## Features

- *MACOM PURE CARBIDE™* Amplifier Series
- Saturated Output Power = 300 W
- Output Power = 55 dBm
- Drain Efficiency = 75%
- Large Signal Gain = 17 dB
- CW Operation
- RoHS* Compliant


**TO248**

## Applications

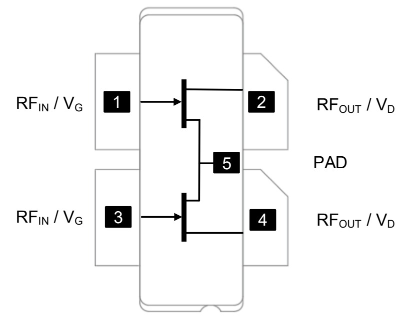
- Microwave Heating
- Industrial, Scientific, & Medical

## Description

The WST33H0NC is a 300 W packaged, partially-matched amplifier utilizing the high performance, 50 V, 0.25 µm GaN on SiC production process. This amplifier operates from 2.40 G - 2.50 GHz and targets microwave heating applications.

Available in a thermally-enhanced, Cu-based package, the WST33H0NC provides superior performance under CW operation allowing customers to improve SWaP-C benchmarks in their next generation systems.

## Functional Schematic




## Typical Performance CW:

- $V_{DS}$ = 50 V, $I_{DQ}$ = 0 mA, $V_{GS}$ = -4 V , $T_C$ = 25°C

| Frequency (GHz) | Output Power[1] (dBm) | Gain[1] (dB) | $\eta_D$ [1] (%) |
|---|---|---|---|
| 2.40 | 56.0 | 18.0 | 75.8 |
| 2.45 | 55.4 | 17.4 | 76.7 |
| 2.50 | 54.8 | 16.8 | 77.3 |

1. Application board performance, Input power is 38 dBm, CW.

## Pin Configuration

| Pin # | Pin Name | Function |
|---|---|---|
| 1, 3 | $RF_{IN}$ / $V_G$ | RF Input / Gate |
| 2, 4 | $RF_{OUT}$ / $V_D$ | RF Output / Drain |
| 5 | Flange[2] | Ground / Source |

2. The flange on the package bottom must be connected to RF, DC and thermal ground.

## Ordering Information

| Part Number | Package |
|---|---|
| WST33H0NC-ASPPR | 250 piece reel |
| WST33H0NC-SBPPR | Sample Board |

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

## RF Electrical Characteristics: $T_C$ = 25°C, $V_{DS}$ = 50 V, $I_{DQ}$ = 0 mA , $V_{GS}$ = -4 V
**Note: Performance in MACOM 2.40 - 2.50 GHz Evaluation Test Fixture, 50 Ω system**

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Output Power | CW, 2.45 GHz, $P_{IN}$ = 38 dBm | $P_{SAT}$ | - | 55.4 | - | dBm |
| Large Signal Gain | CW, 2.45 GHz, $P_{IN}$ = 38 dBm | $G_{SAT}$ | - | 17.4 | - | dB |
| Drain Efficiency | CW, 2.45 GHz, $P_{IN}$ = 38 dBm | $\eta_{SAT}$ | - | 76.7 | - | % |
| Large Signal S11 | CW, 2.45 GHz, $P_{IN}$ = 38 dBm | $L_{SS11}$ | - | -18.0 | - | dB |
| Ruggedness: Output Mismatch | Pulsed[3], All phase angles | Ψ | VSWR = 20:1, No Damage | | | |

3. Pulse Details: 100 µs, 10 % duty cycle.

## RF Electrical Specifications[4]: $T_A$ = 25°C, $V_{DS}$ = 50 V, $I_{DQ}$ = 0 mA, $V_{GS}$ = -4 V
**Note: Performance in MACOM Production Test Fixture, 50 Ω system**

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Saturated Drain Efficiency | Pulsed[5], 2.40 GHz, $P_{IN}$ 40.5 dBm | $\eta_{SAT}$ | - | 52.7 | - | dBm |
| Saturated Output Power | Pulsed[5], 2.40 GHz, $P_{IN}$ 40.5 dBm | $P_{SAT}$ | - | 63.1 | - | % |

4. Test and screening under class-C operation for peak efficiency. User may operate under different operating class depending on specific system requirements.
5. Pulse Details: 100 µs pulse width, 10 % duty cycle.

## DC Electrical Characteristics: $T_A$ = 25°C

| Parameter | Test Conditions | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Drain-Source Leakage Current | $V_{GS}$ = -8 V, $V_{DS}$ = 10 V | $I_{DLK}$ | - | - | 3.6 | mA |
| Gate-Source Leakage Current | $V_{GS}$ = -8 V, $V_{DS}$ = 10 V | $I_{GLK}$ | - | - | 3.6 | mA |
| Gate Pinch-Off Voltage | $V_{DS}$ = 10 V, $I_{DS}$ = 25.6 mA | $V_{P10}$ | -3.5 | - | -1.9 | V |
| Gate Resistance | - | - | 50 | - | - | kΩ |

## Absolute Maximum Ratings [6,7]

| Parameter | Absolute Maximum |
|---|---|
| Drain Source Voltage, $V_{DS}$ | 150 V |
| Gate Source Voltage, $V_{GS}$ | -8 to +2 V |
| Drain Current, $I_D$ | 49 A |
| Gate Current, $I_G$ | 51.2 mA |
| Gate Input Power | 42 dBm |
| Storage Temperature Range | -65°C to +150°C |
| Case Operating Temperature Range | -40°C to +85°C |
| Absolute Maximum Channel Temperature | +275°C, MTTF > 1E6 |

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation above maximum operating conditions.

## Thermal Characteristics [8]

| Parameter | Test Conditions | Symbol | Typical | Units |
|---|---|---|---|---|
| Thermal Resistance using Finite Element Analysis | $V_{DS}$ = 50 V, $P_{DISS}$ = 144 W, $T_C$ = 85°C | $R_\theta$(FEA) | 0.62 | °C/W |
| Thermal Resistance using Infrared Measurement of Die Surface Temperature | $V_{DS}$ = 50 V, $P_{DISS}$ = 205 W, $T_C$ = 85°C | $R_\theta$(IR) | 0.68 | °C/W |

8. Case temperature measured using thermocouple embedded in heat-sink. Contact local applications support team for more details on this measurement.

