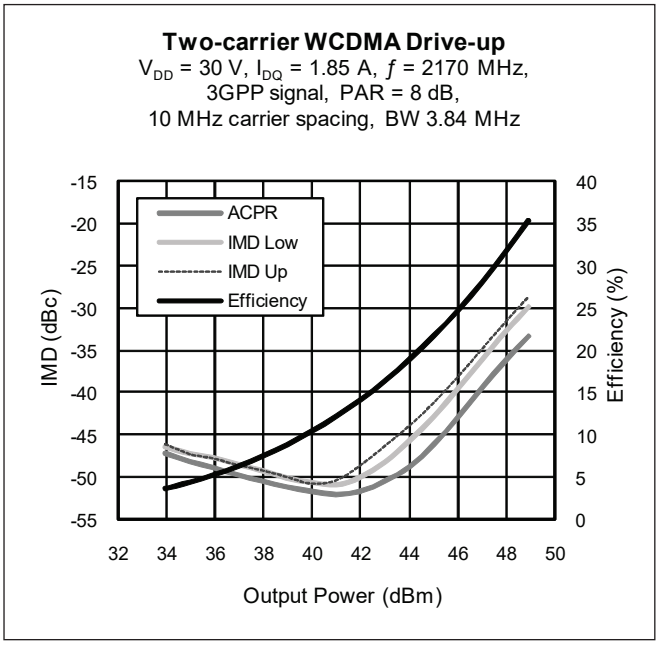
PTFB212503FL

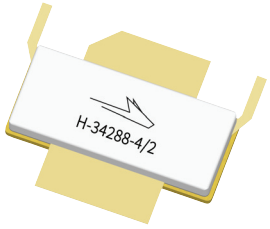
Thermally-Enhanced High Power RF LDMOS FET
240 W, 2110 – 2170 MHz

Description

The PTFB212503FL is a 240-watt LDMOS FETs intended for use in multi-standard cellular power amplifier applications in the 2110 to 2170 MHz frequency band. Features include input and output matching, high gain, wide signal bandwidth and reduced memory effects for unparalleled DPD correctability. Manufactured with Wolfspeed's advanced LDMOS process, this device provides excellent thermal performance and superior reliability.



PTFB212503FL
Package H-34288-4/2



Features

- Broadband internal input and output matching
- Enhanced for use in DPD error correction systems
- Wide video bandwidth
- Typical single-carrier WCDMA performance at 2170 MHz, 30 V, I_{DQ} = 1.85 A, 3GPP signal, channel bandwidth = 3.84 MHz, PAR = 7.5 dB @ 0.01% CCDF
  - Average output power = 49.4 dBm
  - Linear gain = 18 dB
  - Efficiency = 37%
  - Intermodulation distortion = –33 dBc
- Typical CW performance, 2170 MHz, 30 V
  - Output power at $P1_{dB}$ = 240 W
  - Efficiency = 54 %
- Increased negative gate-source voltage range for improved performance in Doherty peaking amplifiers
- Integrated ESD protection: Human Body Model, Class 2 (minimum)
- Capable of handling 10:1 VSWR @ 30 V, 240 W (CW) output power
- Pb-free, RoHS-compliant

RF Characteristics

Two-carrier WCDMA Specifications (not subject to production test—verified by design/characterization in Wolfspeed test fixture)
V_{DD} = 30 V, I_{DQ} = 1.85 A, P_{OUT} = 55 W average, f_1 = 2160 MHz, f_2 = 2170 MHz, 3GPP signal, channel bandwidth = 3.84 MHz, peak/average = 8 dB @ 0.01% CCDF

Characteristic	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	—	18.0	—	dB
Drain Efficiency	ηD	—	31	—	%
Intermodulation Distortion	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 Specifications (tested in Wolfspeed test fixture)
V_{DD} = 30 V, I_{DQ} = 1.85 A, P_{OUT} = 200 W PEP, f = 2170 MHz, tone spacing = 1 MHz

Characteristic	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	17	18	—	dB
Drain Efficiency	ηD	39	40	—	%
Intermodulation Distortion	IMD	—	–30	–28	dBc

DC Characteristics

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_{DS} = 10 mA	$V_{(BR)DSS}$	65	—	—	V
Drain Leakage Current	V_{DS} = 28 V, V_{GS} = 0 V	I_{DSS}	—	—	1.0	µA
Drain Leakage Current	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	$R_{DS(on)}$	—	0.05	—	Ω
Operating Gate Voltage	V_{DS} = 30 V, I_{DQ} = 1.85 A	V_{GS}	2.3	2.8	3.3	V
Gate Leakage Current	V_{GS} = 10 V, V_{DS} = 0 V	I_{GSS}	—	—	1.0	µA

Maximum Ratings

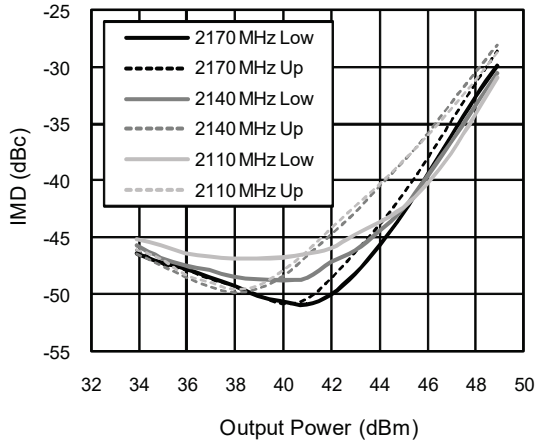
Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	65	V
Gate-Source Voltage	V_{GS}	–6 to +10	V
Junction Temperature	T_J	200	°C
Storage Temperature Range	T_{STG}	–40 to +150	°C
Thermal Resistance (T_{CASE} = 70°C, 200 W CW)	$R_{\theta JC}$	0.26	°C/W

