

### Product Overview

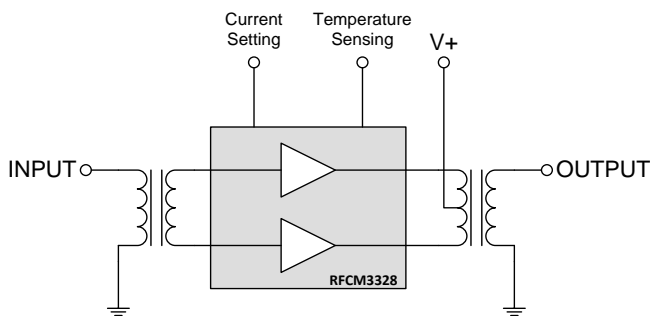
The RFCM3328 is a Power Doubler amplifier SMD Module. The part employs GaAs pHEMT die and GaN HEMT die, has high output capability, and is operated from 45 MHz to 1218 MHz. It provides excellent linearity and superior return loss performance with low noise and optimal reliability.

DC current of the device can be externally adjusted for optimum distortion performance versus power consumption over a wide range of output level.



9 pin, 9.0 mm x 8.0 mm x 1.375 mm

### Functional Block Diagram



### Key Features

- Excellent Linearity
- Superior Return Loss Performance
- Extremely Low Distortion
- Optimal Reliability
- Low Noise
- Unconditionally Stable Under all Terminations
- Extremely High Output Capability
- 25 dB Min. Gain at 1218 MHz
- 480 mA Max. at 24 VDC
- Temperature Sensing Feature

### Applications

- 45 MHz to 1218 MHz CATV Amplifier Systems

### Ordering Information

| Part No.         | Description                      |
|------------------|----------------------------------|
| RFCM3328SB       | Sample bag with 5 pieces         |
| RFCM3328SQ       | Sample bag with 25 pieces        |
| RFCM3328SR       | 7" Reel with 100 pieces          |
| RFCM3328TR7      | 7" Reel with 500 pieces          |
| RFCM3328TR13     | 13" Reel with 1000 pieces        |
| RFCM3328PCBA-410 | Fully Assembled Evaluation Board |

## Absolute Maximum Ratings

| Parameter   | Rating         |
|---|----------------|
| RF Input Voltage (single tone; on evaluation board) | 75 dBmV        |
| DC Supply Over-Voltage (5 minutes)                  | 30 V           |
| Storage Temperature                                 | -40 to +100 °C |
| Operating Mounting Base Temperature                 | -30 to +110 °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.

## Electrical Specifications

| Parameter                      | Conditions <sup>(1)</sup>   | Min  | Typ  | Max  | Units |
|--------------------------------|---|------|------|------|-------|
| Operational Frequency Range    |   | 45   |      | 1218 | MHz   |
| Power Gain                     | 45 MHz  | 23.0 | 23.5 | 24.0 | dB    |
|                                | 1218 MHz  | 25.0 | 25.5 | 26.5 | dB    |
| Slope <sup>(2)</sup>           | 45 MHz to 1218 MHz  | 1.0  | 2.0  | 3.0  | dB    |
| Flatness of Frequency Response | 45 MHz to 1218 MHz (Peak to Valley)   |      |      | 1.5  | dB    |
| Input Return Loss              | 45 MHz to 320 MHz   | -20  |      |      | dB    |
|                                | 320 MHz to 640 MHz  | -19  |      |      | dB    |
|                                | 640 MHz to 870 MHz  | -18  |      |      | dB    |
|                                | 870 MHz to 1000 MHz   | -16  |      |      | dB    |
|                                | 1000 MHz to 1218 MHz  | -15  |      |      | dB    |
| Output Return Loss             | 45 MHz to 320 MHz   | -18  |      |      | dB    |
|                                | 320 MHz to 640 MHz  | -17  |      |      | dB    |
|                                | 640 MHz to 1218 MHz   | -15  |      |      | dB    |
| Noise Figure                   | 50 MHz to 1218 MHz  |      | 2.5  | 3.5  | dB    |
| Total Current Consumption (DC) |   |      | 470  | 480  | mA    |
| Thermal Resistance             | Junction to Mounting Base   |      | 3.7  |      | K/W   |
| CTB                            | V <sub>O</sub> = 61 dBmV at 1218 MHz,<br>22 dB extrapolated tilt,<br>79 analog channels plus<br>111 digital channels (-6 dB offset) <sup>(3)(5)</sup> |      | -80  | -74  | dBc   |
| XMOD                           |   |      | -76  | -72  | dBc   |
| CSO                            |   |      | -80  | -74  | dBc   |
| CIN                            |   | 55   | 58   |      | dB    |
| CTB                            | V <sub>O</sub> = 62 dBmV at 1000 MHz,<br>18 dB extrapolated tilt,<br>79 analog channels plus<br>75 digital channels (-6 dB offset) <sup>(4)(5)</sup>  |      | -73  |      | dBc   |
| XMOD                           |   |      | -68  |      | dBc   |
| CSO                            |   |      | -68  |      | dBc   |
| CIN                            |   |      | 55   |      | dB    |