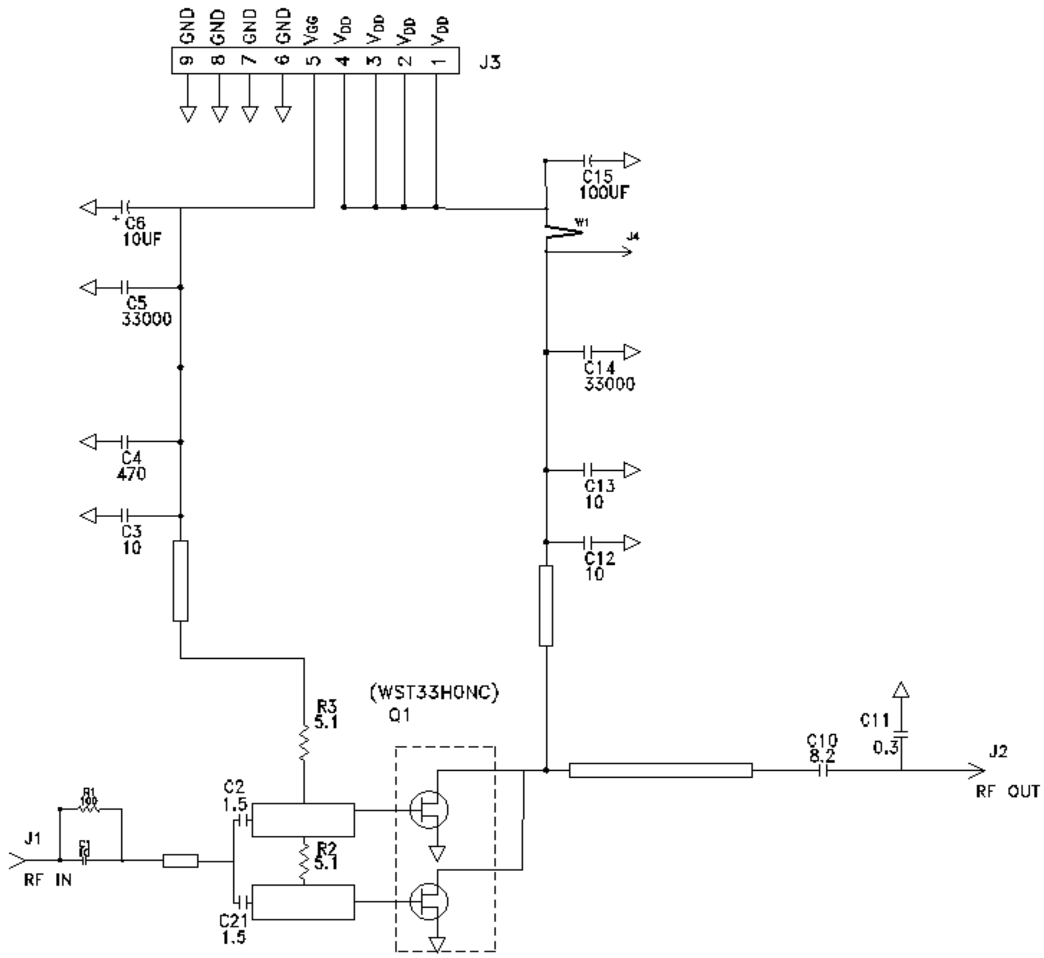
## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

## Evaluation Test Fixture and Recommended Tuning Solution 2.40 - 2.50 GHz




## Description

Parts measured on evaluation board (20-mil thick RO6035 HTC). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

## Bias Sequencing*

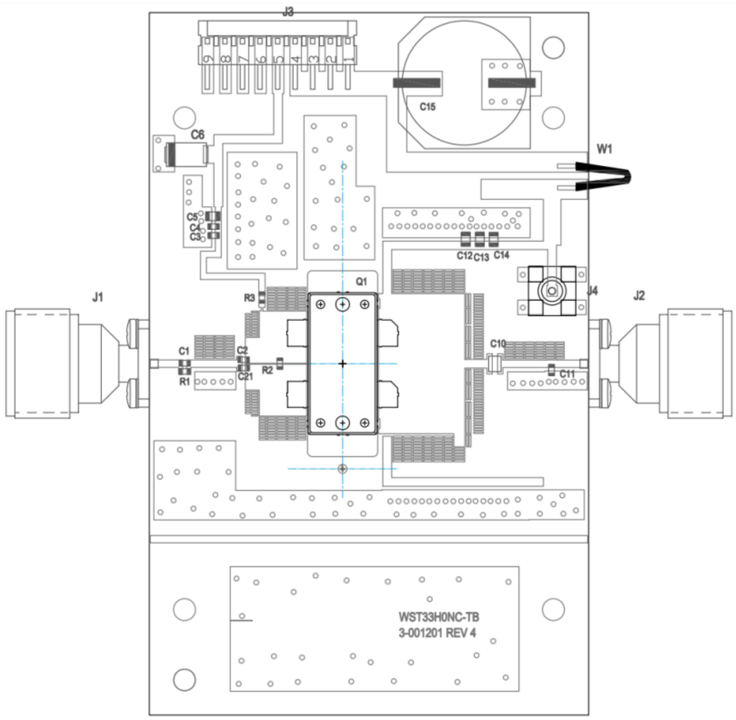
### Turning the device ON

1. Set $V_{GS}$ to pinch-off ($V_P$ = -4 V).
2. Turn on $V_{DS}$ to nominal voltage (50 V).
3. (This device biased in class C, so no need to adjust $V_{GS}$)
4. Apply RF power to desired level.

### Turning the device OFF

1. Turn the RF power OFF.
2. Decrease $V_{DS}$ down to 0 V.
3. Turn off $V_{GS}$.

## Evaluation Test Fixture and Recommended Tuning Solution 2.40 - 2.50 GHz

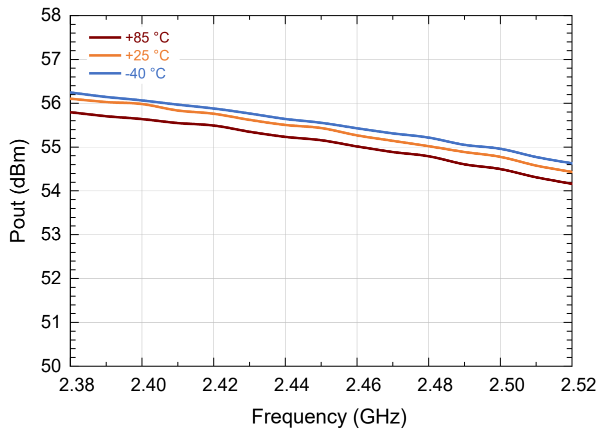



| Reference Designator | Value | Tolerance | Manufacturer | Part Number |
|---|---|---|---|---|
| C1,C3 | 10 pF | ± 5 % | ATC | 600S100JW250XT |
| C2,C21 | 1.5 pF | ± 0.1 pF | ATC | ATC600S1R5BT250T |
| C10 | 8.2 pF | ± 5 % | ATC | 800R8R2JT500XT1K |
| C11 | 0.3 pF | ± 0.05 pF | ATC | 600S0R3AT250XT |
| C12,C13 | 10 pF | ± 1 % | ATC | 600F100FT250XT |
| C5,C14 | 33000 pF | ± 10 % | Murata | GRM21BR72A333KA01 |
| C15 | 100 µF | ± 20 % | Panasonic | EEVEB2C101M |
| C4 | 470 pF | ± 5 % | AVX | 06031C471JAT2A |
| C6 | 10 µF | ± 10 % | AVX | TAJC106K016RNJ |
| R3,R2 | 5.1 Ω | ± 1 % | Vishay | CRCW06035R10FNEA |
| R1 | 100 Ω | ± 1 % | Vishay | CRCW0603100RFKEA |
| W1 | 18 AWG | | BNTECHGO | UPC 74227160 |
| J1,J2 | | | Huber-Shuner | 23N-50-31 |
| J4 | | | Cinch | 131-3711-201 |
| J3 | | | TE Connectivity | 640457-9 |
| Q1 | MACOM GaN Power Amplifier | | | WST33H0NC |
| PCB | RO6035 HTC, 20 mil, 2 oz. Cu, Tin/Lead Finish | | | |

