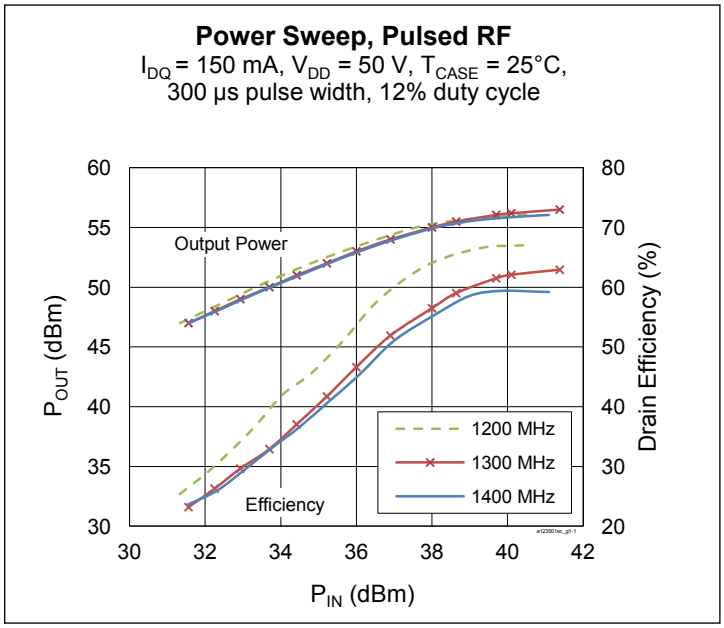
PTVA123501EC/FC

Thermally-Enhanced High Power RF LDMOS FETs
350 W, 50 V, 1200 – 1400 MHz

Description

The PTVA123501EC and PTVA123501FC LDMOS FETs are designed for use in power amplifier applications in the 1200 MHz to 1400 MHz frequency band. Features include high gain and thermally-enhanced package with slotted and earless flanges. Manufactured with an advanced LDMOS process, these devices provide excellent thermal performance and superior reliability.



PTVA123501EC
Package H-36248-2

PTVA123501FC
Package H-37248-2

Features

- Broadband internal input and output matching
- High gain and efficiency
- Integrated ESD protection
- Human Body Model Class 2 (per ANSI/ESDA/JEDEC JS-001)
- Low thermal resistance
- Excellent ruggedness
- Pb-free and RoHS compliant
- Capable of withstanding a 10:1 load mismatch (all phase angles) at 55.5 dBm under pulsed conditions: 300 μs pulse width, 12% duty cycle, V_{DD} = 50 V

RF Characteristics

Pulsed RF Performance (tested in the test fixture)

V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{OUT} = 350 W, f_1 = 1200 MHz, f_2 = 1300 MHz, f_3 = 1400 MHz, 300 μs pulse width, 12% duty cycle

Characteristic	Symbol	Min	Typ	Max	Unit
Gain	G_{ps}	16.5	17	—	dB
Drain Efficiency	η_D	54	55	—	%
Return Loss	IRL	—	–12	–9	dB

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

ESD: Electrostatic discharge sensitive device—observe handling precautions!

Rev. 06, 2018-06-19

RF Characteristics

Typical RF Performance (not subject to production test, verified by design/characterization in the test fixture)
V_{DD} = 50 V, I_{DQ} = 150 mA, Input signal (t_r = 5 ns, t_f = 6.5 ns), 300 μs pulse width, 12% duty cycle, class AB test

Mode of Operation	f (MHz)	IRL (dB)	P_{1dB}			P_{3dB}			Max $P_{droop\ (pulse)}$ dB @ 350 W	$t_{r\ (ns)}$ @ 350 W	$t_{f\ (ns)}$ @ 350 W
			Gain (dB)	Eff (%)	P_{OUT} (W)	Gain (dB)	Eff (%)	P_{OUT} (W)			
Pulsed RF	1200	–14	16.2	59	375	14.2	59	415	0.10	4	5<
Pulsed RF	1300	–14	16.0	59	390	14.0	59	435	0.15	4	5<
Pulsed RF	1400	–12	15.8	56	375	13.8	57	415	0.15	4	5<

Typical RF Performance (not subject to production test, verified by design/characterization in the test fixture)
V_{DD} = 50 V, I_{DQ} = 150 mA, 30 ms pulse width, 30% duty cycle, class AB test

Mode of Operation	f (MHz)	P_{1dB}			P_{3dB}			$P_{droop\ (pulse)}$ dB @ 300 W
		Gain (dB)	Eff (%)	P_{OUT} (W)	Gain (dB)	Eff (%)	P_{OUT} (W)	
Pulsed RF	1200	16	47	316	14	48	350	0.23
Pulsed RF	1300	16	47	324	14	48	355	0.25
Pulsed RF	1400	15.5	45	315	13.5	47	355	0.29

DC Characteristics

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_{DS} = 10 mA	$V_{(BR)DSS}$	105	—	—	V
Drain Leakage Current	V_{DS} = 50 V, V_{GS} = 0 V	I_{DSS}	—	—	1.0	μA
	V_{DS} = 105 V, V_{GS} = 0 V	I_{DSS}	—	—	10.0	μA
On-State Resistance	V_{GS} = 10 V, V_{DS} = 0.1 V	$R_{DS(on)}$	—	0.1	—	Ω
Operating Gate Voltage	V_{DS} = 50 V, I_{DQ} = 150 mA	V_{GS}	3	3.35	4	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}	105	V
Gate-Source Voltage	V_{GS}	–6 to +12	V
Operating Voltage	V_{DD}	0 to +55	V
Junction Temperature	T_J	225	°C
Storage Temperature Range	T_{STG}	–65 to +150	°C
Thermal Resistance (T_{CASE} = 70°C, 300 W CW)	$R_{\theta JC}$	0.34	°C/W

