# TGM2635-CP

## X-Band 100 W GaN Power Amplifier

## Product Overview

Qorvo's TGM2635–CP is a packaged X-band, high power amplifier fabricated on Qorvo's production 0.25um GaN on SiC process. The TGM2635–CP operates from 7.9 – 11 GHz and provides 100 W of saturated output power with 22.5 dB of large signal gain and greater than 35 % power–added efficiency.

The TGM2635-CP is packaged in a 10-lead 19.05 x 19.05 mm bolt-down package with a pure Cu base for superior thermal management. Both RF ports are internally DC blocked and matched to 50 ohms allowing for simple system integration.

The TGM2635-CP is ideally suited for both commercial and military X-Band radar systems, satellite communications systems, and data links.

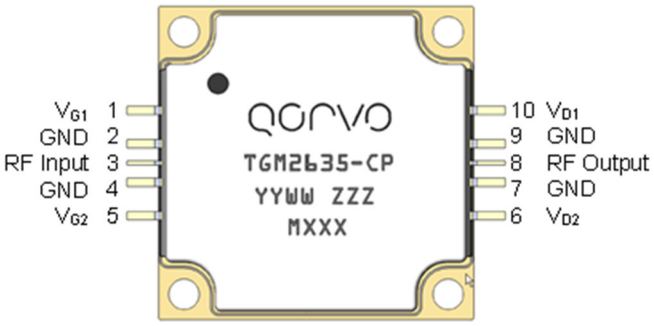
Lead-free and RoHS compliant.

Evaluation boards are available upon request.


## Key Features

- Frequency Range: 7.9 – 11 GHz
- PSAT: > 50 dBm (PIN = 28 dBm)
- PAE: > 35% (PIN = 28 dBm)
- Large Signal Gain: > 22 dB (PIN = 28 dBm)
- Small Signal Gain: > 26 dB
- Bias: VD = 28 V, IDQ = 1.3 A, VG = -2.6 V Typical
- Package Dimensions: 19.05 x 19.05 x 4.52 mm
- Performance Under Pulsed Operation

## Functional Block Diagram




Top View

## Applications

- X-band Radar
- Satellite Communications
- Data Links

## Ordering Information

| Part | ECCN | Description |
|---|---|---|
| TGM2635-CP | 3A001.b.2.b | X-band 100 W GaN Power Amplifier |

## Absolute Maximum Ratings

| Parameter | Rating |
|---|---|
| Drain Voltage (VD) | 40 V |
| Gate Voltage Range (VG) | -8 to -0 V |
| Drain Current (ID) | 16 A |
| Gate Current (IG) at TCH = 200 °C | -52 / 124 mA |
| Power Dissipation (PDISS), 85°C, Pulsed; PW = 100 us, DC = 10% | 316 W |
| Input Power (PIN), 50 Ω, 85°C , VD = 28 V, Pulsed; PW = 100 us, DC = 10% | 33 dBm |
| Input Power (PIN), 85°C, VSWR 3:1, VD = 28 V, Pulsed; PW = 100 us, DC = 10% | 33 dBm |
| Channel Temperature ($T_{CH}$) | 275 °C |
| Mounting Temperature (30 seconds) | 260 °C |
| Storage Temperature | -55 to 150 °C |

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

## Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Drain Voltage ($V_D$) | | 28 | | V |
| Drain Current ($I_{DQ}$, total) | | 1.3 | | A |
| Gate Voltage ($V_G$) | | -2.6 | | V |
| Operating Temperature Range | –40 | | 85 | °C |

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

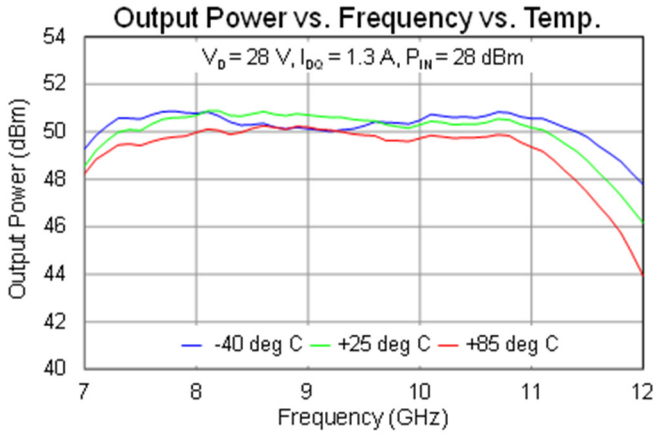
## Electrical Specifications

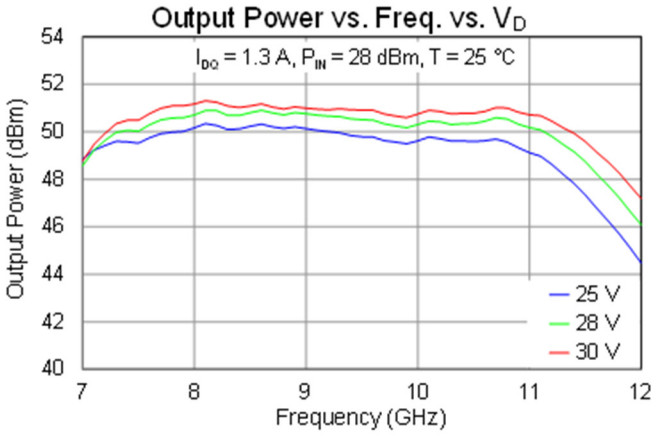
| Parameter | Conditions [1] | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Frequency Range | | 7.9 | | 11.0 | GHz |
| Output Power | $P_{IN}$ = 28 dBm, Pulsed<br>8 GHz<br>9 GHz<br>10 GHz<br>11 GHz | <br>50.0<br>50.0<br>49.5<br>49.5 | <br>51.0<br>51.0<br>51.0<br>51.0 | | dBm |
| Power Added Efficiency | $P_{IN}$ = 28 dBm, Pulsed<br>8 GHz<br>9 GHz<br>10 GHz<br>11 GHz | <br>37<br>33<br>35<br>33 | <br>41<br>41<br>41<br>41 | | % |
| Power Gain | $P_{IN}$ = 28 dBm, Pulsed | | 23 | | dB |
| Output Power Temperature Coefficient | Temp: 25 °C to 85 °C, $P_{IN}$ = 28 dBm) | | –0.010 | | dB/°C |
| Input Return Loss | | | 12 | | dB |
| Output Return Loss | | | 12 | | dB |
| Small Signal Gain | | | 26 | | dB |
| Recommended Operating Voltage | | 20 | 28 | 30 | V |

