

# PTVA123501EC/FC

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

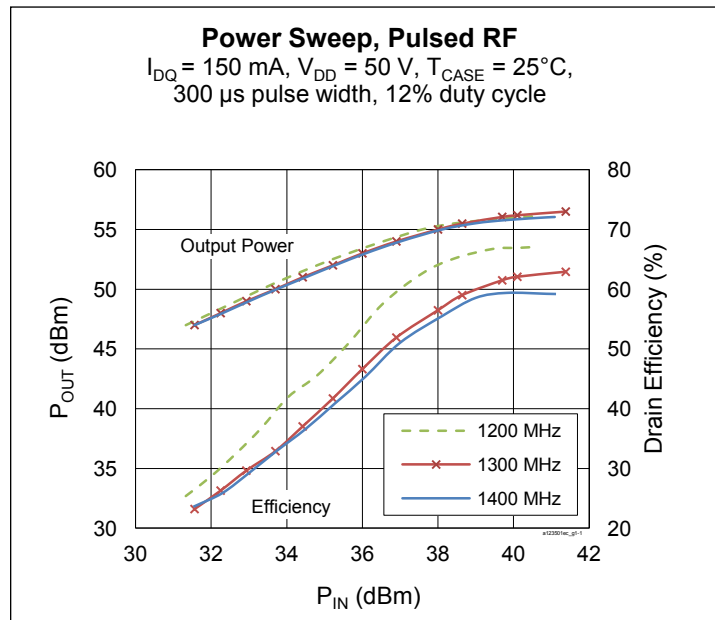
### Description

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  | $\mu\text{A}$ |

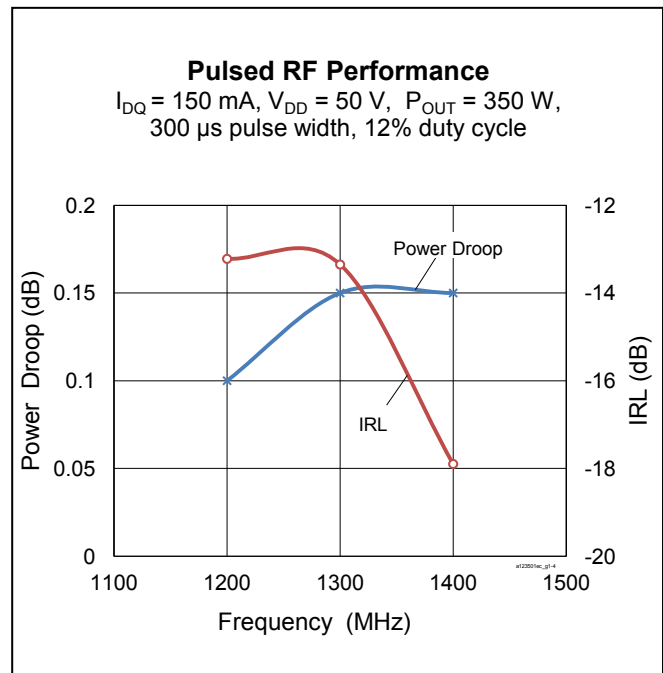
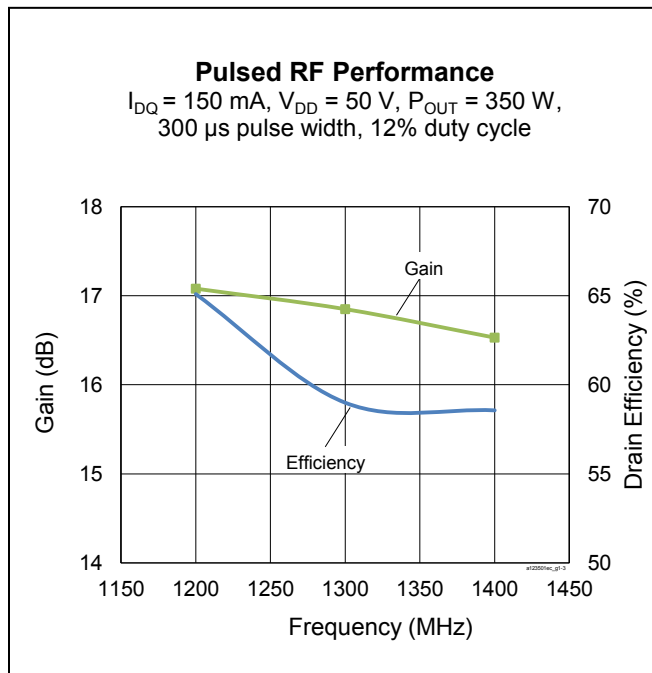
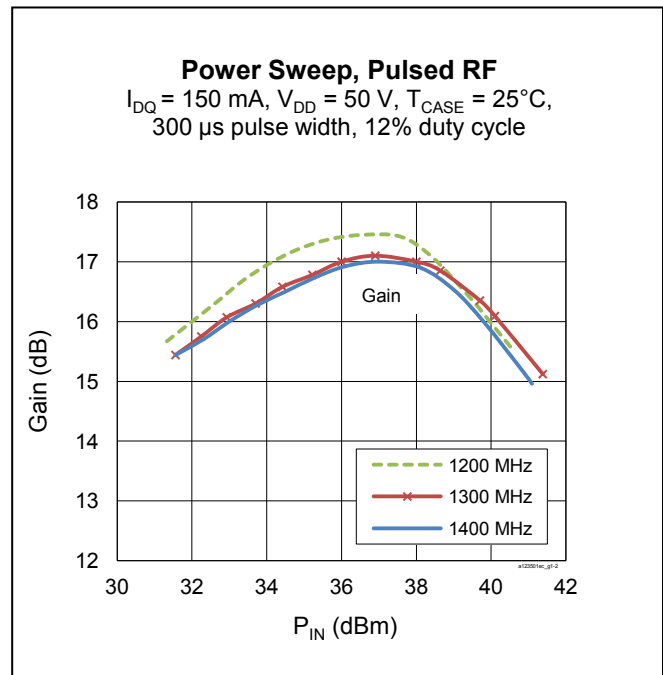
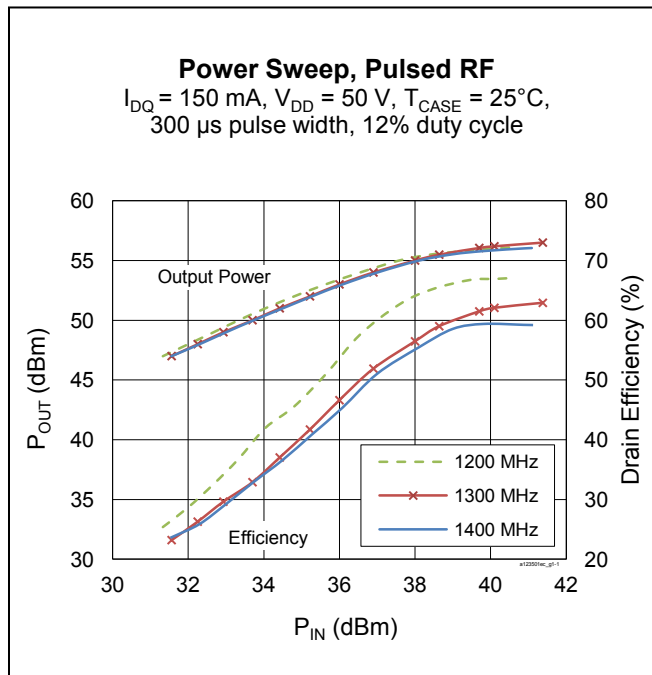
## Maximum Ratings

