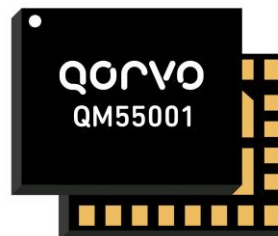


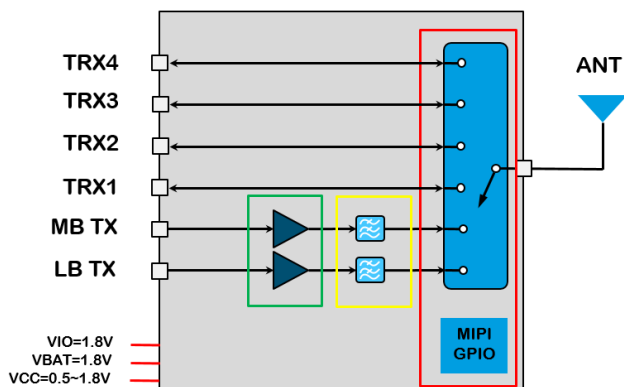
### Product Overview

QM55001 is a hybrid, multi-band multi-chip RF front-end (RFFE) module supporting for NB-IoT and Cat-M1 application. The module supports LB (663MHz – 915MHz) and MB (1695MHz – 1980MHz) and NTN Operation B24/B255, B107, B23/B256. It has integrated harmonic rejection LPF, antenna switch and auxillary TX/RX path for B11 and B31. QM55001 band select and bias are programmed through a Mobile Industry Processor Interface (MIPI).



Package: Module, 24-Pin 5.00 x 4.00 x 0.64 mm

### Functional Block Diagram



Functional Block Diagram

### Key Features

- Integrated Switch Supports Multiple TX and RX paths
- MIPI RFFE Digital Control Interface
- Integrated harmonic reject LPF
- AUX TX/RX paths for B11/B31
- NTN Operation: B24/B255, B107, B23/B256
- 1.8V supplies
- Optimized use with DC/DC Converter Operation
- Average Power Tracking
- Optimized for Narrow-Band IoT and Cat-M1
- Programmable Bias Level Control

### Ordering Information

| Part Number | Description                                           |
|-------------|-------------------------------------------------------|
| QM55001PCK  | Evaluation Board Sample Kit                           |
| QM55001SB   | 5-Piece Sample Bag                                    |
| QM55001SQ   | 25-Piece Sample Bag                                   |
| QM55001SR   | 100-Piece 7inch Sample Reel                           |
| QM55001TR13 | 5000-Piece 13inch Reel                                |
| QM55001DK   | Design Kit: QM55001PCK<br>+RD2000 Communication Board |

### Applications

- LTE mid-bands: 1, 2, 3, 4, 25, 39, 66, 70
- LTE low-bands: 5, 8, 12, 13, 14, 17, 18, 19, 20, 26, 27, 28, 71, 85
- NTN Operation: B24/B255, B107, B23/B256
- Narrow-Band IoT and Cat-M1

## Absolute Maximum Ratings

| Parameter                                     | Conditions                                                                                                                               | Rating         |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Supply Voltage, VCC                           | Standby, Idle, Operating Mode                                                                                                            | 6V             |
| Supply Voltage, Vbatt                         | Standby, Idle, Operating Mode                                                                                                            | 6V             |
| VIO and Digital control signals (SCLK, SDATA) |                                                                                                                                          | 2.0 V          |
| RF Input Power                                |                                                                                                                                          | 10dBm          |
| Output Load VSWR (Ruggedness)                 | Ruggedness is guaranteed with open loop condition, Pin adjusted for Pout = Max Prated into 50Ω load, Vcc = Vbat = 4.5V, over temperature | 20:1           |
| Operating Temperature                         |                                                                                                                                          | -40 to +105 °C |
| Storage Temperature                           |                                                                                                                                          | -50 to 150 °C  |
| ESD                                           | HBM                                                                                                                                      | 1500V          |
| ESD                                           | CDM                                                                                                                                      | 1000V          |

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

## Recommended Operating Conditions

| Parameter                                 | Min.               | Typ. | Max.             | Units |
|-------------------------------------------|--------------------|------|------------------|-------|
| Supply Voltage, Vbatt                     | 1.65               | 1.8  | 4.5              | V     |
| Supply Voltage, Vcc                       | 0.5 <sup>(1)</sup> | 1.8  | 4.5              | V     |
| Supply Voltage, VIO                       | 1.65               | 1.8  | 1.95             | V     |
| MIPI RFFE logic low (SCLK,SDATA)          | 0                  |      | 0.3*VIO          | V     |
| MIPI RFFE logic high (SCLK,SDATA)         | 0.7*VIO            |      | VIO              | V     |
| Leakage Current                           | 0                  | 0.3  | 3 <sup>(2)</sup> | uA    |
| VIO Rise Time (required for device reset) | 0                  |      | 400              | us    |
| Operating Ambient Temperature             | -40                | 25   | +85              | °C    |

Note 1: Vcc down to 0.5V may be used for backed-off power when using DC/DC converter to reduce low power current drain. Refer to Look-up Table (LUT, supplied separately) for recommended Vcc settings for each output power level.

Note 2: Device in Power Down Mode, Vbatt = Vcc = 3.8V.

