

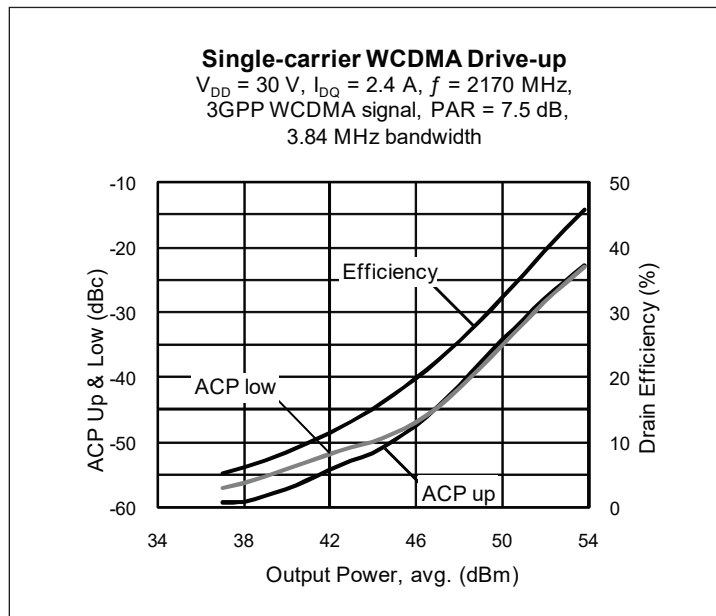
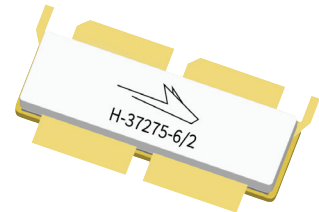
PTFB213004F

High Power RF LDMOS Field Effect Transistor 300 W, 2110 – 2170 MHz

Description

The PTFB213004F is a 300-watt LDMOS FET designed for class AB operation in cellular amplifiers covering the 2110 to 2170 MHz frequency band. Features include high peak power, input and output match, and a thermally-enhanced, open-cavity earless ceramic package.

PTFB213004F
Package H-37275-6/2



Features

- Broadband internal matching
- Enhanced for use in DPD error correction systems
- Wide video bandwidth
- Typical single-carrier WCDMA performance at 2170 MHz, 30 V
 - $P_{OUT} = 49.5\text{ dBm Avg}$
 - Gain = 17.5 dB
 - Efficiency = 30%
- Increased negative gate-source voltage range for improved performance in Doherty amplifiers
- Capable of handling 10:1 VSWR @ 30 V, 300 W (CW) output power
- Excellent thermal stability
- Integrated ESD protection
- Pb-free and RoHS-compliant

RF Characteristics

Two-carrier WCDMA Measurements (tested in Wolfspeed test fixture)

$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $P_{OUT} = 60\text{ W average}$,
 $f_1 = 2167.5\text{ MHz}$, $f_2 = 2172.5\text{ MHz}$, 3GPP signal, channel bandwidth = 3.84 MHz, PAR = 7.5 dB @ 0.01% CCDF

Characteristic	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	17	18	—	dB
Drain Efficiency	η_D	25	26.5	—	%
Intermodulation Distortion	IMD	—	-36	-33	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 (not subject to production test—verified by design / characterization in Wolfspeed test fixture)
 $V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $P_{OUT} = 250\text{ W PEP}$, $f = 2140\text{ MHz}$, tone spacing = 1 MHz

Characteristic	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	—	18	—	dB
Drain Efficiency	η_D	—	37	—	%
Intermodulation Distortion	IMD	—	−30	—	dBc

DC Characteristics

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$, $I_{DS} = 10\text{ }\mu\text{A}$	$V_{(BR)DSS}$	65	—	—	V
Drain Leakage Current	$V_{DS} = 30\text{ V}$, $V_{GS} = 0\text{ V}$	I_{DSS}	—	—	1.0	μA
	$V_{DS} = 63\text{ V}$, $V_{GS} = 0\text{ V}$	I_{DSS}	—	—	10.0	μA
On-State Resistance	$V_{GS} = 10\text{ V}$, $V_{DS} = 0.1\text{ A}$	$R_{DS(on)}$	—	0.03	—	Ω
Operating Gate Voltage	$V_{DS} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$	V_{GS}	2.3	2.8	3.3	V
Gate Leakage Current	$V_{GS} = 10\text{ V}$, $V_{DS} = 0\text{ V}$	I_{GSS}	—	—	1.0	μA

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	−0.5 to +65	V
Gate-Source Voltage	V_{GS}	−6 to +10	V
Junction Temperature	T_J	200	$^{\circ}\text{C}$
Storage Temperature Range	T_{STG}	−40 to +150	$^{\circ}\text{C}$
Thermal Resistance ($T_{CASE} = 70^{\circ}\text{C}$)	$R_{\theta JC}$	0.23	$^{\circ}\text{C/W}$

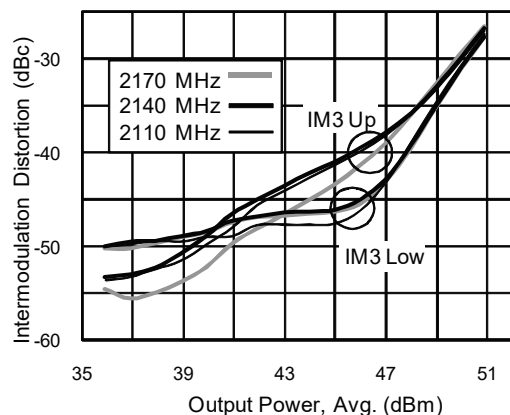
Ordering Information

Type and Version	Order Code	Package Description	Shipping
PTFB213004F V2 R0	PTFB213004F-V2-R0	H-37275-6/2, earless flange	Tape & Reel, 50 pcs
PTFB213004F V2 R250	PTFB213004F-V2-R250	H-37275-6/2, earless flange	Tape & Reel, 250 pcs

