$ | $\mathrm{W}=78, \mathrm{~L}=100$ |
| TL115 | $0.027 \lambda, 63.89 \Omega$ | $\mathrm{W}=0.762, \mathrm{~L}=2.286$ | $\mathrm{W}=30, \mathrm{~L}=90$ |
| TL116 | $0.096 \lambda, 63.89 \Omega$ | $\mathrm{W}=.762, \mathrm{~L}=8.136$ | $\mathrm{W}=30, \mathrm{~L}=320$ |
| TL117 | $0.029 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=2.451$ | W = 40, L = 97 |
| TL118 | $0.018 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=1.524$ | W $=40, \mathrm{~L}=60$ |
| TL119 | $0.021 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=1.727$ | $\mathrm{W}=40, \mathrm{~L}=68$ |
| TL120 | $0.026 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=2.159$ | W = 40, L = 85 |
| TL121, TL122 | $0.002 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=0.127$ | $\mathrm{W}=40, \mathrm{~L}=5$ |
| TL123, TL124 | $0.030 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=2.540$ | $\mathrm{W}=40, \mathrm{~L}=100$ |
| TL125 | $0.053 \lambda, 6.67 \Omega$ | $\mathrm{W}=13.970, \mathrm{~L}=4.064$ | W = 550, L = 160 |
| TL126 | $0.012 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=1.021$ | $\mathrm{W}=40, \mathrm{~L}=40$ |
| TL127 | $0.134 \lambda, 47.12 \Omega$ | $\mathrm{W}=1.270, \mathrm{~L}=11.151$ | $\mathrm{W}=50, \mathrm{~L}=439$ |
| TL128 | $0.012 \lambda, 54.17 \Omega$ | $\mathrm{W}=1.016, \mathrm{~L}=1.016$ | W = 40, L=40 |
| TL130, TL133 | $0.000 \lambda, 144.35 \Omega$ | $\mathrm{W}=0.025, \mathrm{~L}=0.025$ | $\mathrm{W}=1, \mathrm{~L}=1$ |
| TL131 |  | $\begin{aligned} & \mathrm{W} 1=10.922, \mathrm{~W} 2=0.025, \mathrm{~W} 3=10.922 \\ & \mathrm{~W} 4=0.025 \end{aligned}$ | $\begin{aligned} & \mathrm{W} 1=430, W 2=1, W 3=430, \\ & W 4=1 \end{aligned}$ |
| TL132, TL135 | $0.000 \lambda, 8.37 \Omega$ | W = 10.922, L = 0.000 | W = 430, L = 0 |
| TL134 (taper) | $0.033 \lambda, 8.37 \Omega / 47.12 \Omega$ | $\mathrm{W} 1=10.922, \mathrm{~W} 2=1.270, \mathrm{~L}=2.540$ | W1 = 430, W2 = 50, L = 100 |
| TL136, TL137 | $0.012 \lambda, 63.89 \Omega$ | $\mathrm{W} 1=0.762, \mathrm{~W} 2=0.762, \mathrm{~W} 3=1.016$ | $\mathrm{W} 1=30, \mathrm{~W} 2=30, \mathrm{~W} 3=40$ |
| TL138 | $0.012 \lambda, 54.17 \Omega$ | $\mathrm{W} 1=1.016, \mathrm{~W} 2=1.270, \mathrm{~W} 3=1.016$ | $\mathrm{W} 1=40, \mathrm{~W} 2=50, \mathrm{~W} 3=40$ |
| TL140 | $0.021 \lambda, 63.89 \Omega$ | $\mathrm{W}=0.762, \mathrm{~L}=1.778$ | W = 30, L = 70 |

table continued on page 9

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Reference Circuit (cont.)
Electrical Characteristics at 2170 MHz