## Power vs NB-IoT Modulation Table

| ID                   | Modulation | Subcarrier Spacing (KHz) | Number of Tones | Tone Positions | MPR (dB) | Rated Pout (dBm) |
|----------------------|------------|--------------------------|-----------------|----------------|----------|------------------|
| 1tone@positon0       | QPSK       | 15                       | 1               | 0              | 0        | 23.5             |
| 3tone@position0..2   |            | 15                       | 3               | 0..2           | 0.5      | 23               |
| 3tone@position3..5   |            | 15                       | 3               | 3..5           | 0        | 23.5             |
| 3tone@position9..11  |            | 15                       | 3               | 9..11          | 0.5      | 23               |
| 6tone@position0..5   |            | 15                       | 6               | 0..5           | 1        | 22.5             |
| 6tone@position6..11  |            | 15                       | 6               | 6..11          | 1        | 22.5             |
| 12tone@position0..11 |            | 15                       | 12              | 0..11          | 2        | 21.5             |
| 1tone@positon0       | BPSK       | 3.75                     | 1               | 0              | 0        | 23.5             |
| 1tone@positon47      |            | 3.75                     | 1               | 47             | 0        | 23.5             |

## Electrical Specifications: NB-IoT : Band 1, 2, 3, 4, 25, 66, 70

(Temp = +25°C, Vbatt = VCC = VIO= +1.8V, 50 Ω system, Modulation used: QPSK 12tone@position0, 15 KHz subcarrier spacing, 1 tone with MPR=0, unless otherwise specified.)

| Parameter                   |                          | Conditions                                                                            | Min. | Typ.   | Max. | Units      |
|-----------------------------|--------------------------|---------------------------------------------------------------------------------------|------|--------|------|------------|
| Frequency Range             |                          | Band 1                                                                                | 1920 | 1950   | 1980 | MHz        |
|                             |                          | Band 2, 25                                                                            | 1850 | 1882.5 | 1915 |            |
|                             |                          | Band 3, 66                                                                            | 1710 | 1747.5 | 1785 |            |
|                             |                          | Band 4                                                                                | 1710 | 1732.5 | 1755 |            |
|                             |                          | Band 70                                                                               | 1695 | 1702.5 | 1710 |            |
| Maximum Linear Output Power |                          | HPM                                                                                   | 23.5 | -      | -    | dBm        |
| Gain                        | Band 1                   | HPM, Pout = Prated                                                                    | -    | 25.5   | -    | dB         |
|                             | Band 2, 3, 4, 25, 66, 70 |                                                                                       | -    | 26     | -    |            |
| GSM ACLR                    | Band 1                   | HPM, Prated – 2dB (MPR), Vcc = 1.8V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC | -    | -37    | -29  | dBc        |
|                             | Band 2, 3, 4, 25, 66, 70 |                                                                                       | -    | -39    |      |            |
| UTRA ACLR                   |                          |                                                                                       | -    | -64    | -46  |            |
| PA Total Current            |                          | HPM, Pout = Prated                                                                    | -    | 330    | -    | mA         |
|                             |                          | HPM, Pout = 10.5dBm, Vcc = 0.7V                                                       | -    | 102    | -    |            |
| PAE                         |                          | HPM, Pout = Prated                                                                    | -    | 36     | -    | %          |
| EVM                         | Band 1                   | HPM, Prated – 2dB (MPR), Vcc = 1.8V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC | -    | 7.3    | -    | %          |
|                             | Band 2, 25, 3, 4, 66     |                                                                                       | -    | 6.4    | -    |            |
|                             | Band 70                  |                                                                                       | -    | 5.3    | -    |            |
| SEM                         |                          | Pout ≤ Prated, +/- 100kHz                                                             | -    | -32    | -    | dBm/30 kHz |
|                             |                          | Pout ≤ Prated, +/- 150kHz                                                             | -    | -45    | -    |            |
|                             |                          | Pout ≤ Prated, +/- 300kHz                                                             | -    | -49    | -    |            |
|                             |                          | Pout ≤ Prated, +/- 500 to 1700kHz                                                     | -    | -58    | -    |            |
| Harmonic suppression, 2fo   | Band 1                   | Pout ≤ Prated                                                                         | -    | -53    | -    | dBm        |
|                             | Band 2, 25               |                                                                                       | -    | -48    | -    |            |
|                             | Band 3, 4, 66, 70        |                                                                                       | -    | -42    | -    |            |
| Harmonic suppression, 3fo   | Band 1                   | Pout ≤ Prated                                                                         | -    | -59    | -    |            |
|                             | Band 2, 25               |                                                                                       | -    | -55    | -    |            |
|                             | Band 3, 4, 66, 70        |                                                                                       | -    | -49    | -    |            |
| Rx Band Noise               | Band 1 Rx                | RX frequency 2110 – 2170 MHz                                                          | -    | -142   | -    | dBm/Hz     |
|                             | Band 2/25 Rx             | RX frequency 1930 – 1995 MHz                                                          | -    | -126   | -    |            |
|                             | Band 3 Rx                | RX frequency 1805 – 1880 MHz                                                          | -    | -127   | -    |            |
|                             | Band 4 Rx                | RX frequency 2110 – 2155 MHz                                                          | -    | -151   | -    |            |
|                             | Band 66 Rx               | RX frequency 2110 – 2200 MHz                                                          | -    | -141   | -    |            |
|                             | Band 70 Rx               | RX frequency 1995 – 2020 MHz                                                          | -    | -142   | -    |            |
| WiFi Band Noise             |                          | Pout = Prated, 2400 – 2495MHz,                                                        | -    | -146   | -    |            |
|                             |                          | Pout = Prated, 5150 – 5850MHz,                                                        | -    | -160   | -    |            |
| GPS band noise power        |                          | Pout = Prated, 1574 – 1577MHz,                                                        | -    | -137   | -    |            |

### Electrical Specifications: NB-IoT: Band 1, 2, 3, 4, 25, 66, 70 - continued

(Temp = +25°C, Vbatt = VCC = VIO= +1.8V, 50  $\Omega$  system, Modulation used: QPSK 1tone@position0, 15 KHz subcarrier spacing, 1 tone with MPR=0, unless otherwise specified.)