Ordering Information

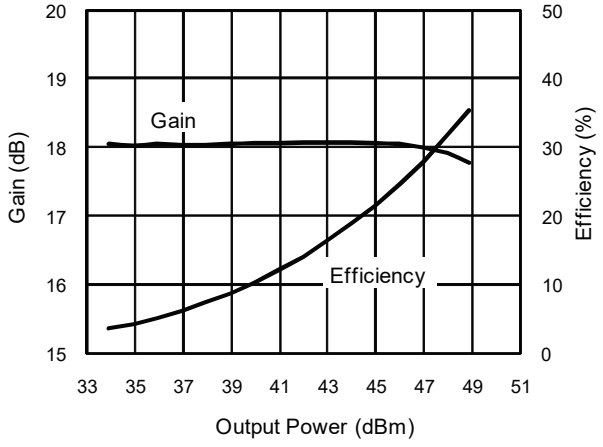
Type and Version	Order Code	Package Description	Shipping
PTFB212503FL V2 R0	PTFB212503FL-V2-R0	H-34288-4/2, earless flange	Tape & Reel, 50 pcs
PTFB212503FL V2 R250	PTFB212503FL-V2-R250	H-34288-4/2, earless flange	Tape & Reel, 250 pcs

Typical Performance (data taken in a production test fixture)

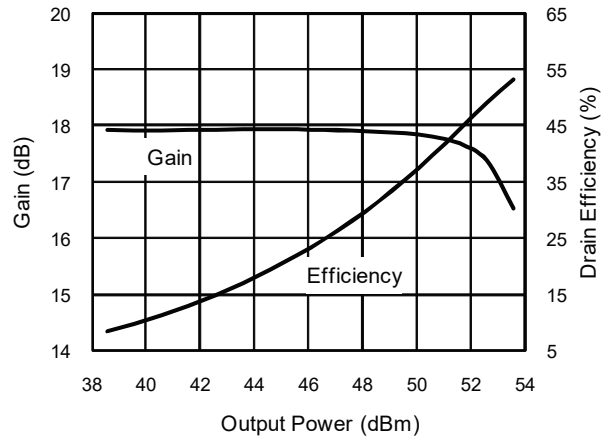
Two-carrier WCDMA Drive-up
V_{DD} = 30 V, I_{DQ} = 1.85 A, 3GPP signal,
PAR = 8 dB, 10 MHz carrier spacing,
BW 3.84 MHz



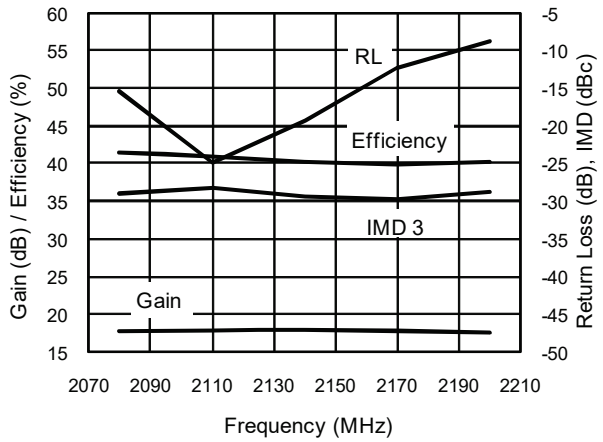
Two-carrier WCDMA Drive-up
V_{DD} = 30 V, I_{DQ} = 1.85 A f = 2170 MHz, 3GPP
WCDMA, PAR = 8 dB, 10 MHz carrier spacing,
BW 3.84 MHz



CW Power Sweep
Gain & Efficiency vs. Output Power
V_{DD} = 30 V, I_{DQ} = 1.85 A, f = 2170 MHz

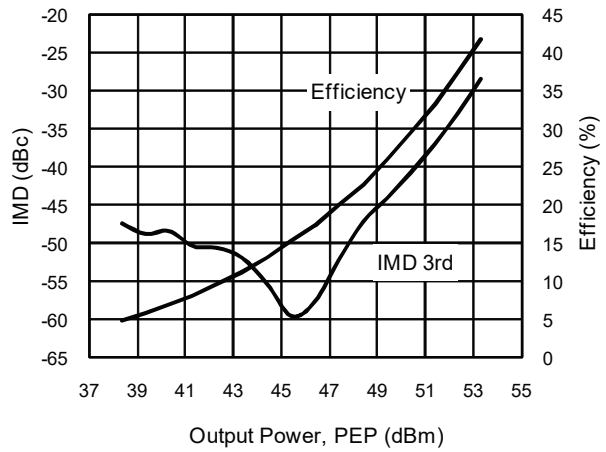


Two-tone Broadband Performance
V_{DD} = 30 V, I_{DQ} = 1.85 A, P_{OUT} = 100 W

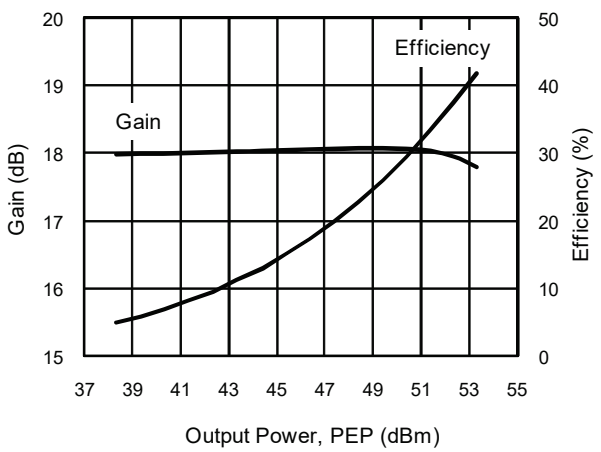


Typical Performance (cont.)