Typical Performance (data taken in a production test fixture)

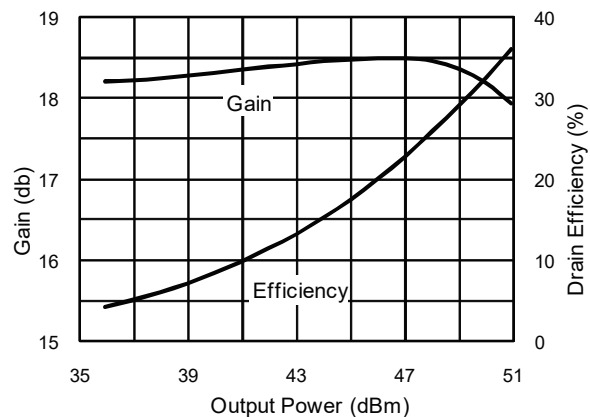
Two-carrier WCDMA Drive-up

$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, 3GPP WCDMA signal,
PAR = 8 dB, 10 MHz carrier spacing, 3.84 MHz BW



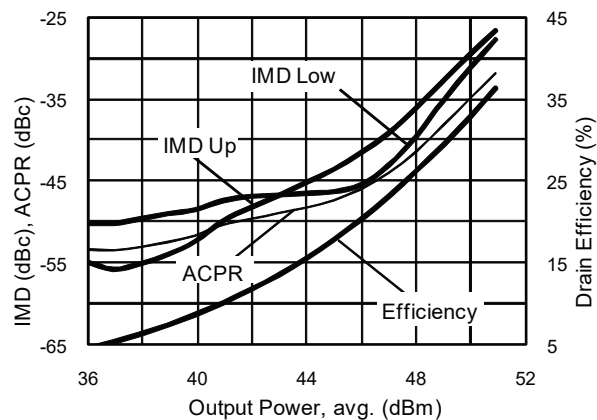
Two-carrier WCDMA Drive-up

$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $f = 2170\text{ MHz}$,
3GPP WCDMA signal, PAR = 8 dB,
10 MHz carrier spacing, 3.85 MHz BW



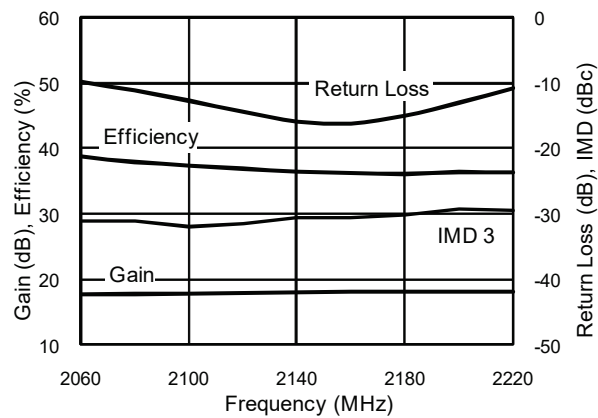
Two-carrier WCDMA Drive-up

$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $f = 2170\text{ MHz}$,
3GPP WCDMA signal, PAR = 8 dB,
10 MHz carrier spacing, 3.84 MHz BW



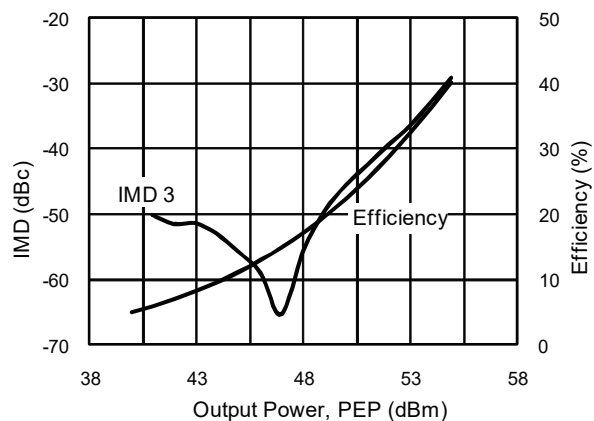
Two-tone Broadband Performance

$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $P_{OUT} = 126\text{ W}$

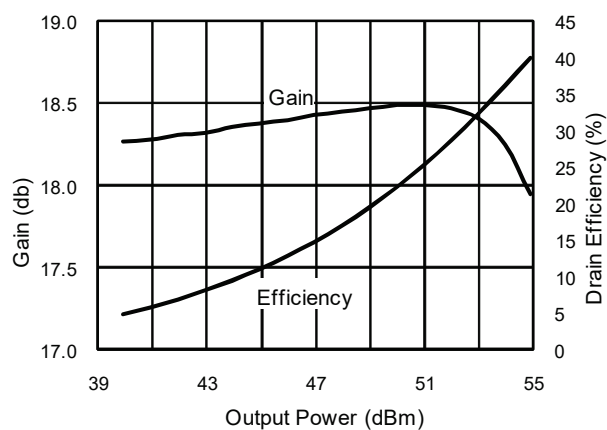


Typical Performance (cont.)

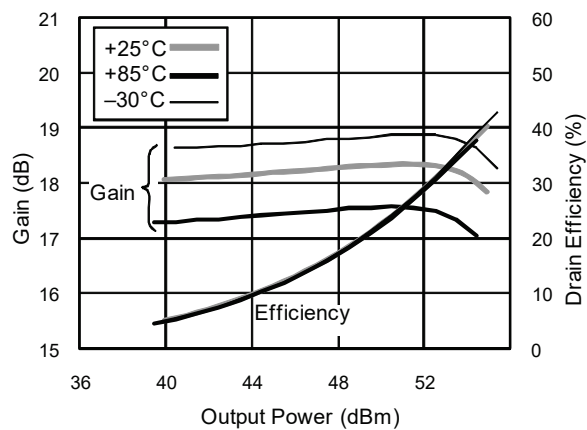
Two-tone Drive-up
 $V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$,
 $f_1 = 2170\text{ MHz}$, $f_2 = 2169\text{ MHz}$



