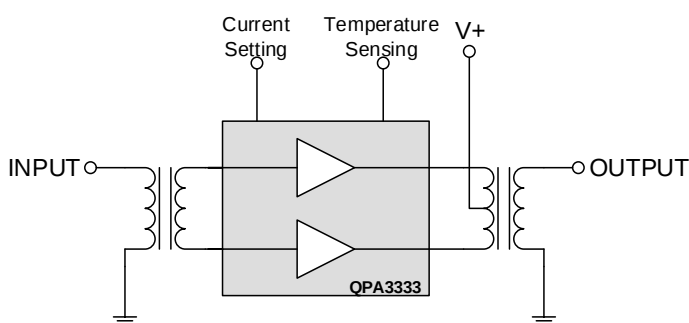


### Product Description

The QPA3333 is a Power Doubler amplifier SMD Module. The part employs GaAs MESFET, GaAs pHEMT and GaN HEMT die and is operated from 45MHz to 1218MHz. It provides excellent linearity and superior return loss performance with low noise and optimal reliability. DC current of the device can be externally adjusted for optimum distortion performance versus power consumption over a wide range of output level.

### Functional Block Diagram



9 pin, 11.0 mm x 8.5 mm x 1.375 mm package

### Product Features

- Excellent Linearity
- Superior Return Loss Performance
- Extremely Low Distortion
- Optimal Reliability
- Low Noise
- Unconditionally Stable Under all Terminations
- 27.0dB Min Gain at 1218 MHz
- 470mA max at 24 VDC

### Applications

- 45 – 1218 MHz CATV Amplifier Systems

### Ordering Information

| Part No.        | Description                      |
|-----------------|----------------------------------|
| QPA3333SB       | Sample bag 5 pcs                 |
| QPA3333SQ       | Sample bag 25 pcs                |
| QPA3333SR       | 7" Reel with 100 pcs             |
| QPA3333TR7      | 7" Reel with 500 pcs             |
| QPA3333TR13     | 13" Reel with 1000 pcs           |
| QPA3333PCBA-410 | Fully assembled Evaluation Board |

## Absolute Maximum Ratings

| Parameter                                              | Value / Range  |
|--------------------------------------------------------|----------------|
| DC Supply over-voltage (5 minutes)                     | +30V           |
| Storage Temperature                                    | -40 to +100 °C |
| Operating Mounting Base Temperature                    | -30 to +100 °C |
| Moisture Sensitivity Level<br>IPC/JEDEC J-STD-20       | MSL3 @ 260 °C  |
| RF Input Voltage (single tone; on<br>Evaluation Board) | 75dBmV         |

Operation of this device outside the parameter ranges given above may cause permanent damage.