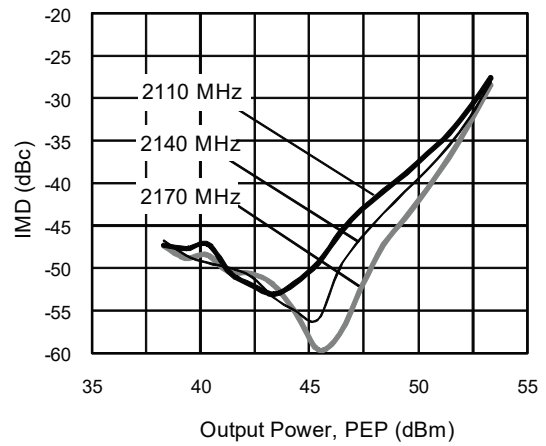
Two-tone Drive-up
V_{DD} = 30 V, I_{DQ} = 1.85 A,
f_1 = 2170 MHz, f_2 = 2169 MHz



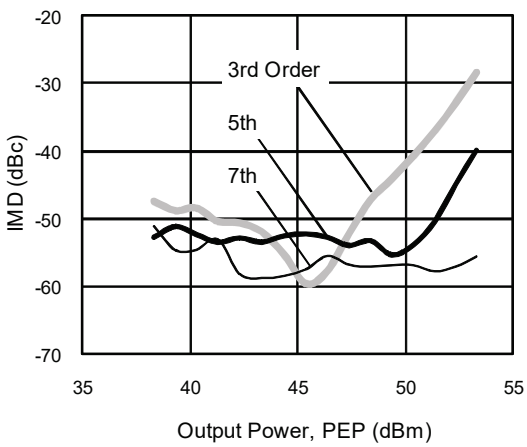
Two-tone Drive-up
V_{DD} = 30 V, I_{DQ} = 1.85 A,
f_1 = 2170 MHz, f_2 = 2169 MHz



Third Order Intermodulation Distortion vs. Output Power
V_{DD} = 30 V, I_{DQ} = 1.85 A,

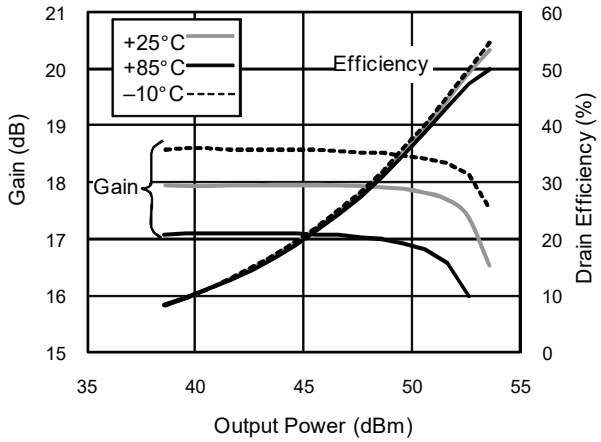


Intermodulation Distortion
V_{DD} = 30 V, I_{DQ} = 1.85 A,
f_1 = 2170 MHz, f_2 = 2169 MHz

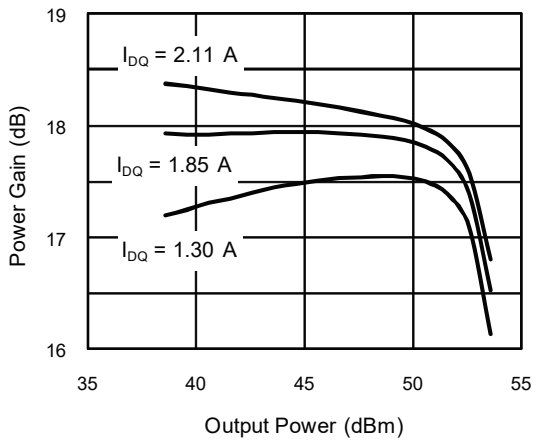


Typical Performance (cont.)

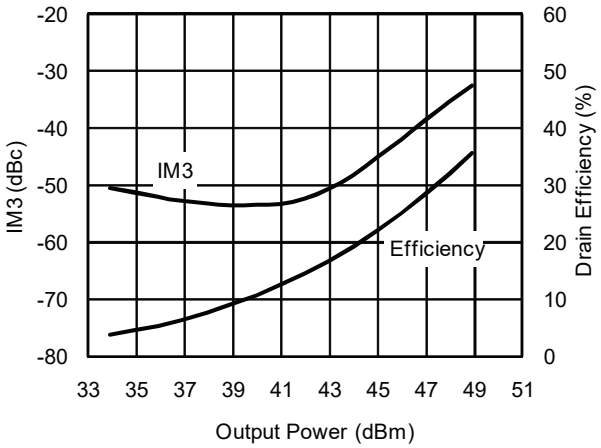
CW Performance
V_{DD} = 30 V, I_{DQ} = 1.85 A, f = 2170 MHz