| 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        | $^{\circ}\text{C/W}$ |

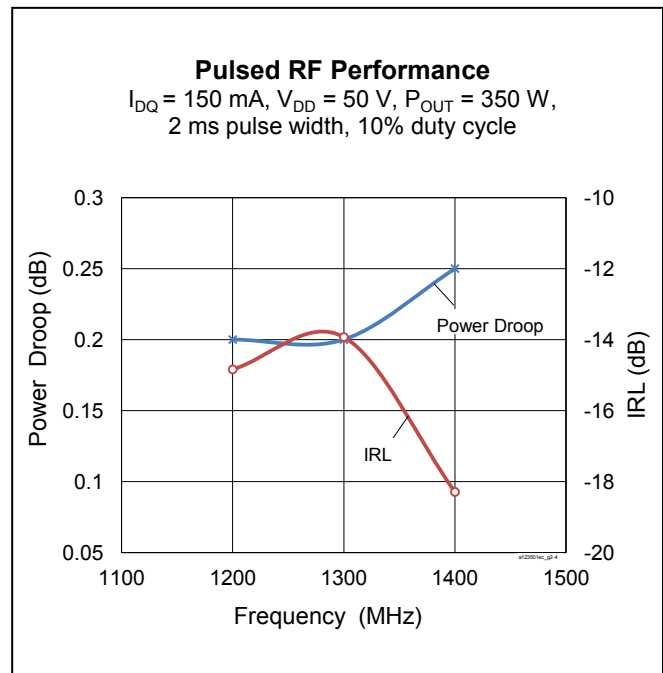
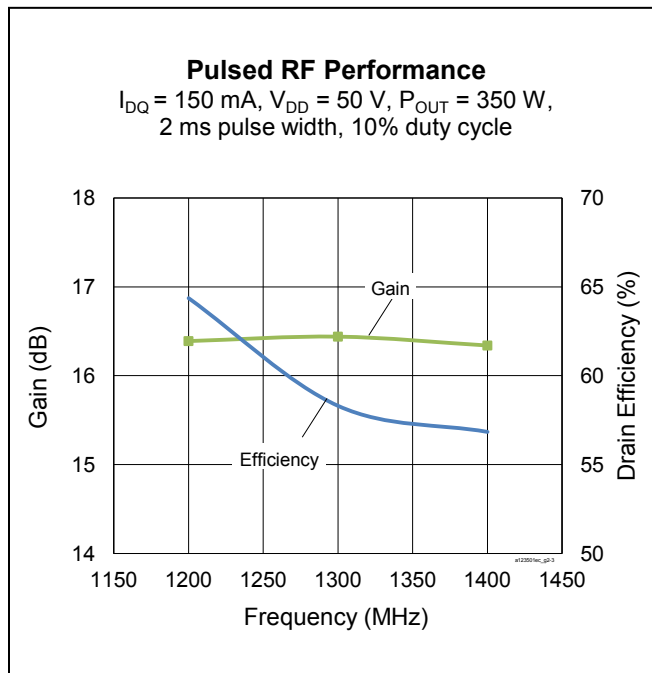
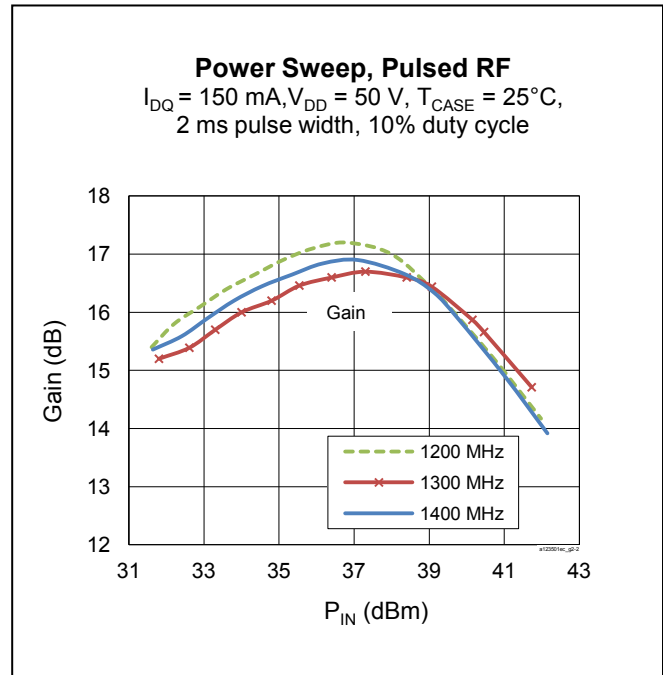
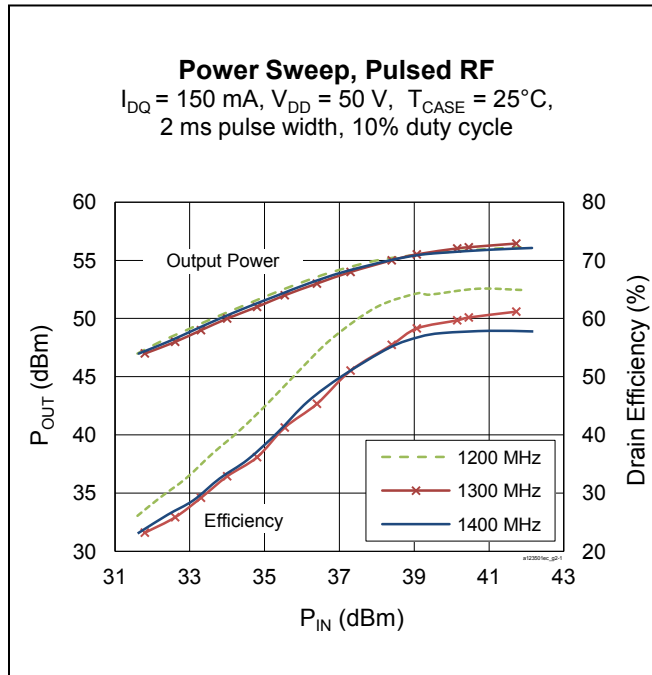
## Ordering Information