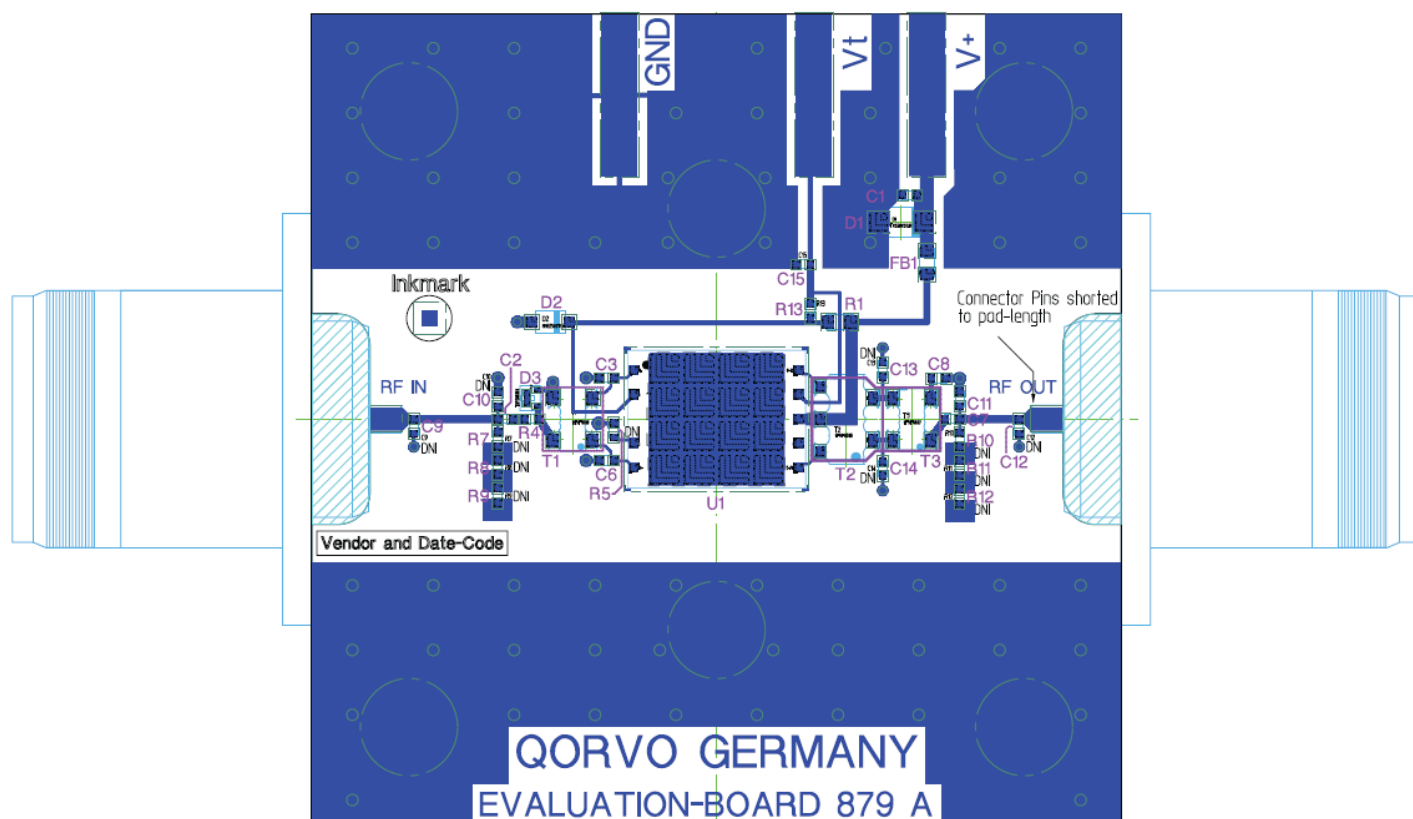
## Electrical Specifications

| Parameter                              | Conditions (V+=24V, TMB=30°C, ZS=ZL=75Ω, Pin3 not connected)                                                                  | Min  | Typ  | Max  | Units |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------|------|------|-------|
| Operational Frequency Range            | –                                                                                                                             | 45   | –    | 1218 | MHz   |
| Current (I <sub>DD</sub> )             | –                                                                                                                             |      | 450  | 470  | mA    |
| Gain                                   | f <sub>0</sub> = 45 MHz                                                                                                       |      | 26.3 |      | dB    |
| Gain                                   | f <sub>0</sub> = 1218 MHz                                                                                                     | 27.0 | 27.8 | 29.0 |       |
| Gain Slope                             | 45 to 1218 MHz <sup>[1]</sup>                                                                                                 |      | 1.4  |      |       |
| Gain Flatness                          | 45 to 1218 MHz                                                                                                                |      | 0.6  |      |       |
| Input Return Loss (-S <sub>11</sub> )  | f <sub>0</sub> = 45 to 320 MHz                                                                                                | 20   |      | –    | dB    |
|                                        | f <sub>0</sub> = 320 to 640 MHz                                                                                               | 19   |      | –    |       |
|                                        | f <sub>0</sub> = 640 to 870 MHz                                                                                               | 19   |      | –    |       |
|                                        | f <sub>0</sub> = 870 to 1003 MHz                                                                                              | 17   |      | –    |       |
|                                        | f <sub>0</sub> = 1003 to 1218 MHz                                                                                             | 16   |      | –    |       |
| Output Return Loss (-S <sub>22</sub> ) | f <sub>0</sub> = 45 to 320 MHz                                                                                                | 20   |      | –    | dB    |