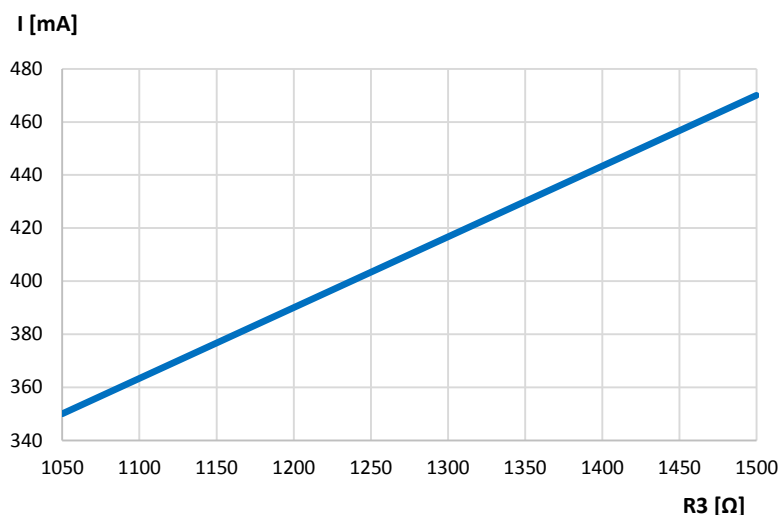
### Notes:

- Test conditions unless otherwise noted: V<sub>+</sub>=24 V, T<sub>MB</sub>=30 °C, Z<sub>S</sub>=Z<sub>L</sub>=75 Ω, I<sub>DC</sub>=I<sub>DC</sub> typical.
- 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: 55.25 MHz to 547.25 MHz, +39 dBmV to +48.3 dBmV tilted output level, plus 111 digital channels, -6 dB offset relative to the equivalent analog carrier.
- 79 analog channels, NTSC frequency raster: 55.25 MHz to 547.25 MHz, +44 dBmV to +53.4 dBmV tilted output level, plus 75 digital channels, -6 dB 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/SCTE 6. Cross Modulation (XMOD) - Cross modulation (XMOD) is measured at baseband (selective voltmeter method), referenced to 100% modulation of the carrier being tested. Carrier to Intermodulation Noise (CIN) - The CIN parameter is defined by ANSI/SCTE 17 (Test procedure for carrier to noise).

## RFCM3328 Current Adjustment

The RFCM3328 can be operated over a wide range of current to provide maximum required performance with minimum current consumption. Changing the value of resistor R3 on application circuit allows a variation of the current between 470 mA and 350 mA (typ.). Within the recommended range of current between 470 mA and 370 mA gain (S21) change is less than 0.2 dB (typ.) and noise figure change is less than 0.2 dB (typ.).

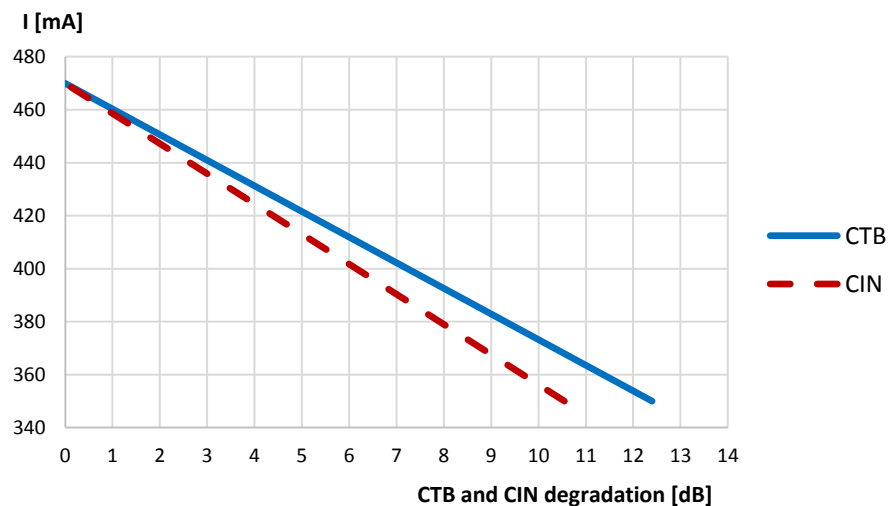
## Device Current versus Resistor R3 (typical values)