| 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 |

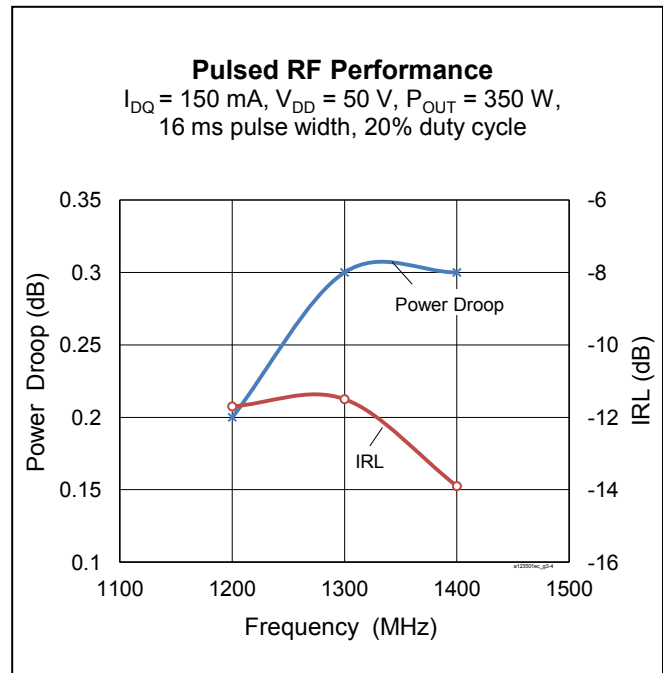
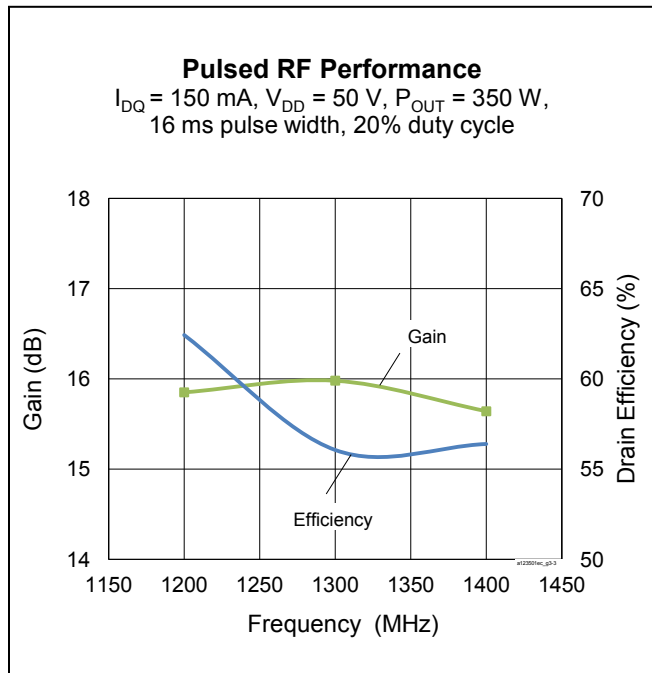
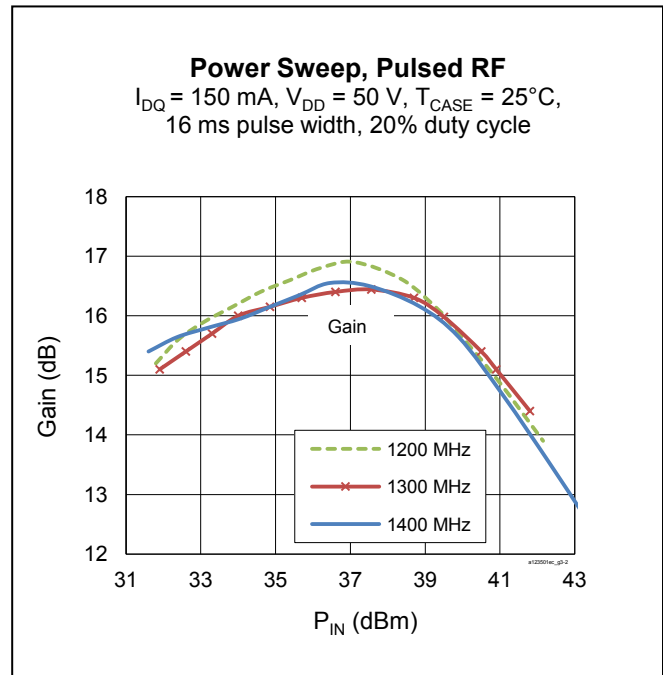
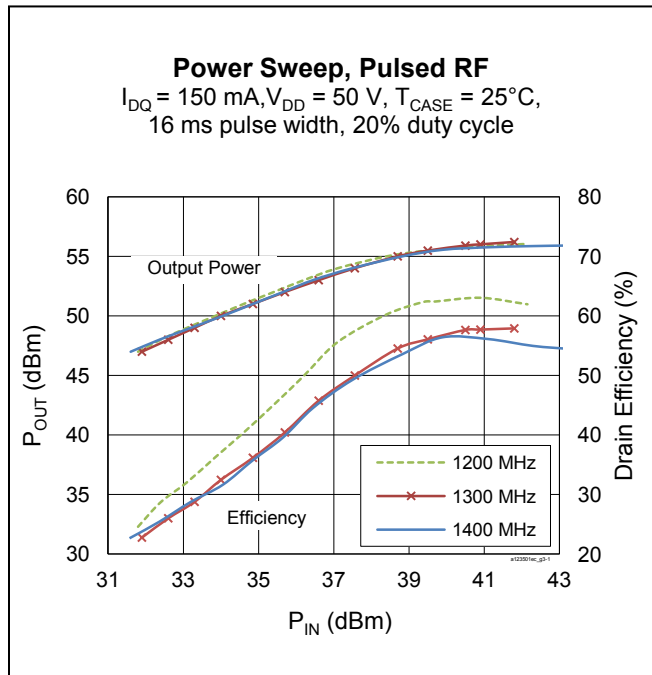
**See next page for Typical RF Performance**