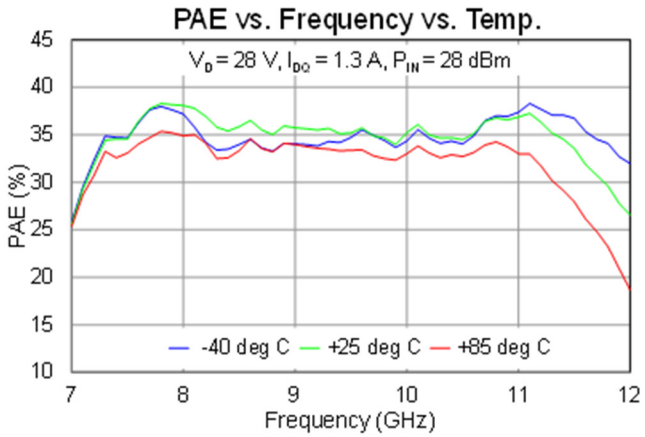
Notes:
1. Test conditions unless otherwise noted: 25 °C , $V_D$ = 28 V, $I_{DQ}$ = 1.3 A, $V_G$ = -2.6 V typical, PW = 100 us, Duty Cycle = 10%

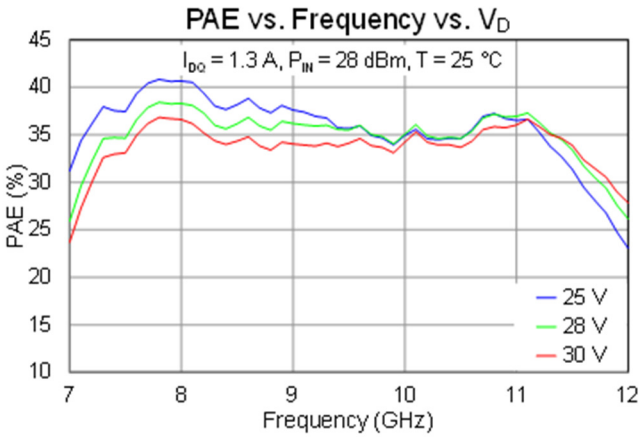
## Performance Plots – Large Signal (Pulsed)

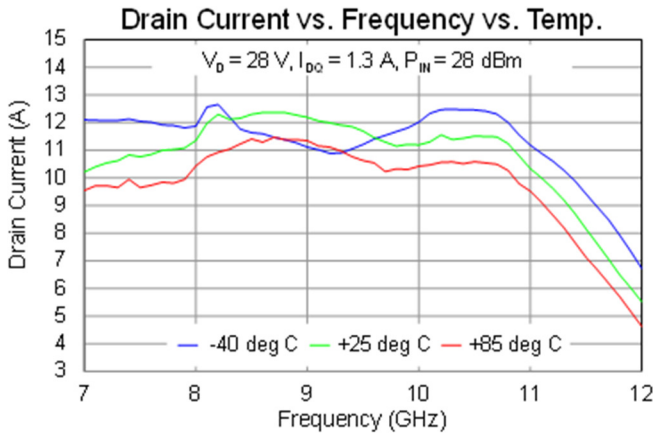
Test conditions unless otherwise noted: 25 °C , $V_D$ = 28 V, $I_{DQ}$ = 1.3 A, PW = 100 us, Duty Cycle = 10%

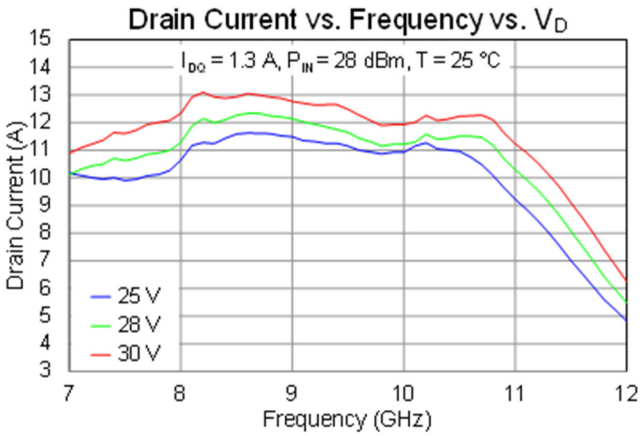


## Performance Plots – Large Signal (Pulsed)

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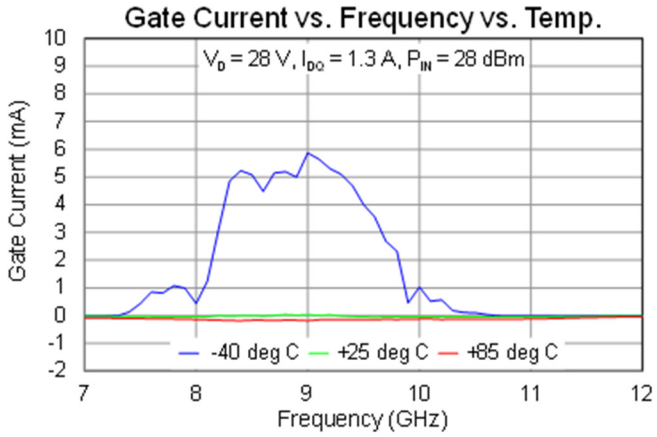