|                                        | f <sub>0</sub> = 320 to 640 MHz                                                                                               | 19   |      | –    |       |
|                                        | f <sub>0</sub> = 640 to 870 MHz                                                                                               | 19   |      | –    |       |
|                                        | f <sub>0</sub> = 870 to 1003 MHz                                                                                              | 17   |      | –    |       |
|                                        | f <sub>0</sub> = 1003 to 1218 MHz                                                                                             | 16   |      | –    |       |
| Noise Figure                           | f <sub>0</sub> = 50 to 1218 MHz                                                                                               |      | 4.6  | 5.0  | dB    |
| Thermal Resistance                     | Junction to Mounting Base                                                                                                     |      | 3.6  |      | K/W   |
| CTB                                    | Vo = 58dBmV at 1218MHz, 16.5dB extrapolated tilt, 79 analog channels plus 111 digital channels (-6dB offset) <sup>[2,3]</sup> |      | -80  | -76  | dBc   |
| XMOD                                   |                                                                                                                               |      | -75  | -70  | dBc   |
| CSO                                    |                                                                                                                               |      | -74  | -70  | dBc   |
| CIN                                    |                                                                                                                               | 56   | 60   |      | dB    |

### Notes:

- The slope is defined as the difference between the gain at the start frequency and the gain at the stop frequency.
- 79 analog channels, NTSC frequency raster: 55.25MHz to 547.25MHz, +41.5dBmV to +48.5dBmV tilted output level, plus 111 digital channels, -6dB offset relative to the equivalent analog carrier.
- Composite Second Order (CSO) – The CSO parameter (both sum and difference products) is defined by ANSI/SCTE 6. Composite Triple Beat (CTB) – The CTB parameter is defined by ANSI/SCTE6. Cross Modulation (XMOD) – Cross modulation (XMOD) is measured at baseband (selective voltmeter method), referenced to 100% modulation of carrier being tested, Carrier to Intermodulation Noise (CIN) – The CIN parameter is defined by ANSI/SCTE17 (Test procedure for carrier to noise)