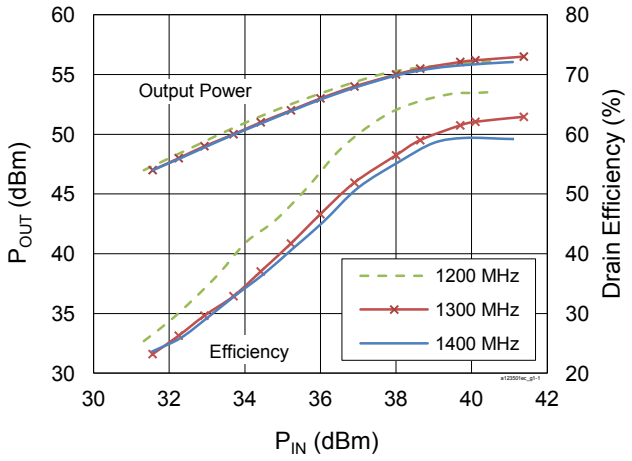
Ordering Information

Type and Version	Order Code	Package Description	Shipping
PTVA123501EC V2 R0	PTVA123501EC-V2-R0	H-36248-2, bolt-down	Tape & Reel, 50 pcs
PTVA123501EC V2 R250	PTVA123501EC-V2-R250	H-36248-2, bolt-down	Tape & Reel, 250 pcs
PTVA123501FC V1 R0	PTVA123501FC-V1-R0	H-37248-2, earless	Tape & Reel, 50 pcs
PTVA123501FC V1 R250	PTVA123501FC-V1-R250	H-37248-2, earless	Tape & Reel, 250 pcs

See next page for Typical RF Performance

Typical RF Performance (data taken in production test fixture)

Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
300 µs pulse width, 12% duty cycle



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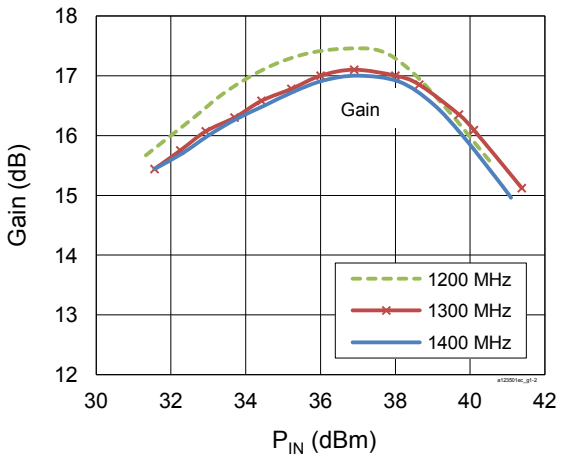
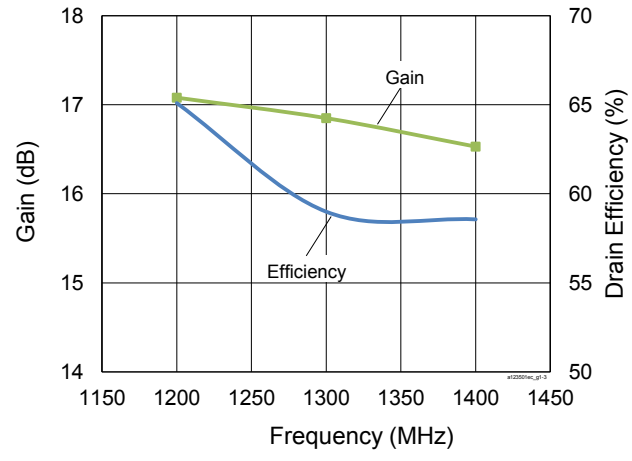


Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 350 W,
300 µs pulse width, 12% duty cycle



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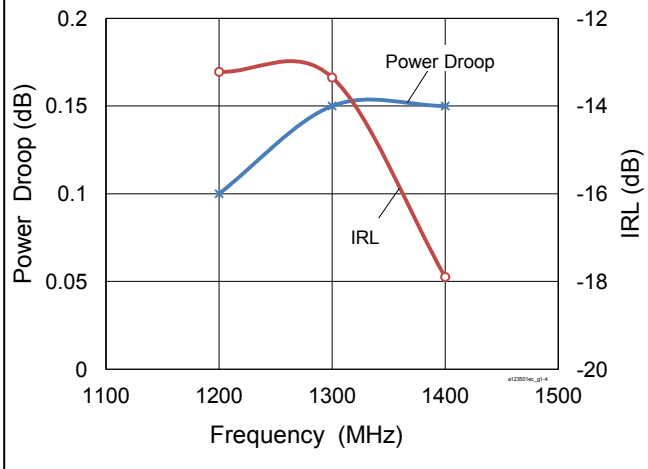
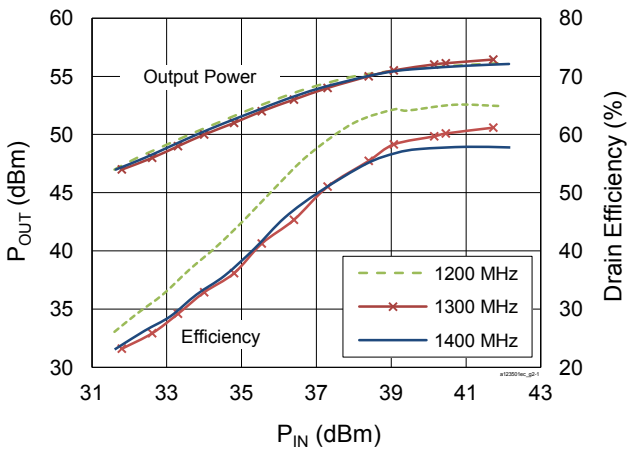
300 µs pulse width, 12% duty cycle

