PTFB090901EA/FA

Thermally-Enhanced High Power RF LDMOS FETs
90 W, 28 V, 920 – 960 MHz

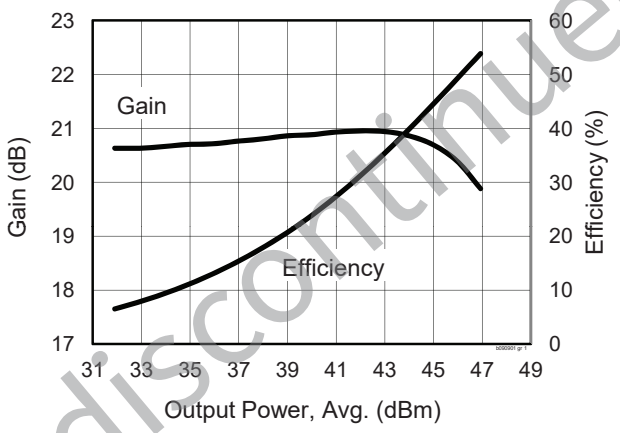
PTFB090901EA
Package H-36265-2

PTFB090901FA
Package H-37265-2

Description

The PTFB090901EA and PTFB090901FA are 90-watt LDMOS FETs intended for use in multi-standard cellular power amplifier applications in the 920 to 960 MHz frequency band. Features include input and output matching, high gain and thermally-enhanced packages. Manufactured with Wolfspeed's advanced LDMOS process, these devices provide excellent thermal performance and superior reliability.

Two-carrier WCDMA Drive-up
V_{DD} = 28 V, I_{DQ} = 650 mA, f = 960 MHz,
3GPP WCDMA signal, PAR = 8 dB,
10 MHz carrier spacing, BW = 3.84 MHz



Features

- Input and output internal matching
- Typical CW performance, 960 MHz, 28 V
  - Output power at P_{1dB} = 90 W
  - Efficiency = 65%
- Typical two-carrier WCDMA performance, 960 MHz, 28 V
  - Average output power = 20 W
  - Linear Gain = 20.8 dB
  - Efficiency = 35%
  - Intermodulation distortion = –35 dBc
- Integrated ESD protection
- Low thermal resistance
- Pb-free and RoHS-compliant
- Capable of handling 10:1 VSWR @ 28 V, 90 W (CW) output power

RF Characteristics

Single-carrier WCDMA Specifications (tested in Wolfspeed test fixture)
V_{DD} = 28 V, I_{DQ} = 650 mA, P_{OUT} = 25 W average, f = 960 MHz
3GPP signal, PAR = 10 dB @ 0.01% CCDF probability, channel bandwidth = 3.84 MHz

Characteristic	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	19	19.5	—	dB
Drain Efficiency	η_D	36	40	—	%
Adjacent Channel Power Ratio	ACPR	—	–35	–31.5	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 (not subject to production test—verified by design/characterization in Wolfspeed test fixture)
V_{DD} = 28 V, I_{DQ} = 650 mA, P_{OUT} = 70 W PEP, f = 960 MHz, tone spacing = 1 MHz

Characteristic	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	—	19.5	—	dB
Drain Efficiency	η_D	—	48	—	%
Intermodulation Distortion	IMD	—	–30	—	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
	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	$R_{DS(on)}$	—	0.123	—	Ω
Operating Gate Voltage	V_{DS} = 28 V, I_{DQ} = 650 mA	V_{GS}	—	3.8	—	V
Gate Leakage Current	V_{GS} = 10 V, V_{DS} = 0 V	I_{GSS}	—	—	1.0	µA

Maximum Ratings

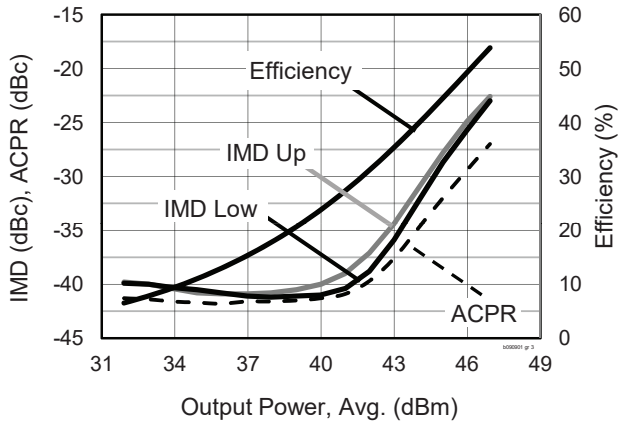
Parameter	Symbol	Value	Unit
Drain-source Voltage	V_{DSS}	65	V
Gate-source Voltage	V_{GS}	–6 to +10	V
Junction Temperature	T_J	200	°C
Storage Temperature Range	T_{STG}	–40 to +150	°C
Thermal Resistance (T_{CASE} = 70°C, 85 W CW)	$R_{\theta JC}$	0.73	°C/W

