

# PTVA123501EC/FC

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

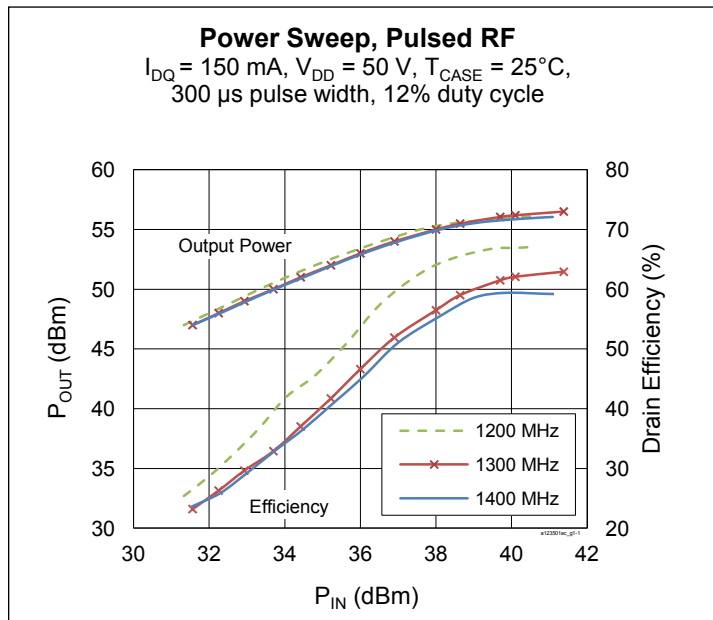
### Description

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  $\mu\text{s}$  pulse width, 12% duty cycle,  $V_{DD} = 50 \text{ V}$

### RF Characteristics

#### Pulsed RF Performance (tested in the test fixture)

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

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

All published data at  $T_{CASE} = 25^\circ\text{C}$  unless otherwise indicated

ESD: Electrostatic discharge sensitive device—observe handling precautions!

## RF Characteristics

**Typical RF Performance** (not subject to production test, verified by design/characterization in the test fixture)

$V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 150\text{ mA}$ , Input signal ( $t_r = 5\text{ ns}$ ,  $t_f = 6.5\text{ ns}$ ),  $300\text{ }\mu\text{s}$  pulse width, 12% duty cycle, class AB test

Mode of Operation	$f$ (MHz)	IRL (dB)	P <sub>1dB</sub>			P <sub>3dB</sub>			Max P <sub>droop</sub> (pulse) dB @ 350 W	$t_r$ (ns) @ 350 W	$t_f$ (ns) @ 350 W
			Gain (dB)	Eff (%)	P <sub>OUT</sub> (W)	Gain (dB)	Eff (%)	P <sub>OUT</sub> (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)

$V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 150\text{ mA}$ , 30 ms pulse width, 30% duty cycle, class AB test

Mode of Operation	$f$ (MHz)	P <sub>1dB</sub>			P <sub>3dB</sub>			P <sub>droop</sub> (pulse) dB @ 300 W
		Gain (dB)	Eff (%)	P <sub>OUT</sub> (W)	Gain (dB)	Eff (%)	P <sub>OUT</sub> (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	$V_{GS} = 0\text{ V}$ , $I_{DS} = 10\text{ mA}$	$V_{(BR)DSS}$	105	—	—	V
Drain Leakage Current	$V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$	$I_{DSS}$	—	—	1.0	$\mu\text{A}$
	$V_{DS} = 105\text{ V}$ , $V_{GS} = 0\text{ V}$	$I_{DSS}$	—	—	10.0	$\mu\text{A}$
On-State Resistance	$V_{GS} = 10\text{ V}$ , $V_{DS} = 0.1\text{ V}$	$R_{DS(on)}$	—	0.1	—	$\Omega$
Operating Gate Voltage	$V_{DS} = 50\text{ V}$ , $I_{DQ} = 150\text{ mA}$	$V_{GS}$	3	3.35	4	V
Gate Leakage Current	$V_{GS} = 10\text{ V}$ , $V_{DS} = 0\text{ V}$	$I_{GSS}$	—	—	1.0	$\mu\text{A}$