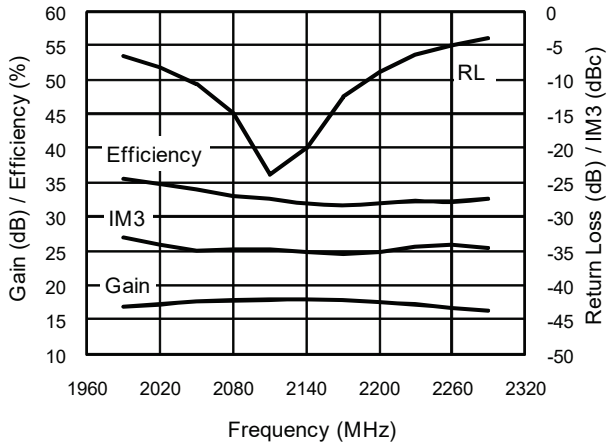
CW Performance
Gain vs. Output Power
V_{DD} = 30 V, f = 2170 MHz



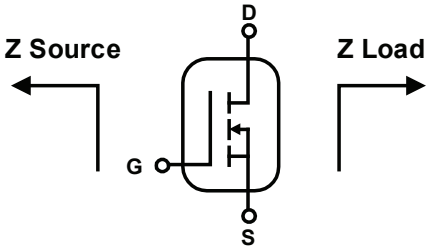
Single-carrier WCDMA
V_{DD} = 30 V, I_{DQ} = 1.85 A f = 2170 MHz, 3GPP
WCDMA, PAR = 8.5 dB, BW 3.84 MHz

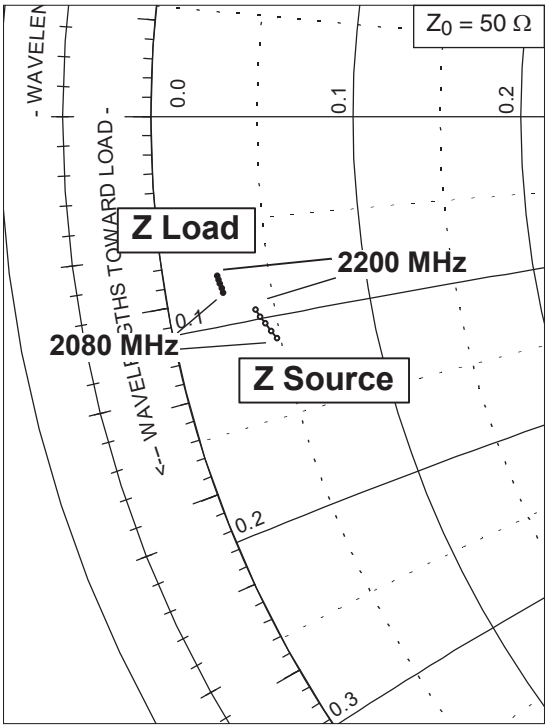


Single-carrier WCDMA, 3GGP Broadband
V_{DD} = 30 V, I_{DQ} = 1.85 A, P_{OUT} = 63 W



