

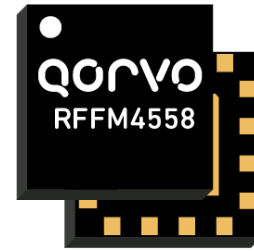
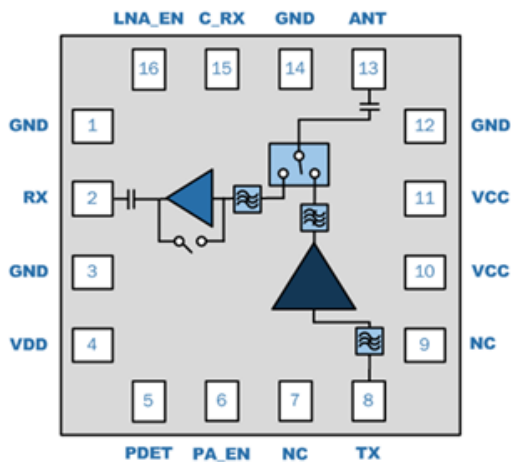
## Product Description

The RFFM4558 provides a complete integrated solution in a single front end module (FEM) for Wi-Fi 802.11a/n/ac systems. The small form factor and integrated matching minimizes layout area in the application and greatly reduces the number of external components.

Performance is focused on conserving power consumption while maintaining the highest linear output power and leading edge throughput.

The RFFM4558 integrates a 5GHz power amplifier (PA), single-pole two-throw switch (SP2T) and a low noise amplifier (LNA) with bypass. Integrated filtering includes 2<sup>nd</sup> and 3<sup>rd</sup> harmonic as well as 2.4GHz rejection for dual-band dual-concurrent operation. The device is provided in a 2.5mm x 2.5mm x 0.98mm, 16-pin laminate package.

## Functional Block Diagram



Package: Laminate, 16-pin,  
2.5mm x 2.5mm x 0.98mm max

## Feature Overview

- $P_{OUT} = +20\text{dBm}$ , 802.11ac, VHT80 MCS9 at -35dB Dynamic EVM
- $P_{OUT} = +21\text{dBm}$ , 802.11n, HT20/40 MCS7 at -30dB Dynamic EVM
- $P_{OUT} = +24\text{dBm}$ , HT20 MCS0 at Spectral Mask Compliance
- 5V Operation
- Low Power Consumption <1W at +20dBm
- LNA Gain = 14dB
- Noise Figure = 2.3dB
- Bypass Loss = 5dB
- Input and Output Matched to 50Ω
- Integrated 2.4GHz Rejection Filter

## Applications

- Wireless Routers
- Access Points
- Residential Gateways
- Consumer Premise Equipment
- Internet of Things

## Ordering Information

| PART NUMBER      | DESCRIPTION                        |
|------------------|------------------------------------|
| RFFM4558SB       | Sample bag with 5 pieces           |
| RFFM4558SQ       | Sample bag with 25 pieces          |
| RFFM4558SR       | 7" Reel with 100 pieces            |
| RFFM4558TR7      | 7" Reel with 2500 pieces           |
| RFFM4558TR13-10K | 13" Reel with 10,000 pieces        |
| RFFM4558PCK-410  | Assembled Evaluation Board + 5 pcs |

## Absolute Maximum Ratings

| PARAMETER                                                     | RATING      | UNIT            |
|---------------------------------------------------------------|-------------|-----------------|
| DC Supply Voltage (No RF Applied)                             | -0.5 to +6  | V <sub>DC</sub> |
| Control Voltage                                               | -0.5 to +5  | V <sub>DC</sub> |
| DC Supply Current                                             | 500         | mA              |
| Storage Temperature                                           | -40 to +150 | °C              |
| Maximum TX Input Power into 50Ω Load for 11a/n/ac (No Damage) | +10         | dBm             |
| Maximum RX Input Power - LNA On Mode (No Damage)              | +10         | dBm             |
| Maximum RX Input Power – Bypass Mode (No Damage)              | +25         | dBm             |

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. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied. This is an InGaP device designed for high duty cycle applications with T<sub>j</sub>>30 °C over ambient