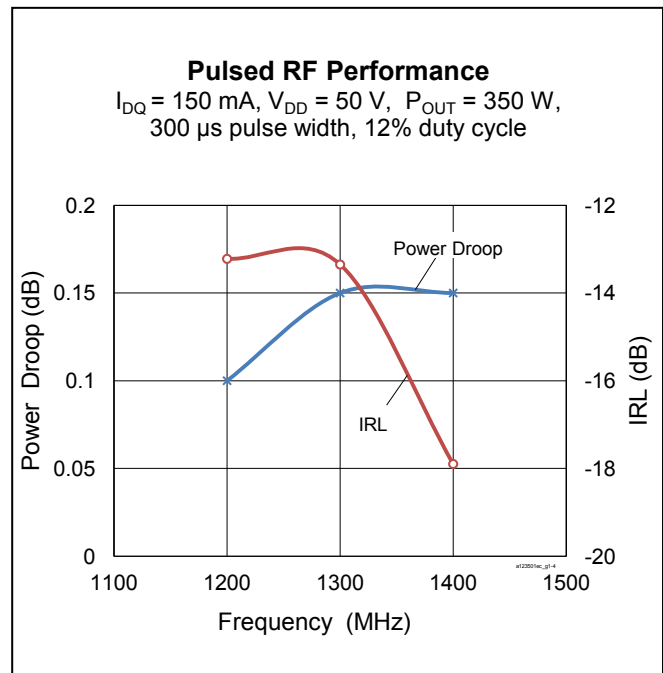
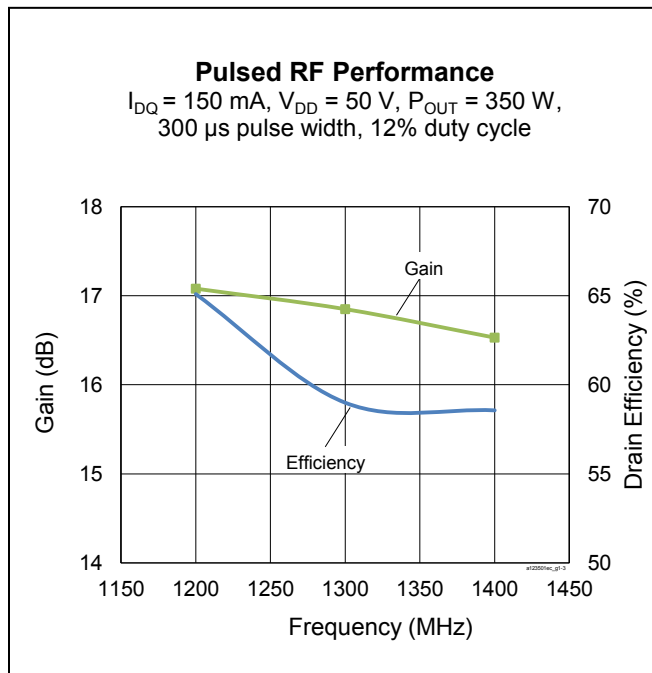
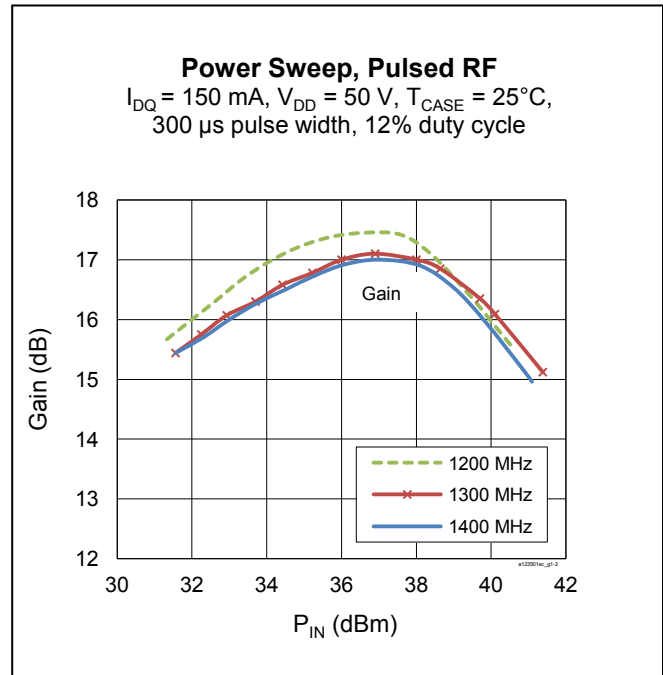
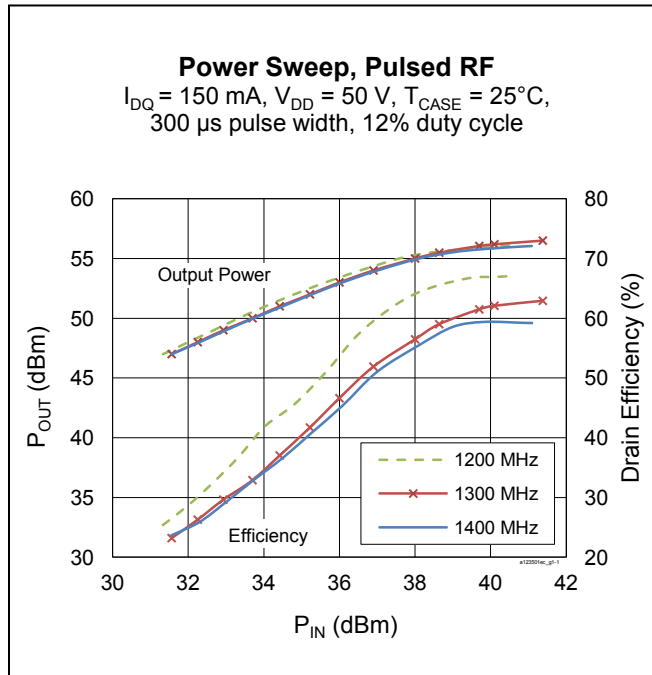
## Maximum Ratings

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	$^{\circ}\text{C}$
Storage Temperature Range	$T_{STG}$	-65 to +150	$^{\circ}\text{C}$
Thermal Resistance ( $T_{CASE} = 70^{\circ}\text{C}$ , 300 W CW)	$R_{\theta JC}$	0.34	$^{\circ}\text{C/W}$