Broadband Circuit Impedance

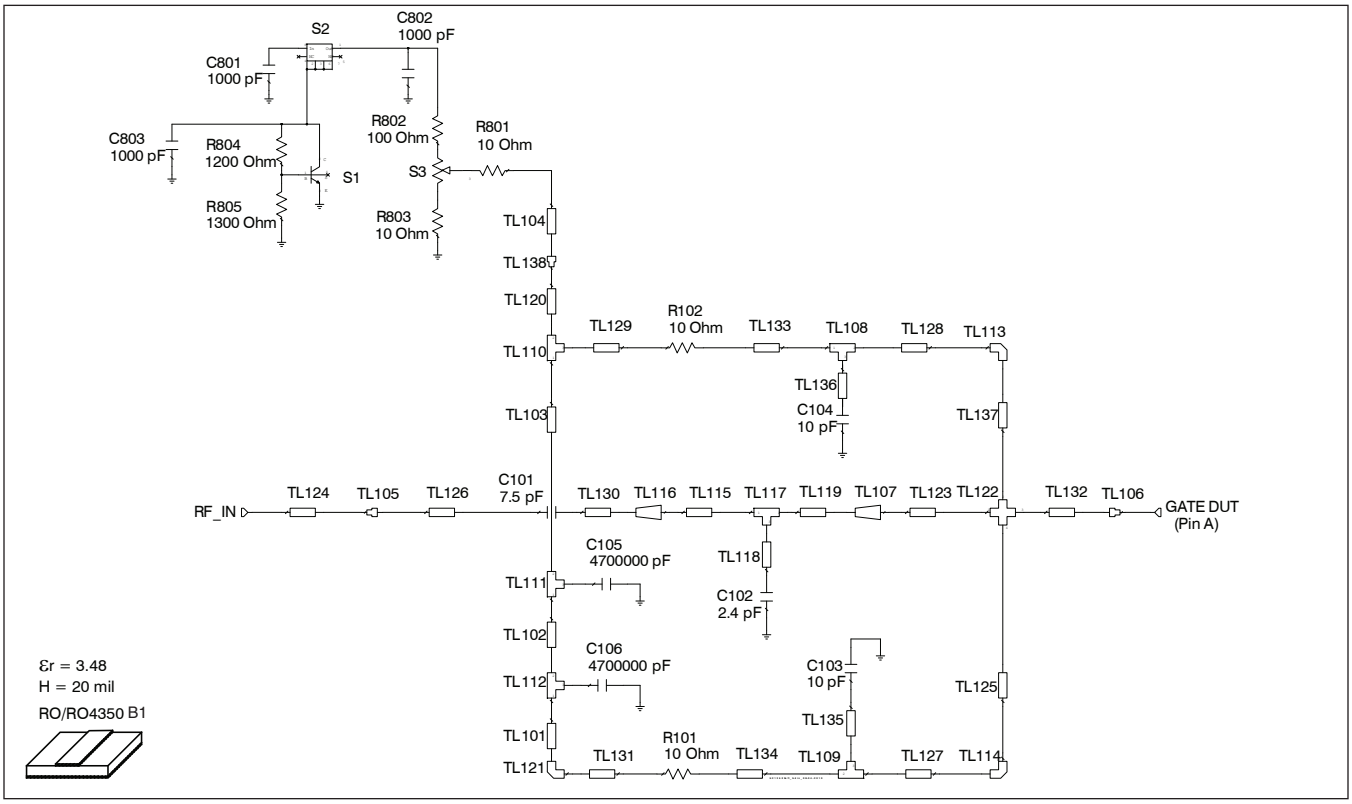




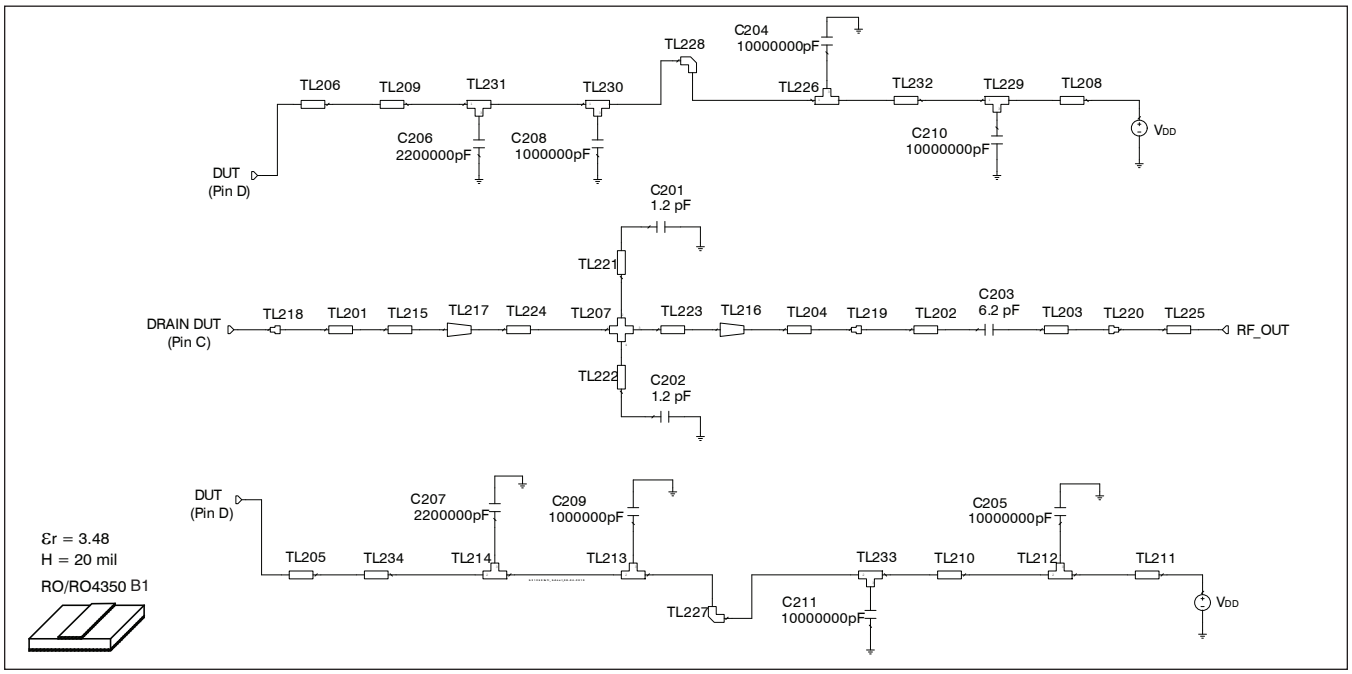
Frequency	Z Source Ω		Z Load Ω	
MHz	R	jX	R	jX
2080	2.42	–5.57	1.34	–4.23
2110	2.31	–5.36	1.32	–4.12
2140	2.21	–5.15	1.29	–4.01
2170	2.12	–4.96	1.27	–3.91
2200	2.04	–4.77	1.25	–3.81

See next page for reference circuit information

Reference Circuit



Reference circuit input schematic for ƒ = 2170 MHz



Reference circuit output schematic for ƒ = 2170 MHz

Reference Circuit (cont.)