| Parameter                         | Conditions                                                                                                              | Min. | Typ.  | Max. | Units |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------|------|-------|------|-------|
| Input VSWR                        | No external matching                                                                                                    | -    | 2.5:1 | -    | -     |
| Gain Switching Time               | Time required for output power to settle to within $\pm 1$ dB of the final output power for any given mode transission. | -    | -     | 10   | uSec  |
| Stability, Spurious Output Levels | Load VSWR = 10:1, all phase angles, Pin adjusted for Pout = 23.5dBm into 50 $\Omega$ load                               | -    | -     | -36  | dBm   |

### Electrical Specifications: Cat-M1 : Band 1, 2, 3, 4, 25, 39, 66, 70

(Temp = +25°C, Vbatt = VIO = +1.8V, Vcc = 2.5V, 50 Ω system, Modulation used: LTE QPSK, 1.4MHz channel, 1 Resource Block with MPR=0, Band39 is TDD, other bands are FDD, unless otherwise specified.)

| Parameter                         |                               | Conditions                                                                        | Min. | Typ.   | Max. | Units  |
|-----------------------------------|-------------------------------|-----------------------------------------------------------------------------------|------|--------|------|--------|
| Frequency Range                   |                               | Band 1                                                                            | 1920 | 1950   | 1980 | MHz    |
|                                   |                               | Band 2, 25                                                                        | 1850 | 1882.5 | 1915 |        |
|                                   |                               | Band 3, 66                                                                        | 1710 | 1747.5 | 1785 |        |
|                                   |                               | Band 4                                                                            | 1710 | 1732.5 | 1755 |        |
|                                   |                               | Band 39                                                                           | 1880 | 1900   | 1920 |        |
|                                   |                               | Band 70                                                                           | 1695 | 1702.5 | 1710 |        |
| Maximum Linear Output Power       |                               | HPM                                                                               | 23.5 | -      | -    | dBm    |
| Gain                              | Band 1                        | HPM, Pout = Prated                                                                | -    | 25.3   | -    | dB     |
|                                   | Bands 2, 3, 4, 25, 39, 66, 70 |                                                                                   | -    | 26     | -    |        |
| ACLR1 - EUTRA                     | Bands 1, 2, 25, 39            | HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = 1.4MHz 6RB QPSK                 | -    | -39    | -33  | dBc    |
|                                   | Bands 3, 4, 66, 70            |                                                                                   | -    | -42    |      |        |
| ACLR1 - UTRA                      |                               |                                                                                   | -    | -42    | -36  |        |
| ACLR2 - UTRA                      |                               |                                                                                   | -    | -66    | -39  |        |
| PA Total Current                  | Bands 1, 2, 25, 39            | HPM, Pout = Prated                                                                | -    | 322    | -    | mA     |
|                                   | Bands 3, 4, 66, 70            |                                                                                   | -    | 339    | -    |        |
| PAE                               |                               | HPM, Pout = Prated                                                                | -    | 27     | -    | %      |
| EVM                               |                               | HPM, Pout ≤ Prated                                                                | -    | 5      | -    | %      |
| Harmonic suppression, 2fo         | Band 1                        | Pout ≤ Prated                                                                     | -    | -48    | -    | dBm    |
|                                   | Bands 2, 25, 39               |                                                                                   | -    | -46    | -    |        |
|                                   | Bands 3, 4, 66, 70            |                                                                                   | -    | -41    | -    |        |
| Harmonic suppression, 3fo         | Band 1                        | Pout ≤ Prated                                                                     | -    | -61    | -    |        |
|                                   | Bands 2, 25, 39               |                                                                                   | -    | -53    | -    |        |
|                                   | Bands 3, 4, 66, 70            |                                                                                   | -    | -46    | -    |        |
| ISM noise power                   |                               | 2400 – 2447 MHz                                                                   | -    | -149   | -    | dBm/Hz |
| Rx Band Noise                     | Band 1 Rx                     | RX frequency 2110 – 2170 MHz                                                      | -    | -140   | -    |        |
|                                   | Band 2/25 Rx                  | RX frequency 1930 – 1995 MHz                                                      | -    | -126   | -    |        |
|                                   | Band 3 Rx                     | RX frequency 1805 – 1880 MHz                                                      | -    | -127   | -    |        |
|                                   | Band 4 Rx                     | RX frequency 2110 – 2155 MHz                                                      | -    | -142   | -    |        |
|                                   | Band 66 Rx                    | RX frequency 2110 – 2200 MHz                                                      | -    | -142   | -    |        |
|                                   | Band 70 Rx                    | RX frequency 1995 – 2020 MHz                                                      | -    | -141   | -    |        |
| GPS band noise power              |                               | Pout = Prated, 1574 – 1577MHz                                                     | -    | -136   | -    |        |
| Stability, Spurious Output Levels |                               | Load VSWR = 10:1, all phase angles, Pin adjusted for Pout = 23.5dBm into 50Ω load | -    | -      | -36  | dBm    |

## Electrical Specifications: NB-IoT : Band 5, 8, 12, 13, 14, 17, 18, 19, 20, 26, 28, 71, 85

(Temp = +25°C, Vbatt = VCC = VIO= +1.8V, 50 Ω system, Modulation used: 1tone@position0, NB-IoT, QPSK, 15 KHz subcarrier spacing, 1tone with MPR=0, unless otherwise specified)