## Nominal Operating Parameters

| PARAMETER                    | MIN   | TYP | MAX             | UNIT | CONDITION                         |
|------------------------------|-------|-----|-----------------|------|-----------------------------------|
| <b>COMPLIANCE</b>            |       |     |                 |      | <b>802.11A, 802.11N, 802.11AC</b> |
| Operating Frequency          | 5.180 |     | 5.925           | GHz  |                                   |
| Extended Operating Frequency | 4.9   |     | 5.925           | GHz  |                                   |
| Operating Temperature        | -40   |     | +85             | °C   |                                   |
| Power Supply V <sub>CC</sub> | 4.75  | 5   | 5.25            | V    |                                   |
| Control Voltage-High         | 2.8   | 3.1 | V <sub>CC</sub> | V    | PA_EN, LNA_EN, C_RX               |
| Control Voltage-Low          | 0     |     | 0.2             | V    | PA_EN, LNA_EN, C_RX               |

|                                        |    |     |     |     |                                                                                                               |
|----------------------------------------|----|-----|-----|-----|---------------------------------------------------------------------------------------------------------------|
| <b>TRANSMIT (TX-ANT) MODE</b>          |    |     |     |     | <b>V<sub>CC</sub>=5V, T=+25°C, f=5.18-5.925GHz, PA_EN=High, LNA_EN &amp; C_RX=Low; Unless otherwise noted</b> |
| 11ac VHT80 Output Power                | 19 | 20  |     | dBm | MCS9                                                                                                          |
| Dynamic EVM                            |    | 1.5 | 1.8 | %   |                                                                                                               |
|                                        |    | -36 | -35 | dB  |                                                                                                               |
| 11n HT20/40 Output Power               | 20 | 21  |     | dBm | MCS7                                                                                                          |
| Dynamic EVM                            |    | 2.5 | 3   | %   |                                                                                                               |
|                                        |    | -32 | -30 | dB  |                                                                                                               |
| Margin to 802.11ac 80MHz Spectral Mask |    | 3   | 0   | dBc | P <sub>OUT</sub> = +23dBm, MCS0                                                                               |
| Margin to 802.11n 20MHz Spectral Mask  |    | 3   | 0   | dBc | P <sub>OUT</sub> = +24dBm, MCS0                                                                               |
| Large Signal Gain                      | 29 | 32  |     | dB  |                                                                                                               |
|                                        | 27 | 29  |     | dB  | T = +85°C                                                                                                     |
| Out of Band Gain                       |    |     | -30 | dB  | f = 1600-1950MHz                                                                                              |
|                                        |    |     | -5  | dB  | f = 3200-3900MHz                                                                                              |
|                                        |    |     | 10  | dB  | f > 7000MHz                                                                                                   |
| Quiescent Current                      |    | 100 | 125 | mA  | RF=Off                                                                                                        |

| PARAMETER                 | MIN | TYP  | MAX | UNIT    | CONDITION                              |
|---------------------------|-----|------|-----|---------|----------------------------------------|
| Operating Current         |     | 175  | 195 | mA      | P <sub>OUT</sub> = 20dBm               |
|                           |     | 240  | 265 | mA      | P <sub>OUT</sub> = 24dBm               |
| TX Port Return Loss       |     | 12   |     | dB      |                                        |
| ANT Port Return Loss      |     | 7    |     | dB      |                                        |
| 2 <sup>nd</sup> Harmonics |     | -35  |     | dBm/MHz | P <sub>OUT</sub> = 24dBm 802.11a 6Mbps |
| 3 <sup>rd</sup> Harmonics |     | -45  |     | dBm/MHz | P <sub>OUT</sub> = 24dBm 802.11a 6Mbps |
| ANT-RX Isolation          | 25  |      |     | dB      |                                        |
| Power Detector Voltage    |     | 0.22 |     | mV      | P <sub>OUT</sub> = 0dBm                |
|                           |     | 0.47 |     | mV      | P <sub>OUT</sub> = +20dBm              |
|                           |     | 0.67 |     | mV      | P <sub>OUT</sub> = +24dBm              |