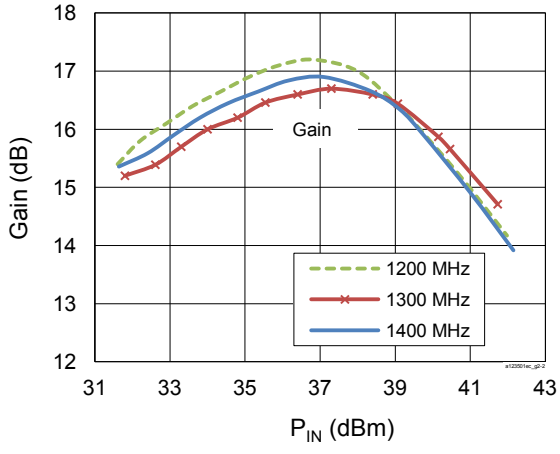


Typical RF Performance (cont.)

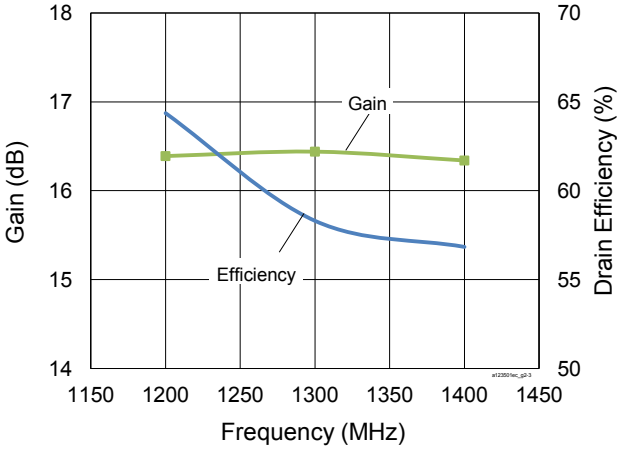
Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
2 ms pulse width, 10% duty cycle



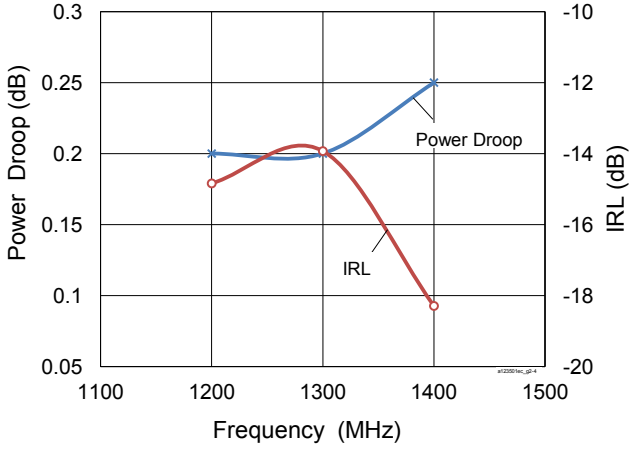
Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
2 ms pulse width, 10% duty cycle



Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 350 W,
2 ms pulse width, 10% duty cycle

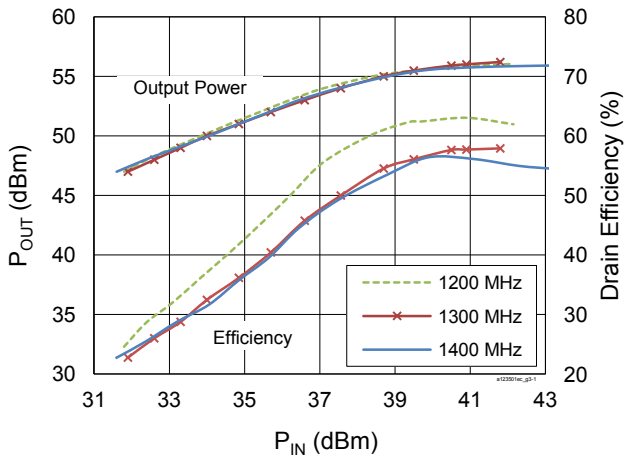


Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 350 W,
2 ms pulse width, 10% duty cycle

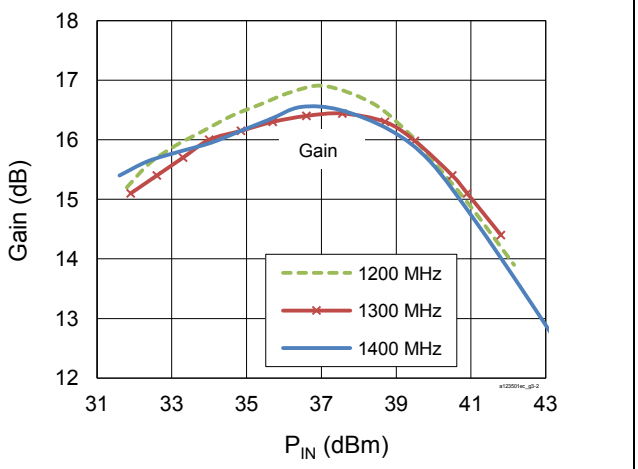


Typical RF Performance (cont.)