Description	
DUT	PTFB212503FL
PCB	0.508 mm [.020"] thick, εr = 3.48, Rogers 4350, 1 oz. copper

Electrical Characteristics at 2170 MHz

Transmission Line	Electrical Characteristics	Dimensions: mm	Dimensions: mils
Input			
TL101	0.043 λ, 54.17 Ω	W = 1.016, L = 3.594	W = 40, L = 142
TL102	0.107 λ, 63.89 Ω	W = 0.762, L = 9.050	W = 30, L = 356
TL103	0.044 λ, 63.89 Ω	W = 0.762, L = 3.734	W = 30, L = 147
TL104	0.031 λ, 34.72 Ω	W = 1.981, L = 2.540	W = 78, L = 100
TL105		W1 = 1.270, W2 = 2.286	W1 = 50, W2 = 90
TL106		W1 = 17.780, W2 = 12.700	W1 = 700, W2 = 500
TL107 (taper)	0.027 λ, 6.67 Ω / 15.80 Ω	W1 = 13.970, W2 = 5.334, L = 2.032	W1 = 550, W2 = 210, L = 80
TL108, TL109	0.012 λ, 54.17 Ω	W1 = 1.016, W2 = 1.016, W3 = 1.016	W1 = 40, W2 = 40, W3 = 40
TL110	0.012 λ, 54.17 Ω	W1 = 1.016, W2 = 1.270, W3 = 1.016	W1 = 40, W2 = 50, W3 = 40
TL111, TL112	0.012 λ, 63.89 Ω	W1 = 0.762, W2 = 0.762, W3 = 1.016	W1 = 30, W2 = 30, W3 = 40
TL113, TL114, TL121		W = 1.016	W = 40
TL115	0.000 λ, 15.80 Ω	W = 5.334, L = 0.000	W = 210, L = 0
TL116 (taper)	0.013 λ, 15.80 Ω / 47.12 Ω	W1 = 5.334, W2 = 1.270, L = 0.991	W1 = 210, W2 = 50, L = 39
TL117	0.000 λ, 15.80 Ω	W1 = 5.334, W2 = 5.334, W3 = 0.025	W1 = 210, W2 = 210, W3 = 1
TL118	0.000 λ, 144.35 Ω	W = 0.025, L = 0.025	W = 1, L = 1
TL119	0.000 λ, 15.80 Ω	W = 5.334, L = 0.000	W = 210, L = 0
TL120	0.018 λ, 54.17 Ω	W = 1.016, L = 1.524	W = 40, L = 60
TL122		W1 = 13.970, W2 = 1.016, W3 = 13.970 W4 = 1.016	W1 = 550, W2 = 40, W3 = 550, W4 = 40
TL123	0.005 λ, 6.67 Ω	W = 13.970, L = 0.381	W = 550, L = 15
TL124	0.032 λ, 47.12 Ω	W = 1.270, L = 2.692	W = 50, L = 106
TL125, TL137	0.026 λ, 54.17 Ω	W = 1.016, L = 2.159	W = 40, L = 85
TL126	0.016 λ, 31.24 Ω	W = 2.286, L = 1.270	W = 90, L = 50
TL127, TL128	0.095 λ, 54.17 Ω	W = 1.016, L = 8.001	W = 40, L = 315
TL129	0.012 λ, 54.17 Ω	W = 1.016, L = 1.016	W = 40, L = 40
TL130	0.134 λ, 47.12 Ω	W = 1.270, L = 11.151	W = 50, L = 439
TL131	0.012 λ, 54.17 Ω	W = 1.016, L = 1.021	W = 40, L = 40
TL132	0.053 λ, 6.67 Ω	W = 13.970, L = 4.064	W = 550, L = 160
TL133, TL134	0.030 λ, 54.17 Ω	W = 1.016, L = 2.540	W = 40, L = 100
TL135, TL136	0.002 λ, 54.17 Ω	W = 1.016, L = 0.127	W = 40, L = 5
TL138		W1 = 1.016, W2 = 1.981	W1 = 40, W2 = 78

table continued on page 9

Reference Circuit (cont.)