| Parameter                   |                                  | Conditions                                                                               | Min.               | Typ.  | Max. | Units      |
|-----------------------------|----------------------------------|------------------------------------------------------------------------------------------|--------------------|-------|------|------------|
| Frequency Range             |                                  | Band 12                                                                                  | 699                | 707.5 | 716  | MHz        |
|                             |                                  | Band 28, 17                                                                              | 703                | 725.5 | 748  |            |
|                             |                                  | Band 13                                                                                  | 777                | 782   | 787  |            |
|                             |                                  | Band 14                                                                                  | 788                | 793   | 798  |            |
|                             |                                  | Band 26, 18, 19                                                                          | 814                | 831.5 | 849  |            |
|                             |                                  | Band 20                                                                                  | 832                | 847   | 862  |            |
|                             |                                  | Band 8                                                                                   | 880                | 897.5 | 915  |            |
|                             |                                  | Band 5                                                                                   | 824                | 836.5 | 849  |            |
|                             |                                  | Band 71                                                                                  | 663                | 680.5 | 698  |            |
|                             |                                  | Band 85                                                                                  | 668                | 707   | 716  |            |
| Maximum Linear Output Power |                                  | HPM                                                                                      | 23.5               | -     | -    | dBm        |
| Gain                        | Bands 5,8,20,13,14, 26,18,19     | HPM, Pout = Prated                                                                       | -                  | 27    | -    | dB         |
|                             | Bands 12,17,28,71,85             |                                                                                          | -                  | 26    | -    |            |
| GSM ACLR                    | Bands 5,8,20,26, 18,19           | HPM, Prated – 2dB (MPR), Vcc = 1.8V, Modulation = QPSK<br>12tone@positon0..11, 15 KHz SC | -                  | -39   | -29  | dBc        |
|                             | Bands 12,13,14,17,28,71,85       |                                                                                          | -                  | -41   |      |            |
| UTRA ACLR                   |                                  |                                                                                          | -                  | -61   | -46  |            |
| PA Total Current            | Band 8                           |                                                                                          | HPM, Pout = Prated | -     | 400  | -          |
|                             | Bands 5,13,14, 18,19, 20, 26, 28 | -                                                                                        |                    | 386   | -    |            |
|                             | Bands 12, 17, 71, 85             | -                                                                                        |                    | 361   | -    |            |
|                             | All bands                        | HPM, Pout = 10.5dBm, Vcc = 0.7V                                                          | -                  | 100   | -    |            |
| PAE                         | Band 8                           | HPM, Pout ≤ Prated                                                                       | -                  | 31    | -    | %          |
|                             | Bands 5,13,14, 18,19, 20, 26, 28 |                                                                                          | -                  | 32    | -    |            |
|                             | Bands 12, 17, 71, 85             |                                                                                          | -                  | 35    | -    |            |
| EVM                         |                                  | HPM, Pout ≤ Prated                                                                       | -                  | 5.5   | -    | %          |
| SEM                         |                                  | Pout ≤ Prated, +/- 100kHz                                                                | -                  | -35   | -    | dBm/30 kHz |
|                             |                                  | Pout ≤ Prated, +/- 150kHz                                                                | -                  | -46   | -    |            |
|                             |                                  | Pout ≤ Prated, +/- 300kHz                                                                | -                  | -49   | -    |            |
|                             |                                  | Pout ≤ Prated, +/- 500 to 1700kHz                                                        | -                  | -54   | -    |            |

## Electrical Specifications: NB-IoT : Band 5, 8, 12, 13, 14, 17, 18, 19, 20, 26, 27, 28, 71, 85 - continued

(Temp = +25°C, Vbatt = VCC = VIO= +1.8V, 50 Ω system, Modulation used: 1tone@position0, NB-IoT, QPSK, 15 KHz subcarrier spacing, 1tone with MPR=0, unless otherwise specified)

| Parameter                         |                                 | Conditions                                                                                                        | Min. | Typ.  | Max. | Units  |
|-----------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------|------|-------|------|--------|
| Harmonic suppression, 2fo         | Bands 12, 17, 71, 85            | $P_{out} \leq P_{rated}$                                                                                          | -    | -48   | -    | dBm    |
|                                   | Band 8                          |                                                                                                                   | -    | -51   | -    |        |
|                                   | Bands 5, 14, 18, 19, 20, 26     |                                                                                                                   | -    | -50   | -    |        |
|                                   | Band 28                         |                                                                                                                   | -    | -48   | -    |        |
|                                   | Bands 13                        |                                                                                                                   | -    | -58   | -    |        |
| Harmonic suppression, 3fo         | Bands 12, 17, 28, 71, 85        | $P_{out} \leq P_{rated}$                                                                                          | -    | -42   | -    | dBm    |
|                                   | Bands 5, 13, 14, 18, 19, 20, 26 |                                                                                                                   | -    | -46   | -    |        |
|                                   | Band 8                          |                                                                                                                   | -    | -52   | -    |        |
| Rx Band Noise                     | Band 71 Rx                      | 617 -652 MHz                                                                                                      | -    | -123  | -    | dBm/Hz |
|                                   | Band 85 Rx                      | 728 -- 746 MHz                                                                                                    | -    | -125  | -    |        |
|                                   | Band 12 Rx                      | 729 – 746 MHz                                                                                                     | -    | -125  | -    |        |
|                                   | Band 13 Rx                      | 746 – 756 MHz                                                                                                     | -    | -131  | -    |        |
|                                   | Band 14 Rx                      | 758 – 768 MHz                                                                                                     | -    | -125  | -    |        |
|                                   | Band 28 Rx                      | 758 – 803 MHz                                                                                                     | -    | -125  | -    |        |
|                                   | Band 26 Rx                      | 859 – 894 MHz                                                                                                     | -    | -125  | -    |        |
|                                   | Band 20 Rx                      | 791 – 821 MHz                                                                                                     | -    | -128  | -    |        |
| WiFi Band Noise                   |                                 | $P_{out} = P_{rated}$ , 2400 – 2495MHz                                                                            | -    | -156  | -    | dBm/Hz |
|                                   |                                 | $P_{out} = P_{rated}$ , 5150 – 5850MHz                                                                            | -    | -150  | -    |        |
| GPS band noise power              |                                 | $P_{out} = P_{rated}$ , 1574 – 1577MHz                                                                            | -    | -166  | -    | -      |
| Input VSWR                        |                                 | No external matching                                                                                              | -    | 2.5:1 | -    |        |
| Gain Switching Time               |                                 | Time required for output power to settle to within ±1dB of the final output power for any given mode transistion. | -    | -     | 10   | uSec   |
| Stability, Spurious Output Levels |                                 | Load VSWR = 10:1, all phase angles, Pin adjusted for $P_{out} = 23.5\text{dBm}$ into 50Ω load                     | -    | -     | -36  | dBm    |