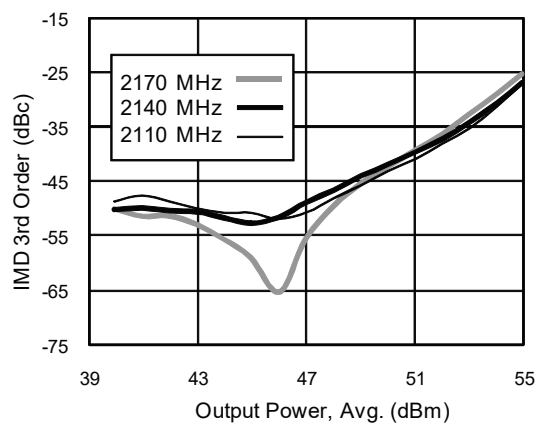
Gain & Efficiency vs. Output Power
 $V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $f = 2170\text{ MHz}$



Two-tone Drive-up (over temp)
 $(P_{OUT}\text{ max 3rd order IMD @ } -30\text{dBc})$
 $V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$,
 $f_1 = 2140.5\text{ MHz}$, $f_2 = 2139.5\text{ MHz}$



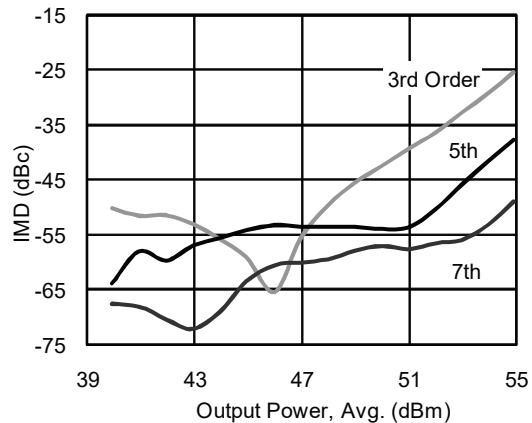
Two-tone IMD vs. Output Power
 $V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$,
tone spacing = 1 MHz



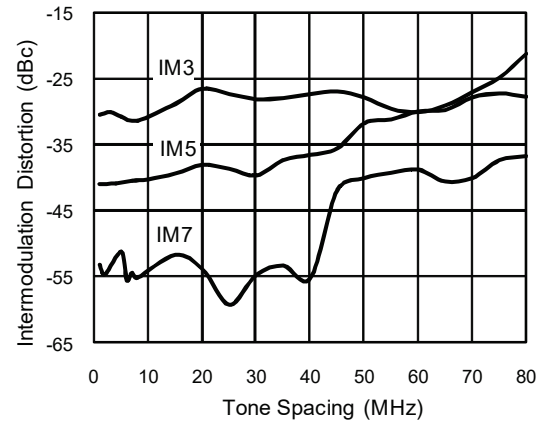
Typical Performance (cont.)

Two-tone IMD vs. Output Power

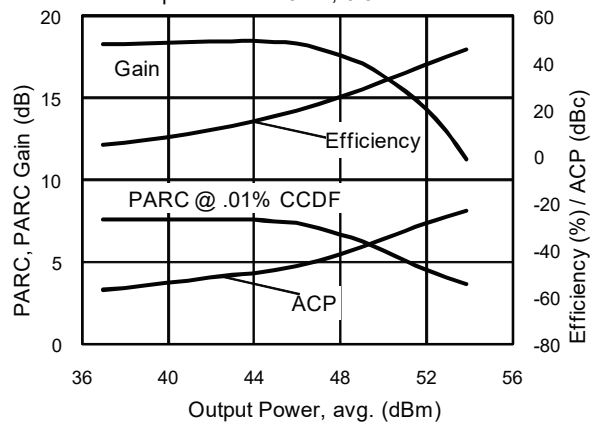
$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$,
 $f_1 = 2170\text{ MHz}$, $f_2 = 2169\text{ MHz}$

**Intermodulation Distortion vs. Tone Spacing**

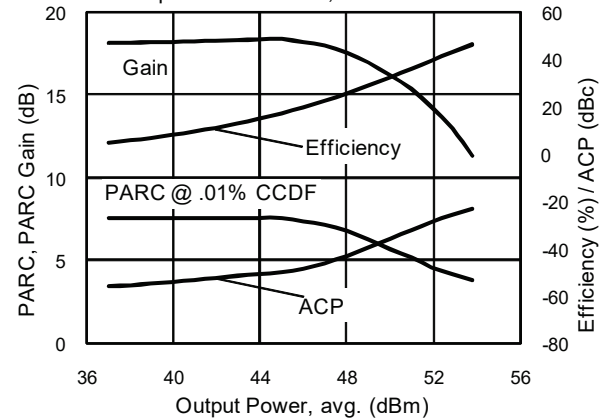
$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $f = 2140\text{ MHz}$,
 $P_{OUT} = 251\text{ W (PEP)}$