| Device Current [mA], typical | R3 [Ω] |
|------------------------------|--------|
| 470                          | 1500   |
| 430                          | 1350   |
| 390                          | 1200   |
| 350                          | 1050   |

Test conditions:  $V_{+}=24$  V,  $T_{MB}=30$  °C,  $Z_S=Z_L=75$  Ω

## Device Current versus Distortion Degradation (typical values)

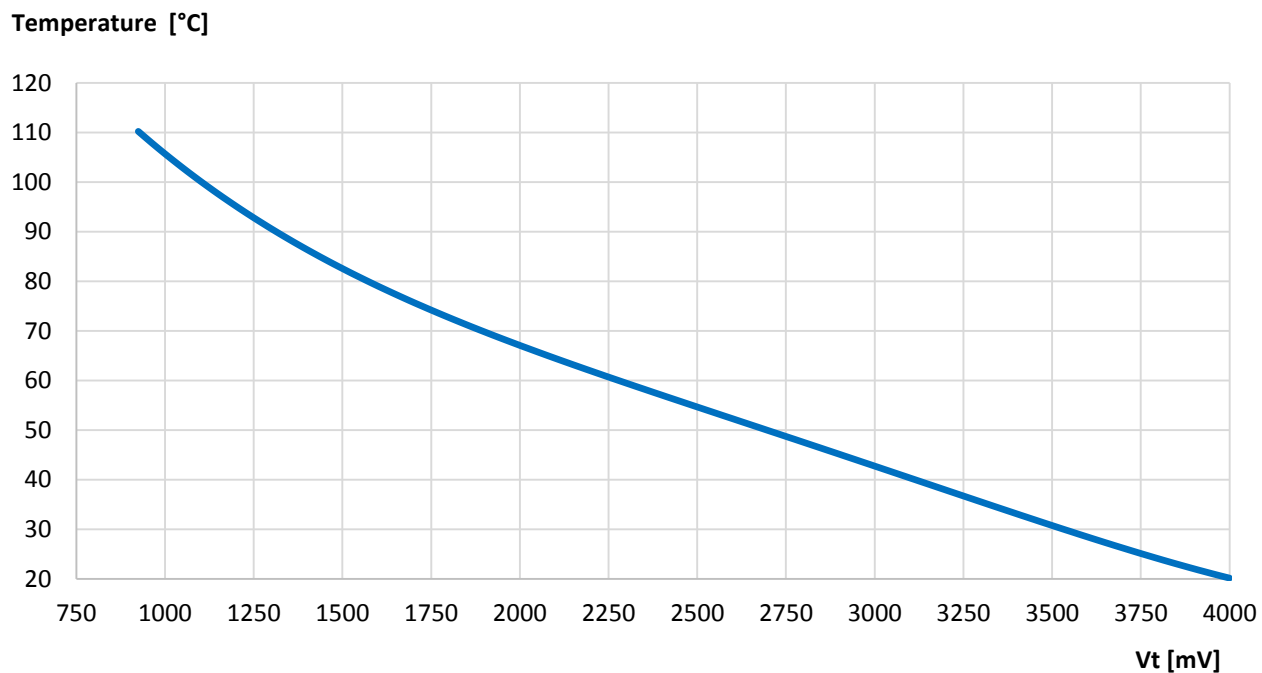


Test condition:  $V_{+}=24$  V,  $T_{MB}=30$  °C,  $Z_S=Z_L=75$  Ω;  $V_O = 61$  dBmV at 1218 MHz, 22 dB extrapolated tilt, 79 analog channels plus 111 digital channels (-6 dB offset)