Electrical Characteristics at 2170 MHz

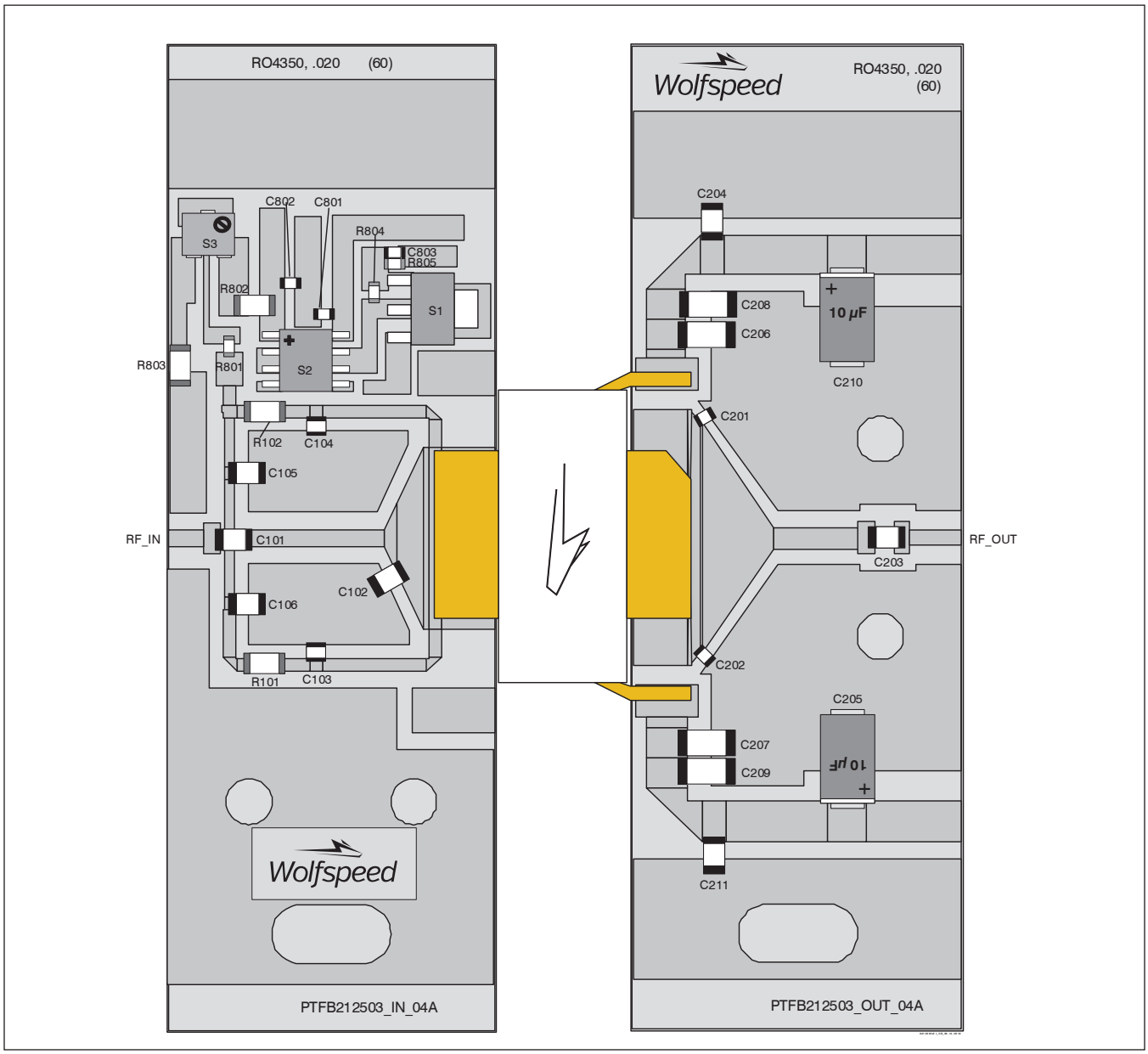
Transmission Line	Electrical Characteristics	Dimensions: mm	Dimensions: mils
Output			
TL201	0.054 λ, 4.84 Ω	W = 19.685, L = 4.064	W = 775, L = 160
TL202, TL203	0.016 λ, 28.85 Ω	W = 2.540, L = 1.270	W = 100, L = 50
TL204	0.078 λ, 39.51 Ω	W = 1.651, L = 6.426	W = 65, L = 253
TL205	0.032 λ, 16.90 Ω	W = 4.928, L = 2.540	W = 194, L = 100
TL206	0.032 λ, 17.05 Ω	W = 4.877, L = 2.540	W = 192, L = 100
TL207		W1 = 17.780, W2 = 0.025, W3 = 17.780 W4 = 0.025	W1 = 700, W2 = 1, W3 = 700, W4 = 1
TL208, TL211	0.092 λ, 25.04 Ω	W = 3.048, L = 7.341	W = 120, L = 289
TL209, TL234	0.010 λ, 25.04 Ω	W = 3.048, L = 0.762	W = 120, L = 30
TL210, TL232	0.098 λ, 25.04 Ω	W = 3.048, L = 7.823	W = 120, L = 308
TL212, TL229	0.038 λ, 25.04 Ω	W1 = 3.048, W2 = 3.048, W3 = 3.048	W1 = 120, W2 = 120, W3 = 120
TL213, TL214, TL230, TL231	0.029 λ, 25.04 Ω	W1 = 3.048, W2 = 3.048, W3 = 2.286	W1 = 120, W2 = 120, W3 = 90
TL215	0.003 λ, 4.84 Ω	W = 19.685, L = 0.254	W = 775, L = 10
TL216 (taper)	0.074 λ, 5.33 Ω / 39.51 Ω	W1 = 17.780, W2 = 1.651, L = 5.588	W1 = 700, W2 = 65, L = 220
TL217 (taper)	0.010 λ, 4.84 Ω / 5.33 Ω	W1 = 19.685, W2 = 17.780, L = 0.762	W1 = 775, W2 = 700, L = 30
TL218		W1 = 12.700, W2 = 17.780	W1 = 500, W2 = 700
TL219		W1 = 1.651, W2 = 2.540	W1 = 65, W2 = 100
TL220		W1 = 1.270, W2 = 2.540	W1 = 50, W2 = 100
TL221, TL222	0.000 λ, 144.35 Ω	W = 0.025, L = 0.025	W = 1, L = 1
TL223, TL224	0.000 λ, 5.33 Ω	W = 17.780, L = 0.025	W = 700, L = 1
TL225	0.047 λ, 47.12 Ω	W = 1.270, L = 3.912	W = 50, L = 154
TL226, TL233	0.023 λ, 25.04 Ω	W1 = 3.048, W2 = 3.048, W3 = 1.829	W1 = 120, W2 = 120, W3 = 72

Reference Circuit (cont.)

Circuit Assembly Information

Test Fixture Part No.	LTN/PTFB212503EF

Find Gerber files for this test fixture on the Wolfspeed Web site at *www.wolfspeed.com/RF*



Reference circuit assembly diagram (not to scale)

Reference Circuit (cont.)