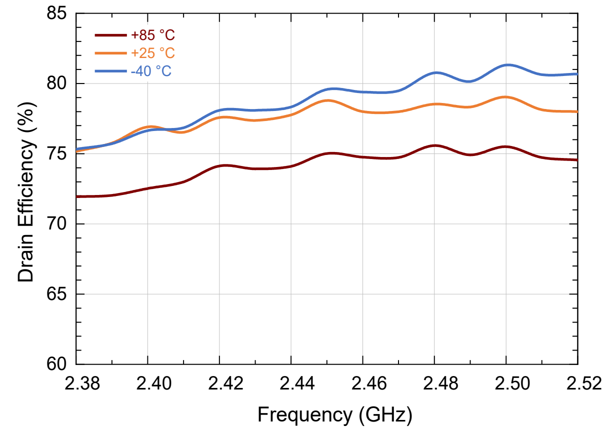
## Typical Performance Curves: Large Signal Performance vs. Temperature

**CW, $V_D$ = 50 V, $P_{IN}$ = 38 dBm, $V_G$ = -4 V, $T_B$ = 25°C (Unless Otherwise Noted)**

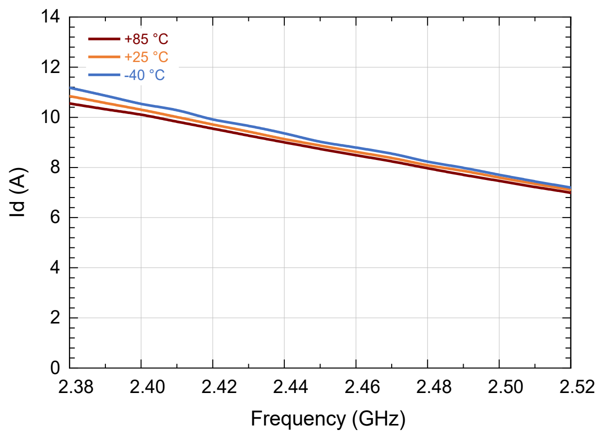
***Output Power***



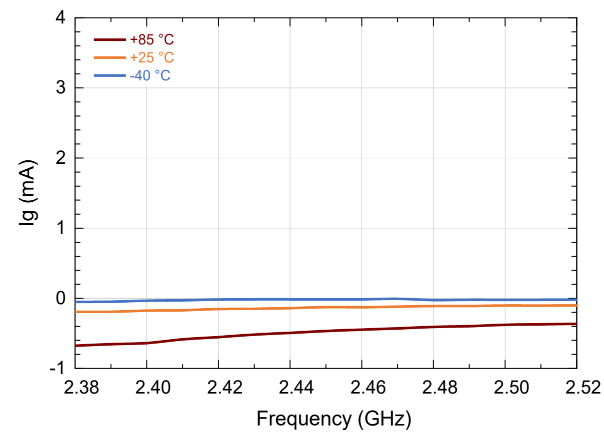

***Drain Efficiency***



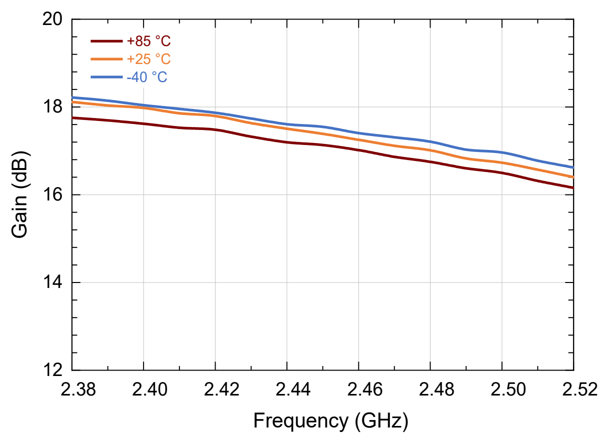

***Drain Current***



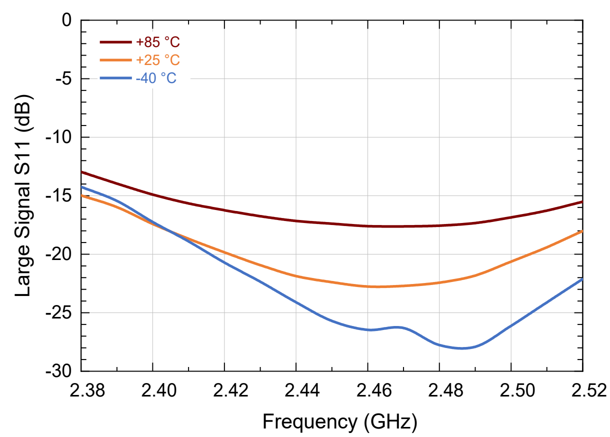

***Gate Current***




***Large Signal Gain***

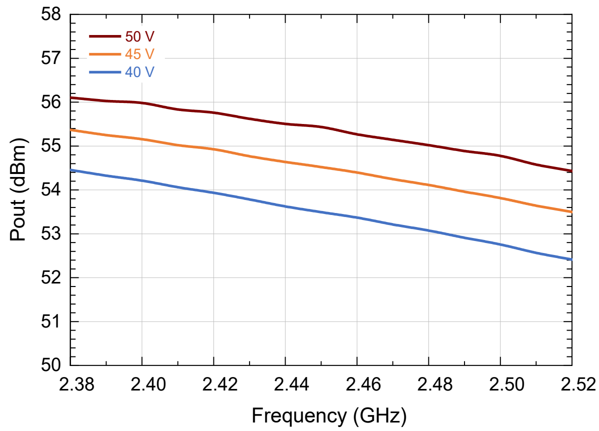



***Large Signal S11***

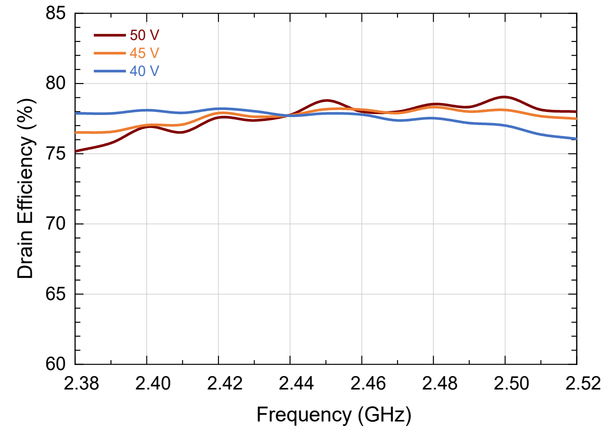


## Typical Performance Curves: Large Signal Performance vs. Drain Voltage
## CW, $P_{IN}$ = 38 dBm, $V_G$ = -4 V, $T_B$ = 25°C