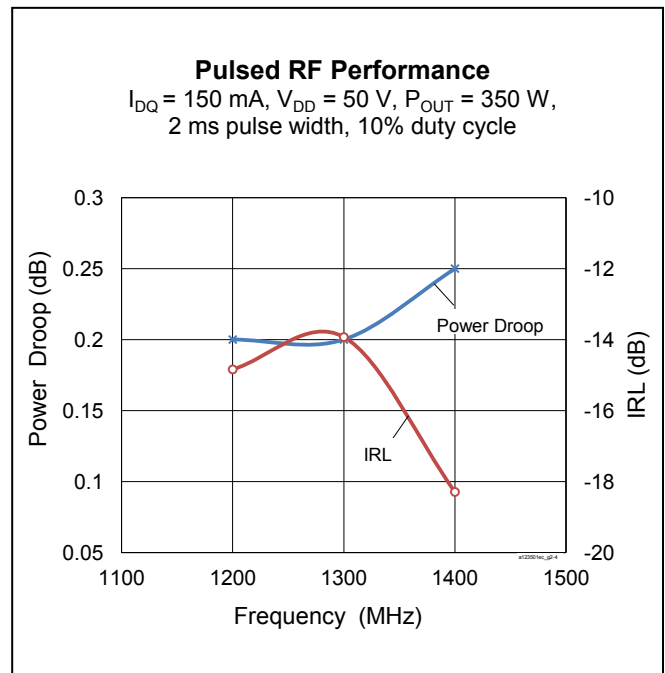
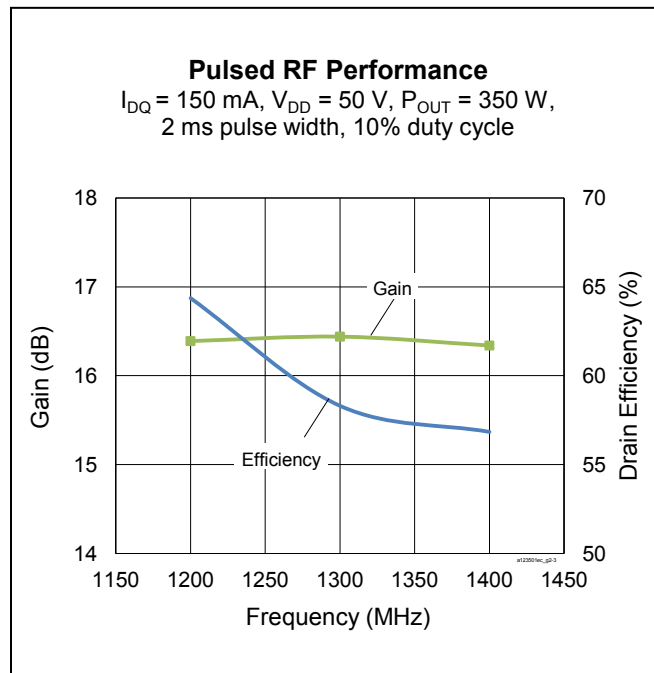
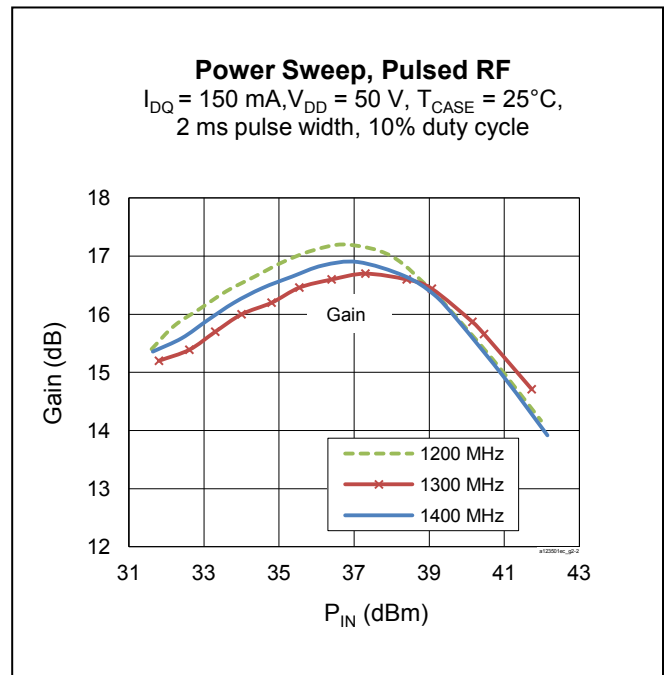
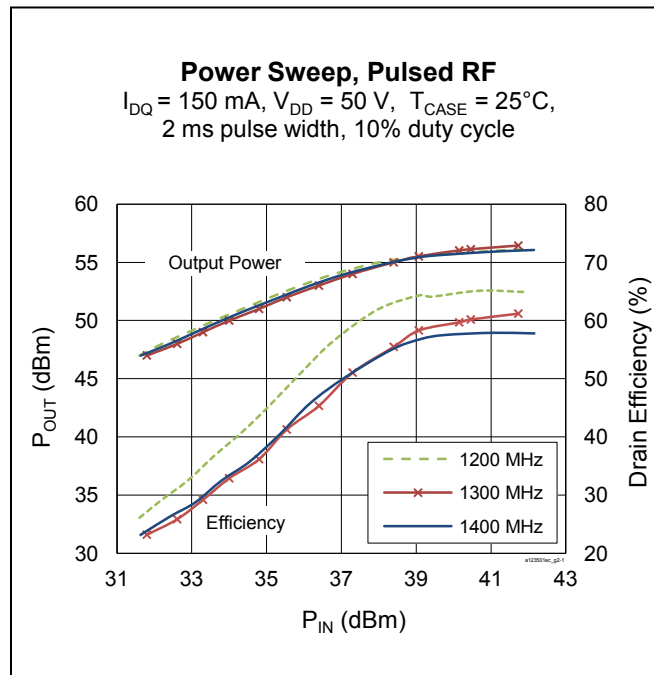
## Ordering Information