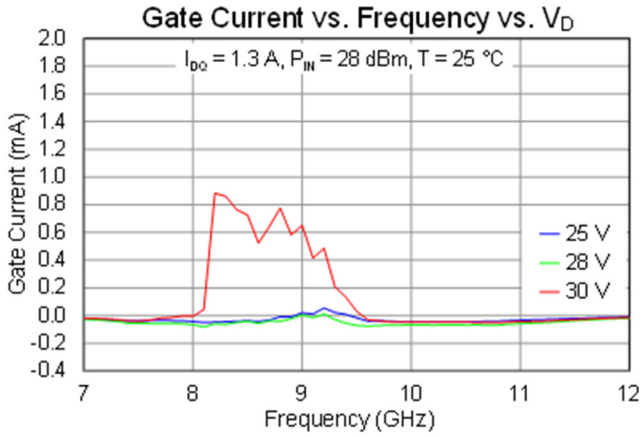


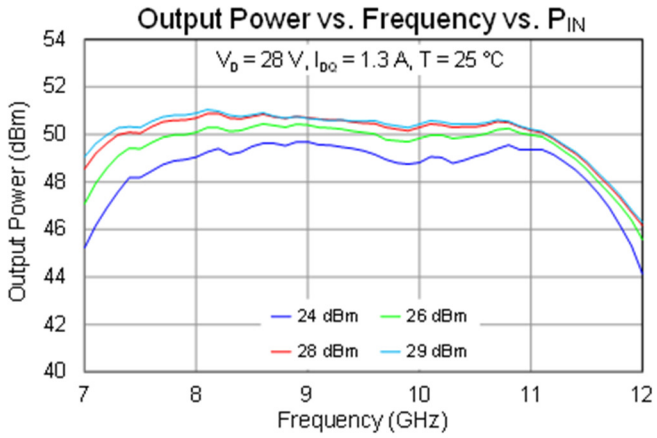


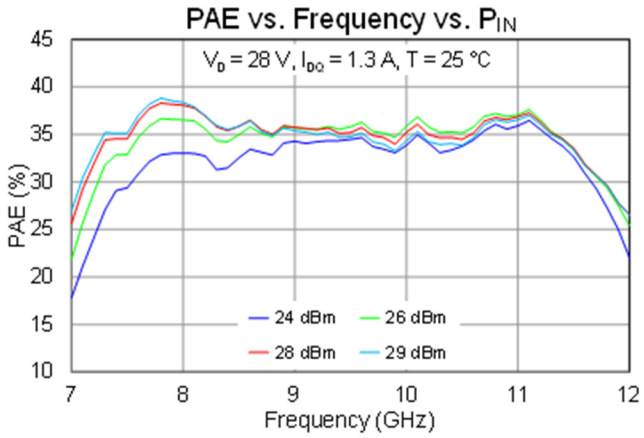


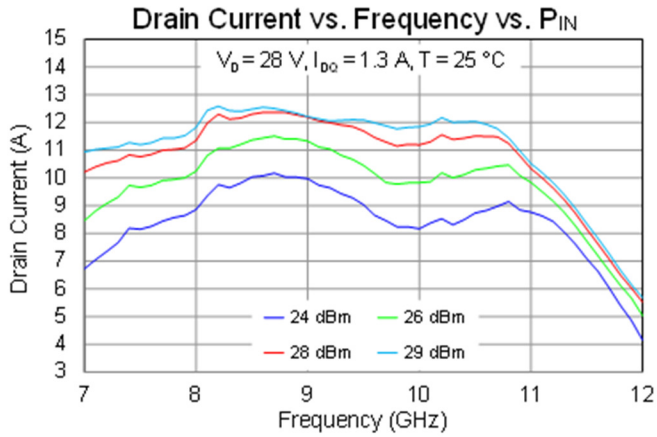


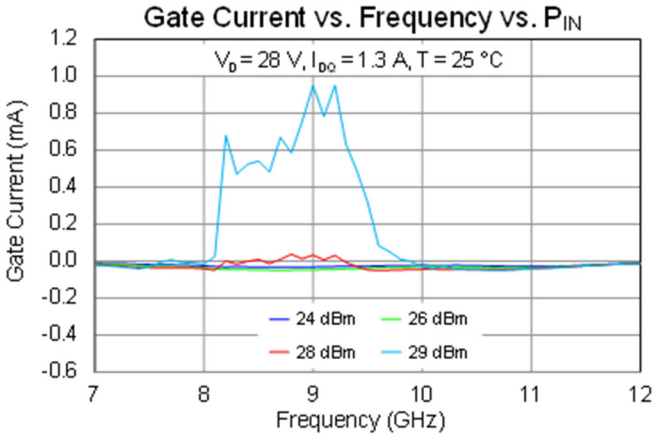

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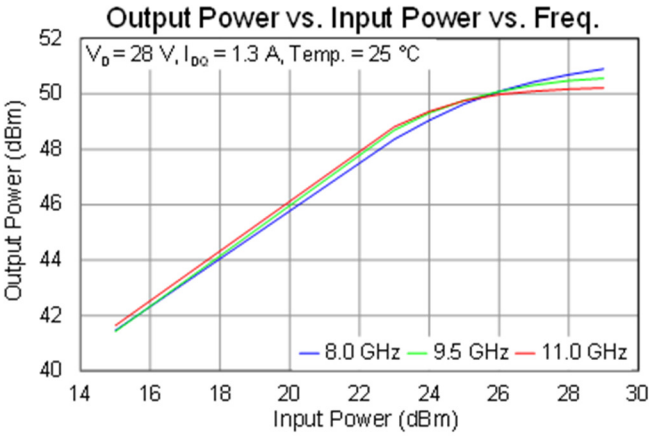