Ordering Information

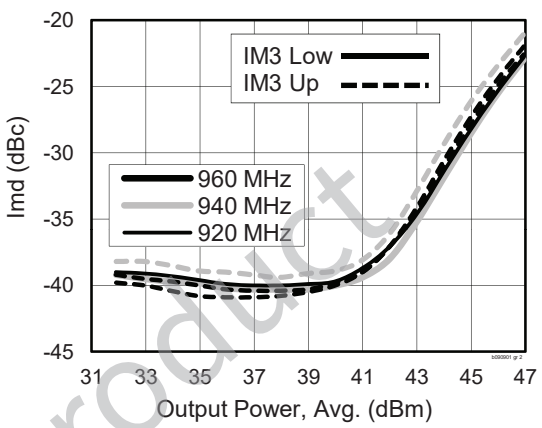
Type and Version	Order Code	Package	Package Description	Shipping
PTFB090901EA V2 R0	PTFB090901EA-V2-R0	H-36265-2	Ceramic open-cavity, bolt-down	Tape & Reel, 50 pcs
PTFB090901EA V2 R250	PTFB090901EA-V2-R250	H-36265-2	Ceramic open-cavity, bolt-down	Tape & Reel, 250 pcs
PTFB090901FA V2 R0	PTFB090901FA-V2-R0	H-37265-2	Ceramic open-cavity, earless	Tape & Reel, 50 pcs
PTFB090901FA V2 R250	PTFB090901FA-V2-R250	H-37265-2	Ceramic open-cavity, earless	Tape & Reel, 250 pcs

Typical Performance (data taken in a production test fixture)

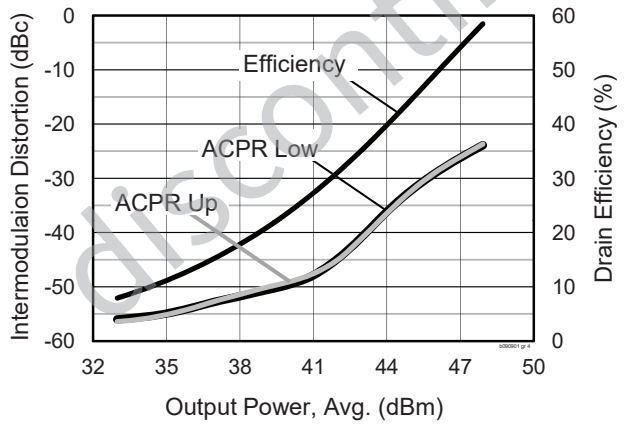
Two-carrier WCDMA Drive-up
V_{DD} = 28 V, I_{DQ} = 650 mA, f = 960 MHz,
3GPP WCDMA signal, PAR = 8 dB,
10 MHz carrier spacing, BW = 3.84 MHz



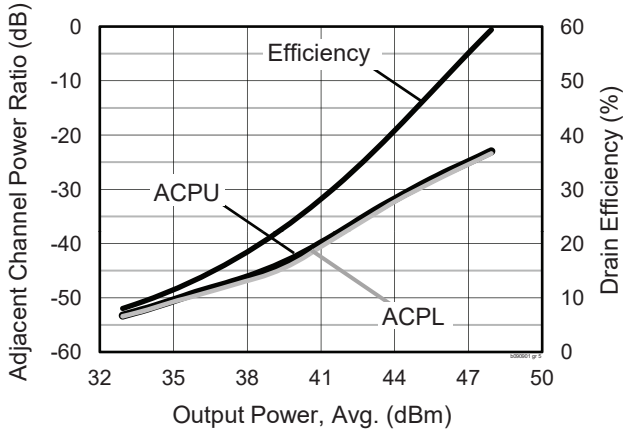
Two-carrier WCDMA Drive-up
V_{DD} = 28 V, I_{DQ} = 650 mA,
3GPP WCDMA signal, PAR = 8 dB,
10 MHz carrier spacing, 3.84 MHz BW



Single-carrier WCDMA Drive-up
V_{DD} = 28 V, I_{DQ} = 650 mA, f = 960 MHz,
3GPP WCDMA signal, TM1 w/64 DPCH,
43% clipping, PAR = 7.5 dB, 3.84 MHz BW

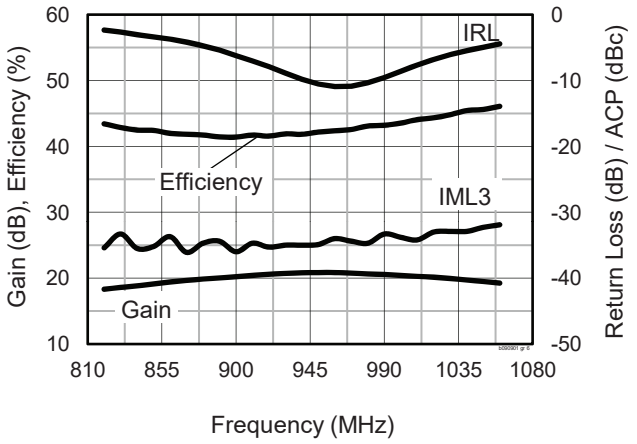


Single-carrier WCDMA Drive-up
V_{DD} = 28 V, I_{DQ} = 650 mA, f = 960 MHz,
3GPP WCDMA signal, TM1 w/64 DPCH,
100% clipping, PAR = 10 dB, 3.84 MHz BW

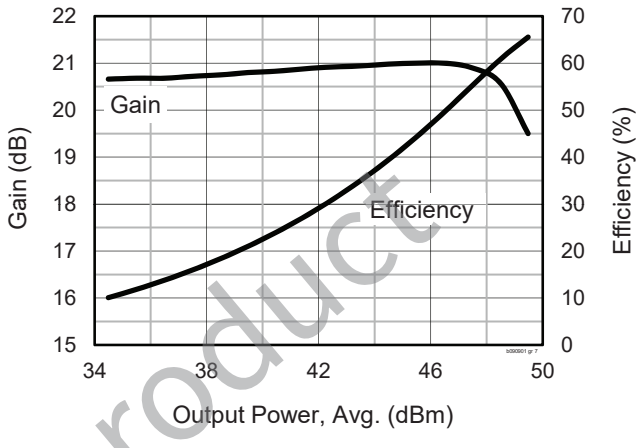


Typical Performance (cont.)