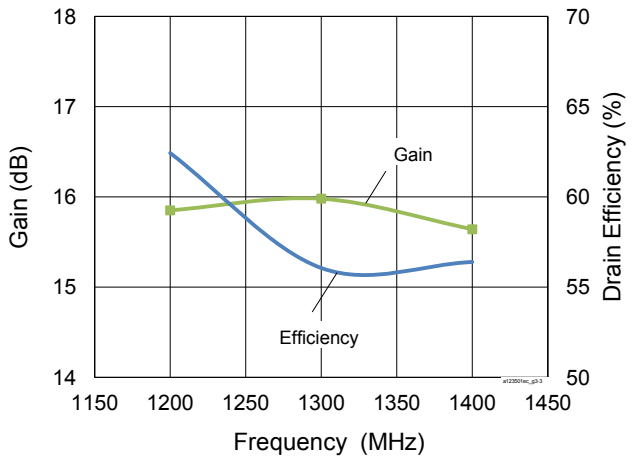
Power Sweep, Pulsed RF
I_{DQ} = 150 mA,V_{DD} = 50 V, T_{CASE} = 25°C,
16 ms pulse width, 20% duty cycle



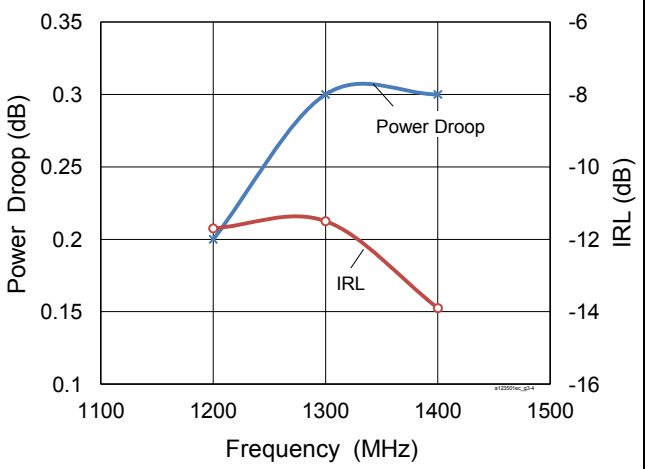
Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
16 ms pulse width, 20% duty cycle



Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 350 W,
16 ms pulse width, 20% duty cycle

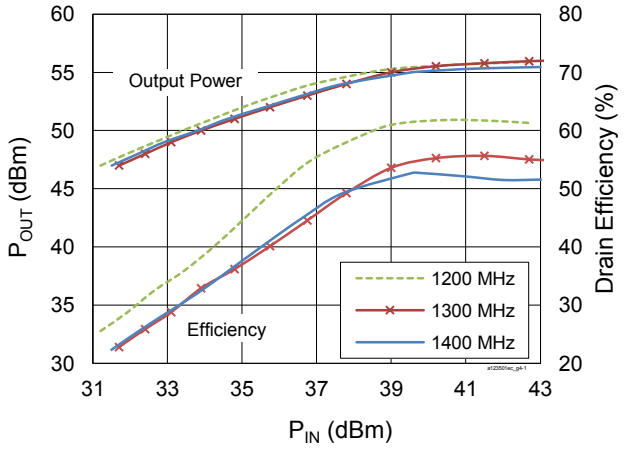


Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 350 W,
16 ms pulse width, 20% duty cycle

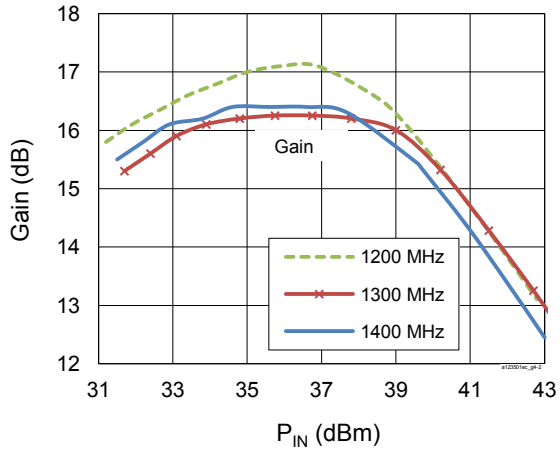


Typical RF Performance (cont.)

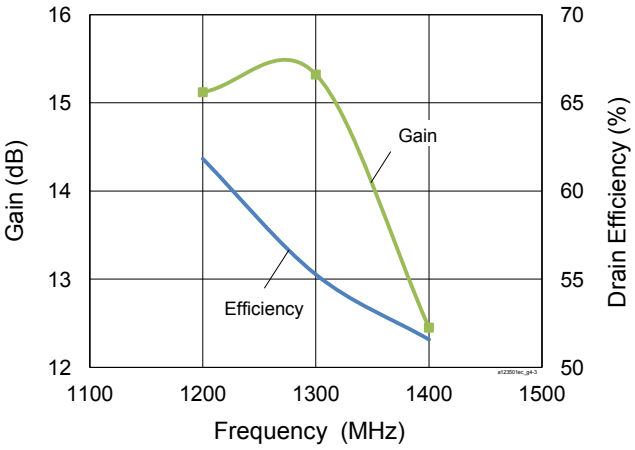
Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
16 ms pulse width, 50% duty cycle



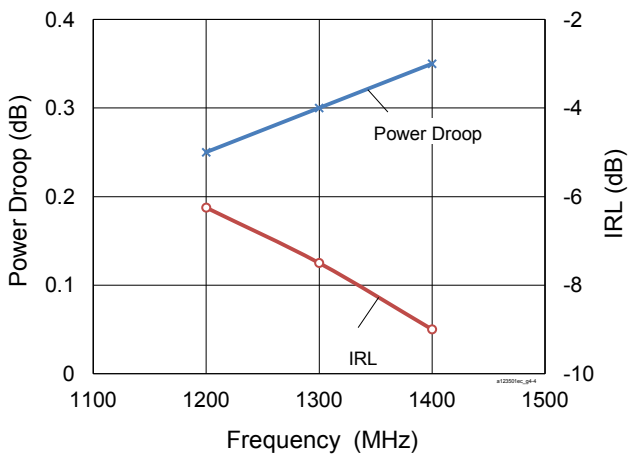
Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
16 ms pulse width, 50% duty cycle



Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 350 W,
16 ms pulse width, 50% duty cycle

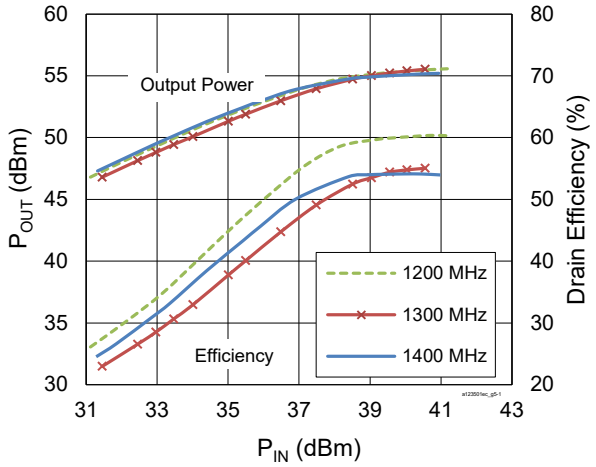


Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 350 W,
16 ms pulse width, 50% duty cycle

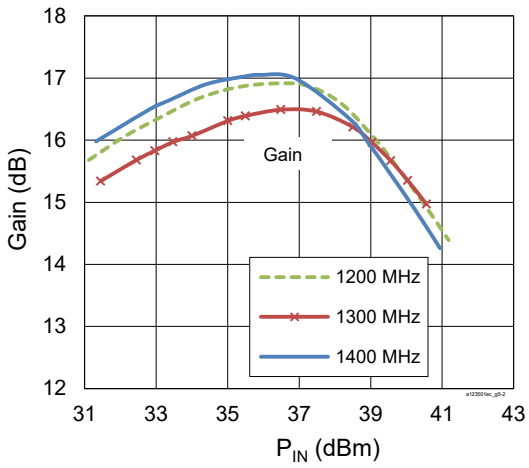


Typical RF Performance (cont.)

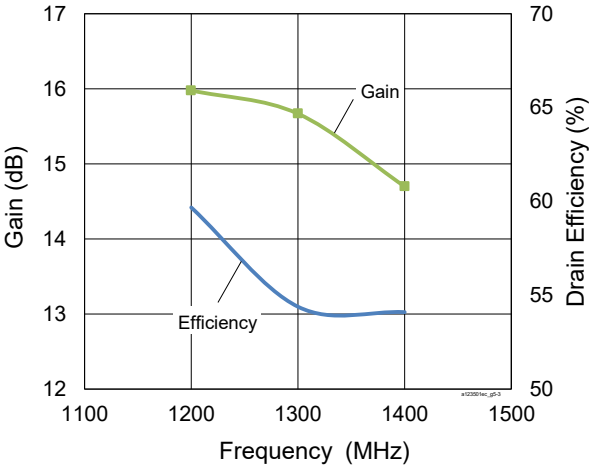
Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
22 ms pulse width, 50% duty cycle



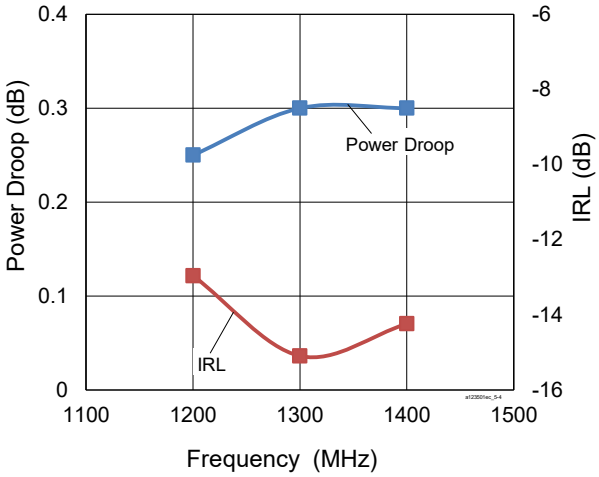
Power Sweep, Pulsed RF
I_{DQ} = 150 mA, V_{DD} = 50 V, T_{CASE} = 25°C,
22 ms pulse width, 50% duty cycle



Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 330 W,
22 ms pulse width, 50% duty cycle

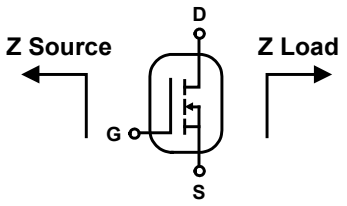


Pulsed RF Performance
I_{DQ} = 150 mA, V_{DD} = 50 V, P_{OUT} = 330 W,
22 ms pulse width, 50% duty cycle



Broadband Circuit Impedance

Freq [MHz]	Z Source Ω		Z Load Ω	
	R	jX	R	jX
1200	1.25	–1.99	1.96	–2.23
1300	1.54	–1.52	1.59	–2.03
1400	1.66	–1.58	1.26	–1.75



Load Pull Performance

Load Pull at Max P_{OUT} Point – 16 µs pulse width, 10% duty cycle, class AB, V_{DD} = 50 V, 150 mA

Freq [MHz]	ZI [Ω]	P_{IN} [dBm]	P_{OUT} [dBm]	P_{OUT} [W]	P_G [dB]	PAE Eff [%]	Z_{OUT} [Ω]
1200	1.91 – j2.04	41.40	56.40	436.52	15	53.80	1.30 – j2.03
1300	2.72 – j3.13	42.24	56.54	450.82	14.30	54.48	1.25 – j1.94
1400	4.83 – j1.46	41.66	56.31	427.56	14.65	53.27	1.03 – j1.94