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


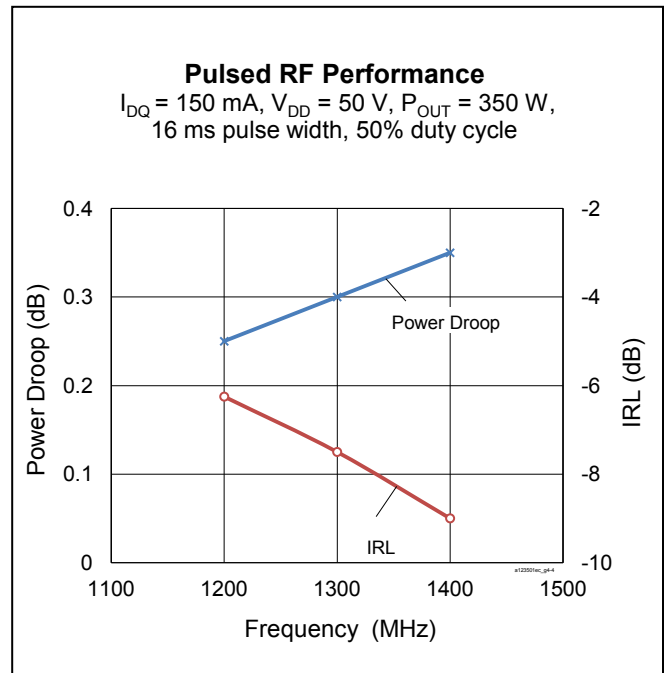
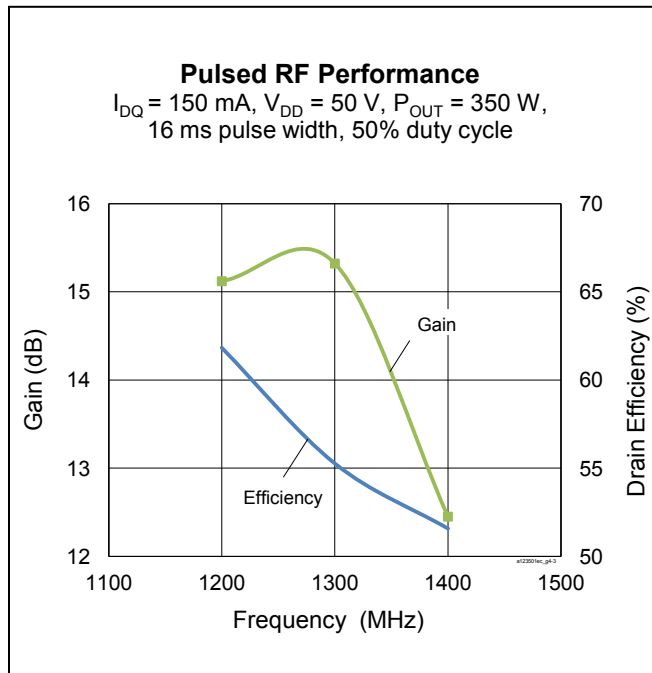
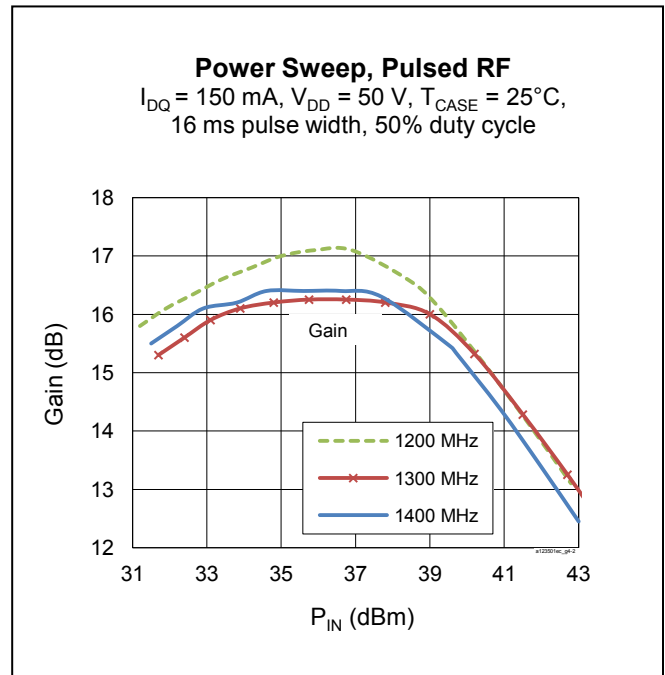
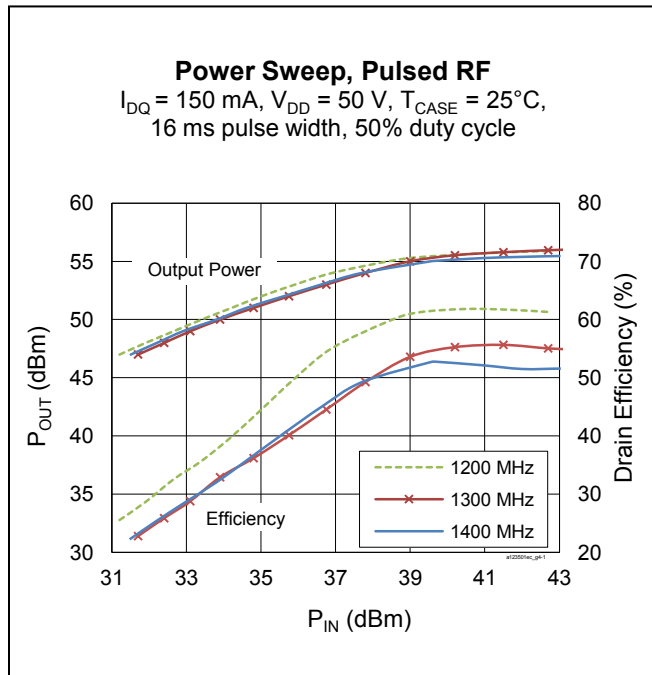
### Typical RF Performance (cont.)



### Typical RF Performance (cont.)



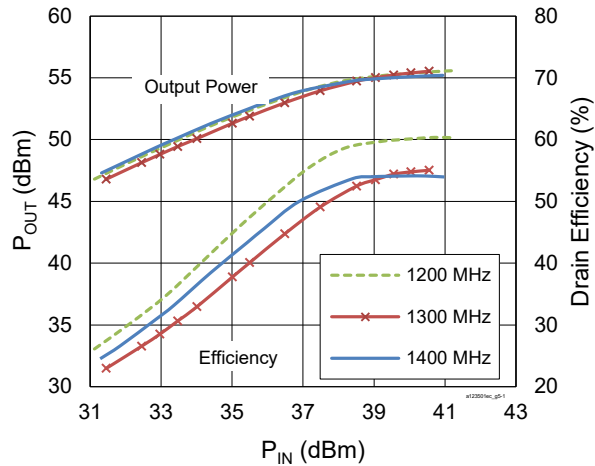
# Typical RF Performance (cont.)