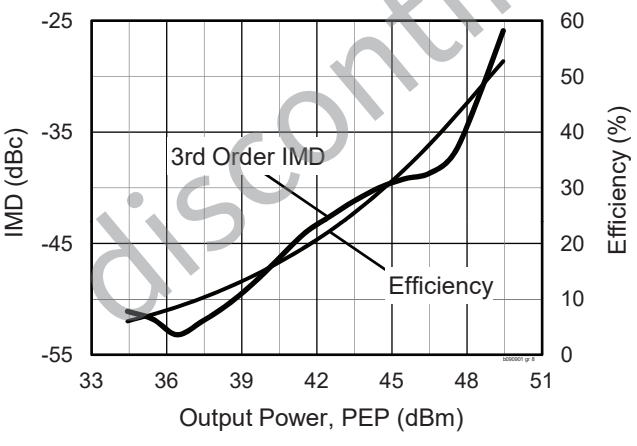
Single-carrier WCDMA Broadband
V_{DD} = 28 V, I_{DQ} = 620 mA, POUT = 28 W,
3GPP WCDMA signal



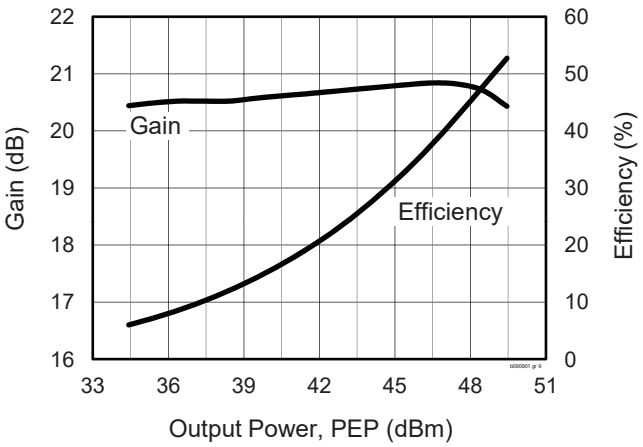
CW Power Sweep
V_{DD} = 30 V, I_{DQ} = 650 mA, f = 960 MHz



Two-tone Drive-up
V_{DD} = 28 V, I_{DQ} = 650 mA,
f_1 = 960 MHz, f_2 = 959 MHz

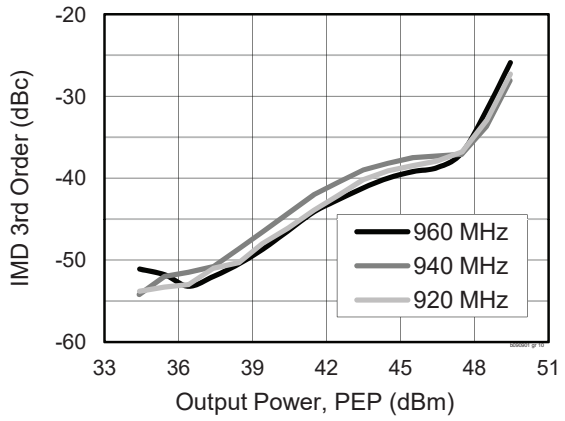


Two-tone Drive-up
V_{DD} = 30 V, I_{DQ} = 650 mA,
f_1 = 960 MHz, f_2 = 959 MHz

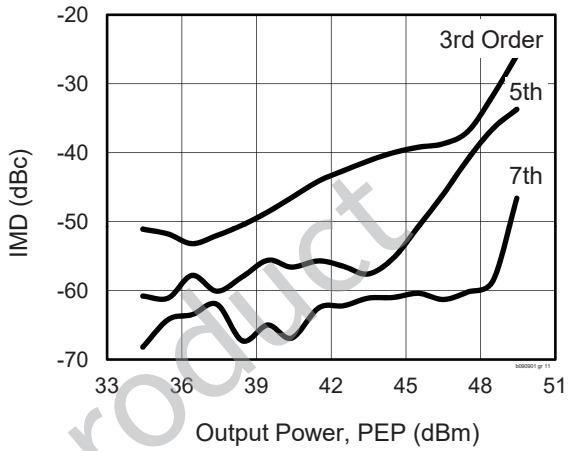


Typical Performance (cont.)

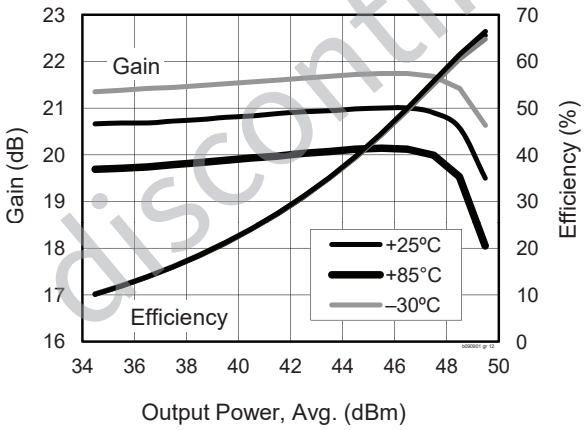
Two-tone Drive-up
at selected frequencies
V_{DD} = 28 V, I_{DQ} = 650 mA, 1 MHz tone spacing