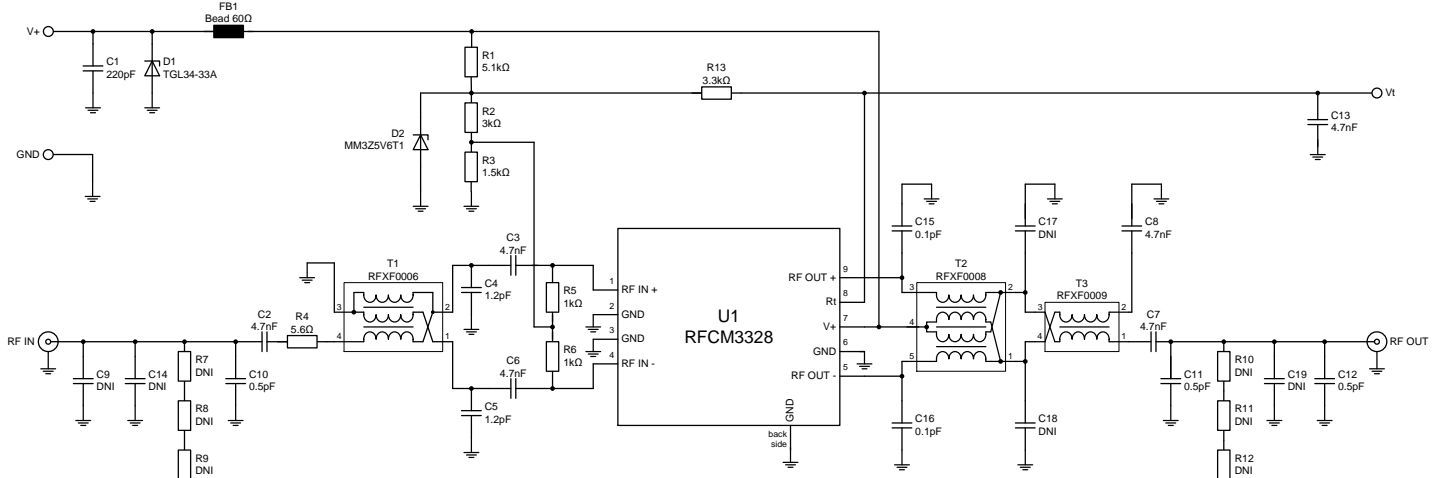
## RFCM3328 Temperature Sensing Feature

The RFCM3328 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.

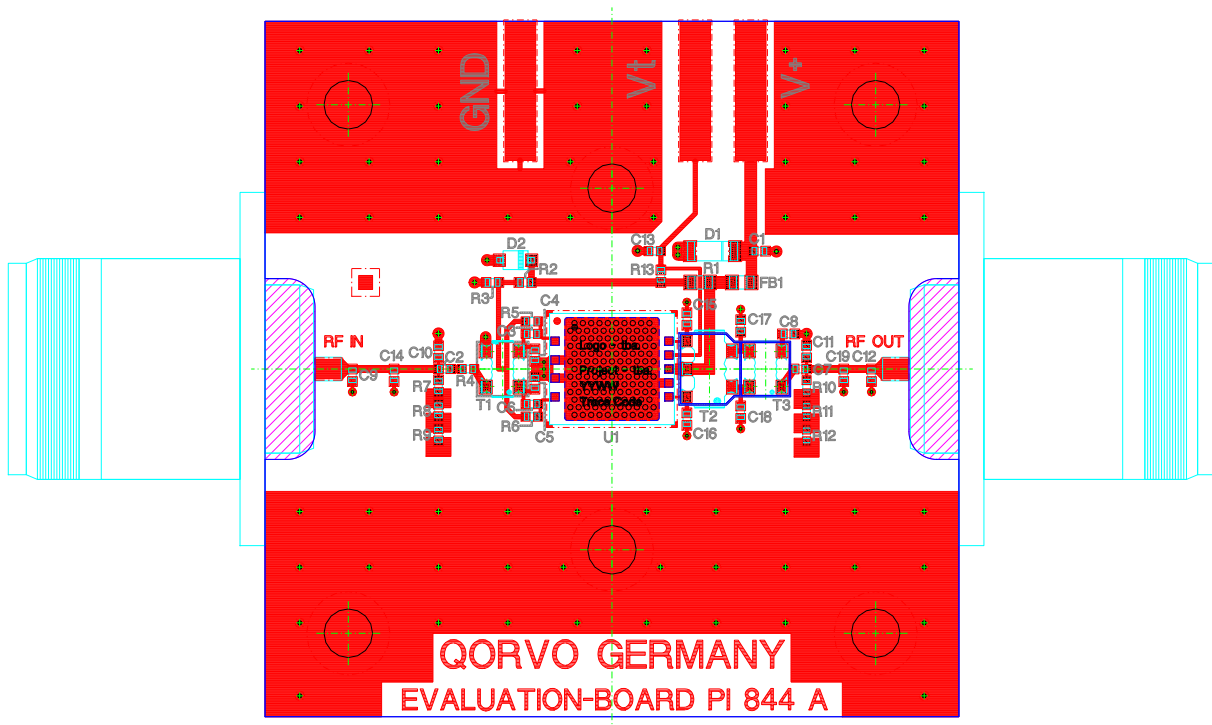
## Module Backside Temperature versus $V_t$ (typical values)