| Transmission Line | Electrical Characteristics | Dimensions: mm | Dimensions: mils |
| :---: | :---: | :---: | :---: |
| Output |  |  |  |
| TL201 (taper) | $0.074 \lambda, 5.33 \Omega / 39.51 \Omega$ | $\mathrm{W} 1=17.780, \mathrm{~W} 2=1.651, \mathrm{~L}=5.613$ | $\mathrm{W} 1=700, \mathrm{~W} 2=65, \mathrm{~L}=221$ |
| TL202 (taper) | $0.010 \lambda, 4.84 \Omega / 5.33 \Omega$ | W1 $=19.685, \mathrm{~W} 2=17.780, \mathrm{~L}=0.787$ | $\mathrm{W} 1=775, \mathrm{~W} 2=700, \mathrm{~L}=31$ |
| TL203 |  | $\mathrm{W} 1=12.700, \mathrm{~W} 2=17.780$ | $\mathrm{W} 1=500, \mathrm{~W} 2=700$ |
| TL204 |  | $\mathrm{W} 1=1.651, \mathrm{~W} 2=2.540$ | $\mathrm{W} 1=65, \mathrm{~W} 2=100$ |
| TL205 |  | $\mathrm{W} 1=1.270, \mathrm{~W} 2=2.540$ | $\mathrm{W} 1=50, \mathrm{~W} 2=100$ |
| TL206 | $0.000 \lambda, 5.33 \Omega$ | $\mathrm{W}=17.780, \mathrm{~L}=0.025$ | W = 700, L = 1 |
| TL207 | $0.047 \lambda, 47.12 \Omega$ | W = 1.270, L= 3.886 | $\mathrm{W}=50, \mathrm{~L}=153$ |
| TL208 | $0.021 \lambda, 39.51 \Omega$ | $\mathrm{W}=1.651, \mathrm{~L}=1.753$ | $\mathrm{W}=65, \mathrm{~L}=69$ |
| TL209 | $0.057 \lambda, 4.84 \Omega$ | $\mathrm{W}=19.685, \mathrm{~L}=4.318$ | $\mathrm{W}=775, \mathrm{~L}=170$ |
| TL210, TL211 | $0.016 \lambda, 28.85 \Omega$ | W = 2.540, L = 1.270 | W = 100, L = 50 |
| TL212 | $0.035 \lambda, 39.51 \Omega$ | W = 1.651, L= 2.896 | $\mathrm{W}=65, \mathrm{~L}=114$ |
| TL213 | $0.032 \lambda, 16.90 \Omega$ | W = 4.928, L = 2.540 | W = 194, L= 100 |
| TL214 | $0.032 \lambda, 17.05 \Omega$ | W = 4.877, L = 2.540 | W = 192, L = 100 |
| TL215, TL231 | $0.032 \lambda, 25.04 \Omega$ | W1 $=3.048, \mathrm{~W} 2=3.048, \mathrm{~W} 3=2.540$ | W 1 = 120, W2 = 120, W3 = 100 |
| TL216, TL217 | $0.095 \lambda, 25.04 \Omega$ | W = 3.048, L = 7.645 | W = 120, L = 301 |
| TL218, TL230 |  | W $=3.048$ | W = 120 |
| TL219, TL225 | $0.054 \lambda, 25.04 \Omega$ | W1 $=3.048, \mathrm{~W} 2=3.048, \mathrm{~W} 3=4.318$ | $\mathrm{W} 1=120, \mathrm{~W} 2=120, \mathrm{~W} 3=170$ |
| TL220, TL221 | $0.029 \lambda, 25.04 \Omega$ | W1 = 3.048, W2 = 3.048, W3 = 2.286 | $\mathrm{W} 1=120, \mathrm{~W} 2=120, \mathrm{~W} 3=90$ |
| TL222, TL224 | $0.067 \lambda, 25.04 \Omega$ | W $=3.048, \mathrm{~L}=5.359$ | W = 120, L = 211 |
| TL223, TL226 | $0.010 \lambda, 25.04 \Omega$ | W = 3.048, L = 0.762 | W = 120, L = 30 |
| TL227, TL228 | $0.029 \lambda, 25.04 \Omega$ | $\mathrm{W} 1=3.048, \mathrm{~W} 2=3.048, \mathrm{~W} 3=2.286$ | $\mathrm{W} 1=120, \mathrm{~W} 2=120, \mathrm{~W} 3=90$ |
| TL229 | $0.022 \lambda, 39.51 \Omega$ | $\mathrm{W} 1=1.651, \mathrm{~W} 2=1.651, \mathrm{~W} 3=1.778$ | $\mathrm{W} 1=65, \mathrm{~W} 2=65, \mathrm{~W} 3=70$ |

## Reference Circuit (cont.)

## Circuit Assembly Information

Test Fixture Part No.
LTN/PTFB211503EF
Find Gerber files for this test fixture on the Infineon Web site at http://www.infineon.com/rfpower


Reference circuit assembly diagram (not to scale)

PTFB211503EL PTFB211503FL

## Reference Circuit (cont.)

| Component Information |  |  |  |
| :---: | :---: | :---: | :---: |
| Component | Description | Suggested Manufacturer | P/N |
| Input |  |  |  |
| C101, C102 | Chip capacitor, 10 pF | ATC | ATC100A100FW150XB |
| C103, C104 | Chip capacitor, $4.71 \mu \mathrm{~F}$ | Digi-Key | 493-2372-2-ND |
| C105 | Chip capacitor, 0.6 pF | ATC | ATC100B0R6BW500XB |
| C106 | Chip capacitor, 2.2 pF | ATC | ATC100B2R2BW500XB |
| C107 | Chip capacitor, 8.2 pF | ATC | ATC100B8R2BW500XB |
| C801, C802, C803 | Capacitor, 1000 pF | Digi-Key | PCC1772CT-ND |
| R101, R104, R803, R805 | Resistor, $10 \Omega$ | Digi-Key | P10ECT-ND |
| R801 | Resistor, $1200 \Omega$ | Digi-Key | P1.2KGCT-ND |
| R802 | Resistor, $1300 \Omega$ | Digi-Key | P1.3KGCT-ND |
| R804 | Resistor, $100 \Omega$ | Digi-Key | P100ECT-ND |
| S1 | Voltage Regulator | Digi-Key | LM78L05ACM-LD |
| S2 | Transistor | Digi-Key | BCP5616TA-ND |
| S3 | Potentiometer, 2k $\Omega$ | Digi-Key | 3224W-202ECT-ND |
| Output |  |  |  |
| C201, C206 | Chip capacitor, $1 \mu \mathrm{~F}$ | Digi-Key | 445-1411-2-ND |
| C202, C210 | Chip capacitor, $2.2 \mu \mathrm{~F}$ | Digi-Key | 445-1447-2-ND |
| C203, C209 | Capacitor, $10 \mu \mathrm{~F}$ | Digi-Key | 281M5002106K |
| C204, C205 | Capacitor, $10 \mu \mathrm{~F}$ | Digi-Key | 587-1818-2-ND |
| C207 | Chip capacitor, 8.2 pF | ATC | ATC100B8R2BW500XB |
| C208 | Chip capacitor, 0.5 pF | ATC | ATC100B0R5BW500XB |

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## Package Outline Specifications



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: |  | 2011-03-07 |
| :--- | :--- | :--- |
| Previous Version: | 2010-11-10, Data Sheet | Data Sheet |
| Page | Subjects (major changes since last revision) |  |
| 1 | Updated features |  |
| 2 | Corrected typo |  |
|  |  |  |
|  |  |  |

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highpowerRF@infineon.com
To request other information, contact us at: +1 8774653667 (1-877-GO-LDMOS) USA or +14087760600 International


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