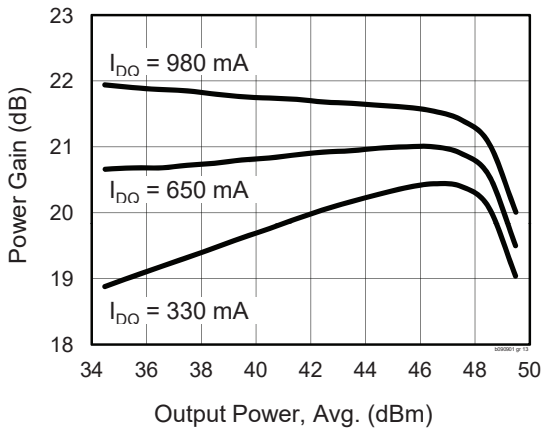
Two-tone Intermodulation Distortion
vs. Output Power
V_{DD} = 28 V, I_{DQ} = 650 mA,
f_1 = 960 MHz, f_2 = 959 MHz



CW Drive-up
(over temperature)
V_{DD} = 28 V, I_{DQ} = 650 mA,
f = 960 MHz

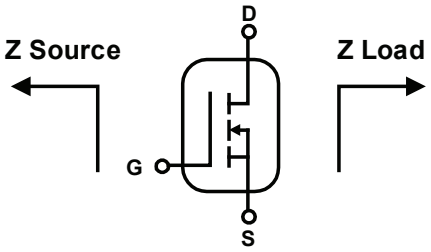


CW Drive-up
V_{DD} = 28 V, f = 960 MHz



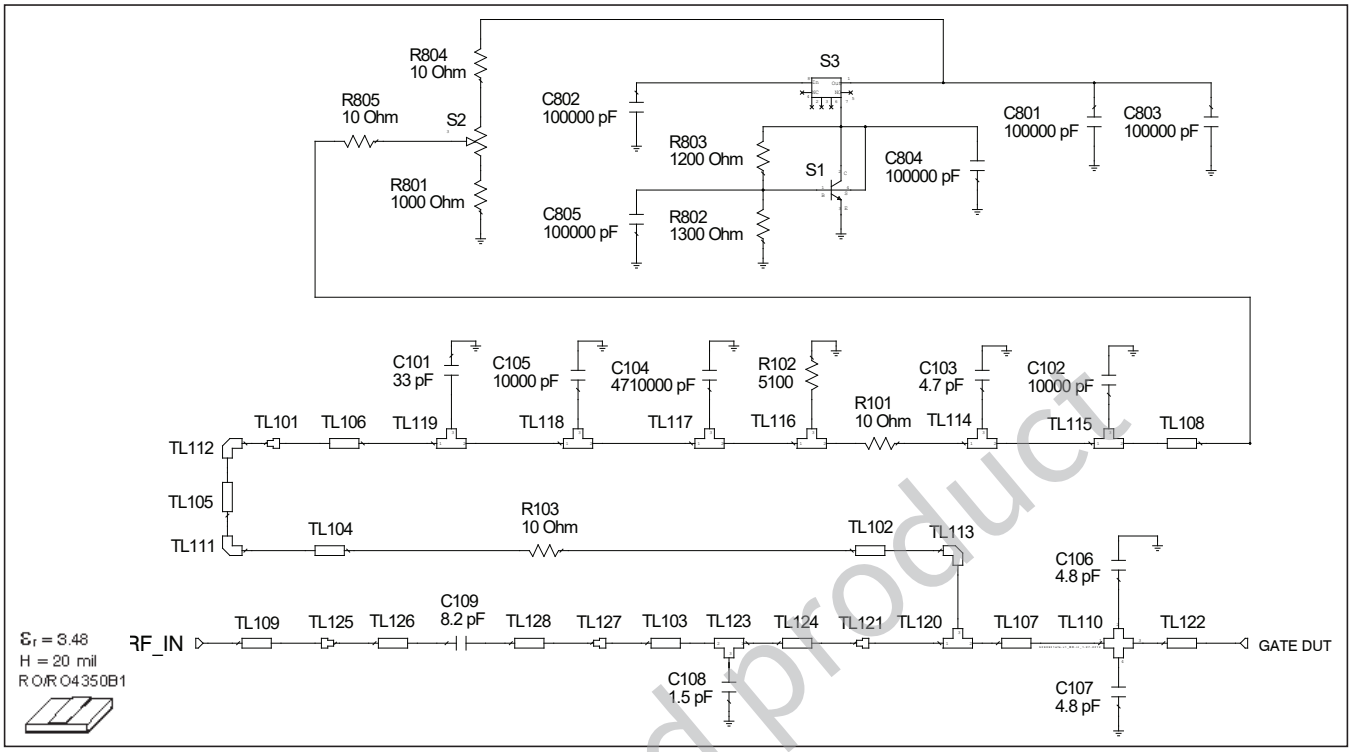
Broadband Circuit Impedance

Frequency	Z Source Ω		Z Load Ω	
MHz	R	jX	R	jX
900	2.3	–6.4	3.8	–2.6
920	2.2	–6.2	3.6	–2.3
940	2.1	–6.0	3.5	–2.1
960	1.9	–5.8	3.4	–1.8
980	1.8	–5.6	3.3	–1.6