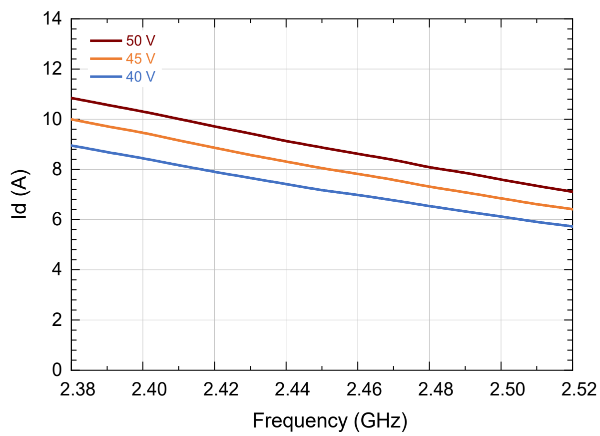
***Output Power***



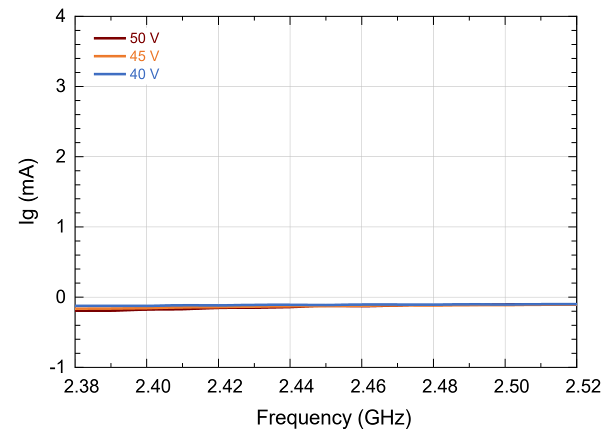

***Drain Efficiency***



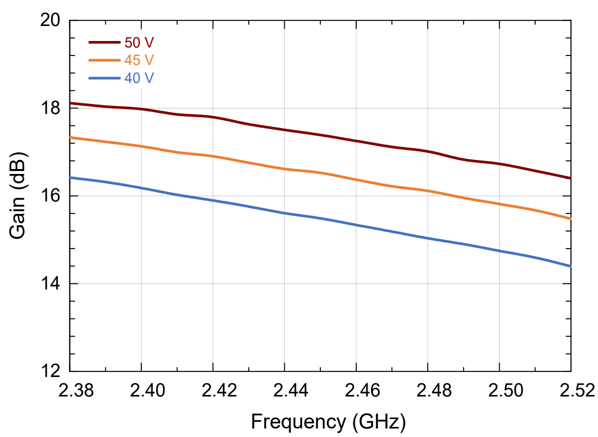

***Drain Current***



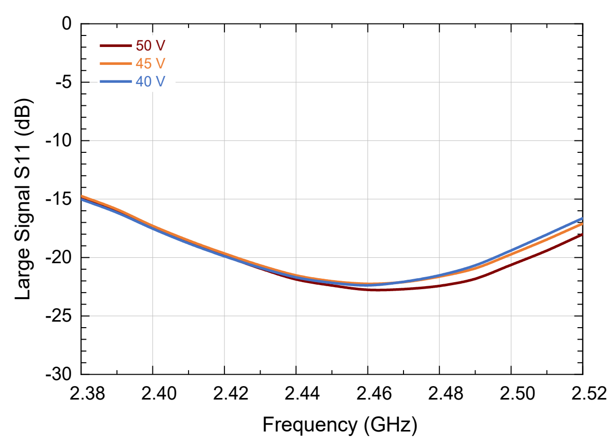

***Gate Current***




***Large Signal Gain***



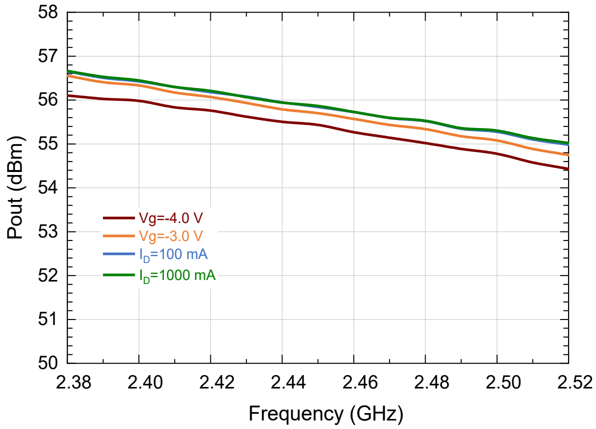

***Large Signal S11***



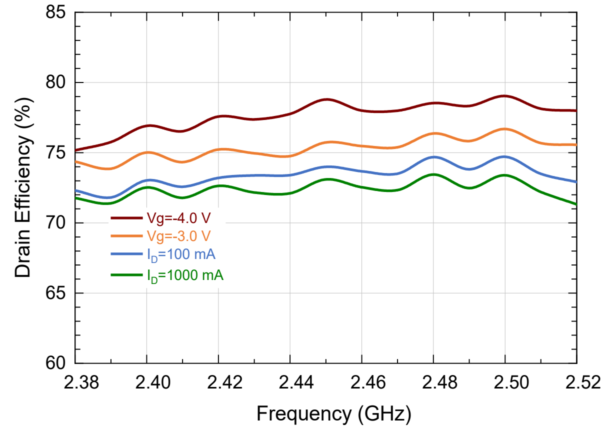
## Typical Performance Curves: Large Signal Performance vs. Quiescent Drain Current