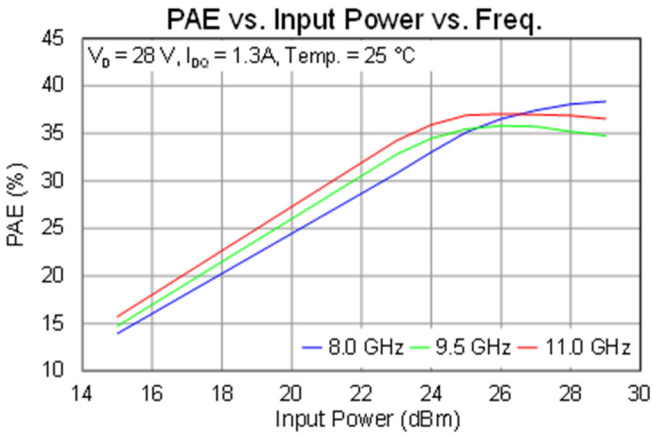


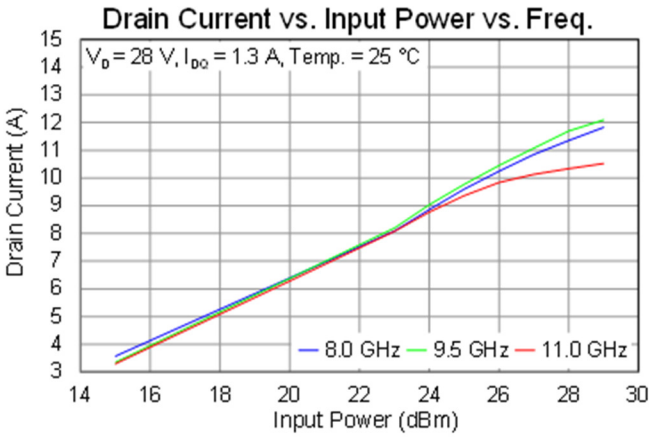


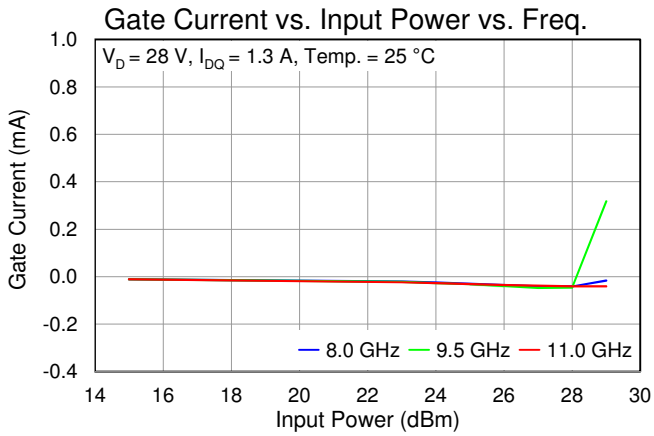

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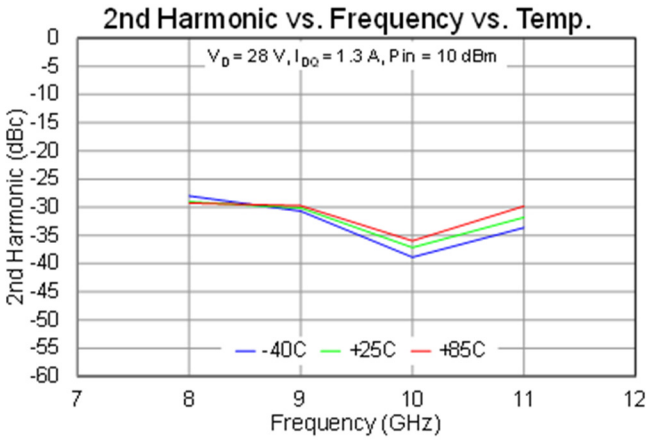
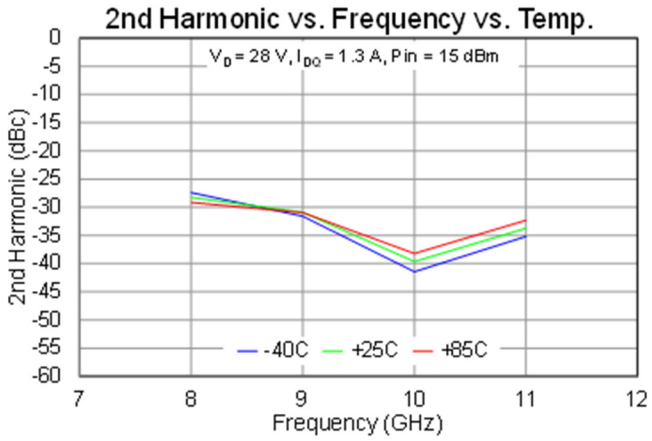
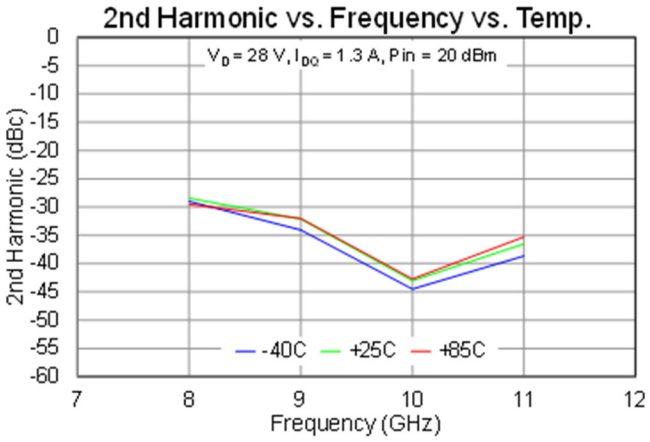
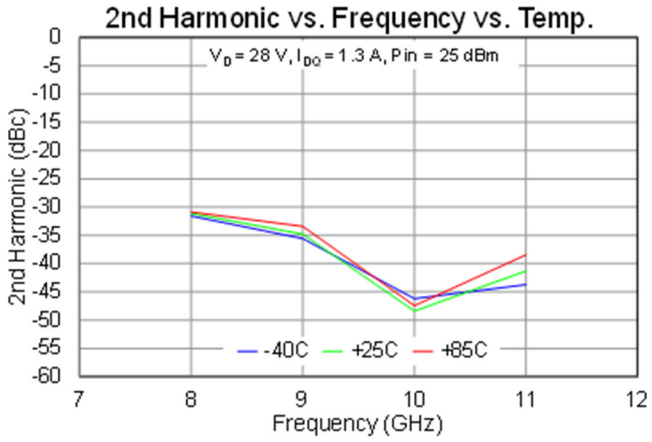
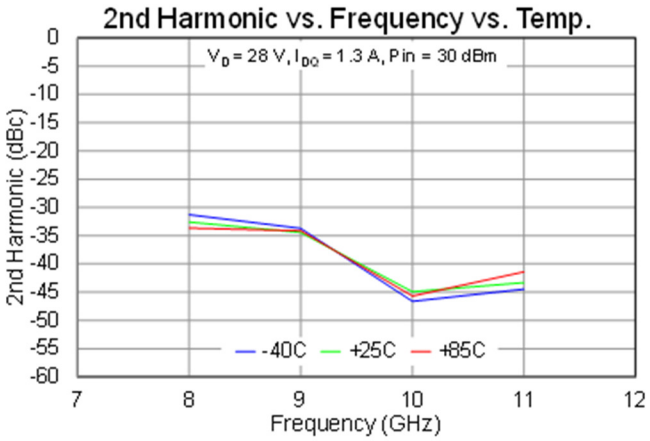
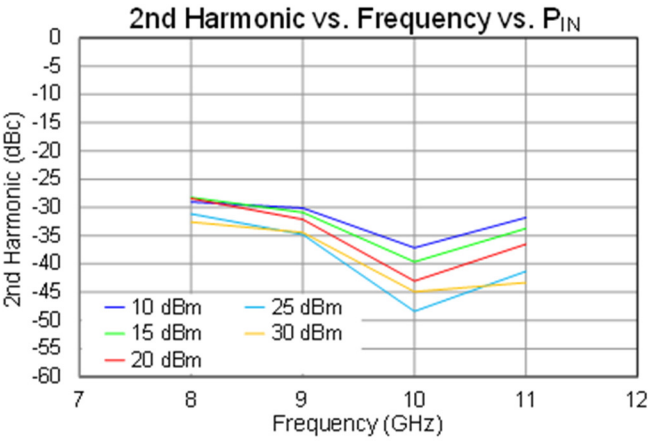