**Electrical Specifications: Cat-M1 : Band 5, 8, 12, 13, 14, 17, 18, 19, 20, 26, 27, 28, 71, 85**

(Temp = +25°C, Vbatt = VIO = +1.8V, Vcc = 2.5V, 50 Ω system, Modulation used: FDD-LTE QPSK, 1.4MHz channel, 1 Resource Block with MPR=0, unless otherwise specified.)

| Parameter                   |                                         | Conditions                                                        | Min. | Typ.  | Max. | Units |
|-----------------------------|-----------------------------------------|-------------------------------------------------------------------|------|-------|------|-------|
| Frequency Range             |                                         | Band 12                                                           | 699  | 707.5 | 716  | MHz   |
|                             |                                         | Band 28, 17                                                       | 703  | 725.5 | 748  |       |
|                             |                                         | Band 13                                                           | 777  | 782   | 787  |       |
|                             |                                         | Band 14                                                           | 788  | 793   | 798  |       |
|                             |                                         | Band 26, 18, 19                                                   | 814  | 831.5 | 849  |       |
|                             |                                         | Band 27                                                           | 807  | 815.5 | 824  |       |
|                             |                                         | Band 20                                                           | 832  | 847   | 862  |       |
|                             |                                         | Band 8                                                            | 880  | 897.5 | 915  |       |
|                             |                                         | Band 5                                                            | 824  | 836.5 | 849  |       |
|                             |                                         | Band 71                                                           | 663  | 680.5 | 698  |       |
|                             |                                         | Band 85                                                           | 668  | 707   | 716  |       |
| Maximum Linear Output Power |                                         | HPM                                                               | 23.5 | -     | -    | dBm   |
| Gain                        | Bands 5, 8, 13, 14, 18, 19, 20, 26, 27  | HPM, Pout = Prated                                                | -    | 26.5  | -    | dB    |
|                             | Bands 12, 17, 28, 71, 85                |                                                                   | -    | 26    | -    |       |
| ACLR1 – EUTRA               | Bands 5, 13, 14, 18, 19, 20, 26, 27     | HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = 1.4MHz 6RB QPSK | -    | -39   | -33  | dBc   |
|                             | Band 8                                  |                                                                   | -    | -43   |      |       |
|                             | Bands 12, 17, 28, 71, 85                |                                                                   | -    | -41   |      |       |
| ACLR1 - UTRA                | Bands 5, 13, 14, 18, 19, 20, 26, 27     |                                                                   | -    | -42   | -36  |       |
|                             | Band 8                                  |                                                                   | -    | -43   |      |       |
|                             | Bands 12, 17, 28, 71, 85                |                                                                   | -    | -45   |      |       |
| ACLR2 – UTRA                |                                         |                                                                   | -    | -66   | -39  |       |
| PA Total Current            | Band 8                                  | HPM, Pout = Prated                                                | -    | 390   | -    | mA    |
|                             | Bands 5, 13, 14, 18, 19, 20, 26, 27, 28 |                                                                   | -    | 375   | -    |       |
|                             | Bands 12, 17, 71, 85                    |                                                                   | -    | 342   | -    |       |
| PAE                         | Band 8                                  | HPM, Pout ≤ Prated                                                | -    | 23    | -    | %     |
|                             | Bands 5, 13, 14, 18, 19, 20, 26, 27, 28 |                                                                   | -    | 24    | -    |       |
|                             | Bands 12, 17, 71, 85                    |                                                                   | -    | 26    | -    |       |
| EVM                         |                                         | HPM, Pout ≤ Prated                                                | -    | 5     | -    | %     |
| Harmonic suppression, 2fo   | Bands 12, 17, 71, 85                    | HPM, Pout ≤ Prated                                                | -    | -42   | -    | dBm   |
|                             | Band 8                                  |                                                                   | -    | -41   | -    |       |
|                             | Bands 5, 14, 18, 19, 20, 26, 27         |                                                                   | -    | -54   | -    |       |
|                             | Band 28                                 |                                                                   | -    | -43   | -    |       |
|                             | Band 13                                 |                                                                   | -    | -54   | -    |       |

## Electrical Specifications: Cat-M1 : Band 5, 8, 12, 13, 17, 18, 19, 20, 26, 28, 71, 85 - continued

(Temp = +25°C, Vbatt = VIO= +1.8V, 50  $\Omega$  system, Modulation used: FDD-LTE QPSK, 1.4MHz channel, 1 Resource Block with MPR=0, unless otherwise specified.)

| Parameter                         |                                     | Conditions                                                                                            | Min. | Typ. | Max. | Units  |
|-----------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------|------|------|------|--------|
| Harmonic suppression, 3fo         | Bands 12, 17, 28, 71, 85            | $P_{out} \leq P_{rated}$                                                                              | -    | -43  | -    | dBm    |
|                                   | Band 8                              |                                                                                                       | -    | -53  | -    |        |
|                                   | Bands 5, 13, 14, 18, 19, 20, 26, 27 |                                                                                                       | -    | -46  | -    |        |
| ISM noise power                   |                                     | 2400 – 2447 MHz                                                                                       | -    | -163 | -    | dBm/Hz |
| Rx Band Noise                     | Band 71 Rx                          | 617 -652 MHz                                                                                          | -    | -124 | -    |        |
|                                   | Band 85 Rx                          | 728 -- 746 MHz                                                                                        | -    | -126 | -    |        |
|                                   | Band 12 Rx                          | 729 – 746 MHz                                                                                         | -    | -126 | -    |        |
|                                   | Band 13 Rx                          | 746 – 756 MHz                                                                                         | -    | -132 | -    |        |
|                                   | Band 14 Rx                          | 758 – 768 MHz                                                                                         | -    | -127 | -    |        |
|                                   | Band 28 Rx                          | 758 – 803 Mhz                                                                                         | -    | -127 | -    |        |
|                                   | Band 27 Rx                          | 852 – 869 MHz                                                                                         | -    | -126 | -    |        |
|                                   | Band 26 Rx                          | 859 – 894 MHz                                                                                         | -    | -127 | -    |        |
|                                   | Band 20 Rx                          | 791 – 821 MHz                                                                                         | -    | -126 | -    |        |
|                                   | Band 8 Rx                           | 925 – 960 MHz                                                                                         | -    | -125 | -    |        |
| GPS band noise power              |                                     | $P_{out} = P_{rated}$ , 1574 – 1577MHz                                                                | -    | -166 | -    |        |
| Stability, Spurious Output Levels |                                     | Load VSWR = 10:1, all phase angles, Pin adjusted for $P_{out} = 23.5\text{dBm}$ into 50 $\Omega$ load | -    | -    | -36  | dBm    |