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

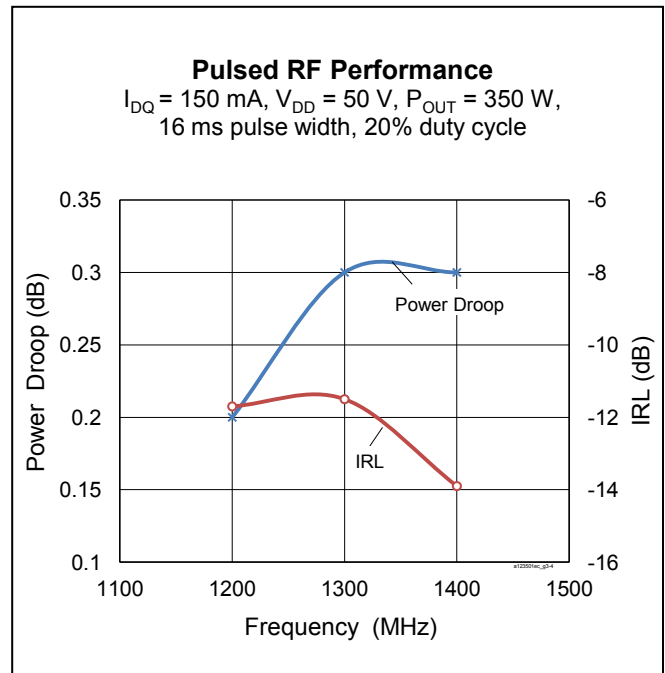
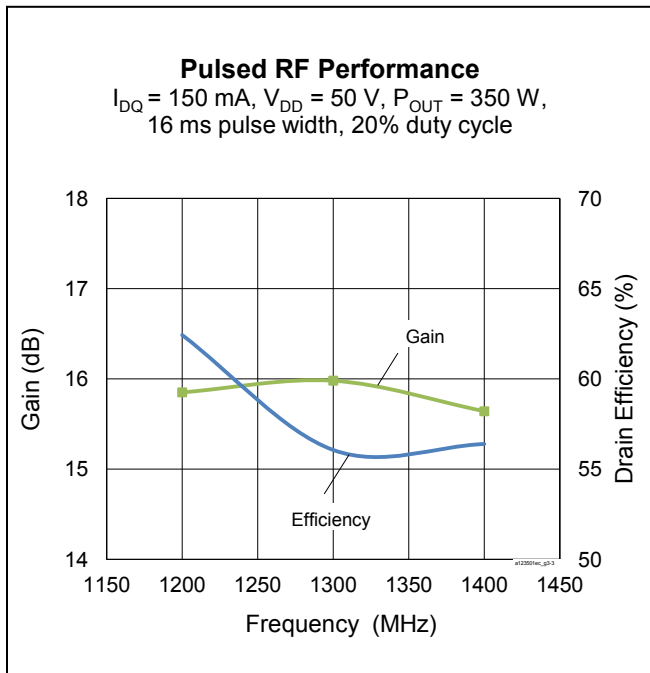
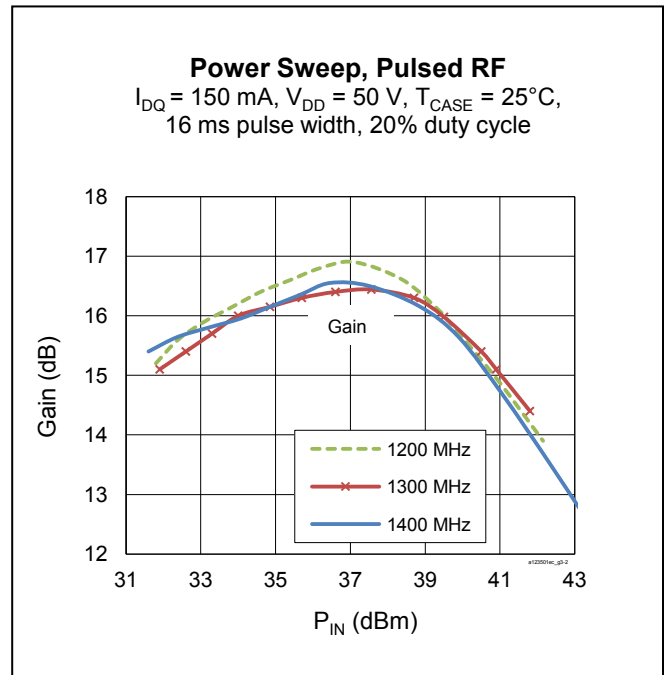
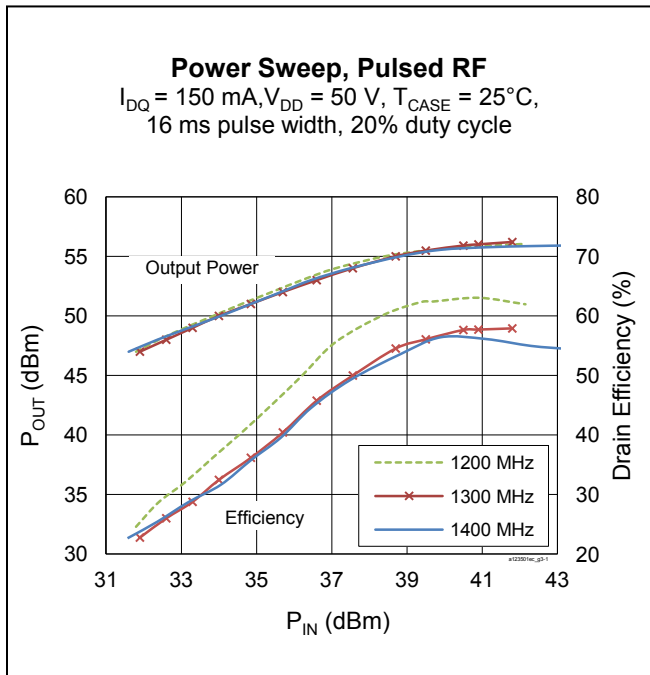
**See next page for Typical RF Performance**