**Output PAR Compression (PARC), 2170 MHz**

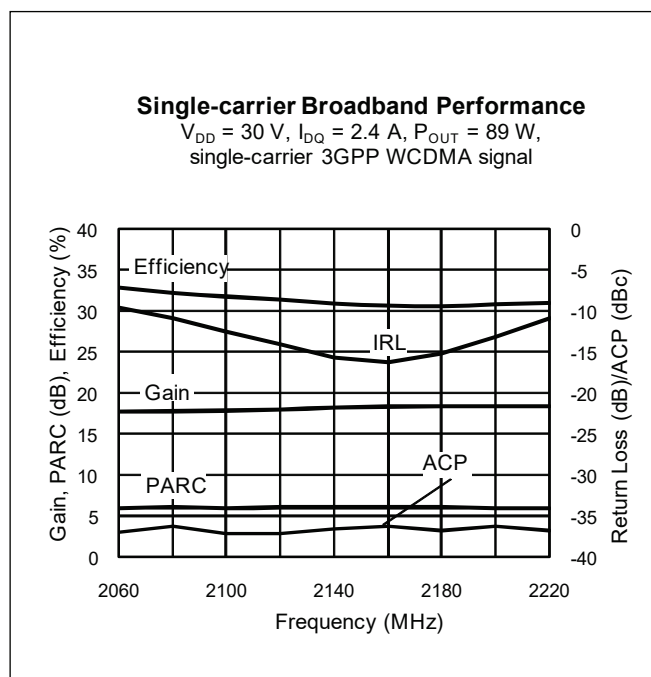
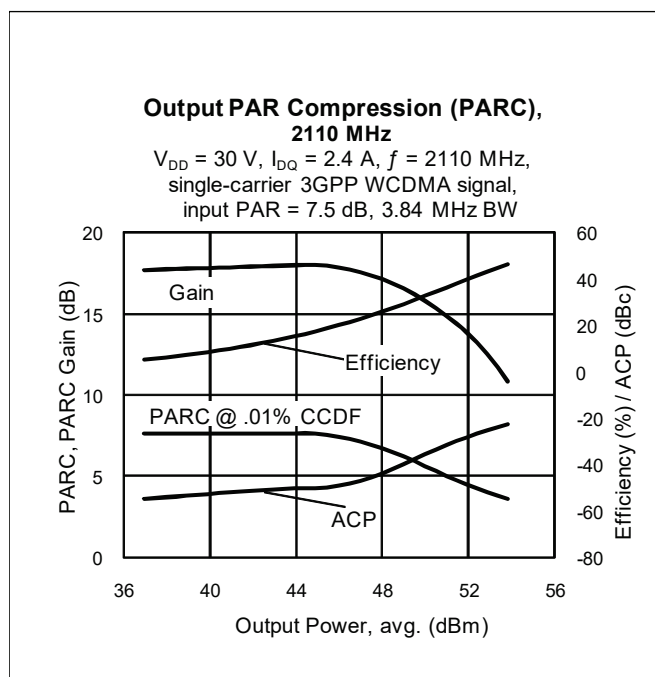
$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $f = 2170\text{ MHz}$,
 single-carrier 3GPP WCDMA signal,
 input PAR = 7.5 dB, 3.84 MHz BW

**Output PAR Compression (PARC), 2140 MHz**

$V_{DD} = 30\text{ V}$, $I_{DQ} = 2.4\text{ A}$, $f = 2140\text{ MHz}$,
 single-carrier 3GPP WCDMA signal,
 input PAR = 7.5 dB, 3.84 MHz BW

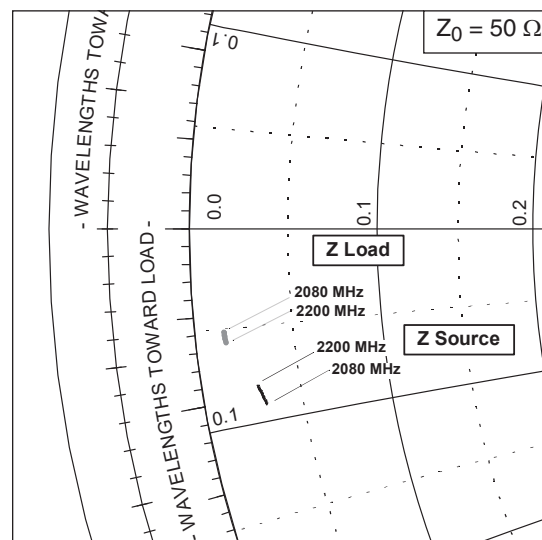
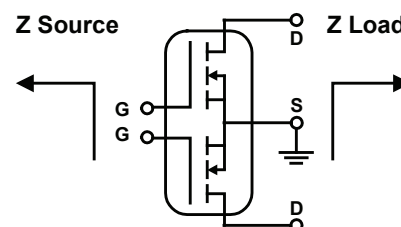


Typical Performance (cont.)