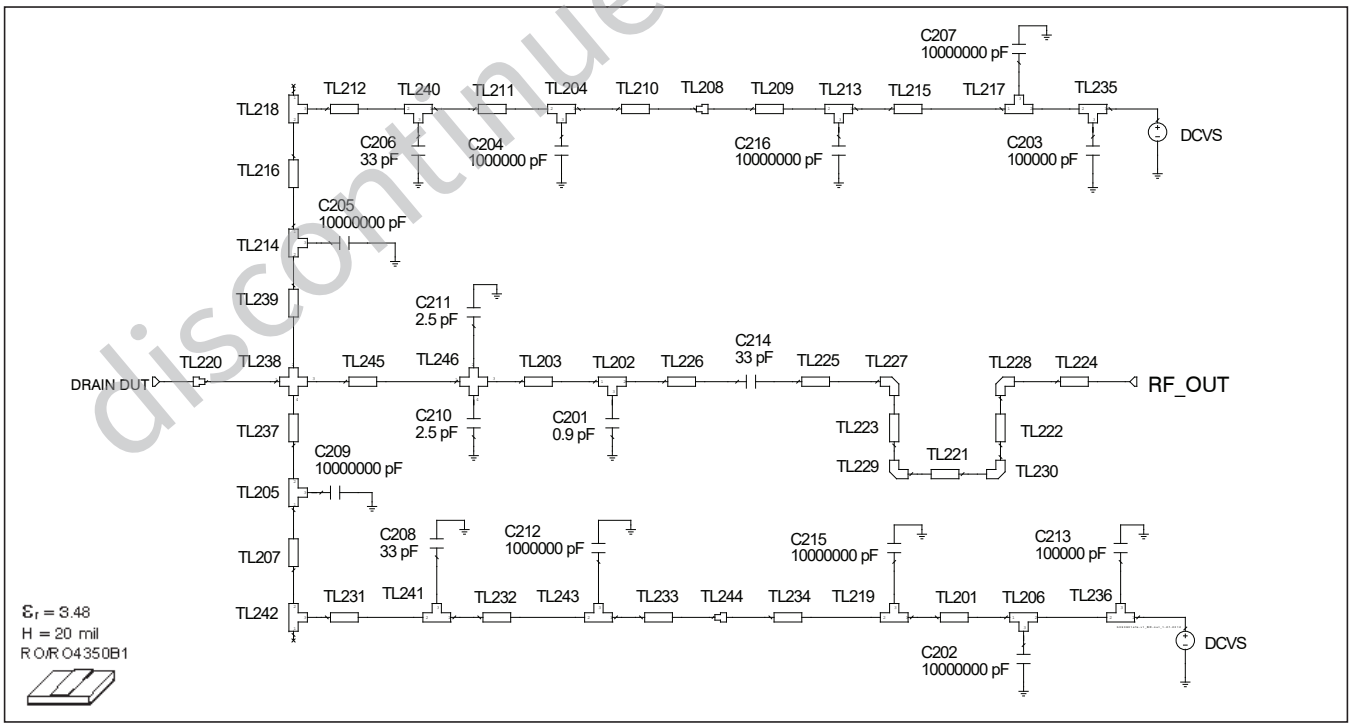


See next page for reference circuit information

Reference Circuit



Reference circuit input schematic for ƒ = 960 MHz



Reference circuit output schematic for ƒ = 960 MHz

Reference Circuit (cont.)

Reference Circuit Assembly		
DUT	PTFB090901EA or PTFB090901FA	
Reference Circuit Part No.	LTN/PTFB090901EA (PTFB090901EA)	LTN/PTFB090901FA (PTFB090901FA)
PCB	Rogers RO4350, 0.508 mm [0.020"] thick, 2 oz. copper, ε_r = 3.48	
Find Gerber files for this test fixture on the Wolfspeed Web site at **www.wolfspeed.com/RF**		