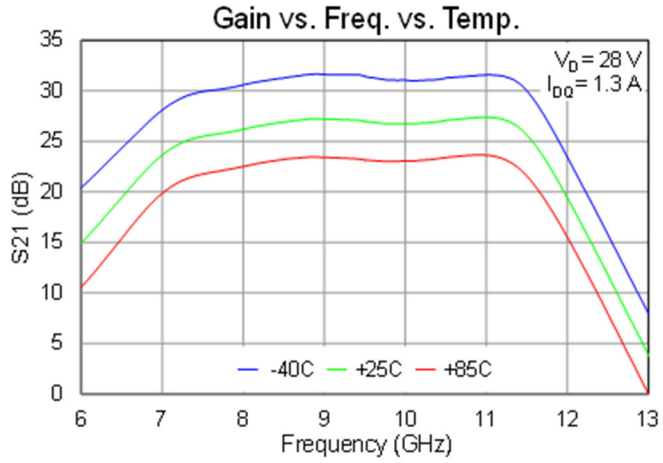



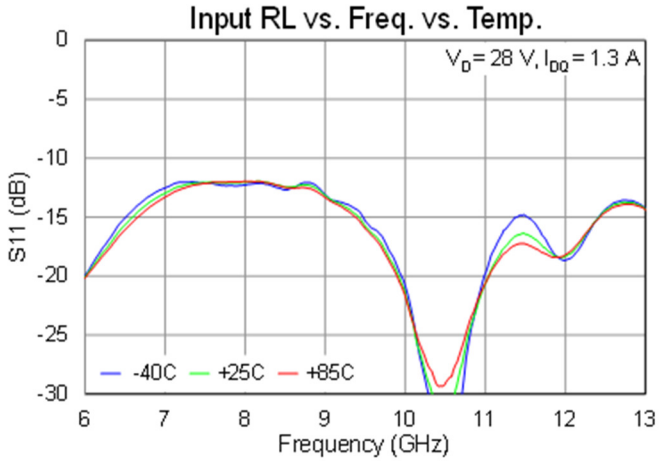



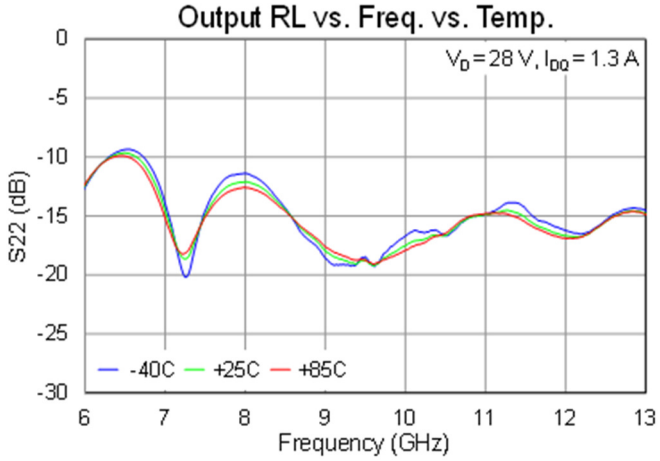



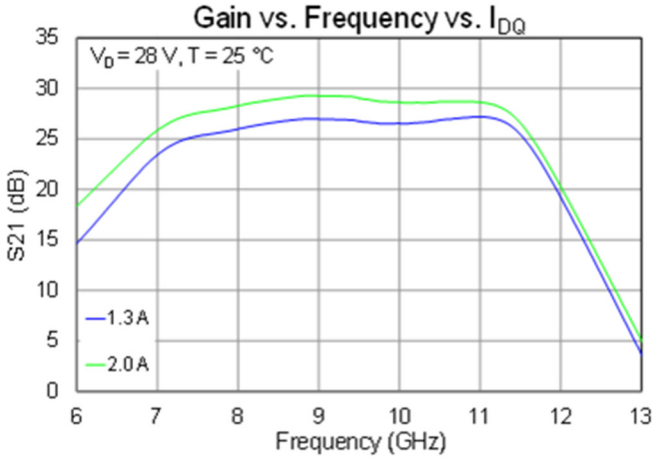
## Performance Plots – Small Signal (CW)

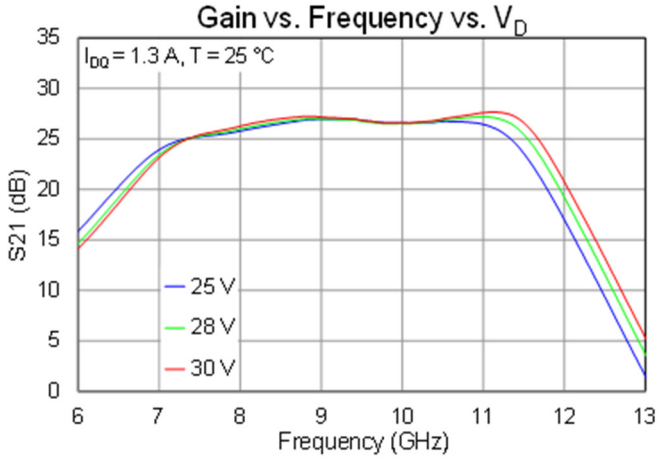
Test conditions unless otherwise noted: 25 °C , $V_D$ = 28 V