| RECEIVE (ANT-RX) LNA ON MODE |      |     |     |     | V <sub>CC</sub> =5V, T=+25°C, f=5.18-5.925GHz, PA_EN=Low, LNA_EN & C_RX=High; Unless otherwise noted |
|------------------------------|------|-----|-----|-----|------------------------------------------------------------------------------------------------------|
| Gain                         | 12.5 | 14  |     | dB  |                                                                                                      |
|                              | 10.5 | 12  |     | dB  | T = +85°C                                                                                            |
| Out of Band Gain             |      | -15 | -13 | dB  | f = 2400-2500MHz                                                                                     |
| Noise Figure                 |      | 2.3 | 2.9 | dB  |                                                                                                      |
| RX Operating Current         | 9.5  | 13  |     | mA  |                                                                                                      |
| RX Port Return Loss          |      | 10  |     | dB  |                                                                                                      |
| ANT Port Return Loss         |      | 5   |     | dB  |                                                                                                      |
| Input P <sub>1dB</sub>       | -10  | -5  |     | dBm |                                                                                                      |
| ANT-RX Isolation             | 25   |     |     | dB  |                                                                                                      |

| RECEIVE (ANT-RX) BYPASS MODE |     |     |  |     | V <sub>CC</sub> =5V, T=+25°C, f=5.18-5.925GHz, PA_EN & LNA_EN=Low, C_RX=High; Unless otherwise noted |
|------------------------------|-----|-----|--|-----|------------------------------------------------------------------------------------------------------|
| Bypass Loss                  |     | 5   |  | dB  |                                                                                                      |
| RX Port Return Loss          |     | 20  |  | dB  |                                                                                                      |
| ANT Port Return Loss         |     | 12  |  | dB  |                                                                                                      |
| Input P <sub>1dB</sub>       | +15 | +20 |  | dBm |                                                                                                      |
| ANT-RX Isolation             | 40  |     |  | dB  |                                                                                                      |

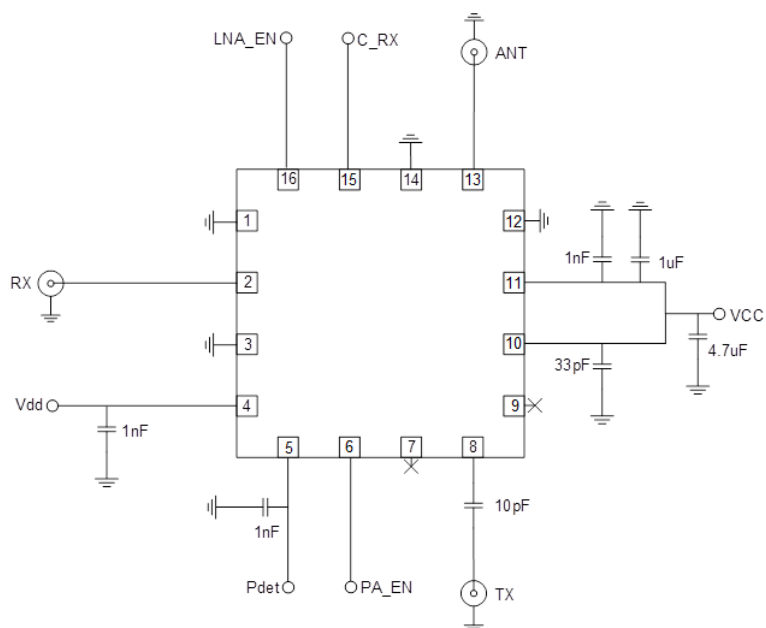
| PARAMETER              | MIN                                                    | TYP | MAX | UNIT | CONDITION                                               |
|------------------------|--------------------------------------------------------|-----|-----|------|---------------------------------------------------------|
| GENERAL SPECIFICATIONS |                                                        |     |     |      |                                                         |
| FEM Leakage Current    |                                                        | 8   | 250 | μA   |                                                         |
| PA_EN Control Current  |                                                        | 1   | 5   | μA   |                                                         |
| LNA_EN Control Current |                                                        | 150 | 200 | μA   |                                                         |
| C_RX Control Current   |                                                        | 10  | 20  | μA   |                                                         |
| PA Turn-On Time        |                                                        | 500 |     | nS   | 10%<->90%; Referencing from control voltage to RF power |
| LNA Turn-On Time       |                                                        | 500 |     | nS   |                                                         |
| PA Stability           | Unconditional into 4:1 VSWR; No spurs above -50dBm/MHz |     |     |      |                                                         |