Electrical Characteristics at 960 MHz

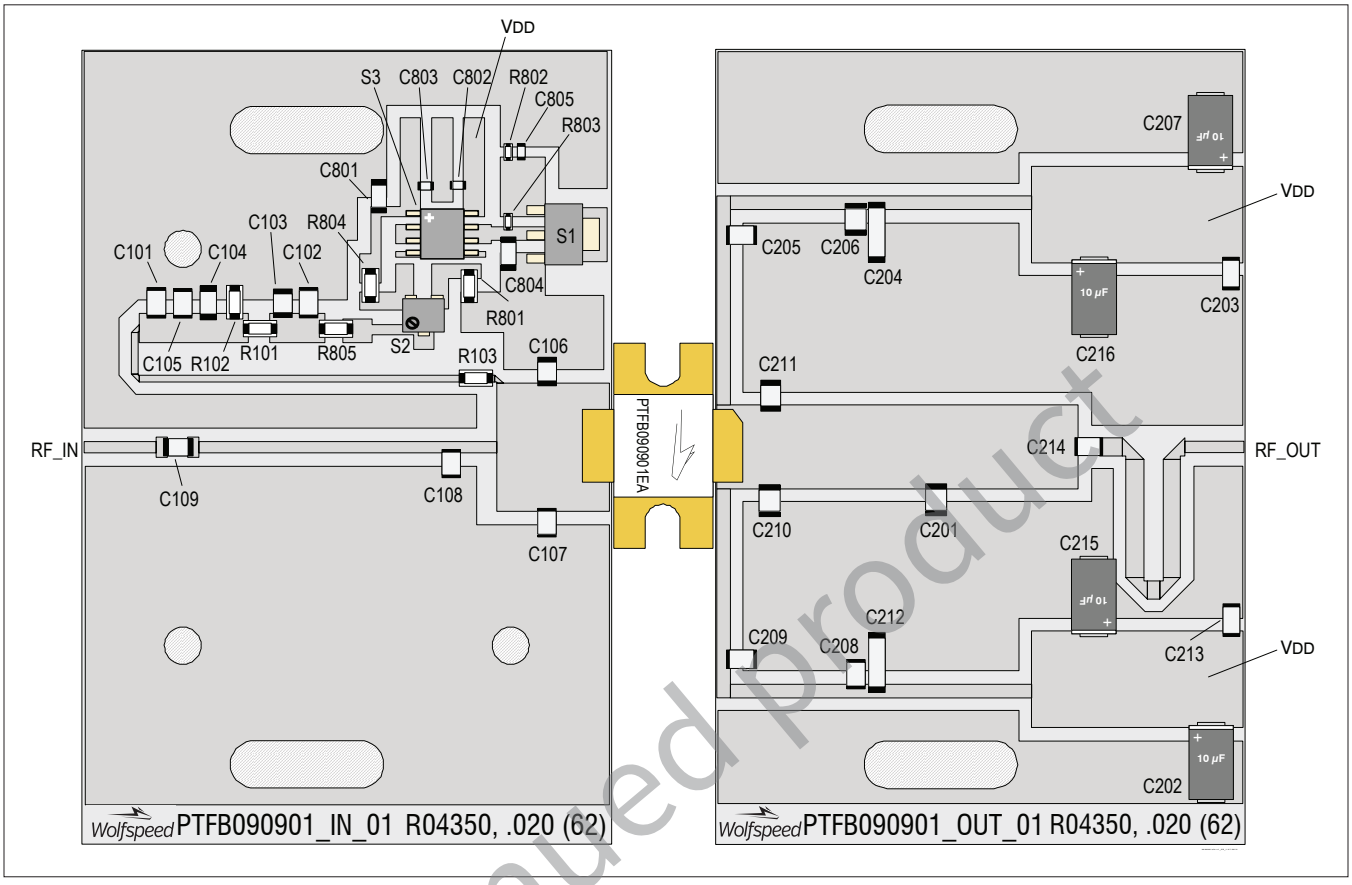
Transmission Line	Electrical Characteristics	Dimensions: mm	Dimensions: mils
Input			
TL102	0.0064 λ, 69.6 Ω	W = 0.65, L = 1.23	W = 25, L = 48
TL103	0.1238 λ, 51.53 Ω	W = 1.1, L = 23.38	W = 43, L = 921
TL104	0.1658 λ, 69.6 Ω	W = 0.65, L = 31.91	W = 25, L = 1256
TL105	0.0205 λ, 69.6 Ω	W = 0.65, L = 3.94	W = 25, L = 155
TL106	0.0014 λ, 26.81 Ω	W = 2.79, L = 0.25	W = 110, L = 10
TL107	0.0195 λ, 7.47 Ω	W = 12.37, L = 3.37	W = 487, L = 133
TL108	0.0014 λ, 26.81 Ω	W = 2.79, L = 0.25	W = 110, L = 10
TL109	0.0369 λ, 51.53 Ω	W = 1.1, L = 6.97	W = 43, L = 275
TL114, TL115, TL116, TL117, TL118, TL119	0.014 λ, 26.81 Ω	W1 = 2.79, W2 = 2.79, W3 = 2.54	W1 = 110, W2 = 110, W3 = 100
TL120	0.0037 λ, 7.47 Ω	W1 = 12.37, W2 = 12.37, W3 = 0.65	W1 = 487, W2 = 487, W3 = 25
TL122	0.0294 λ, 7.47 Ω	W = 12.37, L = 5.08	W = 487, L = 200
TL123	0.0094 λ, 51.53 Ω	W1 = 1.1, W2 = 1.1, W3 = 1.78	W1 = 43, W2 = 43, W3 = 70
TL124	0.0183 λ, 51.53 Ω	W = 1.1, L = 3.45	W = 43, L = 136
TL126, TL128	0.0055 λ, 34.08 Ω	W = 2.03, L = 1.02	W = 80, L = 40

Reference Circuit (cont.)

Electrical Characteristics at 960 MHz (cont.)

Transmission Line	Electrical Characteristics	Dimensions: mm	Dimensions: mils
Output			
TL201	0.055 λ, 9.74 Ω	W = 9.25, L = 9.65	W = 364, L = 380
TL202	0.010 λ, 11.08 Ω	W1 = 8, W2 = 8, W3 = 1.78	W1 = 315, W2 = 315, W3 = 70
TL203	0.081 λ, 11.08 Ω	W = 8, L = 14.2	W = 315, L = 559
TL204, TL243	0.008 λ, 47.12 Ω	W1 = 1.27, W2 = 1.27, W3 = 1.52	W1 = 50, W2 = 50, W3 = 60
TL205, TL214	0.011 λ, 47.12 Ω	W1 = 1.27, W2 = 1.27, W3 = 2.03	W1 = 50, W2 = 50, W3 = 80
TL206, TL213, TL217, TL219	0.009 λ, 9.74 Ω	W1 = 9.25, W2 = 9.25, W3 = 1.52	W1 = 364, W2 = 364, W3 = 60
TL207	0.007 λ, 47.12 Ω	W = 1.27, L = 1.4	W = 50, L = 55
TL209	0.030 λ, 9.74 Ω	W = 9.25, L = 5.21	W = 364, L = 205
TL210	0.075 λ, 47.12 Ω	W = 1.27, L = 14.05	W = 50, L = 553
TL211, TL232	0.002 λ, 47.12 Ω	W = 1.27, L = 0.38	W = 50, L = 15
TL212	0.060 λ, 47.12 Ω	W = 1.27, L = 11.2	W = 50, L = 441
TL215	0.055 λ, 9.74 Ω	W = 9.25, L = 9.65	W = 364, L = 380
TL216	0.007 λ, 47.12 Ω	W = 1.27, L = 1.4	W = 50, L = 55
TL218	0.007 λ, 47.12 Ω	W1 = 1.27, W2 = 1.27, W3 = 1.27	W1 = 50, W2 = 50, W3 = 50
TL221	0.006 λ, 38.69 Ω	W = 1.7, L = 1.14	W = 67, L = 45
TL222, TL223	0.061 λ, 38.69 Ω	W = 1.7, L = 11.3	W = 67, L = 445
TL224	0.030 λ, 51.46 Ω	W = 1.1, L = 5.69	W = 43, L = 224
TL225	0.012 λ, 38.69 Ω	W = 1.7, L = 2.22	W = 67, L = 87
TL226	0.073 λ, 11.08 Ω	W = 8, L = 12.7	W = 315, L = 500
TL231	0.060 λ, 47.12 Ω	W = 1.27, L = 11.2	W = 50, L = 441
TL233	0.075 λ, 47.12 Ω	W = 1.27, L = 14.05	W = 50, L = 553
TL234	0.030 λ, 9.74 Ω	W = 9.25, L = 5.21	W = 364, L = 205
TL235, TL236	0.014 λ, 9.74 Ω	W1 = 9.25, W2 = 9.25, W3 = 2.36	W1 = 364, W2 = 364, W3 = 93
TL237, TL239	0.082 λ, 47.12 Ω	W = 1.27, L = 15.35	W = 50, L = 604
TL240, TL241	0.009 λ, 47.12 Ω	W1 = 1.27, W2 = 1.27, W3 = 1.78	W1 = 50, W2 = 50, W3 = 70
TL242	0.007 λ, 47.12 Ω	W1 = 1.27, W2 = 1.27, W3 = 1.27	W1 = 50, W2 = 50, W3 = 50
TL245	0.017 λ, 11.08 Ω	W = 8, L = 2.92	W = 315, L = 115