### Electrical Specifications: NTN : B24/B255, B23/B256

(Temp = +25°C, VIO= +1.8V, VCC= Vbatt = 3.3V, 50  $\Omega$  system, Modulation used: 1tone@position0, NB-IoT, QPSK, 15 KHz subcarrier spacing, 1tone with MPR=0, unless otherwise specified)

| PARAMETER                         |          | CONDITIONS                                                                                | MIN.   | TYP.  | MAX.   | UNITS      |
|-----------------------------------|----------|-------------------------------------------------------------------------------------------|--------|-------|--------|------------|
| Frequency Range                   |          | B24/B255                                                                                  | 1626.5 | -     | 1660.5 | MHz        |
|                                   |          | B23/B256                                                                                  | 1980   | -     | 2020   |            |
| Maximum Linear Output Power       |          | HPM, NTC                                                                                  | 26.5   |       | -      | dBm        |
| Gain                              | B24/B255 | Pout = 26.5 dBm                                                                           | 26     | 28    | 30     | dB         |
|                                   | B23/B256 |                                                                                           | 25.5   | 27    | 29     |            |
| GSM ACLR                          | B24/B255 | HPM, Prated – 1dB (MPR), Vcc = 3.3V, Modulation = QPSK 12tone@position0..11, 15 KHz SC    | -      | -40   | -35    | dBc        |
|                                   | B23/B256 |                                                                                           | -      | -39   | -32    |            |
| UTRA                              | B24/B255 |                                                                                           | -      | -64   | -61    |            |
|                                   | B23/B256 |                                                                                           | -      | -65   | -61    |            |
| PA Total Current                  | B24/B255 | HPM, Pout = 26.5 dBm                                                                      | -      | 500   | 570    | mA         |
|                                   | B23/B256 |                                                                                           | -      | 476   | 560    |            |
| PAE                               | B24/B255 | HPM, Pout = 26.5 dBm                                                                      | -      | 27    | -      | %          |
|                                   | B23/B256 |                                                                                           | -      | 28    | -      |            |
| EVM                               | B24/B255 | HPM, Prated – 1dB (MPR), Vcc = 3.3V, Modulation = QPSK 12tone@position0..11, 15 KHz SC    | -      | 5     | 7.5    | %          |
|                                   | B23/B256 |                                                                                           | -      | 6.5   | 9      |            |
| SEM                               | B24/B255 | Pout $\leq$ Prated, +/- 100kHz                                                            | -      | -30   | -      | dBm/30 kHz |
|                                   |          | Pout $\leq$ Prated, +/- 150kHz                                                            | -      | -30   | -      |            |
|                                   |          | Pout $\leq$ Prated, +/- 300kHz                                                            | -      | -47   | -      |            |
|                                   |          | Pout $\leq$ Prated, +/- 500 to 1700kHz                                                    | -      | -52   | -      |            |
|                                   | B23/B256 | Pout $\leq$ Prated, +/- 100kHz                                                            | -      | -24   | -      |            |
|                                   |          | Pout $\leq$ Prated, +/- 150kHz                                                            | -      | -23   | -      |            |
|                                   |          | Pout $\leq$ Prated, +/- 300kHz                                                            | -      | -44   | -      |            |
|                                   |          | Pout $\leq$ Prated, +/- 500 to 1700kHz                                                    | -      | -51   | -      |            |
| Harmonic, 2fo                     | B24/B255 | Pout $\leq$ Prated                                                                        | -      | -35   | -      | dBm        |
|                                   | B23/B256 |                                                                                           | -      | -47   | -      |            |
| Harmonic, 3fo                     | B24/B255 | Pout $\leq$ Prated                                                                        | -      | -43   | -      |            |
|                                   | B23/B256 |                                                                                           | -      | -46   | -      |            |
| RX Band Noise                     | B24/B255 | Pout = Prated, 1525 – 1559MHz,                                                            | -      | -127  | -      | dBm/kHz    |
|                                   | B23/B256 | Pout = Prated, 2170 – 2200MHz,                                                            | -      | -136  | -      |            |
| Wi-Fi Band Noise                  | B24/B255 | Pout = Prated, 2400 – 2495MHz,                                                            | -      | -146  | -      |            |
|                                   |          | Pout = Prated, 5150 – 5850MHz,                                                            | -      | -165  | -      |            |
|                                   | B23/B256 | Pout = Prated, 2400 – 2495MHz,                                                            | -      | -131  | -      |            |
|                                   |          | Pout = Prated, 5150 – 5850MHz,                                                            | -      | -159  | -      |            |
| GPS Band Noise                    | B24/B255 | Pout = Prated, 1574 – 1577MHz,                                                            | -      | -127  | -      |            |
|                                   | B23/B256 | Pout = Prated, 1574 – 1577MHz,                                                            | -      | -138  | -      |            |
| Stability, Spurious Output Levels |          | Load VSWR = 10:1, all phase angles, Pin adjusted for Pout = 23.5dBm into 50 $\Omega$ load | -      | -     | -36    | dBm        |
| Input VSWR                        |          | No external matching                                                                      | -      | 2.5:1 |        |            |

| PARAMETER           | CONDITIONS                                                                                                              | MIN. | TYP. | MAX. | UNITS |
|---------------------|-------------------------------------------------------------------------------------------------------------------------|------|------|------|-------|
| Gain Switching Time | Time required for output power to settle to within $\pm 1$ dB of the final output power for any given mode transistion. | -    | -    | 10   | uSec  |