## Switch Control Logic Truth Table

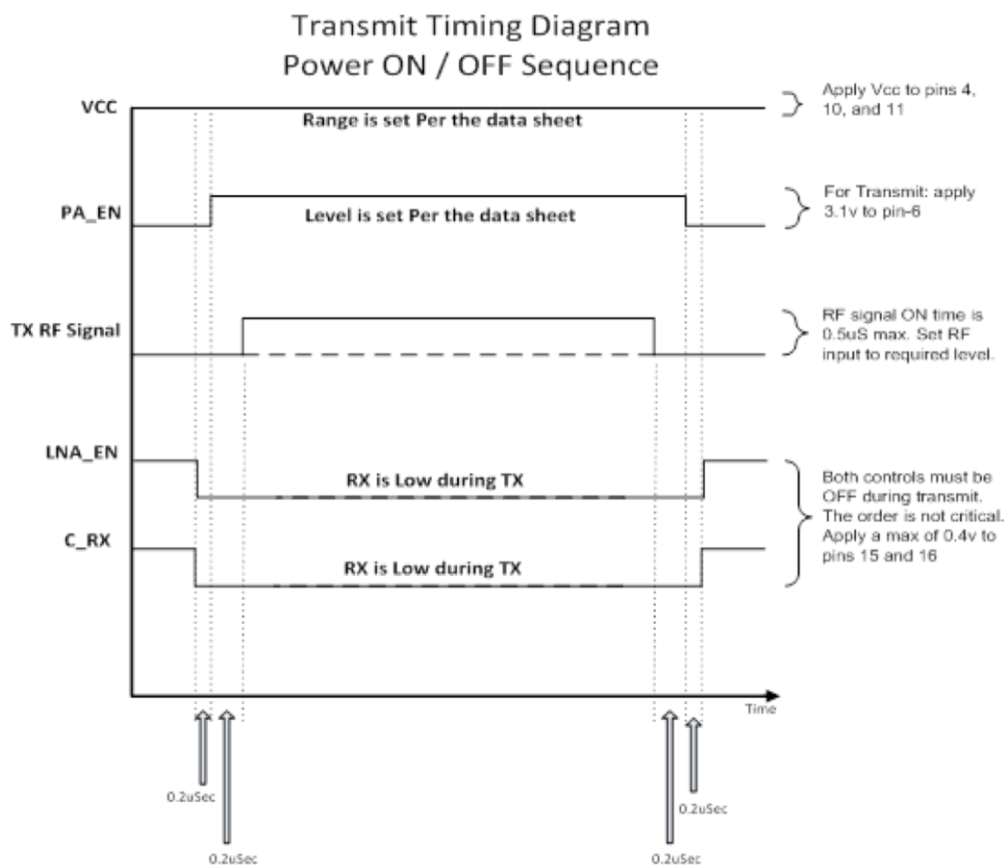
| OPERATING MODE | PA_EN | LNA_EN | C_RX |
|----------------|-------|--------|------|
| Standby Mode   | Low   | Low    | Low  |
| Transmit Mode  | High  | Low    | Low  |
| LNA Mode       | Low   | High   | High |
| Bypass Mode    | Low   | Low    | High |

Note:  
 High = 2.8 to V<sub>CC</sub>. Low = 0V to 0.2V.

## Evaluation Board Schematic

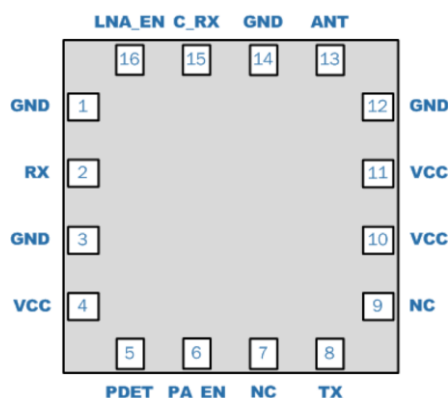


## Transmit Timing Diagram



Note1: RF Signal for each specific mode is applied after the DC bias is applied  
 Note2: Total ON/OFF time includes from 10% of control switching to 90% of RF power  
 Note3: Listed values on diagram are typical. The maximum is 0.5us for each mode