Components Information

Component	Description	Suggested Manufacturer	P/N
Input			
C101	Chip capacitor, 7.5 pF	ATC	ATC100B7R5BW500XB
C102	Chip capacitor, 2.4 pF	ATC	ATC100B2R4BW500XB
C103, C104	Chip capacitor, 10 pF	ATC	ATC100A100JW500XB
C105, C106	Chip capacitor, 4.7 µF	Digi-Key	493-2372-2-ND
C801, C802, C803	Capacitor, 1000 pF	Digi-Key	PCC1772CT-ND
R101, R102, R803	Resistor, 10 Ω	Digi-Key	P10ECT-ND
R801	Resistor, 10 Ω	Digi-Key	P10GCT-ND
R802	Resistor, 100 Ω	Digi-Key	P101ECT-ND
R804	Resistor, 1200 Ω	Digi-Key	P1.2KGCT-ND
R805	Resistor, 1300 Ω	Digi-Key	P1.3KGCT-ND
S1	Transistor	Digi-Key	BCP56
S2	Voltage Regulator	Digi-Key	LM78L05ACM-ND
S3	Potentiometer, 2k Ω	Digi-Key	3224W-202ECT-ND
Output			
C201, C202	Chip capacitor, 1.2 pF	ATC	ATC100A1R2BW500XB
C203	Chip capacitor, 6.2 pF	ATC	ATC100B6R2JW500XB
C204, C211	Capacitor, 10 µF	Digi-Key	587-1818-2-ND
C205, C210	Capacitor, 10 µF	Garrett Electronics	281M5002106K
C206, C207	Chip capacitor, 2.2 µF	Digi-Key	445-1447-2-ND
C208, C209	Chip capacitor, 1 µF	Digi-Key	445-1411-2-ND

Package Outline Specifications

Package H-34288-4/2

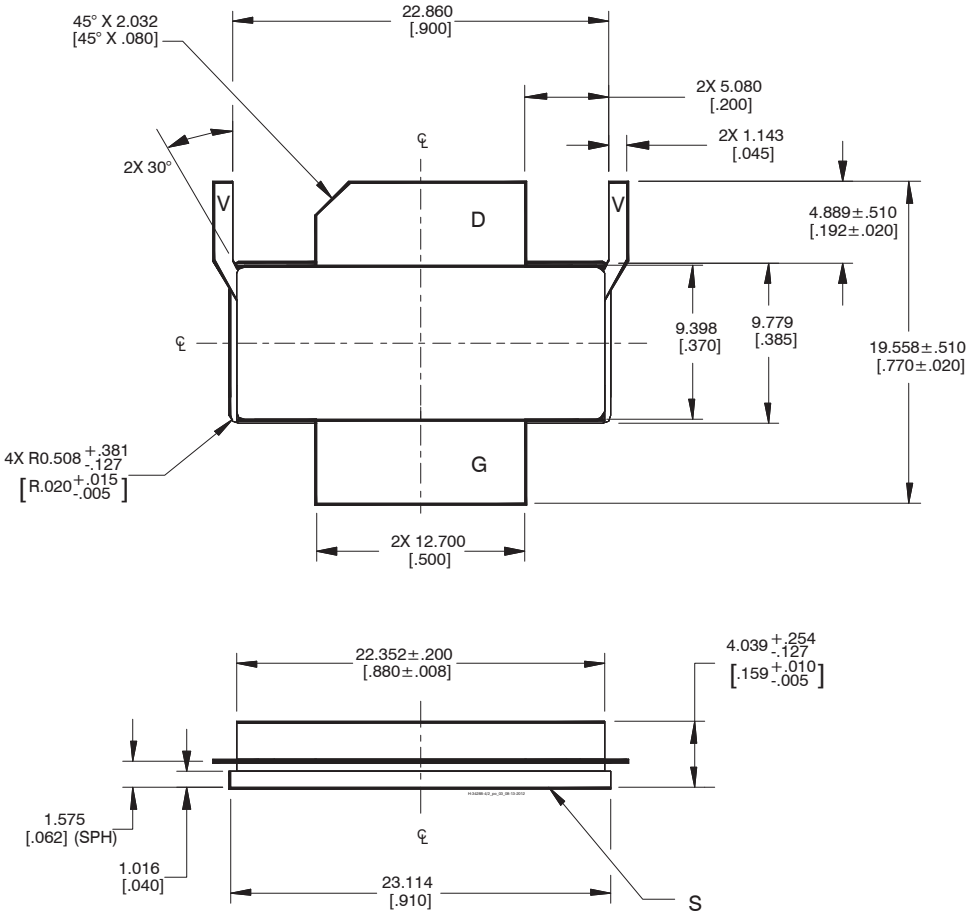


Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994.
2. Primary dimensions are mm. Alternate dimensions are inches.
3. All tolerances ± 0.127 [.005] unless specified otherwise.
4. Pins: D = drain; S = source; G = gate; V = V_{DD}.
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.

Revision History

Revision	Date	Data Sheet Type	Page	Subjects (major changes at each revision)
01	2009-03-27	Preliminary	All	Data Sheet reflects preliminary specification
02	2009-03-27	Preliminary	2	Updated gate-source voltage
03	2009-06-04	Preliminary	1 to 5	Revised operating conditions and provided updated and new performance
04	2009-08-04	Production	All 8 to 13 13, 14	Finalize specifications adn remove Preliminary designation. Add circuit information Revise package notes
05	2009-10-12	Production	2	Revise Vgs and package outline information
06	2010-08-05	Production	1, 2 7 to 11 12, 13	Updated package information Revised reference circuit tables Updated package outline
07	2010-11-04	Production	1, 2, 12 1	Changed eared flange package type Updated VSWR spec to 10:1
07.1	2016-06-15	Production	2	Updated ordering information
08	2018-06-14	Production	All	Removed EL version, Converted to Wolfspeed Data Sheet

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Notes

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