Load Pull at Max G_T Point – 16 µs pulse width, 10% duty cycle, class AB, V_{DD} = 50 V, 150 mA

Freq [MHz]	ZI [Ω]	P_{IN} [dBm]	P_{OUT} [dBm]	P_{OUT} [W]	P_G [dB]	PAE Eff [%]	Z_{OUT} [Ω]
1200	1.91 – j2.04	38.10	54.72	296.48	16.62	57.89	3.03 – j3.11
1300	2.72 – j3.13	38.84	54.83	304.09	15.99	62.54	3.22 – j1.63
1400	4.83 – j1.46	37.21	53.42	219.79	16.21	57.25	2.30 – j0.09

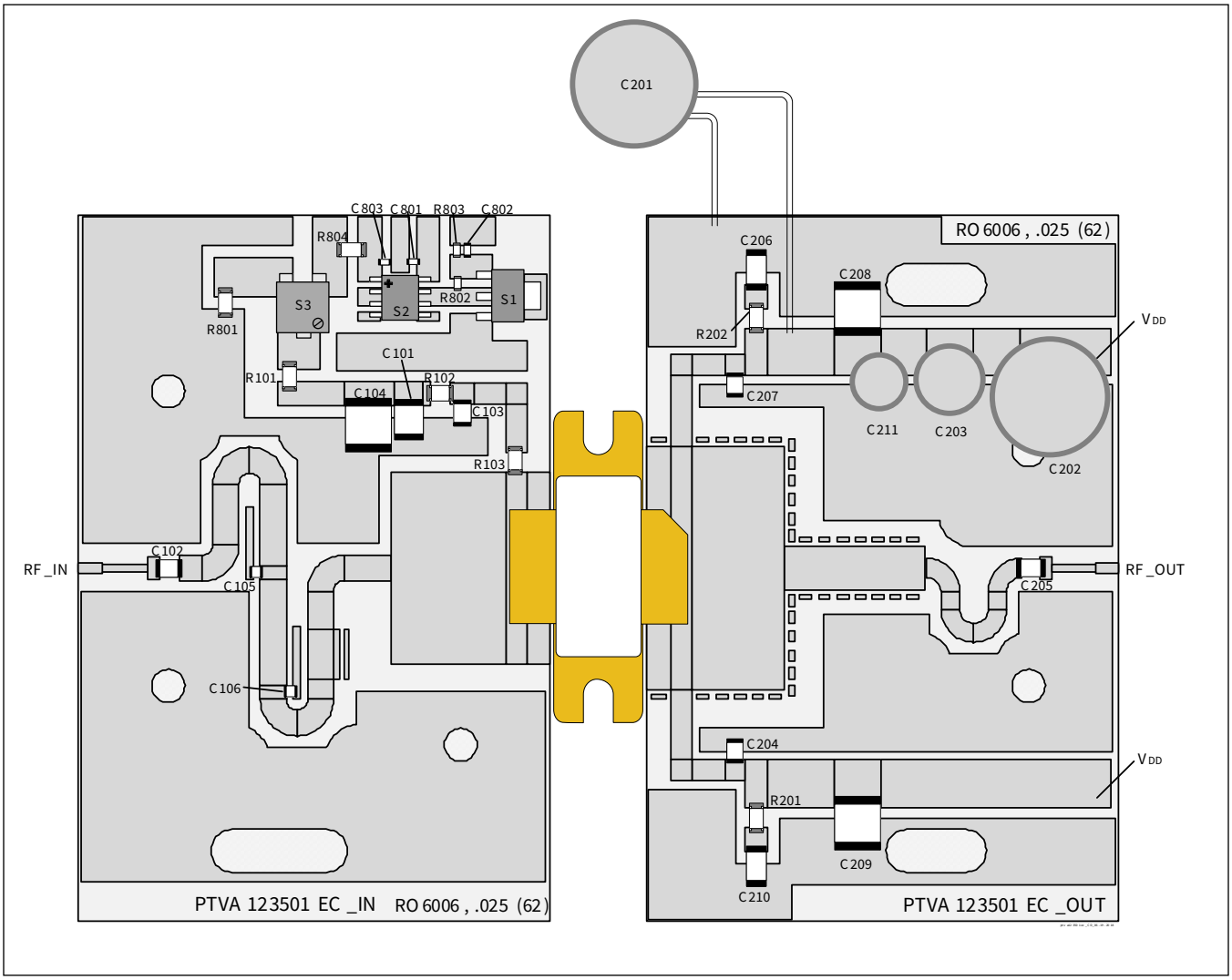
Load Pull at Max Efficiency Point – 16 µs pulse width, 10% duty cycle, class AB, V_{DD} = 50 V, 150 mA

Freq [MHz]	ZI [Ω]	P_{IN} [dBm]	P_{OUT} [dBm]	P_{OUT} [W]	P_G [dB]	PAE Eff [%]	Z_{OUT} [Ω]
1200	1.91 – j2.04	39.60	55.80	380.19	16.20	60.71	2.22 – j2.43
1300	2.72 – j3.13	39.44	55.23	333.43	15.79	63.71	2.81 – j1.90
1400	4.83 – j1.46	39.39	55.19	330.37	15.80	62.26	2.40 – j1.45

Z Optimum – 16 µs pulse width, 10% duty cycle, class AB, V_{DD} = 50 V, 150 mA

Freq [MHz]	ZI [Ω]	P_{IN} [dBm]	P_{OUT} [dBm]	P_{OUT} [W]	P_G [dB]	PAE Eff [%]	Z_{OUT} [Ω]
1200	1.91 – j2.04	39.18	55.58	361.41	16.4	60.5	2.41 – j2.50
1300	2.72 – j3.13	39.50	55.30	338.84	15.8	62.6	2.73 – j1.51
1400	4.83 – j1.46	40	55.60	363.08	15.6	60.7	1.86 – j1.37

Reference Circuit



*Reference circuit assembly diagram (not to scale)**

Reference Circuit (cont.)