**Typical RF Performance** (data taken in production test fixture)


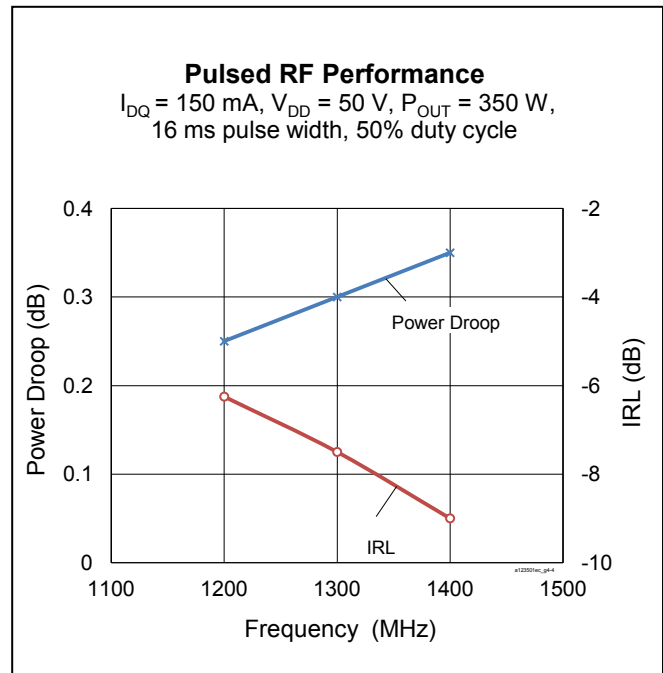
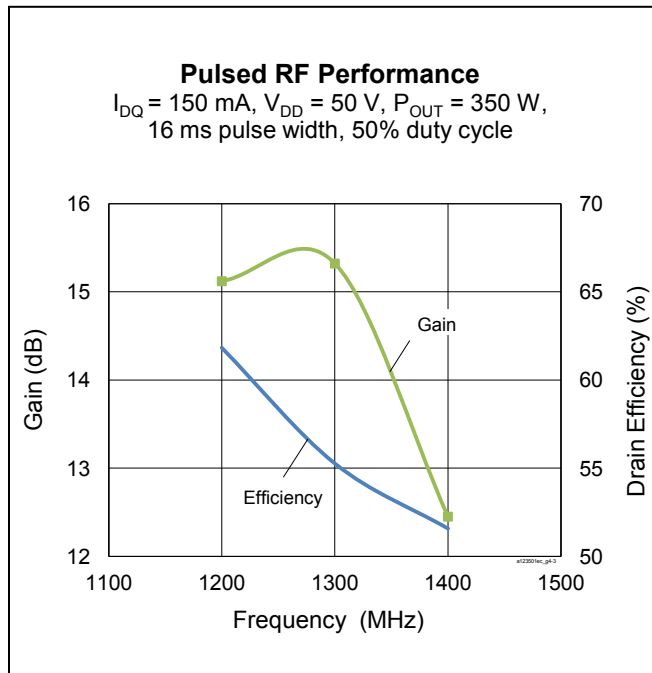
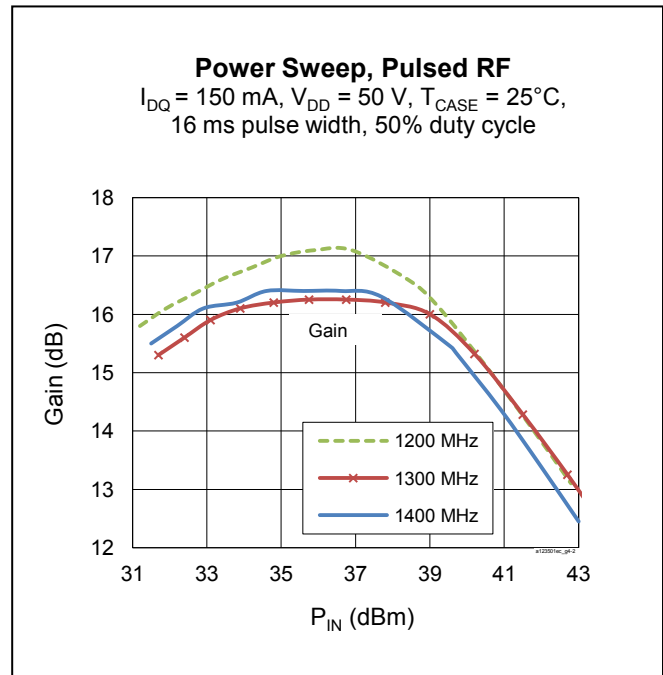
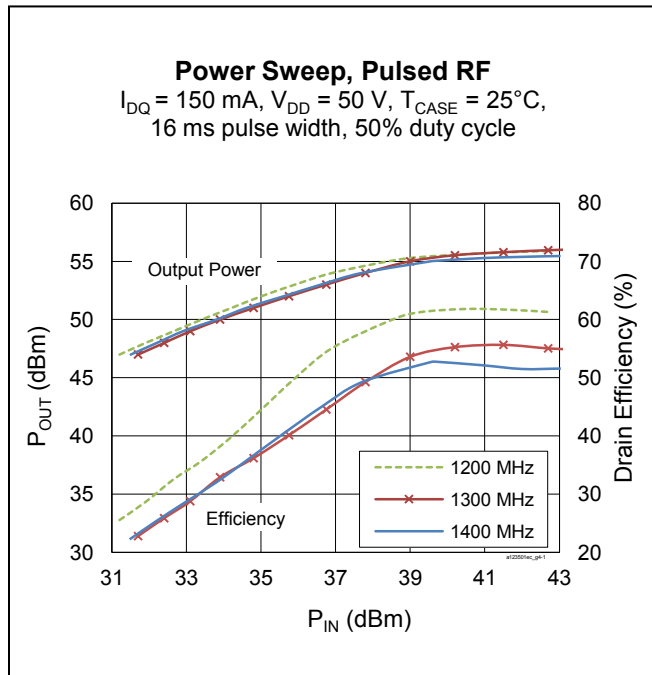
# Typical RF Performance (cont.)



# Typical RF Performance (cont.)



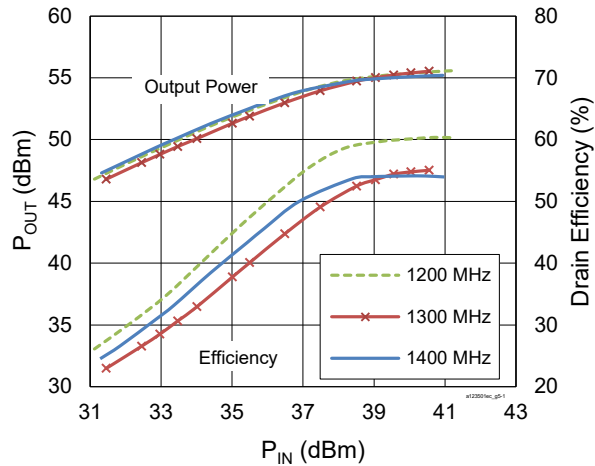
## Typical RF Performance (cont.)



# Typical RF Performance (cont.)

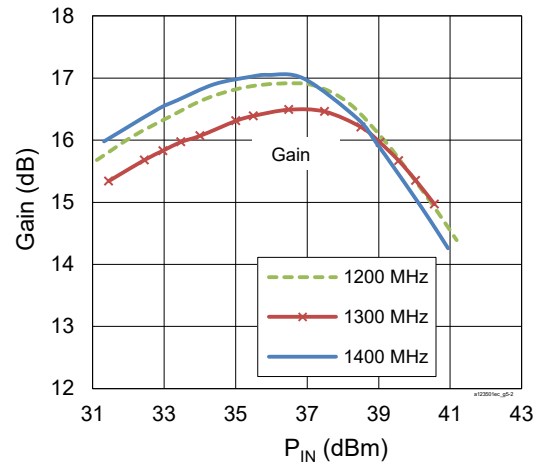
## Power Sweep, Pulsed RF

$I_{DQ} = 150 \text{ mA}$ ,  $V_{DD} = 50 \text{ V}$ ,  $T_{CASE} = 25^\circ\text{C}$ ,  
22 ms pulse width, 50% duty cycle