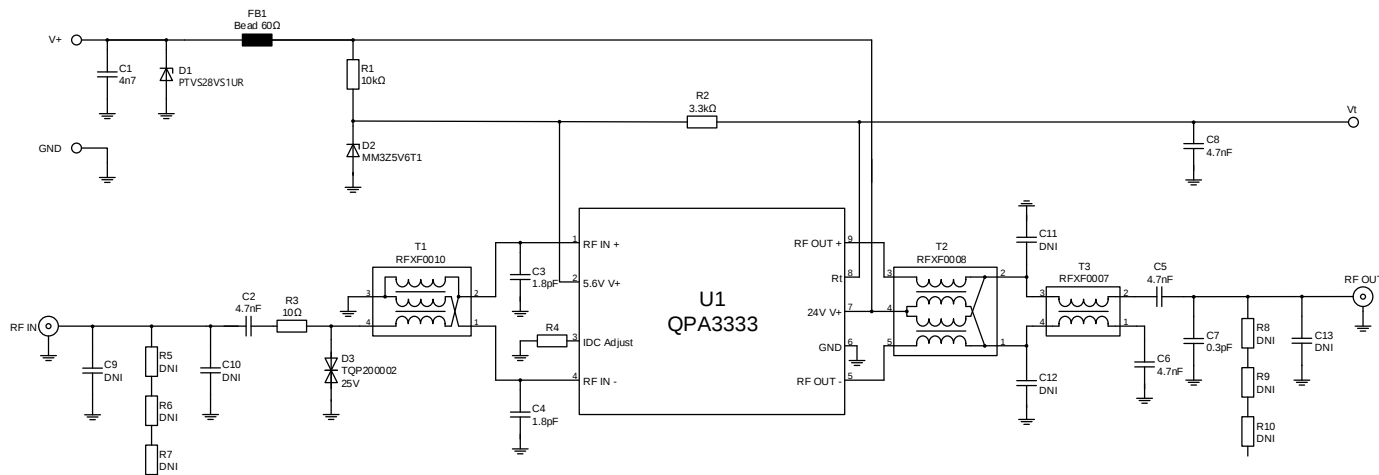
## Evaluation Board Assembly Drawing



### Note:

The ground plane of the QPA3333 module should be soldered onto a board equipped with as many thermal vias as possible. Underneath this thermal via array a heat sink with thermal grease needs to be placed which is able to dissipate the complete module DC power (up to 11.3 Watts). In any case the module backside temperature should not exceed 100°C.

## Evaluation Board Schematic



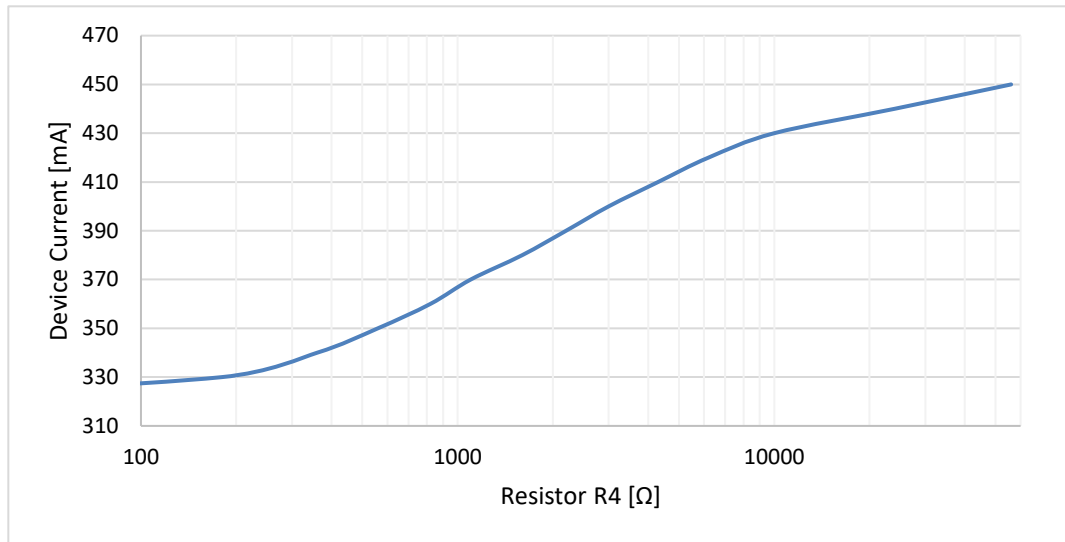
## Evaluation Board Bill of Materials (BOM)