Reference Circuit Assembly

DUT	PTVA123501EC or PTVA123501FC
Test Fixture Part No.	LTN/PTVA123501EC V2 or LTN/PTVA123501FC V1
PCB	Rogers 6006, 0.635 mm [0.025"] thick, 2 oz. copper, $\varepsilon_r = 6.15$

Components Information

Component	Description	Suggested Manufacturer	P/N
Input			
C101	Capacitor, 1 µF	TDK Corporation	C4532X7R2A105M230KA
C102, C103	Capacitor, 39 pF	ATC	ATC100B390KW500XB
C104	Capacitor, 10 µF	TDK Corporation	C5750X5R1H106K230KA
C105	Capacitor, 3 pF	ATC	ATC100A3R0CW150XB
C106	Capacitor, 0.5 pF	ATC	ATC100A0R5CW150XB
C801, C802, C803	Capacitor, 1000 pF	Panasonic Electronic Components	ECJ-1VB1H102K
R101	Resistor, 1000 Ω	Panasonic Electronic Components	ERJ-8GEYJ102V
R102	Resistor, 5600 Ω	Panasonic Electronic Components	ERJ-8GEYJ562V
R103, R804	Resistor, 10 Ω	Panasonic Electronic Components	ERJ-8GEYJ100V
R801	Resistor, 2000 Ω	Panasonic Electronic Components	ERJ-8GEYJ202V
R802	Resistor, 1200 Ω	Panasonic Electronic Components	ERJ-3GEYJ122V
R803	Resistor, 1300 Ω	Panasonic Electronic Components	ERJ-3GEYJ132V
S1	Transistor	Infineon Technologies	BCP56
S2	Voltage Regulator	Texas Instruments	LM7805
S3	Potentiometer, 2k Ω	Bourns Inc.	3224W-1-202E
Output			
C201	Capacitor, 6800 µF	Panasonic Electronic Components	ECO-S2AP682EA
C202	Capacitor, 100 µF	Cornell Dubilier Electronics (CDE)	SK101M100ST
C203	Capacitor, 22 µF	Cornell Dubilier Electronics (CDE)	SEK220M100ST
C204, C205, C207	Capacitor, 39 pF	ATC	ATC100B390KW500XB
C206, C210	Capacitor, 1 µF	TDK Corporation	C4532X7R2A105M230KA
C208, C209	Capacitor, 10 µF	TDK Corporation	C5750X5R1H106K230KA
C211	Capacitor, 10 µF	Panasonic Electronic Components	EEV-HD1H100P
R201, R202	Resistor, 5600 Ω	Panasonic Electronic Components	ERJ-8GEYJ562V