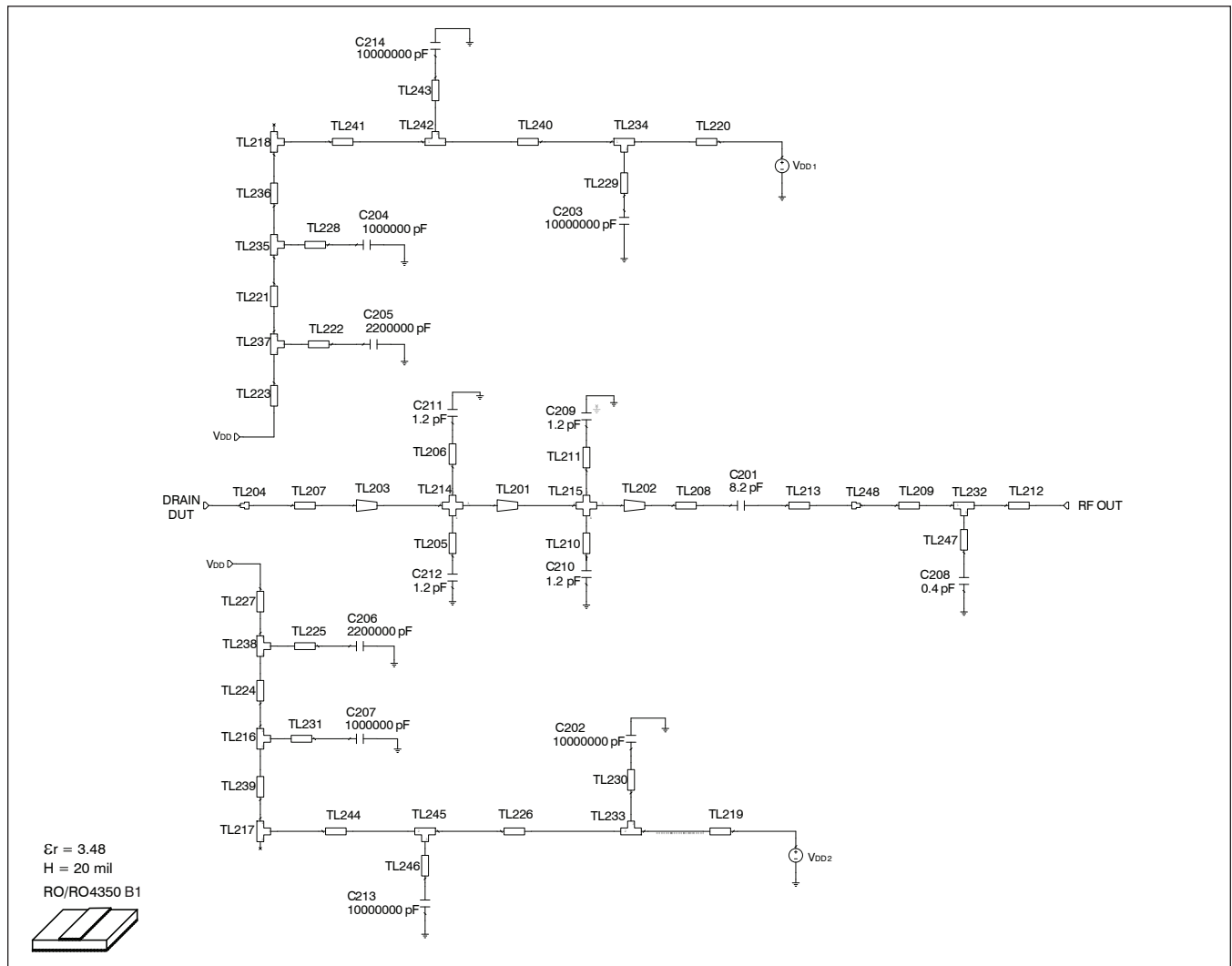
Broadband Circuit Impedance

Frequency MHz	Z Source Ω		Z Load Ω	
	R	jX	R	jX
2080	1.55	-4.57	0.71	-2.91
2090	1.54	-4.52	0.71	-2.89
2100	1.52	-4.48	0.70	-2.86
2110	1.51	-4.44	0.70	-2.84
2120	1.50	-4.40	0.70	-2.81
2130	1.48	-4.36	0.70	-2.79
2140	1.47	-4.32	0.70	-2.77
2150	1.46	-4.28	0.70	-2.74
2160	1.45	-4.24	0.69	-2.72
2170	1.43	-4.20	0.69	-2.70
2180	1.42	-4.17	0.69	-2.67
2190	1.41	-4.13	0.69	-2.65
2200	1.40	-4.09	0.69	-2.63





Reference Circuit (cont.)

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

Reference Circuit (cont.)

Description			
DUT	PTFB213004F	LDMOS Transistor	
PCB	LTN/PTFB213004EF	0.508 mm [.020"] thick, $\epsilon_r = 3.48$	Rogers 4350, 1 oz. copper
Electrical Characteristics at 2170 MHz			
Transmission Line	Electrical Characteristics	Dimensions: mm	Dimensions: mils
Input			
TL101	0.004λ , 51.98 Ω	$W1 = 1.087$, $W2 = 1.087$, $W3 = 0.813$	$W1 = 43$, $W2 = 43$, $W3 = 32$
TL101	0.010λ , 28.85 Ω	$W = 2.540$, $L = 0.787$	$W = 100$, $L = 31$
TL102	0.207λ , 63.89 Ω	$W = 0.762$, $L = 17.526$	$W = 30$, $L = 690$
TL103	0.006λ , 63.89 Ω	$W = 0.762$, $L = 0.508$	$W = 30$, $L = 20$
TL104	0.070λ , 8.03 Ω	$W = 11.430$, $L = 5.359$	$W = 450$, $L = 211$
TL105, TL106	0.017λ , 8.03 Ω	$W = 11.430$, $L = 1.270$	$W = 450$, $L = 50$
TL107	0.025λ , 32.60 Ω	$W = 2.159$, $L = 2.032$	$W = 85$, $L = 80$
TL108	0.015λ , 49.69 Ω	$W = 1.168$, $L = 1.270$	$W = 46$, $L = 50$
TL109, TL110, TL111, TL112		$W = 2.540$	$W = 100$
TL113, TL114		$W = 1.016$	$W = 40$
TL115, TL131	0.000λ , 41.75 Ω	$W = 1.524$, $L = 0.025$	$W = 60$, $L = 1$
TL116, TL133	0.016λ , 34.08 Ω	$W = 2.032$, $L = 1.270$	$W = 80$, $L = 50$
TL117	0.016λ , 17.20 Ω	$W = 4.826$, $L = 1.270$	$W = 190$, $L = 50$
TL118	0.041λ , 63.89 Ω	$W = 0.762$, $L = 3.480$	$W = 30$, $L = 137$
TL119, TL136	0.000λ , 41.75 Ω	$W = 1.524$, $L = 0.025$	$W = 60$, $L = 1$
TL120, TL122	0.015λ , 54.17 Ω	$W = 1.016$, $L = 1.262$	$W = 40$, $L = 50$
TL121, TL135	0.020λ , 54.17 Ω	$W = 1.016$, $L = 1.651$	$W = 40$, $L = 65$
TL123, TL130	0.017λ , 54.17 Ω	$W = 1.016$, $L = 1.397$	$W = 40$, $L = 55$
TL124, TL129	0.000λ , 34.08 Ω	$W = 2.032$, $L = 0.025$	$W = 80$, $L = 1$
TL125, TL128	0.091λ , 54.17 Ω	$W = 1.016$, $L = 7.620$	$W = 40$, $L = 300$
TL126, TL127	0.009λ , 54.17 Ω	$W = 1.016$, $L = 0.762$	$W = 40$, $L = 30$
TL132	0.018λ , 63.89 Ω	$W = 0.762$, $L = 1.524$	$W = 30$, $L = 60$
TL134	0.006λ , 63.89 Ω	$W = 0.762$, $L = 0.508$	$W = 30$, $L = 20$
TL137, TL138	0.024λ , 54.17 Ω	$W1 = 1.016$, $W2 = 1.016$, $W3 = 2.032$	$W1 = 40$, $W2 = 40$, $W3 = 80$
TL139, TL141	0.018λ , 63.89 Ω	$W1 = 0.762$, $W2 = 0.762$, $W3 = 1.524$	$W1 = 30$, $W2 = 30$, $W3 = 60$
TL140, TL142	0.012λ , 63.89 Ω	$W1 = 0.762$, $W2 = 0.762$, $W3 = 1.016$	$W1 = 30$, $W2 = 30$, $W3 = 40$
TL143		$W1 = 0.003$, $W2 = 0.005$, Offset = 0.000	$W1 = 3$, $W2 = 190$, Offset = 10
TL144		$W1 = 0.005$, $W2 = 0.011$, Offset = -0.003	$W1 = 5$, $W2 = 450$, Offset = -130
TL145		$W1 = 0.003$, $W2 = 0.005$, Offset = 0.000	$W1 = 3$, $W2 = 190$, Offset = -10
TL146		$W1 = 2.032$, $W2 = 0.762$	$W1 = 80$, $W2 = 30$
TL147		$W1 = 2.540$, $W2 = 0.762$	$W1 = 100$, $W2 = 30$
TL148		$W1 = 1.168$, $W2 = 2.159$	$W1 = 46$, $W2 = 85$
TL149	0.009λ , 28.85 Ω	$W = 2.540$, $L = 0.762$	$W = 100$, $L = 30$
TL150, TL151	0.006λ , 17.20 Ω	$W = 4.826$, $L = 0.508$	$W = 190$, $L = 20$