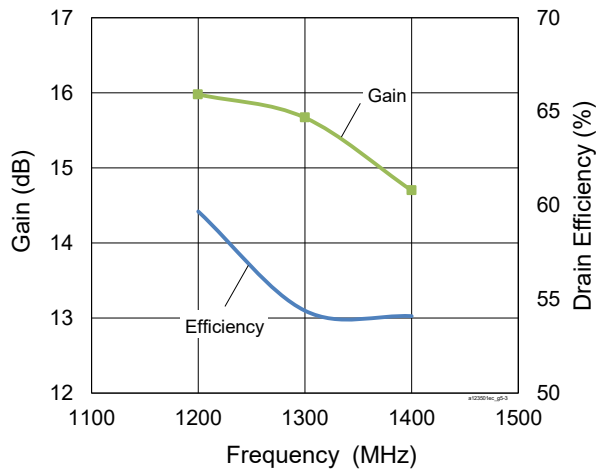
## Power Sweep, Pulsed RF

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22 ms pulse width, 50% duty cycle



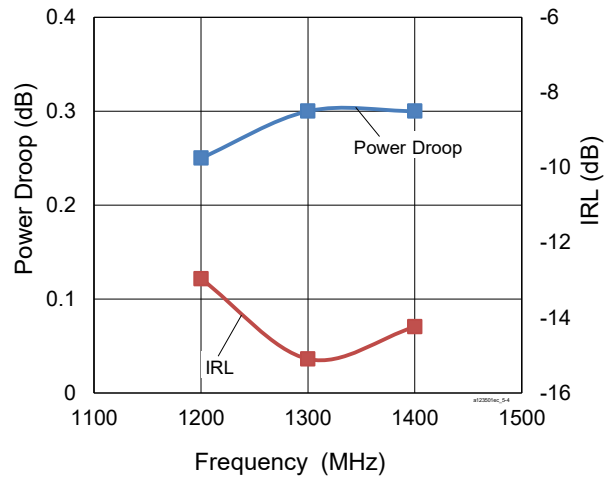
## Pulsed RF Performance

$I_{DQ} = 150 \text{ mA}$ ,  $V_{DD} = 50 \text{ V}$ ,  $P_{OUT} = 330 \text{ W}$ ,  
22 ms pulse width, 50% duty cycle



## Pulsed RF Performance

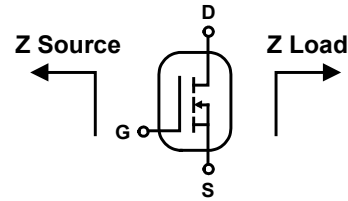
$I_{DQ} = 150 \text{ mA}$ ,  $V_{DD} = 50 \text{ V}$ ,  $P_{OUT} = 330 \text{ W}$ ,  
22 ms pulse width, 50% duty cycle





## Broadband Circuit Impedance

Freq [MHz]	Z Source $\Omega$		Z Load $\Omega$	
	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<sub>OUT</sub> Point** – 16  $\mu$ s pulse width, 10% duty cycle, class AB, V<sub>DD</sub> = 50 V, 150 mA

Freq [MHz]	Z <sub>I</sub> [ $\Omega$ ]	P <sub>IN</sub> [dBm]	P <sub>OUT</sub> [dBm]	P <sub>OUT</sub> [W]	P <sub>G</sub> [dB]	PAE Eff [%]	Z <sub>OUT</sub> [ $\Omega$ ]
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<sub>T</sub> Point** – 16  $\mu$ s pulse width, 10% duty cycle, class AB, V<sub>DD</sub> = 50 V, 150 mA

Freq [MHz]	Z <sub>I</sub> [ $\Omega$ ]	P <sub>IN</sub> [dBm]	P <sub>OUT</sub> [dBm]	P <sub>OUT</sub> [W]	P <sub>G</sub> [dB]	PAE Eff [%]	Z <sub>OUT</sub> [ $\Omega$ ]
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

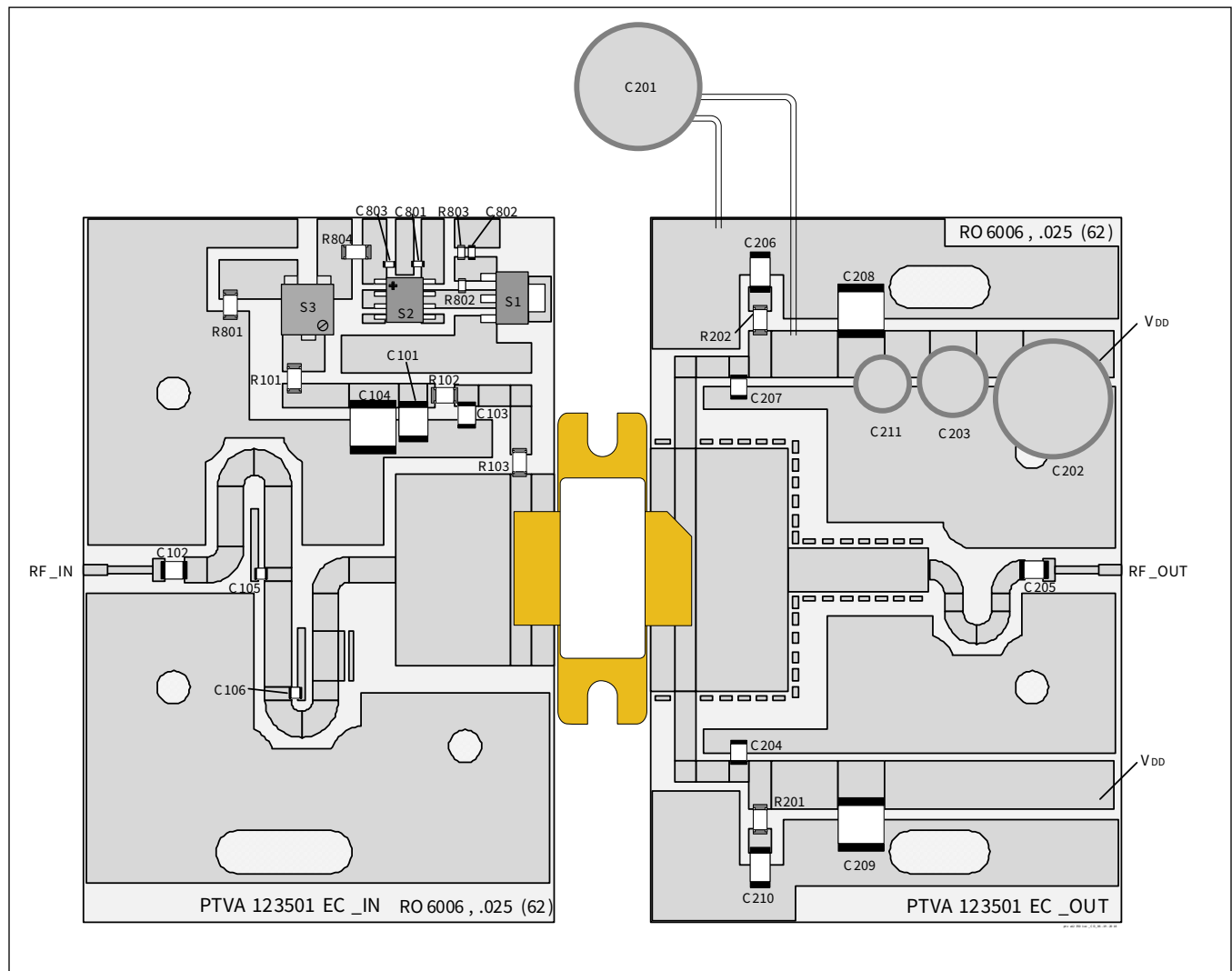
**Load Pull at Max Efficiency Point** – 16  $\mu$ s pulse width, 10% duty cycle, class AB, V<sub>DD</sub> = 50 V, 150 mA