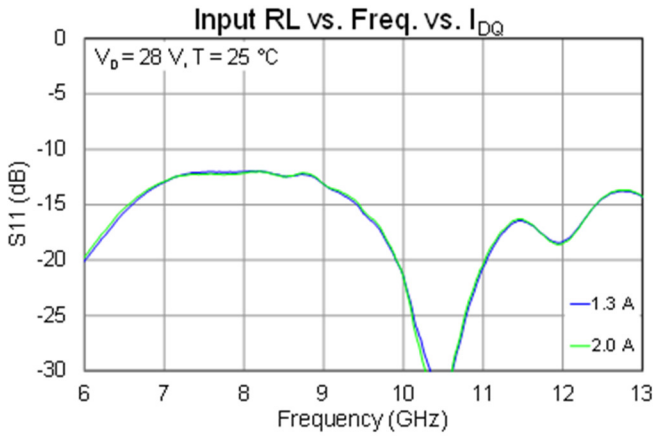



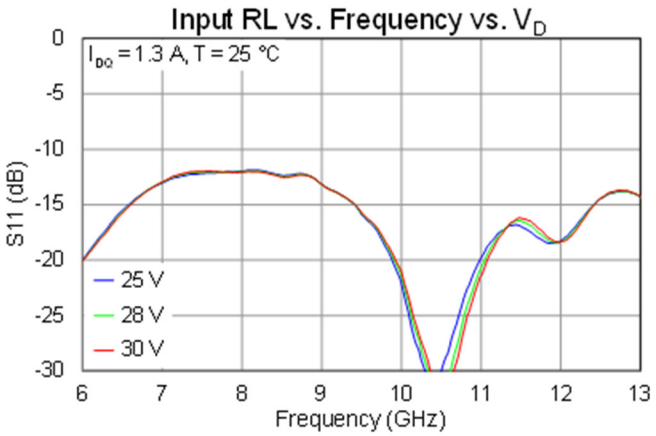



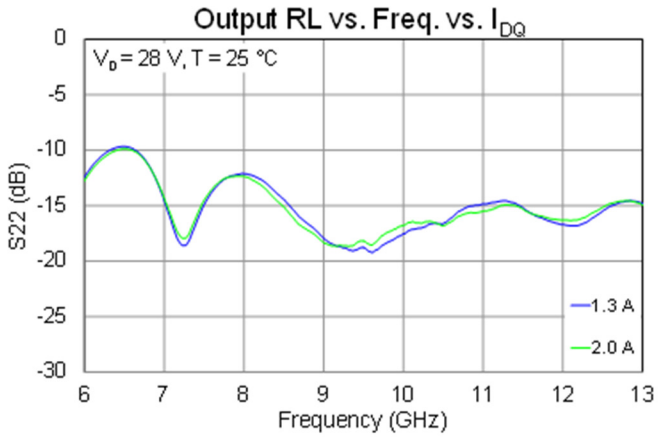



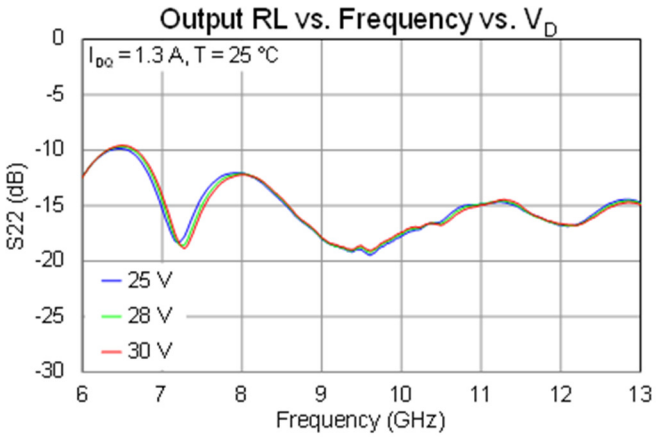
## Performance Plots – Small Signal (CW)

Test conditions unless otherwise noted: 25 °C , $V_D$ = 28 V



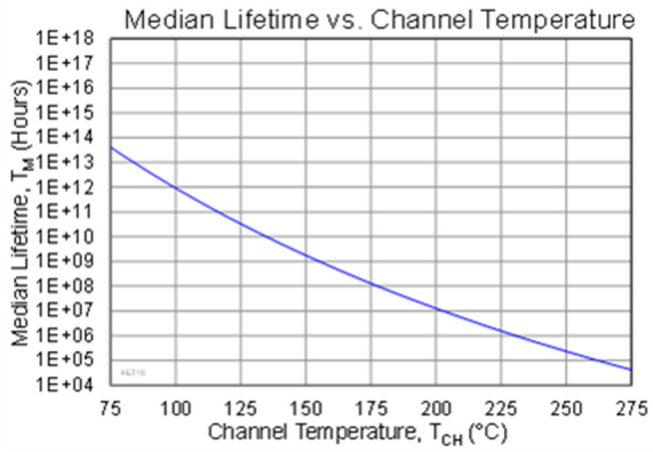
## Thermal and Reliability Information

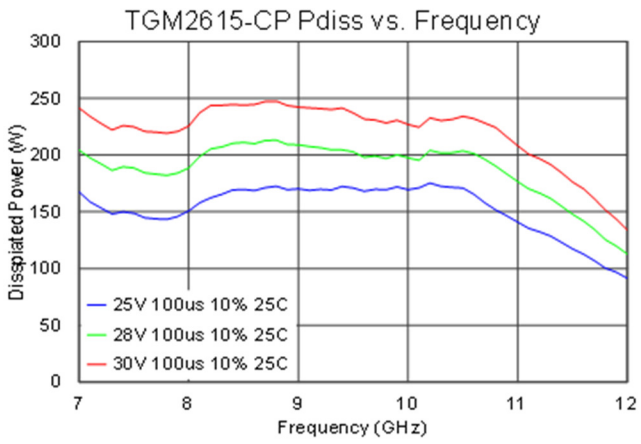
| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$) (1) | $T_{Base}$ = 85 °C<br>$V_D$ = 28 V, $I_{DQ}$ = 1.3 A<br>$P_{DISS}$ = 36.4 W | 0.30 | °C/W |
| Channel Temperature, $T_{CH}$ (No RF drive) | | 96 | °C |
| Median Lifetime ($T_M$) | | 162E12 | Hrs |
| Thermal Resistance ($\theta_{JC}$) (1) | $T_{Base}$ = 85 °C, $V_D$ = 28 V, $I_{DQ}$ = 1.3 A, Freq = 9.0 GHz,<br>$I_{D\_Drive}$ = 11 A, $P_{IN}$ = 28 dBm, $P_{OUT}$ = 50.0 dBm, $P_{DISS}$ =<br>173 W, PW = 100 us, DC = 10% | 0.33 | °C/W |
| Channel Temperature, $T_{CH}$ (Under RF) | | 142 | °C |
| Median Lifetime ($T_M$) | | 4.31E09 | Hrs |
| Thermal Resistance ($\theta_{JC}$) (1) | $T_{Base}$ = 85 °C, $V_D$ = 28 V, $I_{DQ}$ = 1.3 A, Freq = 9.0 GHz,<br>$I_{D\_Drive}$ = 12 A, $P_{IN}$ = 31 dBm, $P_{OUT}$ = 50.5 dBm, $P_{DISS}$ =<br>195 W, PW = 100 us, DC = 10% | 0.34 | °C/W |
| Channel Temperature, $T_{CH}$ (Under RF) | | 150 | °C |
| Median Lifetime ($T_M$) | | 175E09 | Hrs |

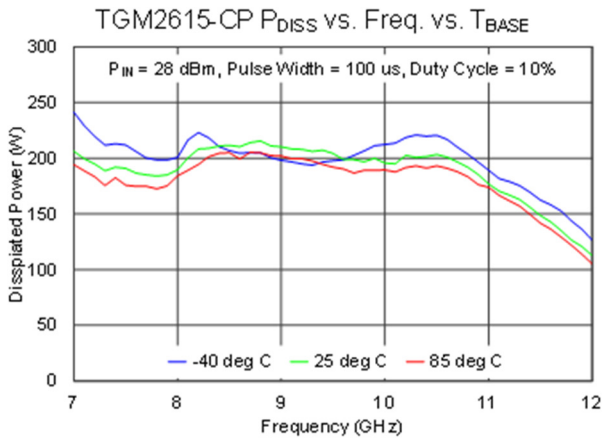
Notes:
1. Thermal resistance measured at back of package.