table continued on page 10

Reference Circuit (cont.)**Electrical Characteristics at 2170 MHz**

Transmission Line	Electrical Characteristics	Dimensions: mm	Dimensions: mils
Input			
TL152	0.070 λ , 8.03 Ω	W = 11.430, L = 5.359	W = 450, L = 211
TL153	0.018 λ , 63.89 Ω	W = 0.762, L = 1.524	W = 30, L = 60
TL154	0.016 λ , 17.20 Ω	W = 4.826, L = 1.270	W = 190, L = 50
TL155	0.060 λ , 49.69 Ω	W = 1.168, L = 5.022	W = 46, L = 198
TL156	0.002 λ , 49.69 Ω	W = 1.168, L = 0.203	W = 46, L = 8
TL157	0.015 λ , 49.69 Ω	W1 = 1.168, W2 = 1.168, W3 = 1.270	W1 = 46, W2 = 46, W3 = 50
TL158	0.027 λ , 28.85 Ω	W1 = 2.540, W2 = 2.540, W3 = 2.159	W1 = 100, W2 = 100, W3 = 85
TL159, TL162	0.013 λ , 8.03 Ω	W1 = 11.430, W2 = 11.430, W3 = 1.016	W1 = 450, W2 = 450, W3 = 40
TL160, TL161	0.018 λ , 63.89 Ω	W1 = 0.762, W2 = 0.762, W3 = 1.524	W1 = 30, W2 = 30, W3 = 60
TL163, TL164	0.004 λ , 63.89 Ω	W = 0.762, L = 0.330	W = 30, L = 13
TL165, TL171		W1 = 0.011, W2 = 0.003, Offset = 0.005	W1 = 11, W2 = 100, Offset = 200
TL166		W1 = 0.005, W2 = 0.011, Offset = 0.003	W1 = 5, W2 = 450, Offset = 130
TL167		W1 = 0.000, W2 = 0.000, W3 = 0.000	W1 = 0, W2 = 1, W3 = 1
TL168	0.000 λ , 148.22 Ω	W1 = 0.013, W2 = 0.013, W3 = 0.013	W1 = 1, W2 = 1, W3 = 1
TL169	0.000 λ , 102.05 Ω	W = 0.254, L = 0.025	W = 10, L = 1
TL170	0.000 λ , 47.12 Ω	W = 1.270, L = 0.025	W = 50, L = 1