Freq [MHz]	Z <sub>I</sub> [ $\Omega$ ]	P <sub>IN</sub> [dBm]	P <sub>OUT</sub> [dBm]	P <sub>OUT</sub> [W]	P <sub>G</sub> [dB]	PAE Eff [%]	Z <sub>OUT</sub> [ $\Omega$ ]
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  $\mu$ s pulse width, 10% duty cycle, class AB, V<sub>DD</sub> = 50 V, 150 mA

Freq [MHz]	Z <sub>I</sub> [ $\Omega$ ]	P <sub>IN</sub> [dBm]	P <sub>OUT</sub> [dBm]	P <sub>OUT</sub> [W]	P <sub>G</sub> [dB]	PAE Eff [%]	Z <sub>OUT</sub> [ $\Omega$ ]
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.)

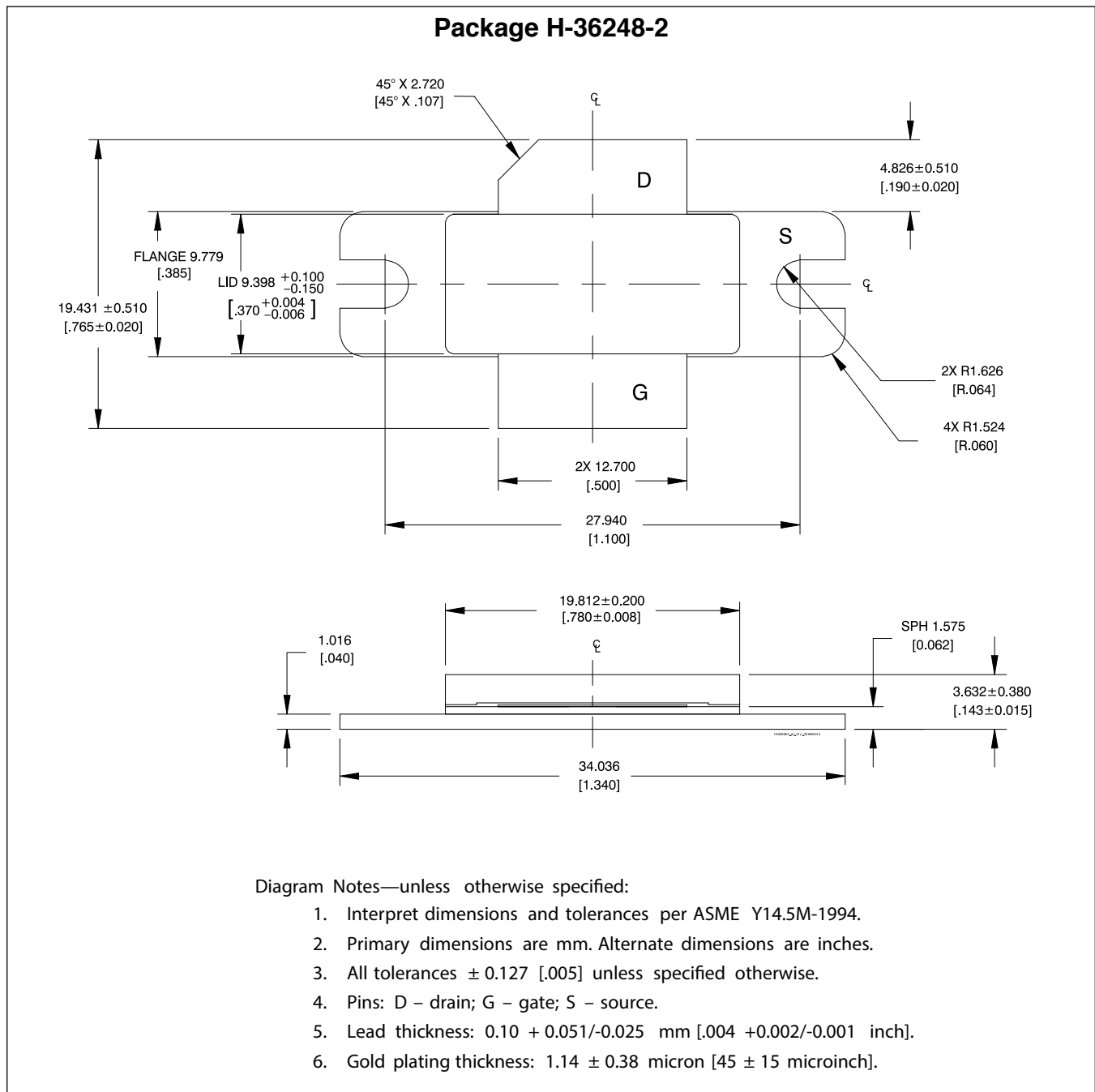
### Reference Circuit Assembly

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, $\epsilon_r = 6.15$

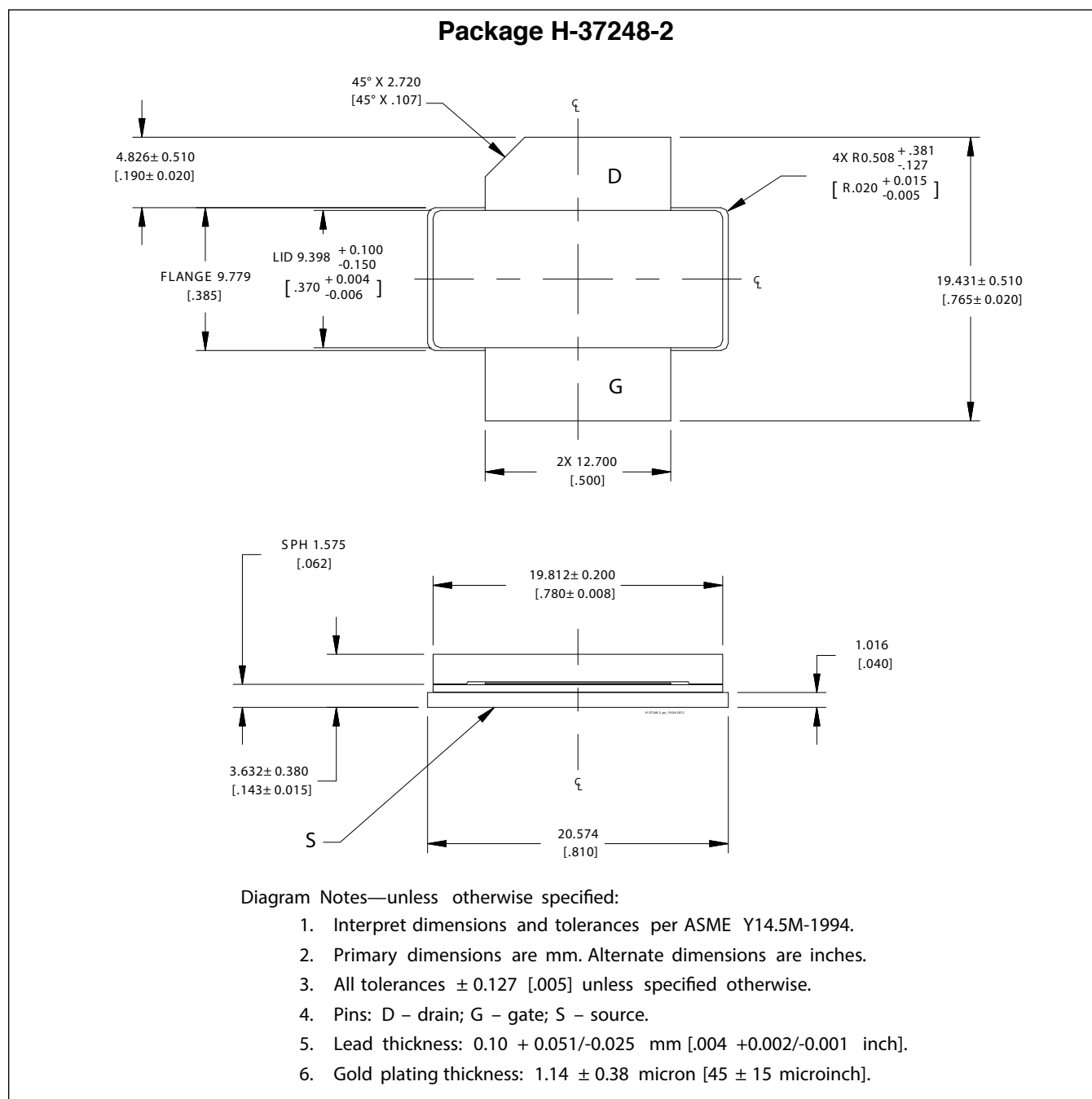
### Components Information

Component	Description	Suggested Manufacturer	P/N
<b>Input</b>			
C101	Capacitor, 1 $\mu\text{F}$	TDK Corporation	C4532X7R2A105M230KA
C102, C103	Capacitor, 39 pF	ATC	ATC100B390KW500XB
C104	Capacitor, 10 $\mu\text{F}$	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 $\Omega$	Panasonic Electronic Components	ERJ-8GEYJ102V
R102	Resistor, 5600 $\Omega$	Panasonic Electronic Components	ERJ-8GEYJ562V
R103, R804	Resistor, 10 $\Omega$	Panasonic Electronic Components	ERJ-8GEYJ100V