### CW, $V_D$ = 50 V, $P_{IN}$ = 38 dBm, $T_B$ = 25°C

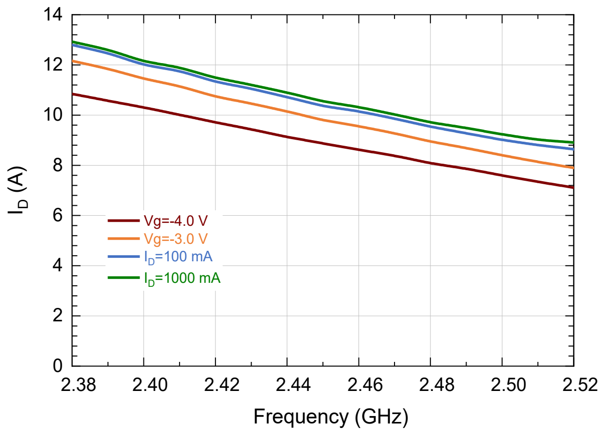
***Output Power***



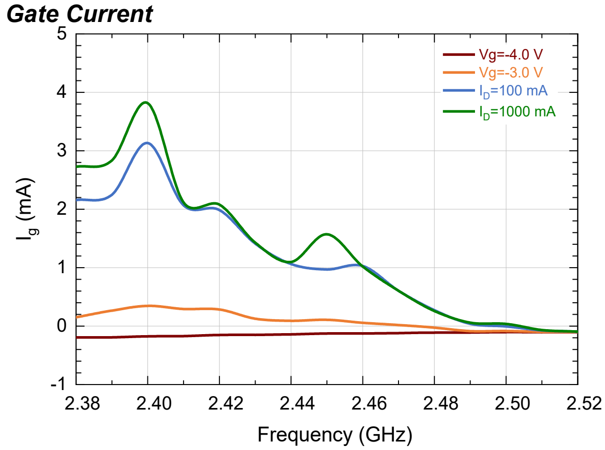

***Drain Efficiency***



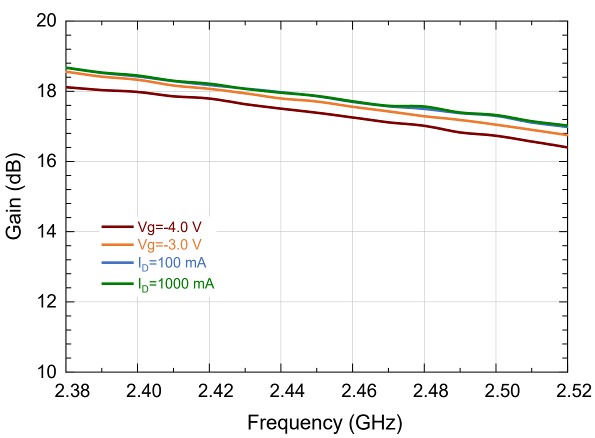

***Drain Current***



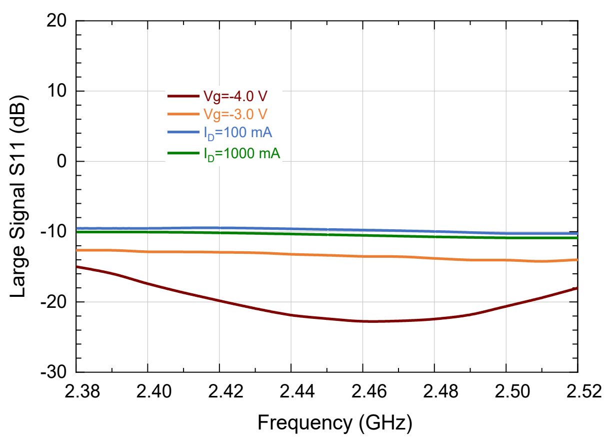

***Gate Current***




***Large Signal Gain***



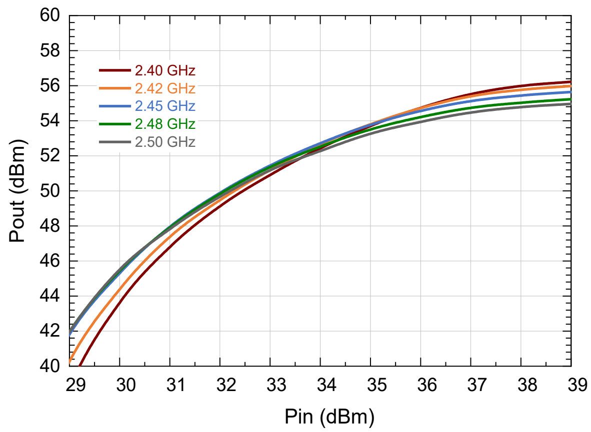

***Large Signal S11***



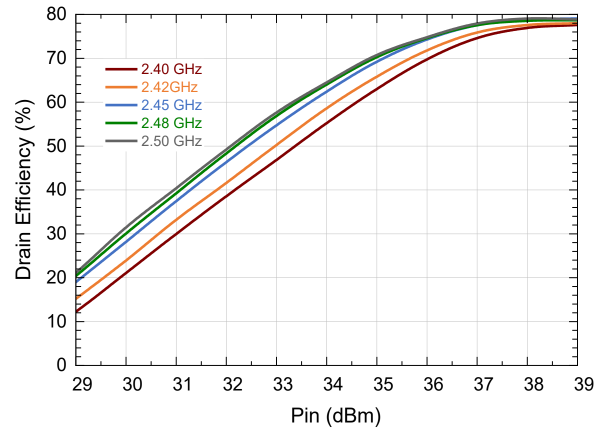
## Typical Performance Curves: Drive-Up vs. Frequency