## Evaluation Board Schematic



## Evaluation Board Assembly Drawing



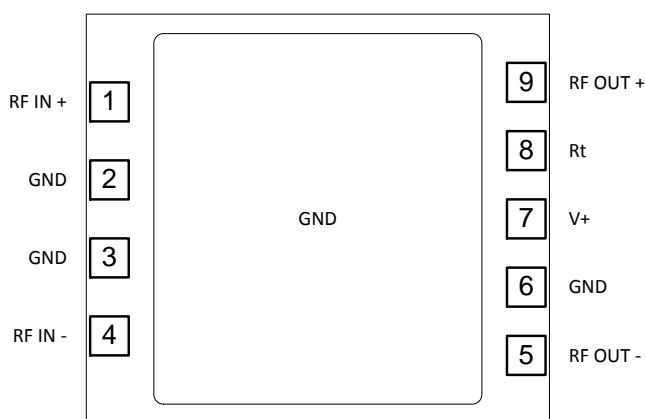
Note: The ground plane of the RFCM3328 module should be soldered onto a board equipped with as many thermal vias as possible. Underneath this thermal via array a heat sink with thermal grease needs to be placed which is able to dissipate the complete module DC power (up to 11.3 Watts). In any case the module backside temperature should not exceed 110 °C.

## Evaluation Board Bill of Materials (BOM)

| Reference Des.            | Value                 | Description   | Manuf.           | Part Number    |
|---------------------------|-----------------------|---|------------------|----------------|
| n/a                       | n/a                   | Printed Circuit Board   | Qorvo            | PI844A         |
| C1                        | 220 pF                | Cap., 0402, 50V, NP0/C0G                                      | various          |                |
| C2, C3, C6, C7, C8, C13   | 4.7 nF                | Cap., 0402, $\pm 10\%$ , 50V, X7R                             | various          |                |
| C4, C5                    | 1.2 pF                | Cap., 0402, $\pm 0.25\text{pF}$ , 50V, NP0/C0G                | various          |                |
| C9, C14, C17, C18, C19    | DNI                   | Cap., 0402, NP0/C0G <sup>(1)</sup>                            | various          |                |
| C10, C11, C12             | 0.5 pF                | Cap., 0402, $\pm 0.1\text{pF}$ , 50V, NP0/C0G <sup>(1)</sup>  | various          |                |
| C15, C16                  | 0.1 pF                | Cap., 0402, $\pm 0.05\text{pF}$ , 50V, NP0/C0G <sup>(1)</sup> | various          |                |
| R1                        | 5.1 k $\Omega$        | Res., 0603, $\pm 1\%$ , TK100                                 | various          |                |
| R2                        | 3 k $\Omega$          | Res., 0402, $\pm 1\%$ , TK100                                 | various          |                |
| R3                        | 1.5 k $\Omega$        | Res., 0402, $\pm 1\%$ , TK100                                 | various          |                |
| R4                        | 5.6 $\Omega$          | Res., 0402, $\pm 1\%$ , TK200                                 | various          |                |
| R5, R6                    | 1 k $\Omega$          | Res., 0402, $\pm 1\%$ , TK100                                 | various          |                |
| R7, R8, R9, R10, R11, R12 | DNI                   | Res., 0402, 0 $\Omega$ <sup>(1)</sup>                         | various          |                |
| R13                       | 3.3 k $\Omega$        | Res., 0402, $\pm 1\%$ , TK100                                 | various          |                |
| FB1                       | 60 $\Omega$ @ 100 MHz | Impedance Bead  | Taiyo Yuden      | BK 1608HS600-T |
| D1                        | TGL34-33A             | Transient Voltage Suppressor Diode                            | Diotec           | TGL34-33A      |
| D2                        | 5.6 V                 | Zener Diode   | ON Semiconductor | MM3Z5V6T1G     |
| T1                        | RFXF0006              | Transformer   | Qorvo            | RFXF0006       |
| T2                        | RFXF0008              | Transformer   | Qorvo            | RFXF0008       |
| T3                        | RFXF0009              | Transformer   | Qorvo            | RFXF0009       |
| U1                        | RFCM3328              | DUT   | Qorvo            | RFCM3327       |