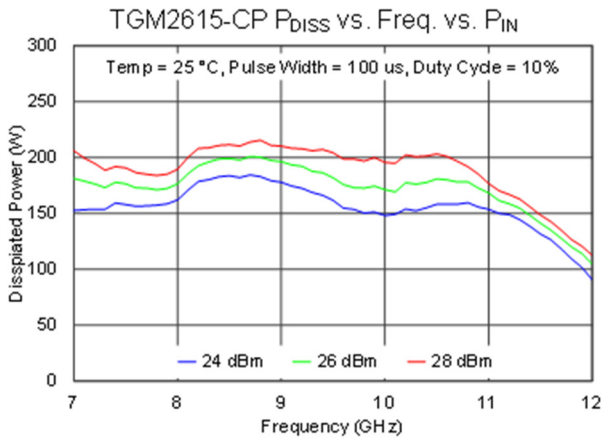
## Median Lifetime

Test Conditions: $V_D$ = +40 V; Failure Criteria is 10% reduction in $I_{D\_MAX}$

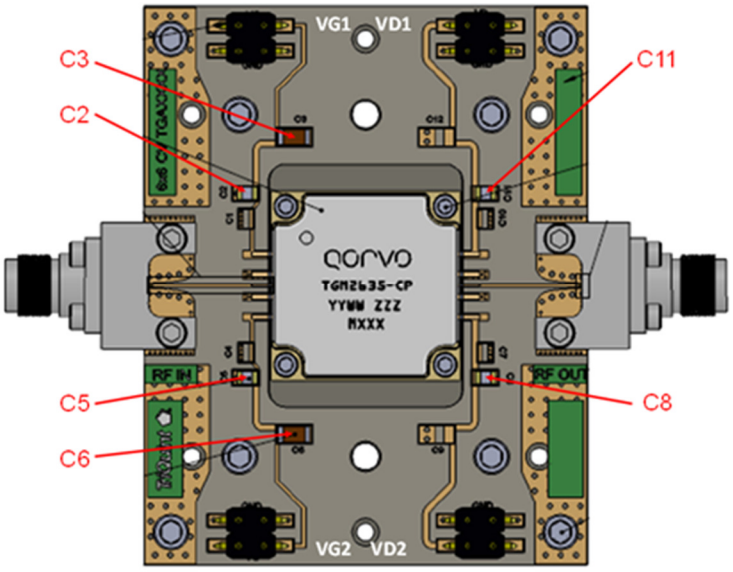


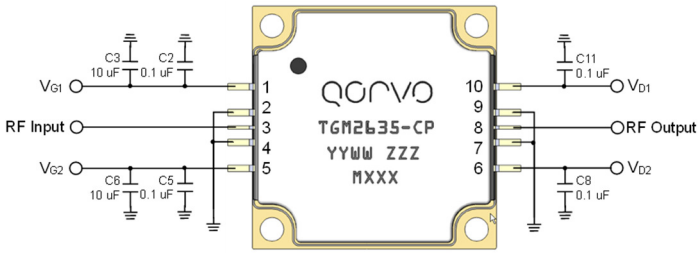



## Evaluation Board (EVB) and Application Circuit




Notes:
1. See Evaluation Board PCB Information for material and stack up.
2. Part requires biasing from both sides of the EVB.

## Bill of Material

| Ref. Des. | Value | Description | Manuf. | Part Number |
|---|---|---|---|---|
| n/a | n/a | Printed Circuit Board | Qorvo | |
| U1 | n/a | X-Band 100 W GaN Power Amplifier | Qorvo | TGM2635-CP |
| C3, C6 | 10 uF, ±20 %, 50 V (1206), X5R | Surface Mount Cap | Various | |
| C2, C5, C8, C11 | 0.1 uF, ±10 %, 50 V (0805), X7R | Surface Mount Cap | Various | |
| J1, J2 | 2.92 mm | 2.92 mm End Launch Connector | Southwest Microwave | 1092-02A-5 |

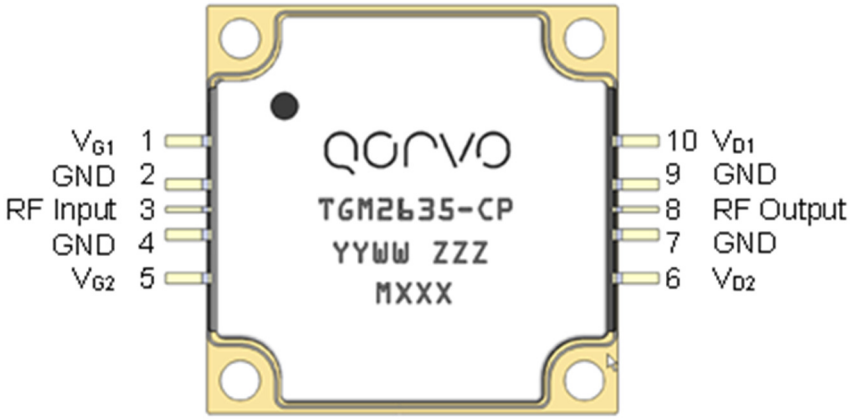
## EVB Bias-Up Procedure

1. Set $I_D$ limit to 16 A, $I_G$ limit to 124 mA
2. Set $V_G$ to –5.0 V
3. Set $V_D$ +28 V
4. Adjust $V_G$ more positive until $I_{DQ}$ = 1.3 A ($V_G$ ~ –2.6 V Typical)
5. Apply RF signal

## EVB Bias-Down Procedure

1. Turn off RF signal
2. Reduce $V_G$ to –5.0V. Ensure $I_{DQ}$ ~ 0mA
3. Set $V_D$ to 0V
4. Turn off $V_D$ supply
5. Turn off $V_G$ supply