| Reference Des.          | Value                 | Description                         | Manuf.           | Part Number    |
|-------------------------|-----------------------|-------------------------------------|------------------|----------------|
| n/a                     | n/a                   | Printed Circuit Board               | Qorvo            |                |
| C1, C2, C5, C6, C8      | 4.7nF                 | Cap., 0402, 10%, 50V, X7R           | various          |                |
| C3, C4                  | 1.8pF                 | Cap., 0402, $\pm 0.25$ pF, 50V, C0G | various          |                |
| C7                      | 0.3pF                 | Cap., 0402, $\pm 0.1$ pF, 50V, C0G  | various          |                |
| C9, C10, C11, C12, C13  | DNI                   |                                     |                  |                |
| R1                      | 10k $\Omega$          | Res., 0603, $\pm 1\%$ , TK100       | various          |                |
| R2                      | 3.3k $\Omega$         | Res., 0402, $\pm 1\%$ , TK100       | various          |                |
| R3                      | 10 $\Omega$           | Res., 0402, $\pm 1\%$ , TK100       | various          |                |
| R4                      | See page 5            | Optional to set current value       | various          |                |
| R5, R6, R7, R8, R9, R10 | DNI                   | Res., 0402, 0 $\Omega$ , TK100      | various          |                |
| FB1                     | 60 $\Omega$ at 100MHz | Impedance Bead                      | Taiyo Yuden      | BK 1608 HS 600 |
| D1                      | 28V                   | Transient Voltage Suppressor Diode  | NXP              | PTVS28VS1UR    |
| D2                      | 5.6V                  | Zener Diode                         | ON Semiconductor | MM3Z5V6T1G     |
| D3                      | 25V                   | ESD Diode                           | Qorvo / Unisem   | TQP200002      |
| T1                      | RFXF0010              | Transformer                         | Qorvo            | RFXF0010       |
| T2                      | RFXF0008              | Transformer                         | Qorvo            | RFXF0008       |
| T3                      | RFXF0007              | Transformer                         | Qorvo            | RFXF0007       |
| U1                      | QPA3333               | CATV Power Doubler Module           | Qorvo            | QPA3333        |

## Current Adjustment

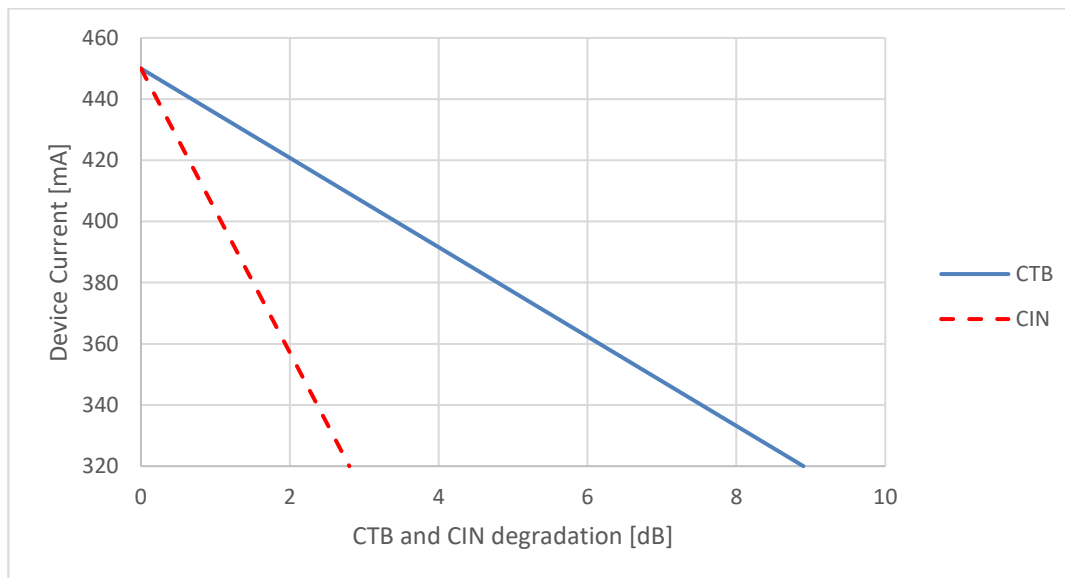
The QPA3333 can be operated over a wide range of current to provide maximum required performance with minimum current consumption. Changing the value of resistor R4 on application circuit allows a variation of the current between 450 mA and 320 mA (typ.). Within the recommended range of current between 450 mA and 320 mA gain (S21) change is less than 0.4 dB (typ.) and noise figure change is less than 0.2 dB (typ.).