## Electrical Specifications: Switch And Port Isolation

(Temp = +25°C, Nominal test conditions unless otherwise specified. All unused ports terminated in 50Ω. Logic state given in register table.)

| Parameter          | Conditions                 | Min. | Typ. | Max. | Units |
|--------------------|----------------------------|------|------|------|-------|
| Insertion Loss, IL | ANT to TRX1, 450 – 2200MHz | -    | 0.7  | -    | dB    |
|                    | ANT to TRX2, 450 – 2200MHz | -    | 0.7  | -    |       |
|                    | ANT to TRX3, 450 – 2200MHz | -    | 0.7  | -    |       |
|                    | ANT to TRX4, 450 – 2200MHz | -    | 0.7  | -    |       |
| Isolation, ISO     | ANT to TRX1, 450 – 2200MHz | -    | 23   | -    |       |
|                    | ANT to TRX2, 450 – 2200MHz | -    | 26   | -    |       |
|                    | ANT to TRX3, 450 – 2200MHz | -    | 26   | -    |       |
|                    | ANT to TRX4, 450 – 2200MHz | -    | 26   | -    |       |

**Table 1: RFFE MIPI Register Map (1 of 4)**

### Register Details

This section displays each register in table form. Table headers described here:

TRIG. – Indicates whether the Write Command can be triggered. The value in the Trig. Column indicates which trigger causes the Bit Field to be loaded from the shadow register. “T012” means that any or all triggers will cause a load from shadow register.

#### Register 0 (0x00) – PA\_CTRL0

| BITS | FIELD NAME    | DEFAULT | DESCRIPTION                                                                                                                                                                                            | R/W | B/G | TRIG. |
|------|---------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7:6  | Reserved[1:0] | 0b00    | This is a read-only bit that is reserved and yields a value of 0 at readback                                                                                                                           | R   | No  | No    |
| 5:3  | PA_BAND[2:0]  | 0b000   | PA Band<br>000: off<br>001: TRX4<br>010: TRX3<br>011: TRX1<br>100: LB_TX<br>101: Reserved<br>110: MB_TX<br>111: TRX2                                                                                   | R/W |     | T012  |
| 2    | TX_EN[2]      | 0b0     | Transmit Enable<br>0 = Transmit mode disabled<br>1 = Transmit mode enabled<br>Set this bit to 1 to turn on the module's PA for LB or MB transmit or to use one of the four TRX ports in transmit mode. | R/W |     | T012  |
| 1    | PA_MODE[1]    | 0b0     | PA Power Control Mode<br>0 = HPM<br>1 = LPM                                                                                                                                                            | R/W |     | No    |
| 0    | Reserved[0]   | 0b0     | This is a read-only bit that is reserved and yields a value of 0 at readback.                                                                                                                          | R/W |     | No    |

#### Register 1 (0x01) – PA\_CTRL1

| BITS | FIELD NAME    | DEFAULT | DESCRIPTION            | R/W | B/G | TRIG. |
|------|---------------|---------|------------------------|-----|-----|-------|
| 7:4  | PA_BIAS2[3:0] | 0b0000  | PA Bias – power stage  | R/W | No  | T012  |
| 3:0  | PA_BIAS1[3:0] | 0b0000  | PA Bias – driver stage | R/W | No  | T012  |

#### Register 2 (0x02) – PA\_CTRL2

| BITS | FIELD NAME    | DEFAULT | DESCRIPTION                                                                      | R/W | B/G | TRIG. |
|------|---------------|---------|----------------------------------------------------------------------------------|-----|-----|-------|
| 7:4  | Reserved[3:0] | 0b0000  | These are a read-only bits that are reserved and yield a value of 0 at readback. | R/W | No  | No    |
| 3:0  | PA_TUNE[3:0]  | 0b0000  | PA Tuning Cap                                                                    | R/W | No  | T012  |

**Table 1: RFFE MIPI Register Map (2 of 4)**

**Register 26 (0x1A) – RFFE\_STATUS**

| BIT(S) | FIELD NAME          | DEFAULT | DESCRIPTION                                                                                                                | R/W | B/G | TRIG. |
|--------|---------------------|---------|----------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7      | SW_RESET[7]         | 0b0     | 0: Normal operation<br>1: Software reset (reset of all configurable registers to default values, except for USID&#38;GSID) | R/W | No  | No    |
| 6      | CMD_FRAME_P_ERR[6]  | 0b0     | Command sequence received with parity error – discard command.                                                             |     |     |       |
| 5      | CMD_LEN_ERR[5]      | 0b0     | Command length error                                                                                                       |     |     |       |
| 4      | ADDR_FRAME_P_ERR[4] | 0b0     | Address frame parity error = 1                                                                                             |     |     |       |
| 3      | DATA_FRAME_P_ERR[3] | 0b0     | Data Frame received with a parity error                                                                                    |     |     |       |
| 2      | READ_UNUSED_REG[2]  | 0b0     | Read Command to an invalid address                                                                                         |     |     |       |
| 1      | WRITE_UNUSED_REG[1] | 0b0     | Write command to an invalid address                                                                                        |     |     |       |
| 0      | BID_GID_ERR[0]      | 0b0     | Read command with a Broadcast_ID or GROUP_ID                                                                               |     |     |       |