Reference Circuit (cont.)



Reference circuit assembly diagram (not to scale)

Component ID	Description	Manufacturer	P/N
Input			
C101	Chip capacitor, 33 pF	ATC	100B330FW500XB
C102	Chip capacitor, 10000 pF	ATC	200B103MW
C103	Chip capacitor, 4.7 pF	ATC	100B4R7BW500XB
C104	Chip capacitor, 4.7 µF	Nichicon	F931C475MAA
C105	Chip capacitor, 10000 pF	ATC	200B103MW
C106, C107	Chip capacitor, 4.8 pF	ATC	100B4R8BW500XB
C108	Chip capacitor, 1.5 pF	ATC	100B1R5BW500XB
C109	Chip capacitor, 8.2 pF	ATC	100B8R2BW500XB
C801, C804	Chip capacitor, 0.1 µF	Panasonic Electronic Components	ECJ-3VB1H104K
C802, C803, C805	Chip capacitor, 1,000 pF	Panasonic Electronic Components	ECJ-1VB1H102K
R801	Resistor, 1.0k Ω	Panasonic Electronic Components	ERJ-8GEYJ102V
R802	Resistor, 1.3k Ω	Panasonic Electronic Components	ERJ-8GEYJ132V
R803	Resistor, 1.2k Ω	Panasonic Electronic Components	ERJ-8GEYJ122V
R804, R805	Resistor, 10 Ω	Panasonic Electronic Components	ERJ-8GEYJ100V

table cont. next page

Reference Circuit (cont.)

Component ID	Description	Manufacturer	P/N
Input (cont.)			
S1	Transistor	Fairchild Semiconductor	BCP56
S2	Potentiometer, 2k Ω	Bourns Inc.	3224W-1-202E
S3	Voltage Regulator	National Semiconductor	LM7805
Output			
C201	Chip capacitor, 1 pF	ATC	100B0R9BW500XB
C202, C207, C215, C216	Chip capacitor, 1.0 µF	ATC	281M5002106K
C203, C213	Chip capacitor, 0.1 µF	Panasonic Electronic Components	ECJ-3VB1H104K
C204, C212	Chip capacitor, 1 µF	AVX Corporation	2225PC105KAT1A
C205, C209	Capacitor, 10 µF	Taiyo Yuden	UMK325C7106MM-T
C206, C208	Chip capacitor, 33 pF	ATC	100B330JW500XB
C210, C211	Chip capacitor, 3 pF	ATC	100B2R5BW500XB
C214	Chip capacitor, 33 pF	ATC	100B330FW500XB