### Device Current vs. Resistor R4 (typical values)



| Device Current [mA] (typical) | R4 [Ω] |
|-------------------------------|--------|
| 450                           | open   |
| 430                           | 10000  |
| 410                           | 4300   |
| 390                           | 2200   |
| 370                           | 1100   |
| 350                           | 560    |
| 330                           | 180    |
| 320                           | 0      |

### Device Current vs. Distortion Degradation (typical values)

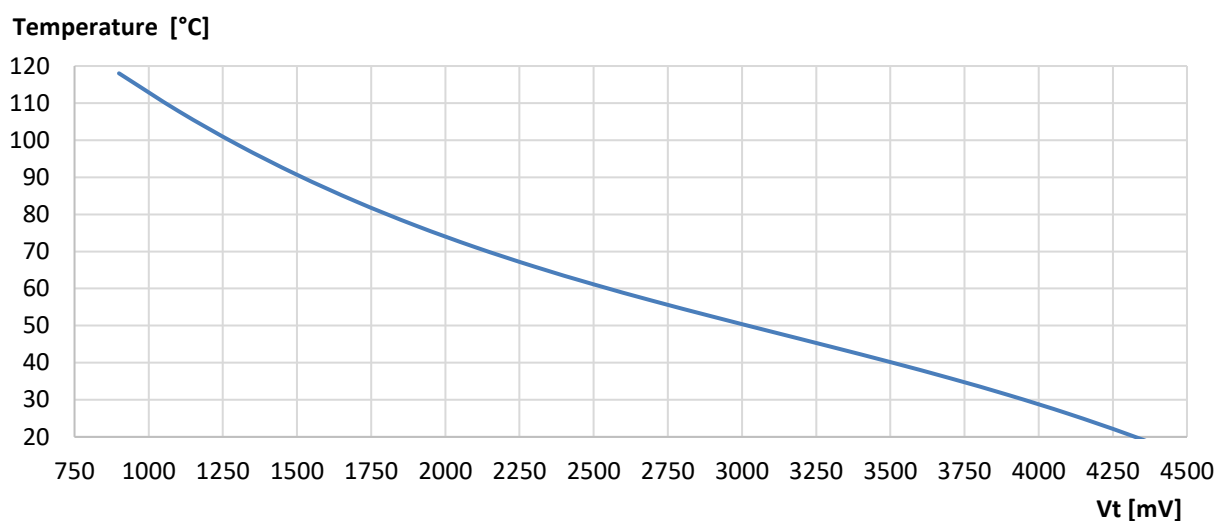


Test Condition: V+=24V, TMB=30°C, ZS=ZL=75Ω, IDC=IDC (typ.), NTSC, 79ch analog: 48.5dBmV @ 547.25 MHz; 7 dB tilt, with 111 J.83/B QAM256 channels (6 dB down)

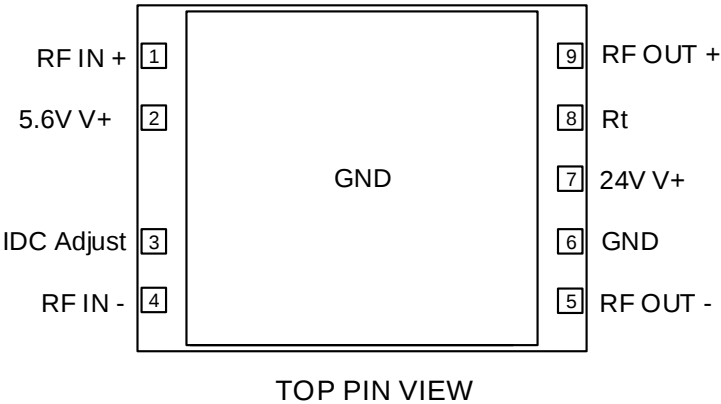
## QPA3333 Temperature Sensing Feature

The QPA3333 provides an internal NTC resistor for temperature sensing. This resistor is located right next to the output transistor stage. Within the application circuit the NTC is part of a voltage divider. The output voltage of the voltage divider ( $V_t$ ) can be correlated to the module backside temperature.