## Pad Configuration and Description



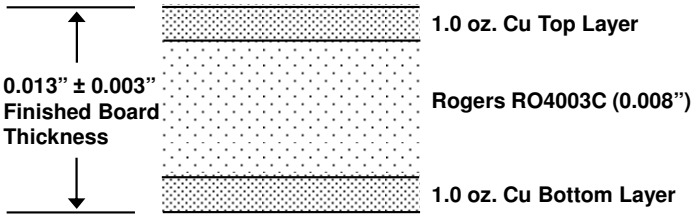

Top View

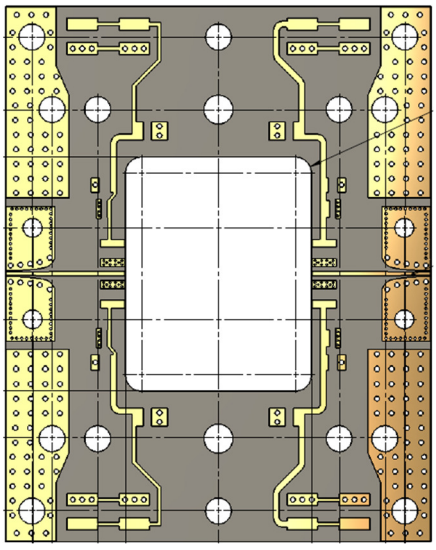
| Pad No. | Label | Description |
|---|---|---|
| 1 | $V_{G1}$ | Gate voltage stage 1. Bias network is required; see Application Circuit as an example |
| 2, 4, 7, 9 | GND | RF Ground |
| 3 | RF Input | RF Input; matched to 50Ω; DC Blocked |
| 5 | $V_{G2}$ | Gate voltage stage 2. Bias network is required; see Application Circuit as an example |
| 6 | $V_{D2}$ | Drain voltage stage 2. Bias network is required; see Application Circuit as an example. |
| 8 | RF Output | RF Output; matched to 50Ω; DC Blocked, DC Shorted |
| 10 | $V_{D1}$ | Drain voltage stage 1. Bias network is required; see Application Circuit as an example |

## Evaluation Board PCB Information

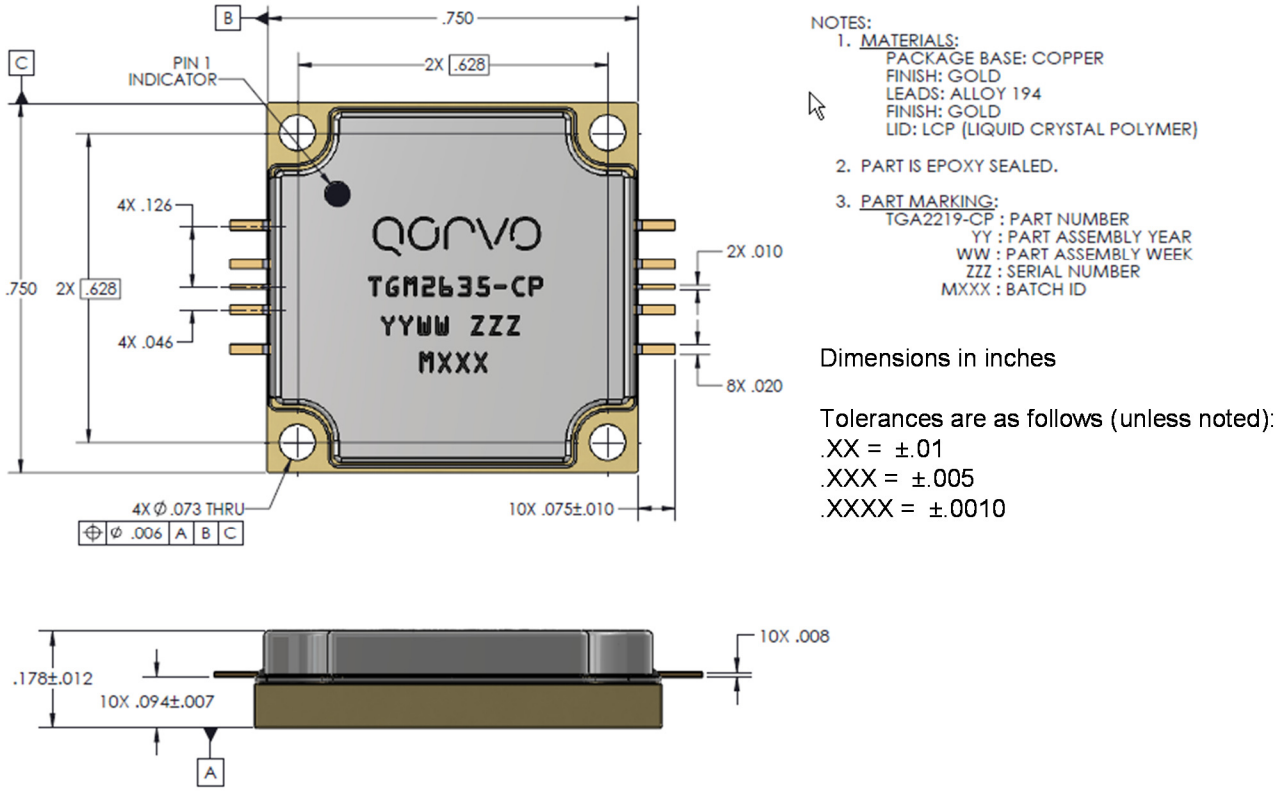
### EVB PC Board Layout

**PCB Material Stack-up**



## Package Marking and Dimensions




NOTES:
1. MATERIALS:
   PACKAGE BASE: COPPER
   FINISH: GOLD
   LEADS: ALLOY 194
   FINISH: GOLD
   LID: LCP (LIQUID CRYSTAL POLYMER)
2. PART IS EPOXY SEALED.
3. PART MARKING:
   TGA2219-CP : PART NUMBER
   YY : PART ASSEMBLY YEAR
   WW : PART ASSEMBLY WEEK
   ZZZ : SERIAL NUMBER
   MXXX : BATCH ID

Dimensions in inches

Tolerances are as follows (unless noted):
.XX = ±.01
.XXX = ±.005
.XXXX = ±.0010

Notes:
1. Contact plating: Ni – Au

## Assembly Notes

1. Clean the PCB, heat sink, and module with alcohol. Allow it to dry fully.
2. Nylock screws are recommended for mounting the TGM2635-CP to a heat sink.
3. To improve the thermal and RF performance, we recommend the following:
   a. Mount the part to a high thermal conductivity heat sink.
   b. Apply Arctic Silver thermal compound or a 4 mils thick indium shim between the package and the heat sink.
   c. Do not mount the part to a PCB, even when using thermal vias.
4. Apply solder to each pin of the TGM2635-CP.
5. Clean the assembly with alcohol.

## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | Class 0B | ANSI / ESDA / JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | Class C3 | ANSI / ESDA / JEDEC JS-002 |
| MSL – Moisture Sensitivity Level | Level 5a | IPC/JEDEC J-STD-020 |

Caution!
ESD-Sensitive Device

## Solderability

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes.
Solder profiles available upon request.
Contact plating: Ni – Au

## RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free


## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

**Web:** www.qorvo.com
**Tel:** 1-844-890-8163
**Email:** customer.support@qorvo.com

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