See next page for package outline

Package Outline Specifications

Package H-36265-2

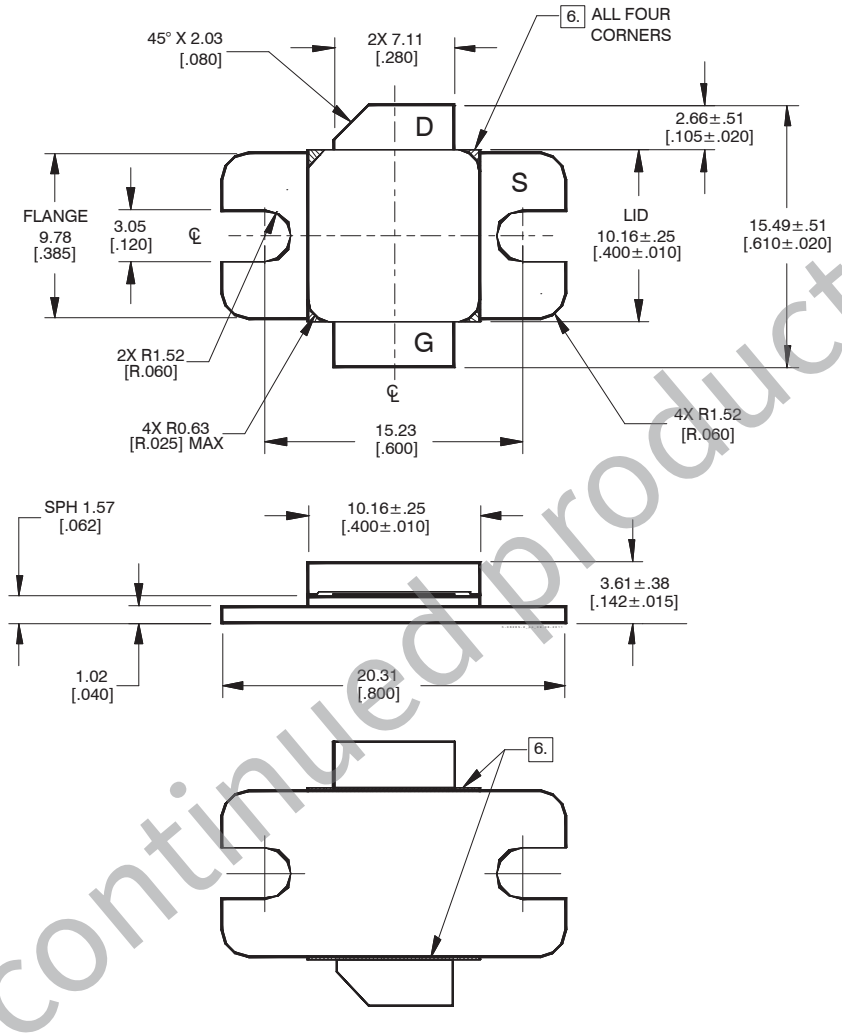


Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994.
2. Primary dimensions are mm. Alternate dimensions are inches.
3. All tolerances ± 0.127 [0.005] unless specified otherwise.
4. Pins: D – drain, S – source, G – gate.
5. Lead thickness: 0.10 +0.051/–0.025 [.004 +.002/–.001].
6. Exposed metal plane on top and bottom of ceramic insulator.
7. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch].

Package Outline Specifications (cont.)

Package H-37265-2

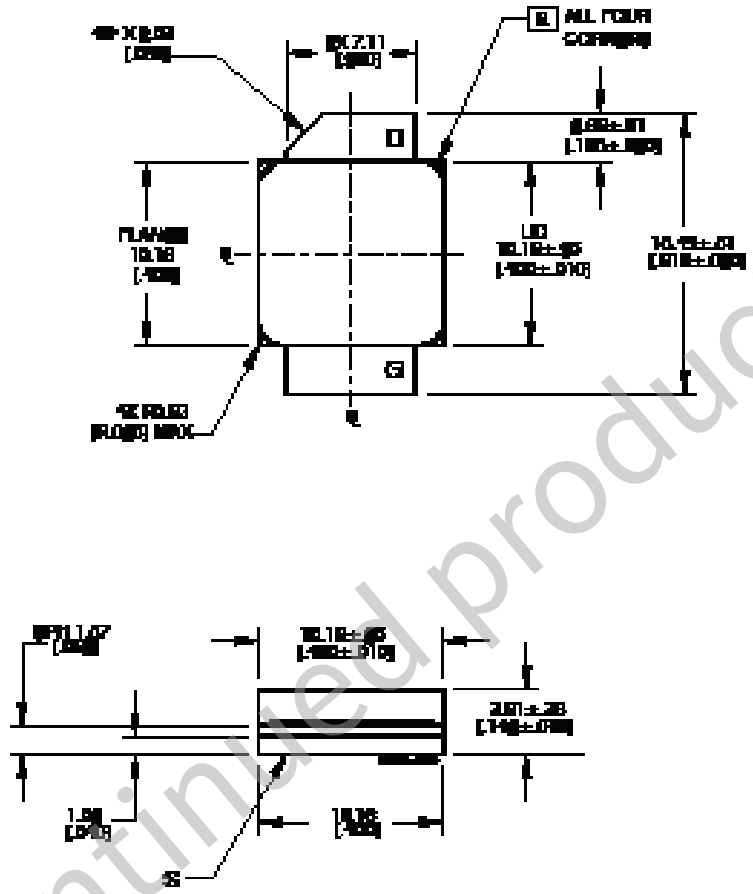


Diagram Notes—unless otherwise specified:

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, G – gate, S – source.
5. Lead thickness: 0.10 +0.051/–0.025 [.004 +.002/–.001].
6. Exposed metal plane on top of ceramic insulator.
7. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch].

Revision History

Revision	Date	Data Sheet Type	Page	Subjects (major changes at each revision)
01	2010-09-02	Advance	All	New product PTFB090801FA, proposed only.
02	2010-11-05	Advance	All	Product number revised.
03	2011-09-08	Advance	All	Added eared package H-36265-2
04	2012-02-23	Production	All	Products released to production: specifications finalized, circuit information added.
05	2013-01-23	Production	All	Version 2 (V2) products will replace previous Version 1 (V1) products. No change to form, fit or function.
05.1	2014-07-08	Production	7 10-11	Correct label for output schematic. Identify component manufacturer and part number.
05.2	2016-06-09	Production	2	Updated ordering code to R0
06	2018-06-22	Production	All	Converted to Wolfspeed Data Sheet
07	2020-06-02`	End of life	All	Product discontinued

For more information, please contact:

4600 Silicon Drive
Durham, North Carolina, USA 27703
www.wolfspeed.com/RF

Sales Contact
RFSales@wolfspeed.com

RF Product Marketing Contact
RFMarketing@wolfspeed.com
919.407.7816

Notes

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