### Module Backside Temperature versus $V_t$ (typical values)



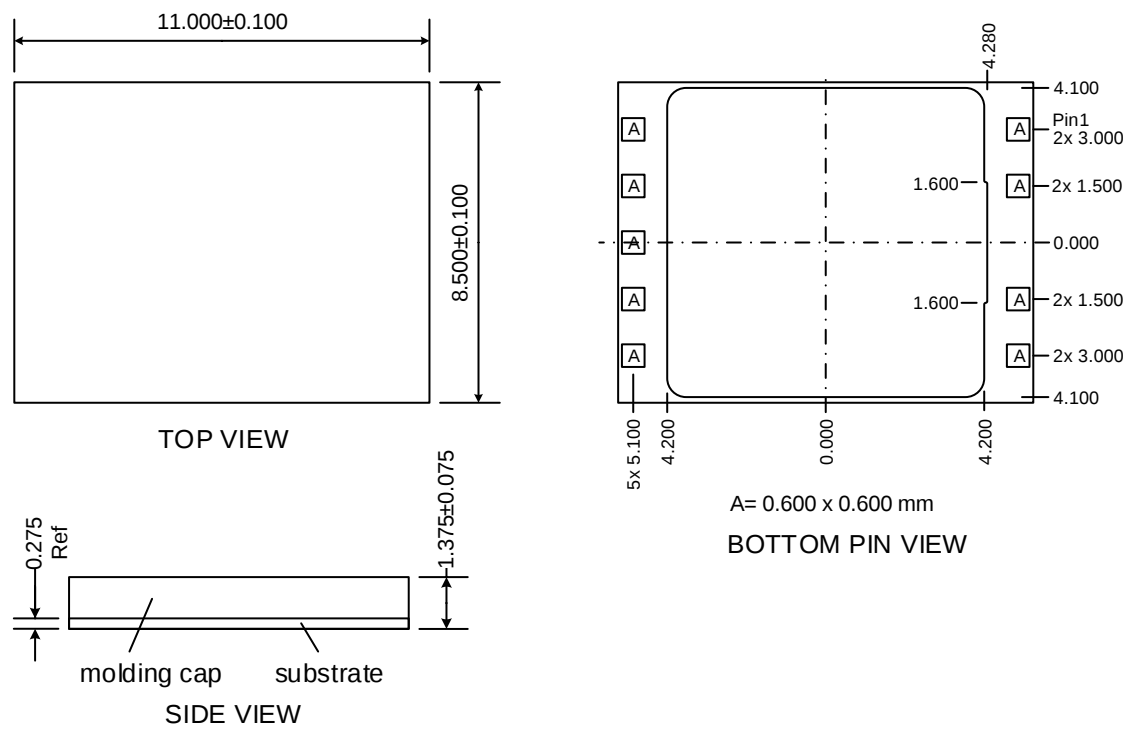
Pin Configuration



Pin Description

| Pin No. | Label      | Description                        |
|---------|------------|------------------------------------|
| 1       | RF IN (+)  | RF AMP Positive Input              |
| 2       | 5.6V V+    | Supply Voltage 5.6V                |
| 3       | IDC Adjust | Current Adjustment                 |
| 4       | RF IN (-)  | RF AMP Negative Input              |
| 5       | RF OUT (-) | RF AMP Negative Output             |
| 6       | GND        | Ground                             |
| 7       | 24V V+     | Supply Voltage 24V                 |
| 8       | Rt         | NTC Output for Temperature Sensing |
| 9       | RF OUT (+) | RF AMP Positive Output             |

Package Outline Drawing (Dimensions in millimeters)



## Handling Precautions

| Parameter                        | Rating  | Standard              |
|----------------------------------|---------|-----------------------|
| ESD – Human Body Model (HBM)     | 1B      | ANSI/ESD/JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | C3      | ANSI/ESD/JEDEC JS-002 |
| MSL – Moisture Sensitivity Level | Level 3 | 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: NiPdAu

## 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:

- Halogen Free (Chlorine, Bromine)

## Contact Information

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

Web: [www.qorvo.com](http://www.qorvo.com)

Tel: 1-844-890-8163

Email: [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

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