Note: 1. Optional to improve matching in application.

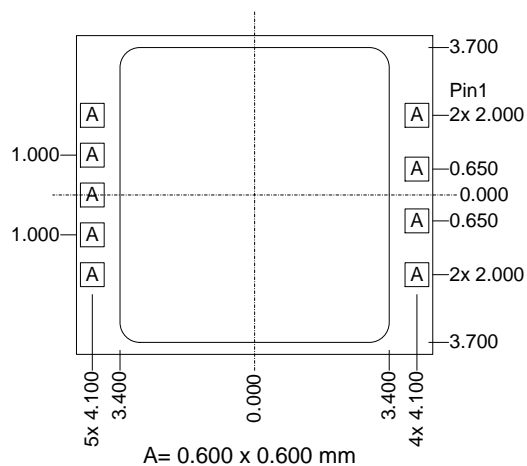
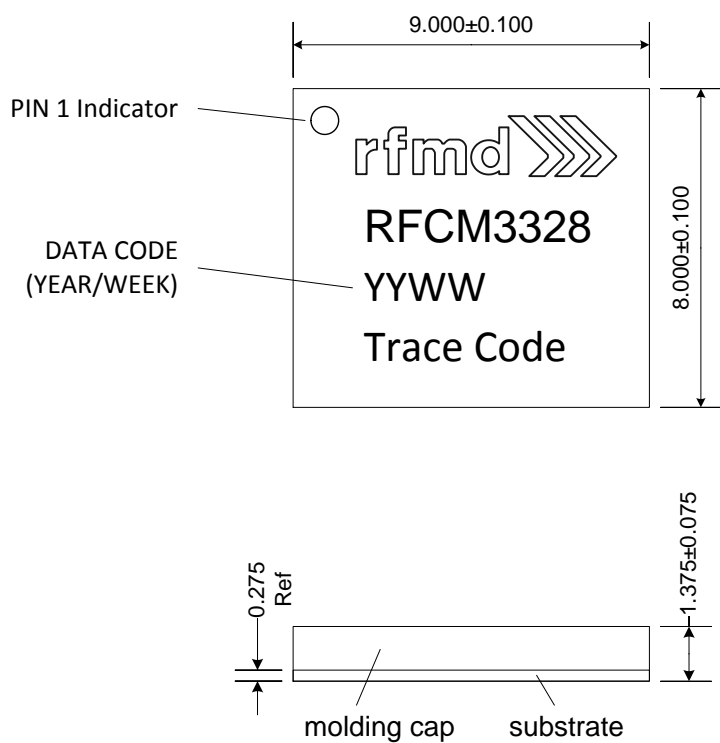
## Pin Out



Top View

### Package Outline and Branding Drawing

(Dimensions in millimeters)



### Pin Names and Descriptions

| Pin     | Name     | Description                        |
|---------|----------|------------------------------------|
| 1       | RF IN +  | RF AMP Positive Input              |
| 2, 3, 6 | GND      | Ground pins                        |
| 4       | RF IN -  | RF AMP Negative Input              |
| 5       | RF OUT - | RF AMP Negative Output             |
| 7       | V+       | Supply Voltage, +24V               |
| 8       | Rt       | NTC Output for Temperature Sensing |
| 9       | RF OUT + | RF AMP Positive Output             |

## Handling Precautions

| Parameter                        | Rating   | Standard                 |
|----------------------------------|----------|--------------------------|
| ESD – Human Body Model (HBM)     | Class 1A | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | Class C1 | JEDEC JESD22-C101F       |
| 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:

- Lead Free
- Halogen Free (Chlorine, Bromine)



## Contact Information

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

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