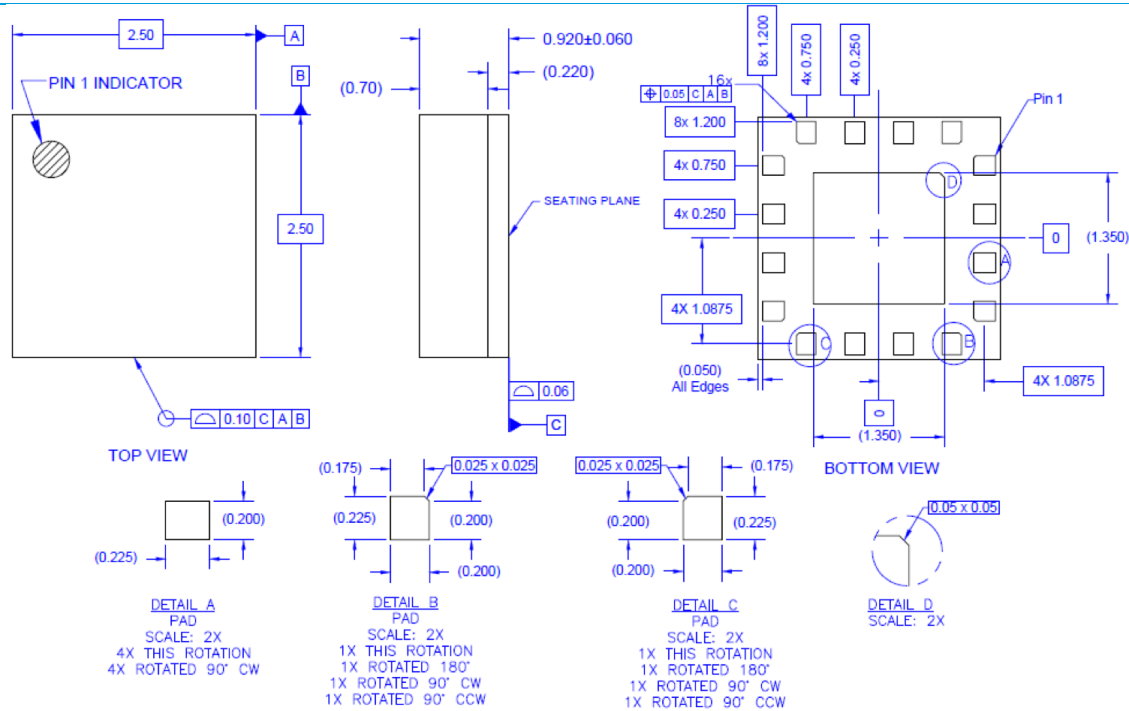
## Pin Out



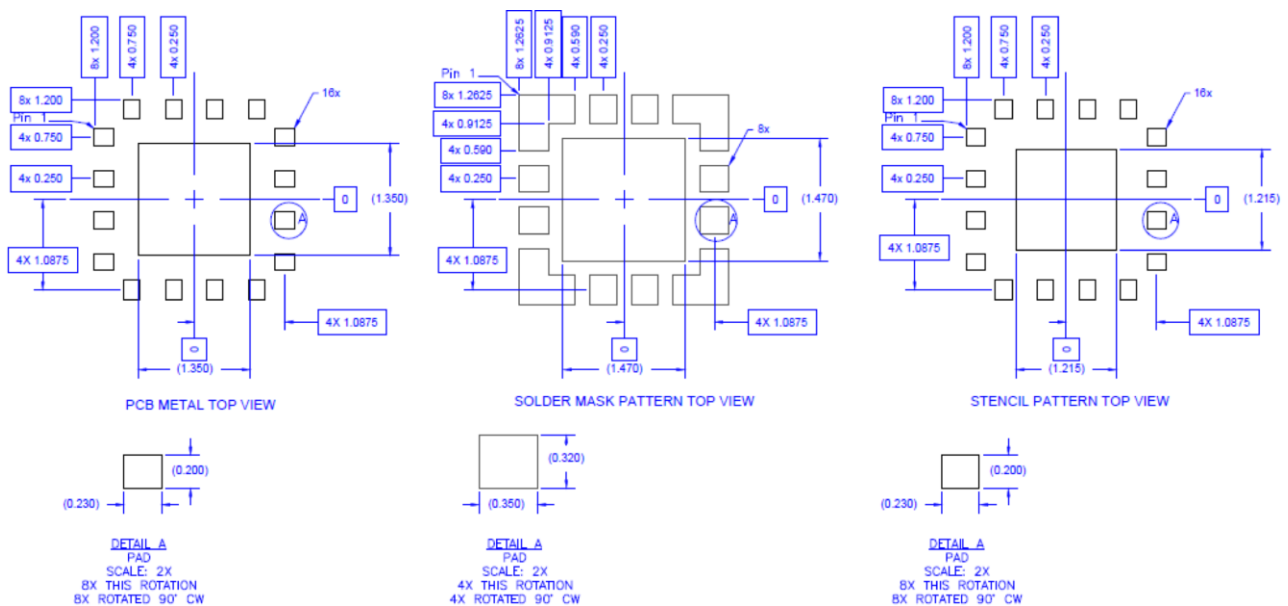
## Pin Names and Descriptions

| PIN      | NAME   | DESCRIPTION                                                                                                                                                       |
|----------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | GND    | Ground connection                                                                                                                                                 |
| 2        | RX     | RF output port for the LNA. This port is matched to 50Ω and DC blocked internally.                                                                                |
| 3        | GND    | Ground connection.                                                                                                                                                |
| 4        | VCC    | Supply voltage for the LNA and PA Regulator. See applications schematic for biasing and bypassing components.                                                     |
| 5        | PDET   | Power Detector voltage for the TX path. May need external series R/shunt C to adjust voltage level and to filter RF noise.                                        |
| 6        | PA_EN  | Control voltage for the PA and TX switch. See Switch Control Logic Truth Table for proper voltage settings.                                                       |
| 7        | NC     | No connect. This pin is not connected internally and can be left floating or connected to ground.                                                                 |
| 8        | TX     | RF input port for the PA. This port is matched to 50Ω and DC shorted internally.                                                                                  |
| 9        | NC     | No connect. This pin is not connected internally and can be left floating or connected to ground.                                                                 |
| 10       | VCC    | Supply voltage for the 1 <sup>st</sup> and 2 <sup>nd</sup> stages of the PA. See applications schematic for biasing and bypassing components.                     |