### CW, $V_D$ = 50 V, $V_G$ = -4 V, $T_B$ = 25°C

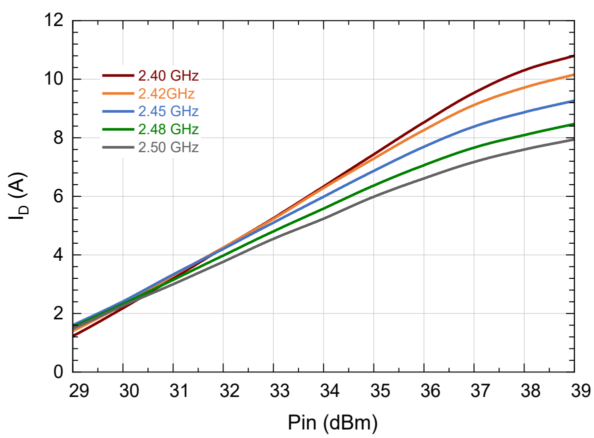
***Output Power***



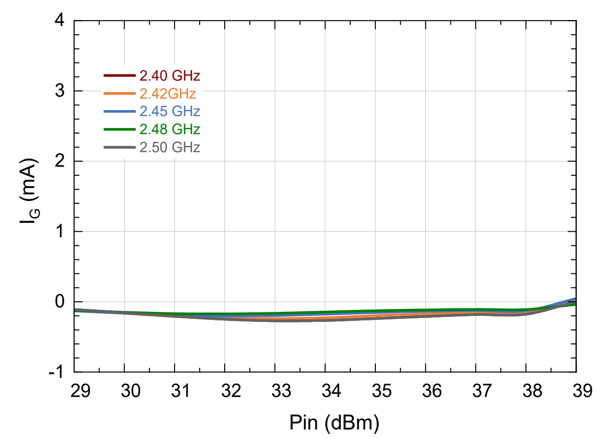

***Drain Efficiency***



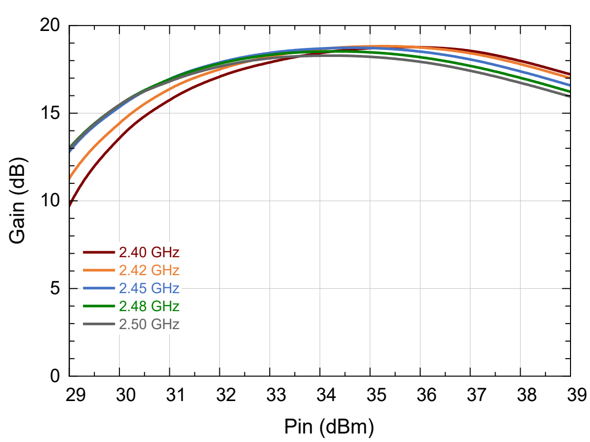

***Drain Current***



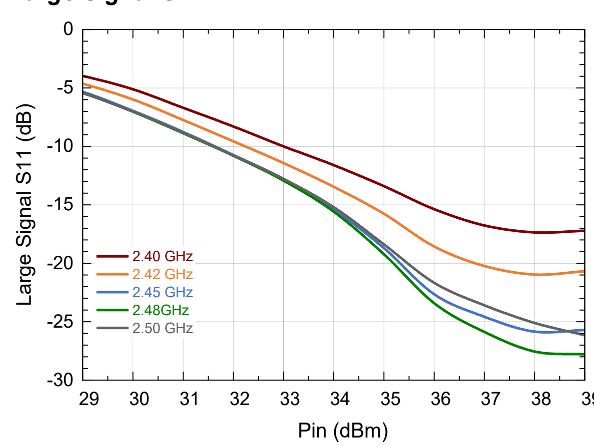

***Gate Current***




***Gain***

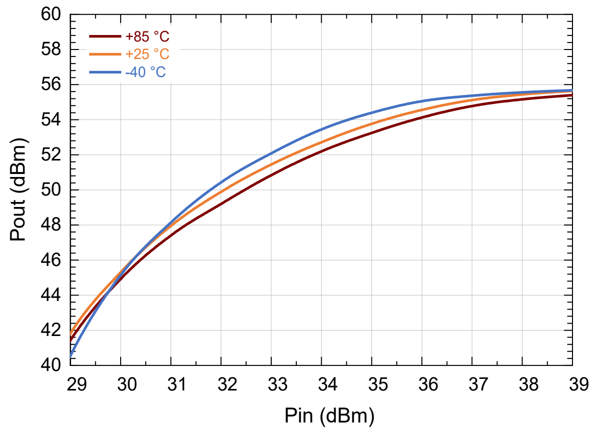



***Large Signal S11***

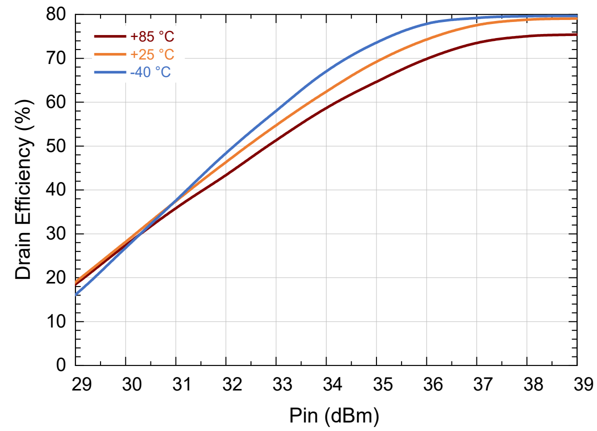


## Typical Performance Curves: Drive-Up vs. Temperature
### CW, $V_D$ = 50 V, Freq. = 2.45 GHz, $V_G$ = -4 V

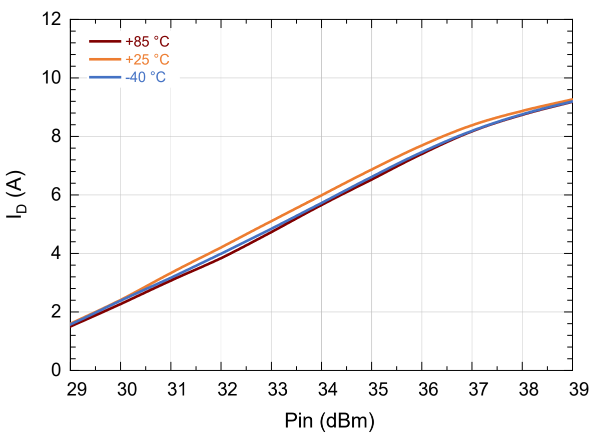
***Output Power***



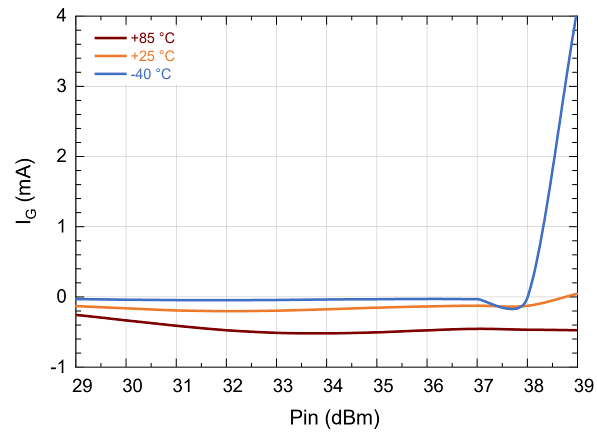

***Drain Efficiency***



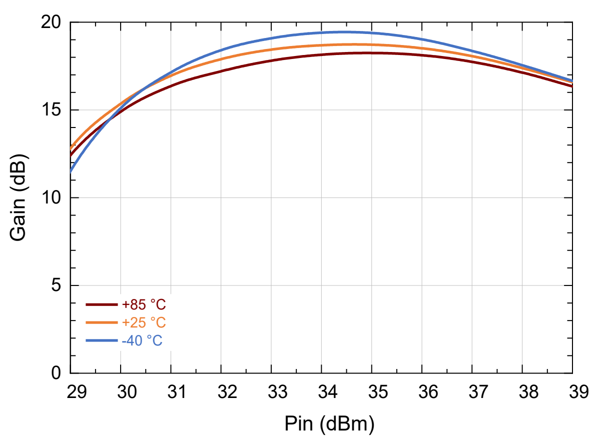