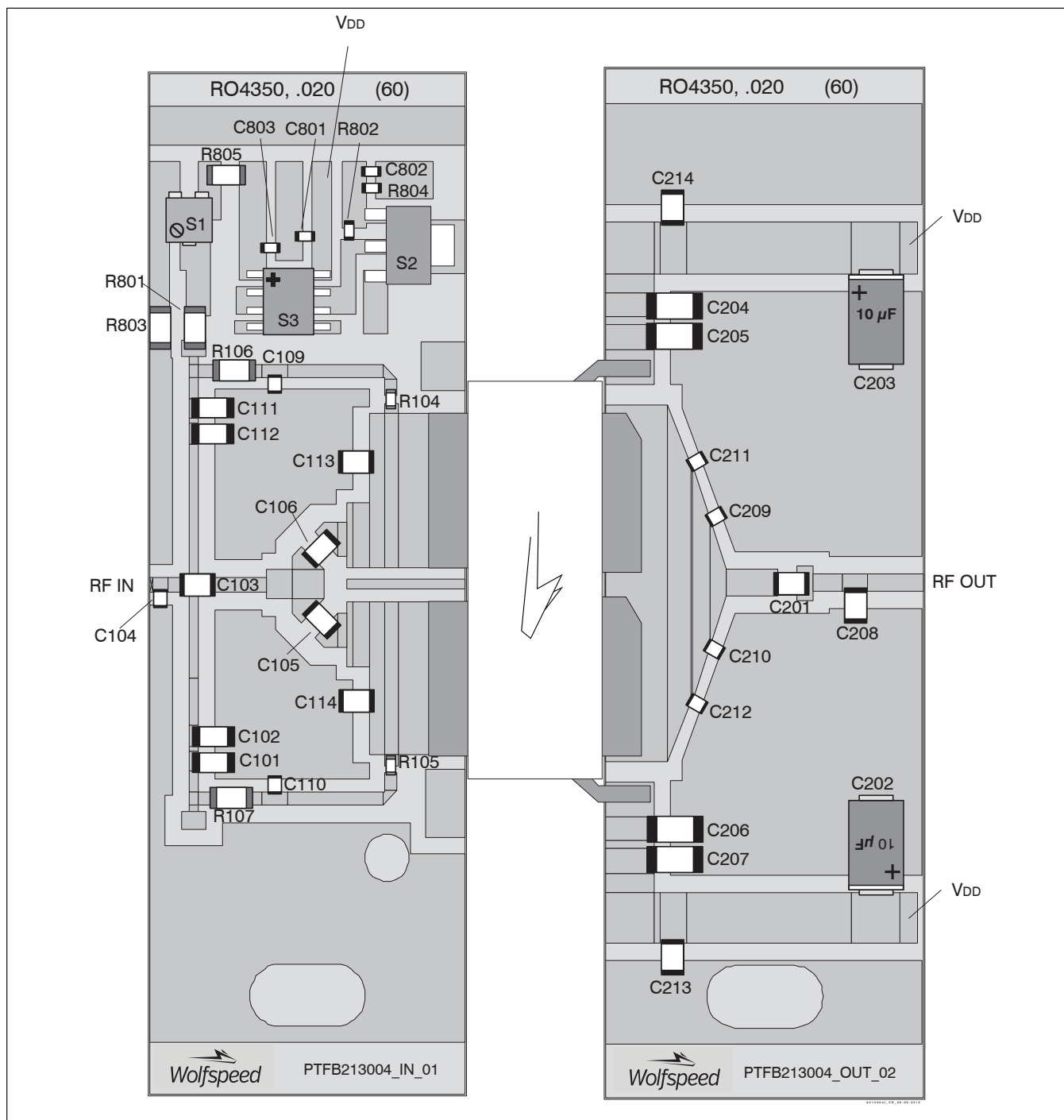
See next page for reference circuit output characteristics

Reference Circuit (cont.)

Electrical Characteristics at 2170 MHz

Transmission Line	Electrical Characteristics	Dimensions: mm	Dimensions: mils
Output			
TL201 (taper)	0.018λ , 5.40Ω / 9.59Ω	$W1 = 17.526$, $W2 = 9.398$, $L = 1.397$	$W1 = 690$, $W2 = 370$, $L = 55$
TL202 (taper)	0.016λ , 9.59Ω / 34.72Ω	$W1 = 9.398$, $W2 = 1.981$, $L = 1.270$	$W1 = 370$, $W2 = 78$, $L = 50$
TL203 (taper)	0.026λ , 3.67Ω / 5.40Ω	$W1 = 26.365$, $W2 = 17.526$, $L = 1.956$	$W1 = 1038$, $W2 = 690$, $L = 77$
TL204		$W1 = 25.400$, $W2 = 26.365$	$W1 = 1000$, $W2 = 1038$
TL205, TL206, TL210, TL211	0.000λ , 144.35Ω	$W = 0.025$, $L = 0.025$	$W = 1$, $L = 1$
TL207	0.064λ , 3.67Ω	$W = 26.365$, $L = 4.801$	$W = 1038$, $L = 189$
TL208	0.050λ , 34.72Ω	$W = 1.981$, $L = 4.115$	$W = 78$, $L = 162$
TL209	0.028λ , 47.12Ω	$W = 1.270$, $L = 2.337$	$W = 50$, $L = 92$
TL212	0.053λ , 47.12Ω	$W = 1.270$, $L = 4.394$	$W = 50$, $L = 173$
TL213	0.016λ , 28.85Ω	$W = 2.540$, $L = 1.270$	$W = 100$, $L = 50$
TL214		$W1 = 17.526$, $W2 = 0.025$, $W3 = 17.526$, $W4 = 0.025$	$W1 = 690$, $W2 = 1$, $W3 = 690$, $W4 = 1$
TL215		$W1 = 9.398$, $W2 = 0.025$, $W3 = 9.398$, $W4 = 0.025$	$W1 = 370$, $W2 = 1$, $W3 = 370$, $W4 = 1$
TL216	0.022λ , 20.93Ω	$W1 = 3.810$, $W2 = 3.810$, $W3 = 1.778$	$W1 = 150$, $W2 = 150$, $W3 = 70$
TL217, TL218	0.048λ , 20.93Ω	$W1 = 3.810$, $W2 = 3.810$, $W3 = 3.810$	$W1 = 150$, $W2 = 150$, $W3 = 150$
TL219, TL220	0.017λ , 20.93Ω	$W = 3.810$, $L = 1.372$	$W = 150$, $L = 54$
TL221	0.008λ , 20.93Ω	$W = 3.810$, $L = 0.635$	$W = 150$, $L = 25$
TL222, TL225, TL228, TL231	0.000λ , 37.51Ω	$W = 1.778$, $L = 0.025$	$W = 70$, $L = 1$
TL223	0.032λ , 20.93Ω	$W = 3.810$, $L = 2.540$	$W = 150$, $L = 100$
TL224	0.008λ , 20.93Ω	$W = 3.810$, $L = 0.635$	$W = 150$, $L = 25$
TL226	0.165λ , 20.93Ω	$W = 3.810$, $L = 13.106$	$W = 150$, $L = 516$
TL227	0.032λ , 20.93Ω	$W = 3.810$, $L = 2.540$	$W = 150$, $L = 100$
TL229, TL230	0.000λ , 20.93Ω	$W = 3.810$, $L = 0.025$	$W = 150$, $L = 1$
TL232	0.024λ , 47.12Ω	$W1 = 1.270$, $W2 = 1.270$, $W3 = 2.032$	$W1 = 50$, $W2 = 50$, $W3 = 80$
TL233, TL234	0.048λ , 20.93Ω	$W1 = 3.810$, $W2 = 3.810$, $W3 = 3.810$	$W1 = 150$, $W2 = 150$, $W3 = 150$
TL235, TL237, TL238	0.022λ , 20.93Ω	$W1 = 3.810$, $W2 = 3.810$, $W3 = 1.778$	$W1 = 150$, $W2 = 150$, $W3 = 70$
TL236, TL239	0.018λ , 20.93Ω	$W = 3.810$, $L = 1.397$	$W = 150$, $L = 55$
TL240	0.165λ , 20.93Ω	$W = 3.810$, $L = 13.106$	$W = 150$, $L = 516$
TL241	0.006λ , 20.93Ω	$W = 3.810$, $L = 0.508$	$W = 150$, $L = 20$
TL242, TL245	0.026λ , 20.93Ω	$W1 = 3.810$, $W2 = 3.810$, $W3 = 2.032$	$W1 = 150$, $W2 = 150$, $W3 = 80$
TL243, TL246, TL247	0.000λ , 34.08Ω	$W = 2.032$, $L = 0.025$	$W = 80$, $L = 1$
TL244	0.006λ , 20.93Ω	$W = 3.810$, $L = 0.508$	$W = 150$, $L = 20$
TL248		$W1 = 2.540$, $W2 = 1.270$	$W1 = 100$, $W2 = 50$