R801	Resistor, 2000 $\Omega$	Panasonic Electronic Components	ERJ-8GEYJ202V
R802	Resistor, 1200 $\Omega$	Panasonic Electronic Components	ERJ-3GEYJ122V
R803	Resistor, 1300 $\Omega$	Panasonic Electronic Components	ERJ-3GEYJ132V
S1	Transistor	Infineon Technologies	BCP56
S2	Voltage Regulator	Texas Instruments	LM7805
S3	Potentiometer, 2k $\Omega$	Bourns Inc.	3224W-1-202E
<b>Output</b>			
C201	Capacitor, 6800 $\mu\text{F}$	Panasonic Electronic Components	ECO-S2AP682EA
C202	Capacitor, 100 $\mu\text{F}$	Cornell Dubilier Electronics (CDE)	SK101M100ST
C203	Capacitor, 22 $\mu\text{F}$	Cornell Dubilier Electronics (CDE)	SEK220M100ST
C204, C205, C207	Capacitor, 39 pF	ATC	ATC100B390KW500XB
C206, C210	Capacitor, 1 $\mu\text{F}$	TDK Corporation	C4532X7R2A105M230KA
C208, C209	Capacitor, 10 $\mu\text{F}$	TDK Corporation	C5750X5R1H106K230KA
C211	Capacitor, 10 $\mu\text{F}$	Panasonic Electronic Components	EEV-HD1H100P
R201, R202	Resistor, 5600 $\Omega$	Panasonic Electronic Components	ERJ-8GEYJ562V

## Package Outline Specifications



# Package Outline Specifications (cont.)



## 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 Characteristics 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

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