| 11       | VCC    | Supply voltage for the final stage of the PA. See applications schematic for biasing and bypassing components.                                                    |
| 12       | GND    | Ground connection                                                                                                                                                 |
| 13       | ANT    | RF bi-directional antenna port matched to 50Ω and DC blocked internally.                                                                                          |
| 14       | GND    | Ground connection                                                                                                                                                 |
| 15       | C_RX   | Transmit-Receive Switch control pin. See Switch Control Logic Truth Table for proper voltage settings.                                                            |
| 16       | LNA_EN | Control voltage for LNA. When this pin is set to a Low logic state, the Bypass Mode is enabled. See Switch Control Logic Truth Table for proper voltage settings. |
| Pkg Base | GND    | Ground connection. The backside of the package should be connected to the ground plane through a short path, i.e., PCB vias under the device are recommended.     |

## Package Outline (Dimensions in millimeters)



## PCB Mounting Pattern (Dimensions in millimeters)



## Product Compliance Information

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**Caution! ESD-Sensitive Device**

### ESD Sensitivity Ratings

ESD Rating: Class 1B  
Voltage: Passes  $\geq 500V$  to  $< 1000V$   
Test: Human Body Model (HBM)  
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class C3  
Voltage: Passes  $\geq 1000V$   
Test: Charged Device Model (CDM)  
Standard: JEDEC Standard JESD22-C101

### MSL Rating

MSL Rating: Level 3  
Test:  $260^{\circ}C$  convection reflow  
Standard: JEDEC Standard IPC/JEDEC J-STD-020

### Solderability

Compatible with both lead-free ( $260^{\circ}C$  max. reflow temperature) and tin/lead ( $245^{\circ}C$  max. reflow temperature) soldering processes.

### RoHS Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free

## Contact Information

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

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