# Typical RF Performance (cont.)

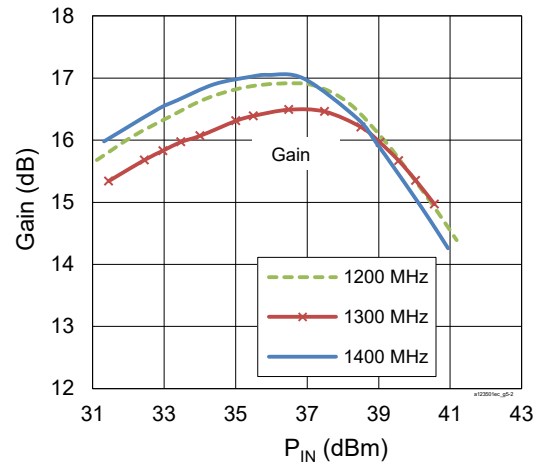
## Power Sweep, Pulsed RF

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



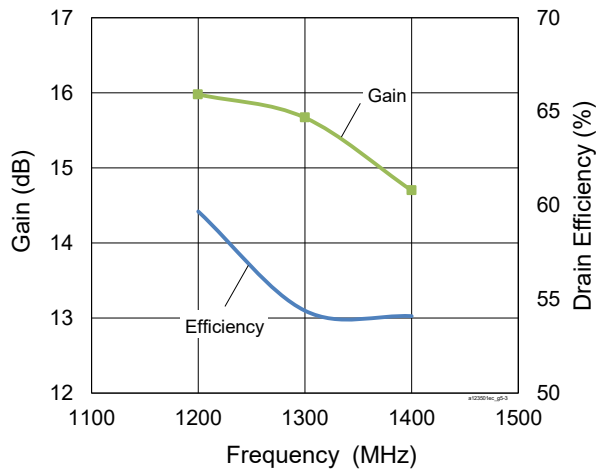
## Power Sweep, Pulsed RF

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



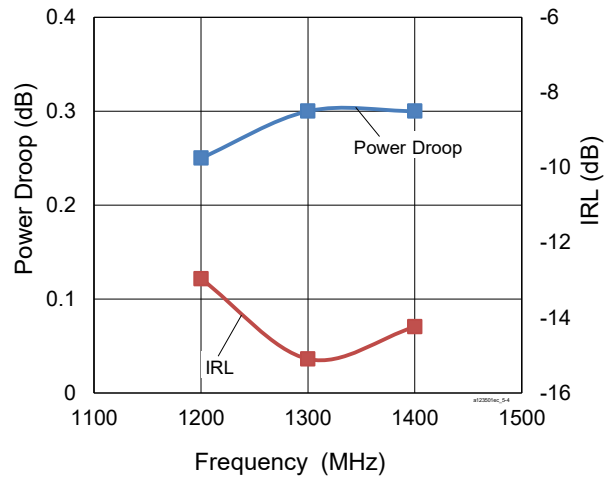
## Pulsed RF Performance

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



## Pulsed RF Performance

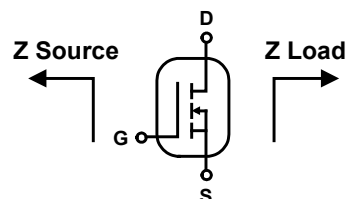
$I_{DQ} = 150 \text{ mA}$ ,  $V_{DD} = 50 \text{ V}$ ,  $P_{OUT} = 330 \text{ W}$ ,  
22 ms pulse width, 50% duty cycle