Package Outline Specifications

Package H-36248-2

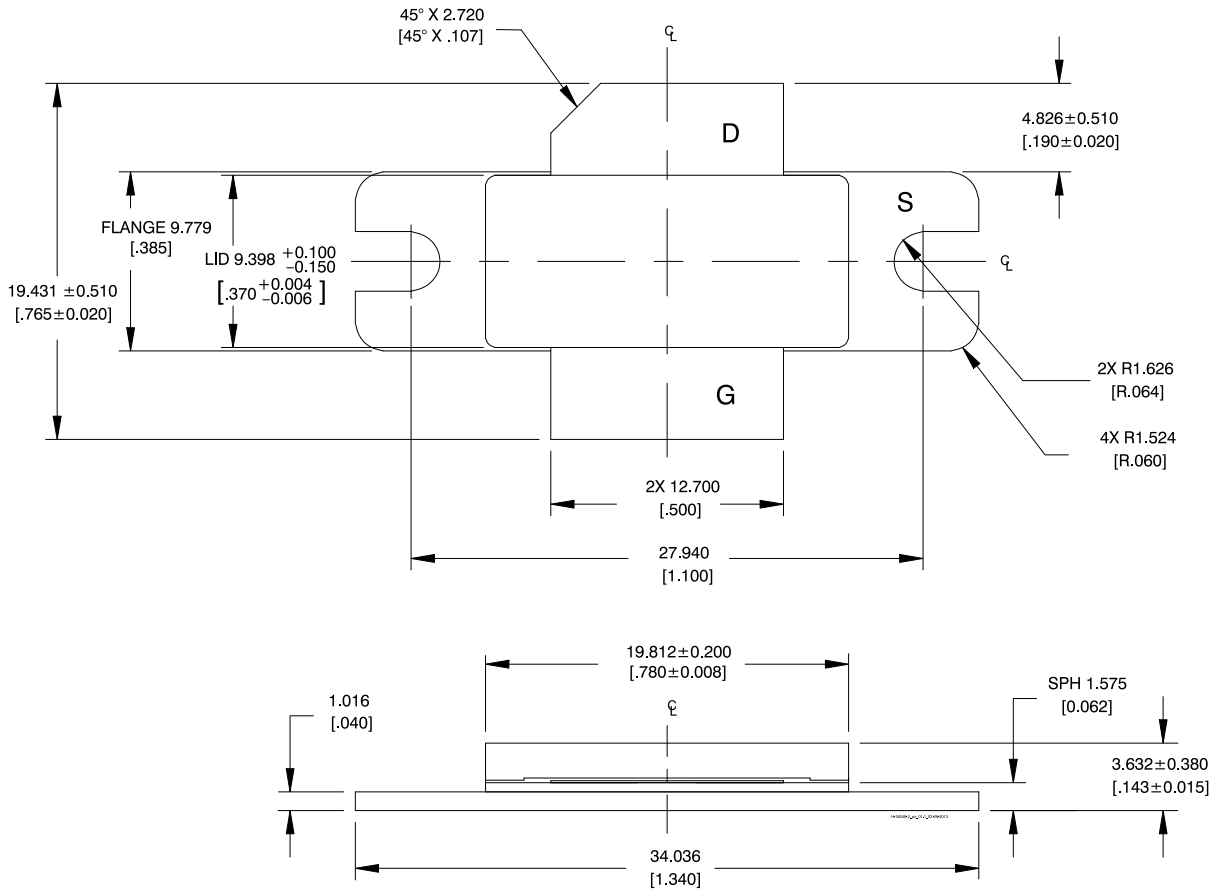
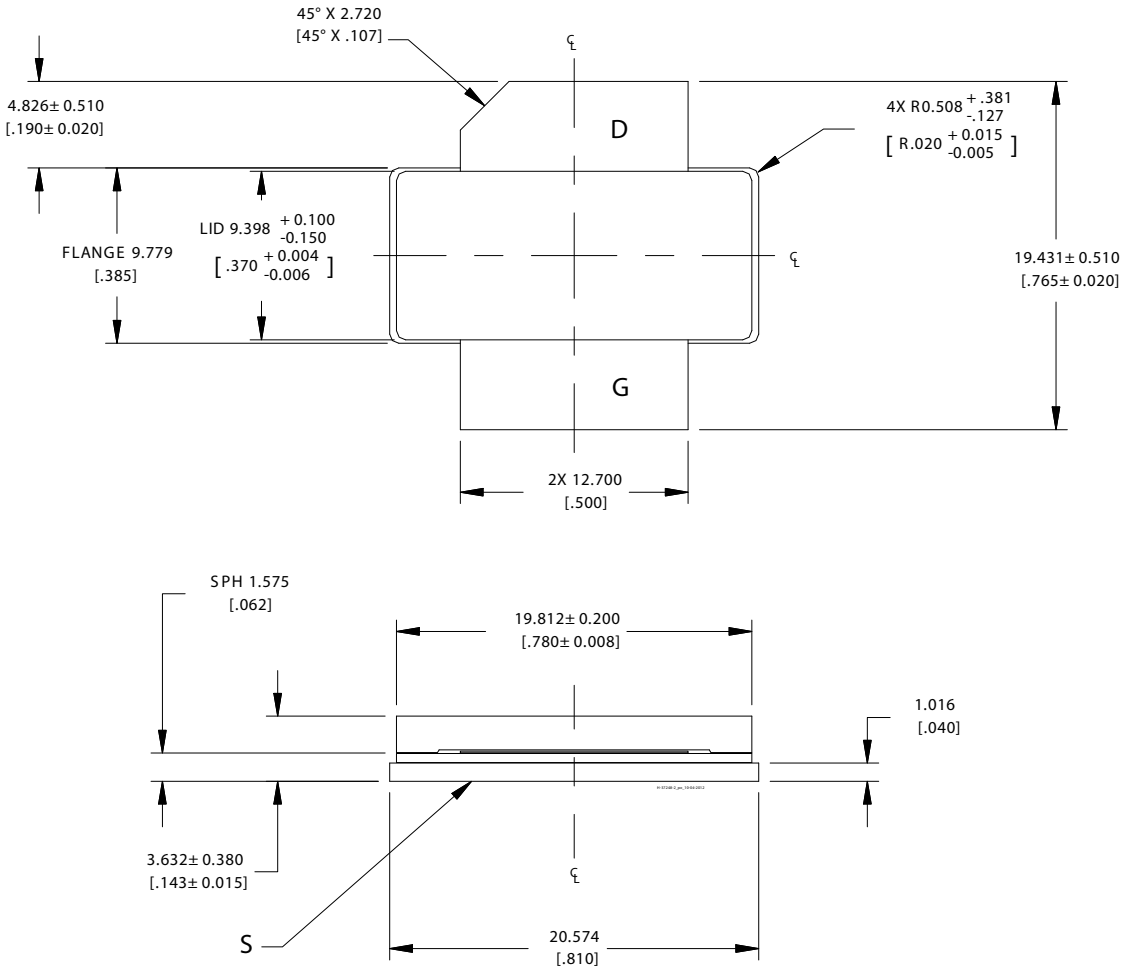


Diagram Notes—unless otherwise specified:

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 mm [.004 +0.002/-0.001 inch].
6. Gold plating thickness: 1.14 ± 0.38 micron [45 ± 15 microinch].

Package Outline Specifications (cont.)

Package H-37248-2



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Revision History

Revision	Date	Data Sheet Type	Page	Subjects (major changes since last revision)
01	2012-06-05	Preliminary	All	Data Sheet reflects preliminary specification
02	2013-03-06	Production	All	Data Sheet reflects released product specification
03	2013-07-11	Production	All 1, 9, 12	Updated to include FC version Revised Pulsed RF performance table, Minor cosmetic changes only, Added package outline
04	2014-04-29	Production	All, 1	Revised product from V1 to V2, Revised target RF Charateristics table
04.1	2014-06-26	Production	All 3	Corrected FC version to V1 throughout Corrected package to H-36248-2 and H-37248-2 in ordering table
05	2015-07-07	Production	8	Added typical performance at 22ms, 50% pulse
05.1	2016-04-26	Production	1, 3	Added ESD rating, updated ordering information
05.2	2016-02-07	Production	2	Updated operating voltage and junction temperature
06	2018-06-19	Production	All	Converted to the Data Sheet

Notes & Disclaimer

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