Reference Circuit (cont.)

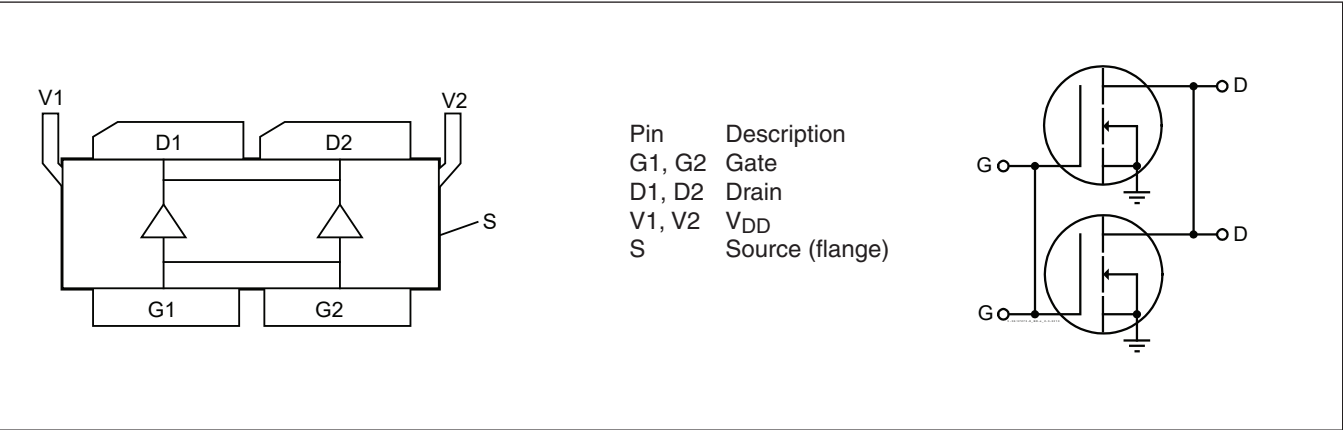


*Gerber Files for this circuit available on request

Reference Circuit (cont.)**Circuit Assembly Information**

Component	Description	Suggested Manufacturer	P/N
Input			
C101, C108, C111	Chip capacitor, 0.1 μ F	Digi-Key	PCC104BTR-ND
C102, C112	Chip capacitor, 4.7 μ F	Digi-Key	493-2372-2-ND
C103	Chip capacitor, 8.2 pF	ATC	ATC100B8R2BW500XB
C104	Chip capacitor, 0.7 pF	ATC	ATC100A0R7BW150XB
C105, C106	Chip capacitor, 10 pF	ATC	ATC100B100FW500XB
C107	Capacitor, 10 μ F	Digi-Key	399-1655-2-ND
C109, C110	Chip capacitor, 10 pF	ATC	ATC100A100FW150XB
C113, C114	Chip capacitor, 0.6 pF	ATC	ATC100B0R6BW500XB
C801, C802, C803	Chip capacitor, 1000 pF	Digi-Key	PCC1772CT-ND
R101, R102	Resistor, 0 Ω	Digi-Key	P0.0ECT-ND
R103, R106, R107, R801, R803	Resistor, 10 Ω	Digi-Key	P10ECT-ND
R104, R105	Resistor, 0 Ω	Digi-Key	P0.0GCT-ND
R802	Resistor, 1200 Ω	Digi-Key	P1.2KECT-ND
R804	Resistor, 1300 Ω	Digi-Key	P1.3KGCT-ND
R805	Resistor, 100 Ω	Digi-Key	P100ECT-ND
S1	Potentiometer, 2k Ω	Digi-Key	3224W-202ECT-ND
S2	Transistor	Digi-Key	BCP56
S3	Voltage Regulator	Digi-Key	LM7805
Output			
C201	Chip capacitor, 8.2 pF	ATC	ATC100B8R2BW500XB
C202, C203	Capacitor, 10 μ F	Digi-Key	399-1655-2-ND
C204, C207	Chip capacitor, 1 μ F	Digi-Key	445-1411-2-ND
C205, C206	Chip capacitor, 2.2 μ F	Digi-Key	445-1447-2-ND
C208	Chip capacitor, 0.4 pF	ATC	ATC100B0R4BW500XB
C209, C210, C211, C212	Chip capacitor, 1.2 pF	ATC	ATC100A1R2BW150XB
C213, C214	Capacitor, 10 μ F	Digi-Key	587-1818-2-ND

Pinout Diagram



See next page for package outline specifications

Revision History

Revision	Date	Data Sheet Type	Page	Subjects (major changes at each revision)
05.3	2016-06-15	Production	2	Updated ordering information
06	2018-06-29	Production	All	Converted to Wolfspeed Data Sheet

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Notes

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