***Drain Current***



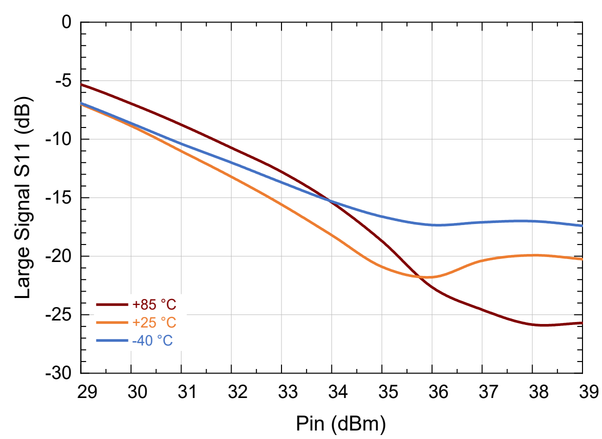

***Gate Current***




***Gain***

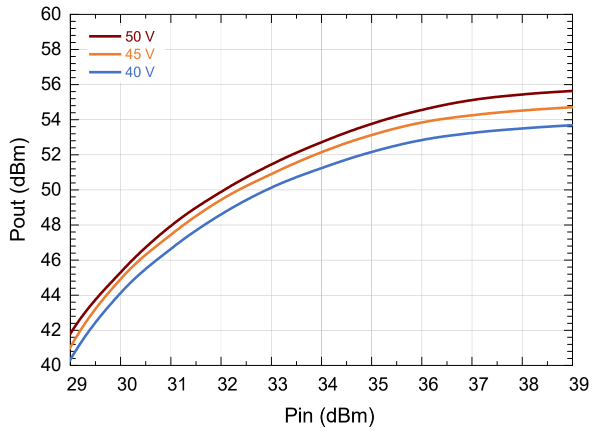



***Large Signal S11***

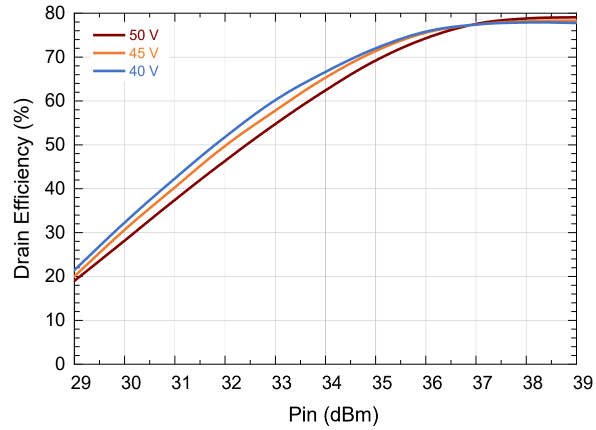


## Typical Performance Curves: Drive-Up vs. Drain Voltage
## CW, Freq. = 2.45 GHz, $V_G$ = -4 V, $T_B$ = 25°C

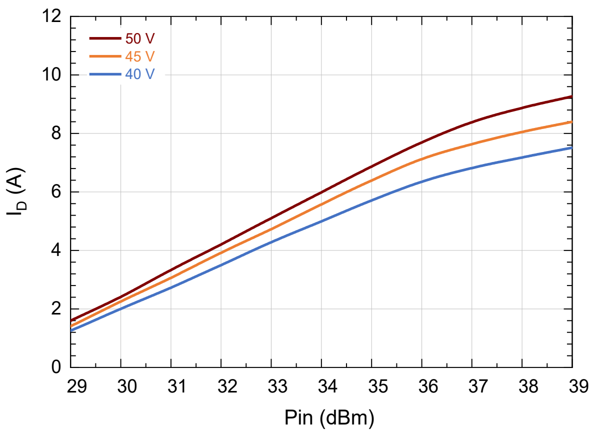
***Output Power***



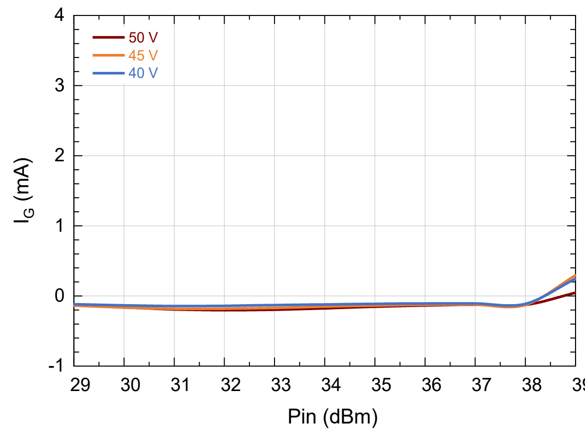

***Drain Efficiency***



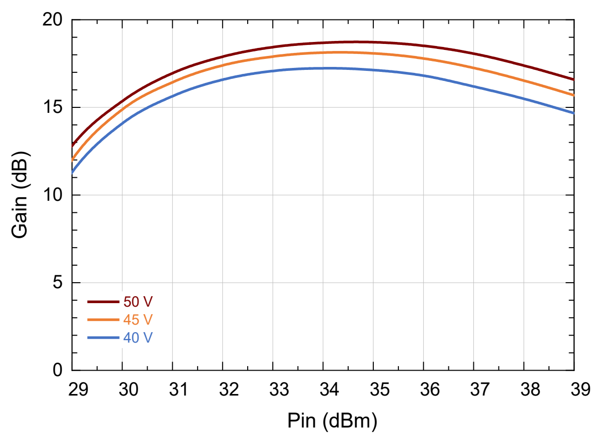

***Drain Current***



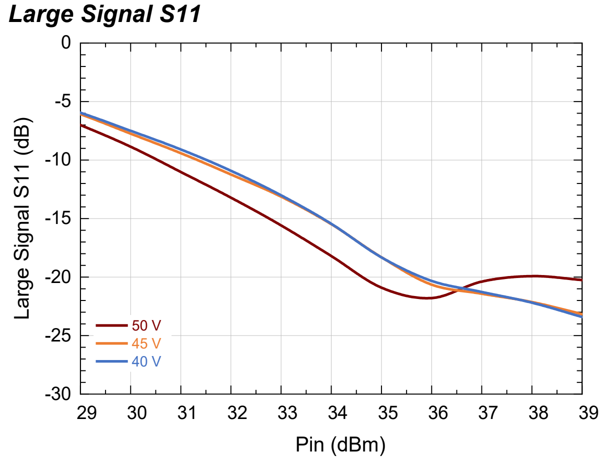

***Gate Current***




***Gain***



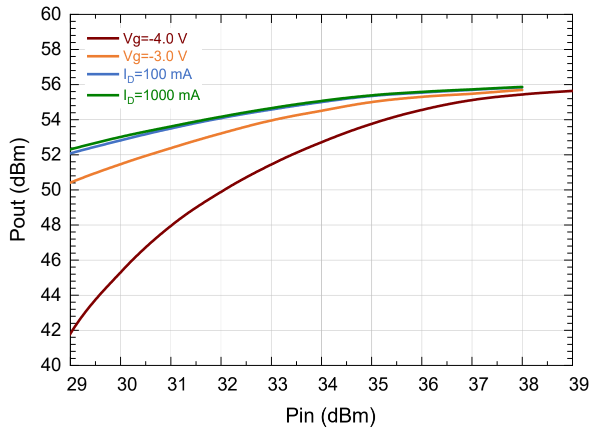

***Large Signal S11***



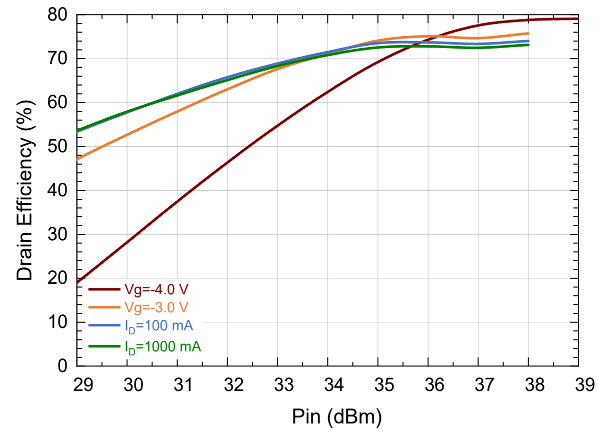
## Typical Performance Curves: Drive-Up vs. Quiescent Drain Current