## Broadband Circuit Impedance

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

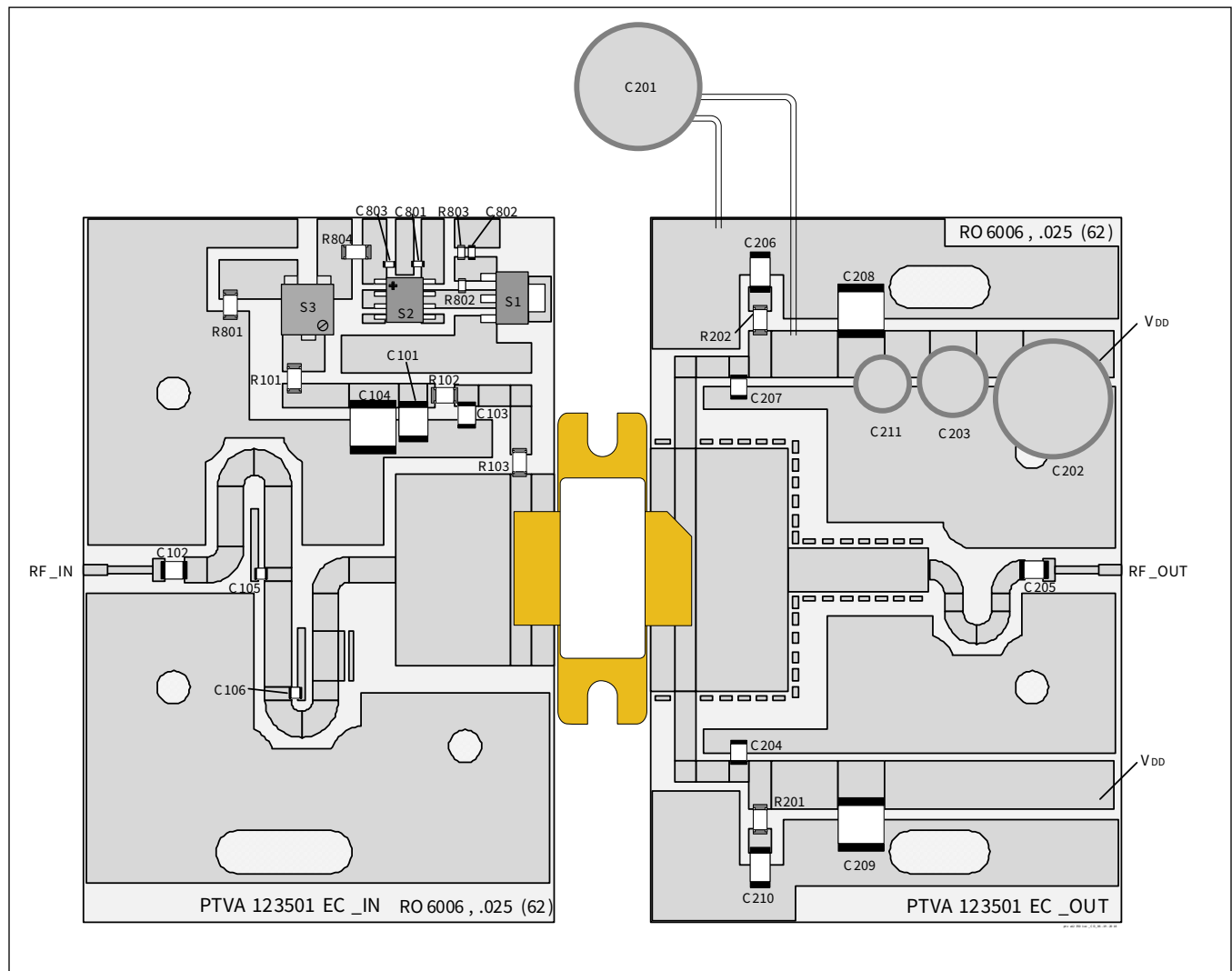
**Load Pull at Max Efficiency Point** – 16  $\mu$ s pulse width, 10% duty cycle, class AB, V<sub>DD</sub> = 50 V, 150 mA