### CW, $V_D$ = 50 V, Freq. = 2.45 GHz, $T_B$ = 25°C

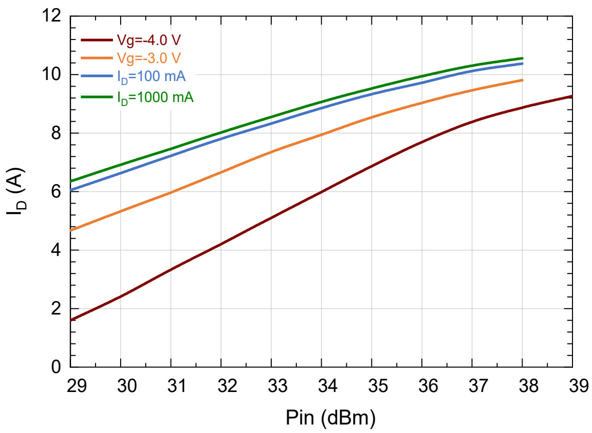
***Output Power***



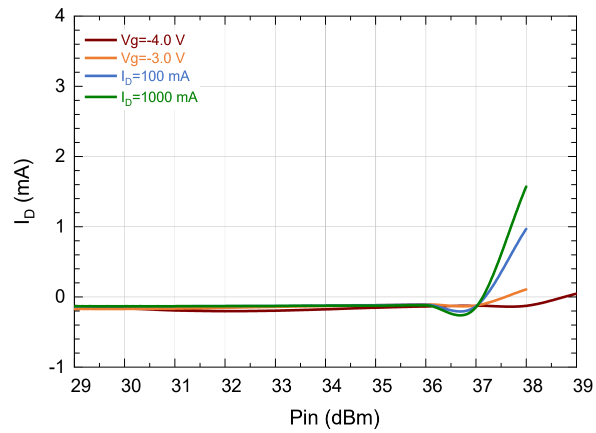

***Drain Efficiency***



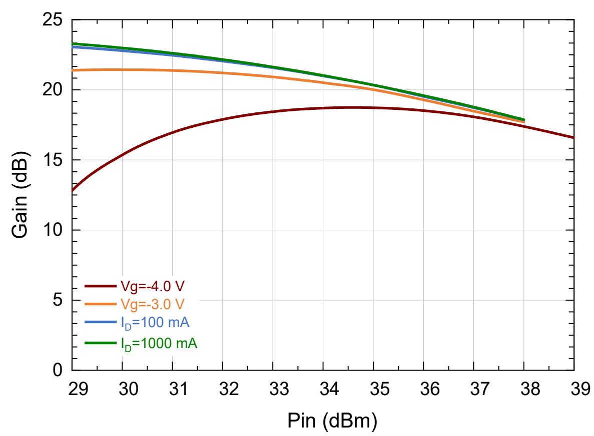

***Drain Current***



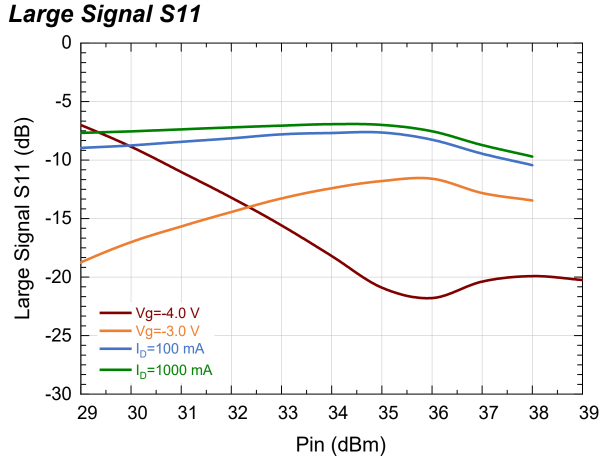

***Gate Current***



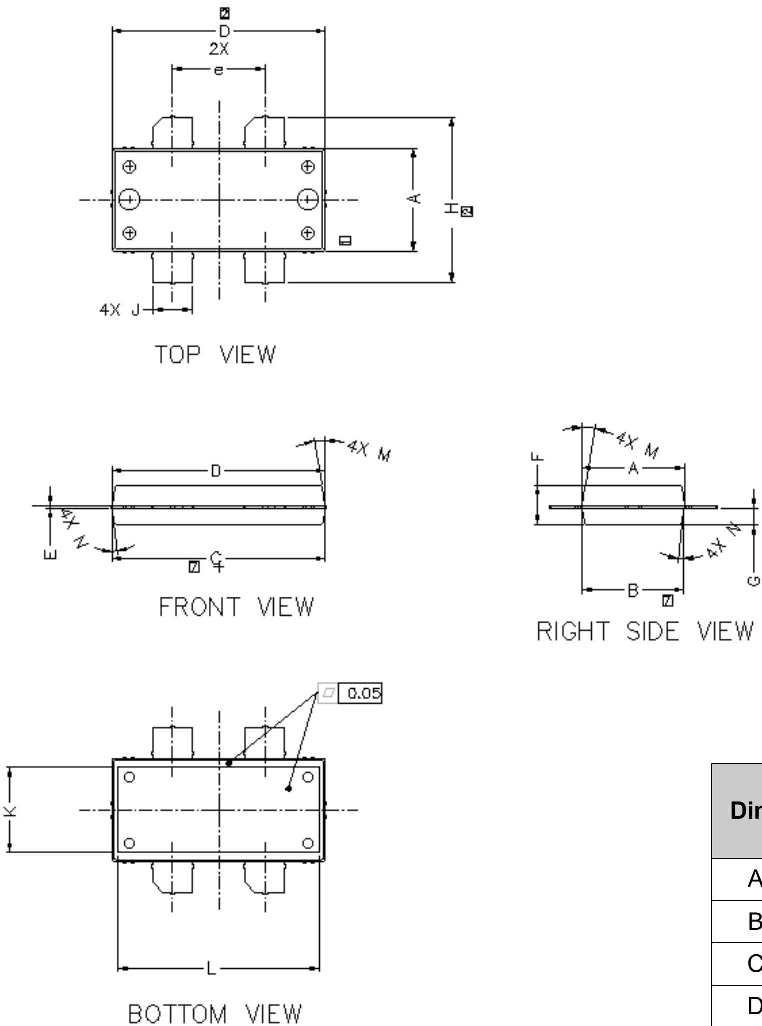

***Gain***




***Large Signal S11***



## Lead-Free Outline Drawing†




Remarks:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994
2. Mold/Dam Bar/Metal protrusion of 0.30mm max per side not included.
3. Metal protrusions are connected to source and shall not exceed 0.10mm max.
4. Fillets and radii:- Unless otherwise noted all radii are 0.30mm max.
5. Molded package Ra 1.2-1.6um.
6. All metal surfaces are tin plated, except area of cut.
7. Does not include Mold/Dam Bar and Metal protrusion.

| Dim. | Inches | | | Millimeters | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.390 | 0.392 | 0.394 | 9.91 | 9.96 | 10.01 |
| B | 0.383 | 0.385 | 0.387 | 9.73 | 9.78 | 9.83 |
| C | 0.808 | 0.810 | 0.812 | 20.52 | 20.57 | 20.62 |
| D | 0.808 | 0.810 | 0.812 | 20.52 | 20.57 | 20.62 |
| E | 0.007 | 0.010 | 0.013 | 0.17 | 0.25 | 0.33 |
| F | 0.148 | 0.150 | 0.152 | 3.76 | 3.81 | 3.86 |
| G | 0.060 | 0.062 | 0.064 | 1.52 | 1.57 | 1.62 |
| H | 0.624 | 0.628 | 0.632 | 15.86 | 15.96 | 16.06 |
| J | 0.148 | 0.150 | 0.152 | 3.76 | 3.81 | 3.86 |
| K | — | 0.325 | — | — | 8.25 | — |
| L | — | 0.764 | — | — | 19.4 | — |
| M | — | 10°±1° | — | — | 10°±1° | — |
| N | — | 7°±1° | — | — | 7°±1° | — |
| e | — | 0.350 | — | — | 8.89 | — |