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

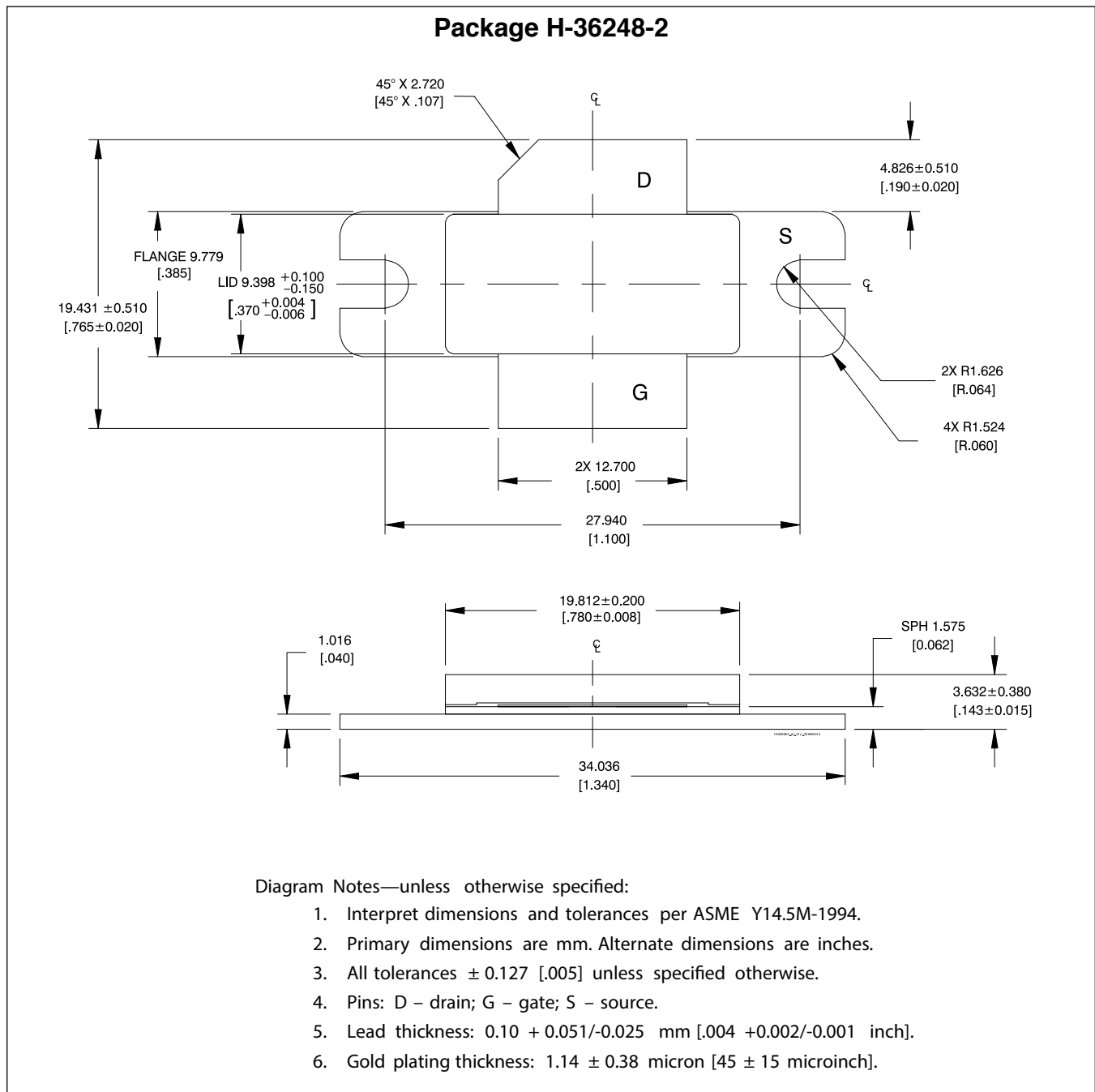
### Reference Circuit Assembly

|                       |   |
|-----------------------|---|
| 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, $\epsilon_r = 6.15$ |

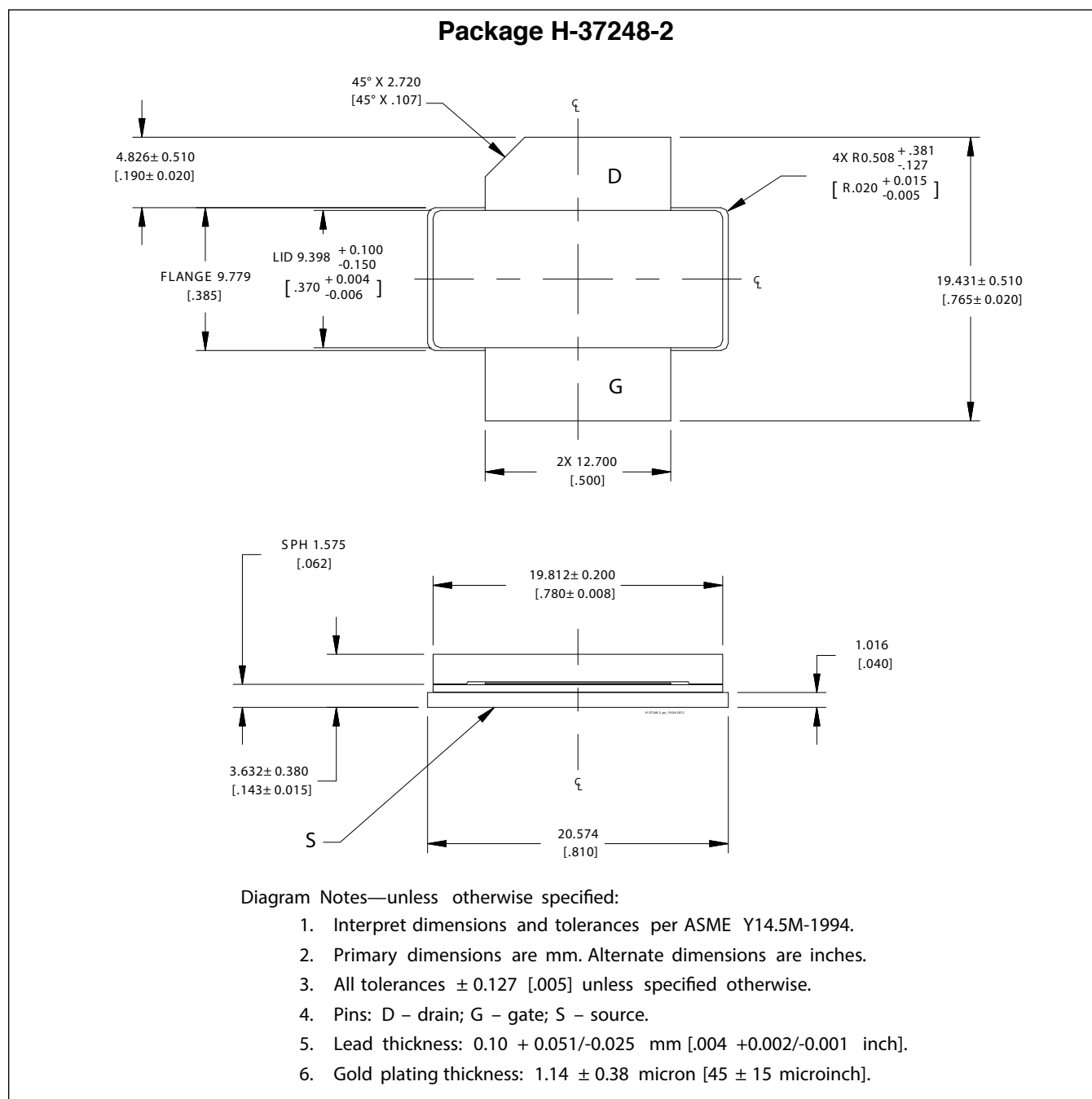
### Components Information

| 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<br>1, 9, 12 | Updated to include FC version<br>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<br>3        | Corrected FC version to V1 throughout<br>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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