**Register 27 (0x1B) – GROUP\_ID**

| BIT(S) | FIELD NAME | DEFAULT | DESCRIPTION      | R/W | B/G | TRIG. |
|--------|------------|---------|------------------|-----|-----|-------|
| 7:4    | GSID0[3:0] | 0b0000  | Group Slave ID 0 | R/W | No  | No    |
| 3:0    | GSID1[3:0] | 0b0000  | Group Slave ID 1 |     |     |       |

**Register 28 (0x1C) – PM\_TRIG**

| BIT(S) | FIELD NAME       | DEFAULT | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                  | R/W | B/G | TRIG. |
|--------|------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7      | PWR_MODE_MSB[7]  | 0b1     | 0: Normal operation (ACTIVE)<br>1: Secondary mode (LOW POWER)                                                                                                                                                                                                                                                                                                                                                                | R/W | Yes | No    |
| 6      | PWR_MODE_LSB[6]  | 0b0     | RFFE State machine vector.<br>0: active mode<br>1: in reset state<br><br>Writing a 1 to this bit forces a reset. All registers including USID and GSID are reset to default values. This bit always reads as 0.                                                                                                                                                                                                              | R/W | Yes | No    |
| 5:3    | TriggerMask[2:0] | 0b000   | Setting these bits to '1' will cause the corresponding triggers to be masked (disabled), and RFFE writes to corresponding registers will change configuration immediately (no trigger command necessary).<br>TriggerMask[2] = TriggerMask_2, TriggerMask[1] = TriggerMask_1,&#38;TriggerMask[0] = TriggerMask_0<br>Note: Qorvo does not allow for changing the trigger mask and sending triggers within the same RFFE write. | R/W | No  | No    |
| 2:0    | Trigger[2:0]     | 0b000   | Setting these bits to '1' will cause the registers associated with that trigger to be loaded with the contents of its corresponding shadow register. Trigger[2] = Trigger_2, Trigger[1] = Trigger_1, and Trigger[0] = Trigger_0<br>Note: Qorvo does not allow for changing the trigger mask and sending triggers within the same RFFE write.                                                                                 | W   | Yes | No    |

**Table 1: RFFE MIPI Register Map (3 of 4)**

**Register 29 (0x1D) – PRODUCT\_ID**

| BITS | FIELD NAME      | DEFAULT | DESCRIPTION                                                                                                                                                                        | R/W | B/G | TRIG. |
|------|-----------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7:0  | PRODUCT_ID[7:0] | 0x07    | This is a read-only register. However, during the programming of the USID a write command sequence is performed on this register, even though the write does not change its value. | R   | No  | No    |

**Register 30 (0x1E) – MANUFACTURER\_ID**

| BITS | FIELD NAME               | DEFAULT | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                | R/W | B/G | TRIG. |
|------|--------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7:0  | MANUFACTURER_ID_LSB[7:0] | 0xC6    | This is a read-only register. However, during the programming of the USID, a write command sequence is performed on this register, even though the write does not change its value. Note: This is the lower 8 least significant bits of the RFFE's MANUFACTURER_ID (i.e. MANUFACTURER_ID[7:0] = MANUFACTURER_ID_LSB[7:0]<br>Qorvo Manufacturer ID = 0x3C6 = 0011_1100_0110 | R   | No  | No    |

**Register 31 (0x1F) – MAN\_US\_ID**

| BITS | FIELD NAME               | DEFAULT | DESCRIPTION                                                                                                                                                                                                                                                                                                    | R/W | B/G | TRIG. |
|------|--------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7:4  | MANUFACTURER_ID_MSB[3:0] | 0b0011  | These bits are read-only. However, during the programming of the USID, a write command sequence is performed on this register even though the write does not change its value. Note: This is the 4 most significant bits of the RFFE's MANUFACTURER_ID (i.e. MANUFACTURER_ID[11:8] = MANUFACTURER_ID_MSB[3:0]) | R   | No  | No    |
| 3:0  | USID[3:0]                | 0b1111  | Programmable USID. Performing a write to this register using the described programming sequences will program the USID in devices supporting this feature. These bits store the USID of the device.                                                                                                            | R/W | No  | No    |

**Register 32 (0x20) – EXT\_PRODUCT\_ID**

| BITS | FIELD NAME          | DEFAULT | DESCRIPTION                                                                                                                                                                        | R/W | B/G | TRIG. |
|------|---------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7:0  | EXT_PRODUCT_ID[7:0] | 0x00    | This is a read-only register. However, during the programming of the USID a write command sequence is performed on this register, even though the write does not change its value. | R   | No  | No    |

**Register 33 (0x21) – REVISION\_ID**

| BITS | FIELD NAME  | DEFAULT | DESCRIPTION                                                                         | R/W | B/G | TRIG. |
|------|-------------|---------|-------------------------------------------------------------------------------------|-----|-----|-------|
| 7:0  | REVISION_ID | 0x01    | This is an RFFE2 register to contain information about the revision of this module. | R   | No  | No    |

**Table 1: RFFE MIPI Register Map (4 of 4)**

**Register 34 (0x22) – GROUP\_ID2**

| BIT(S) | FIELD NAME   | DEFAULT | DESCRIPTION                                                                                                                                                                                               | R/W | B/G | TRIG. |
|--------|--------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7:4    | GSID0_2[3:0] | 0x00    | Group slave ID 0<br>There is only 1 register for GSID0&#38;GSID1, but this register can be accessed from either Reg27 or Reg34. This means that write to Reg34 will reflect in Reg27 also, and vice versa | R/W | No  | No    |
| 3:0    | GSID1_2[3:0] | 0x00    | Group slave ID 1<br>There is only 1 register for GSID0&#38;GSID1, but this register can be accessed from either Reg27 or Reg34. This means that write to Reg34 will reflect in Reg27 also, and vice versa |     |     |       |

**Register 35 (0x23) – RFFE\_STATUS2**

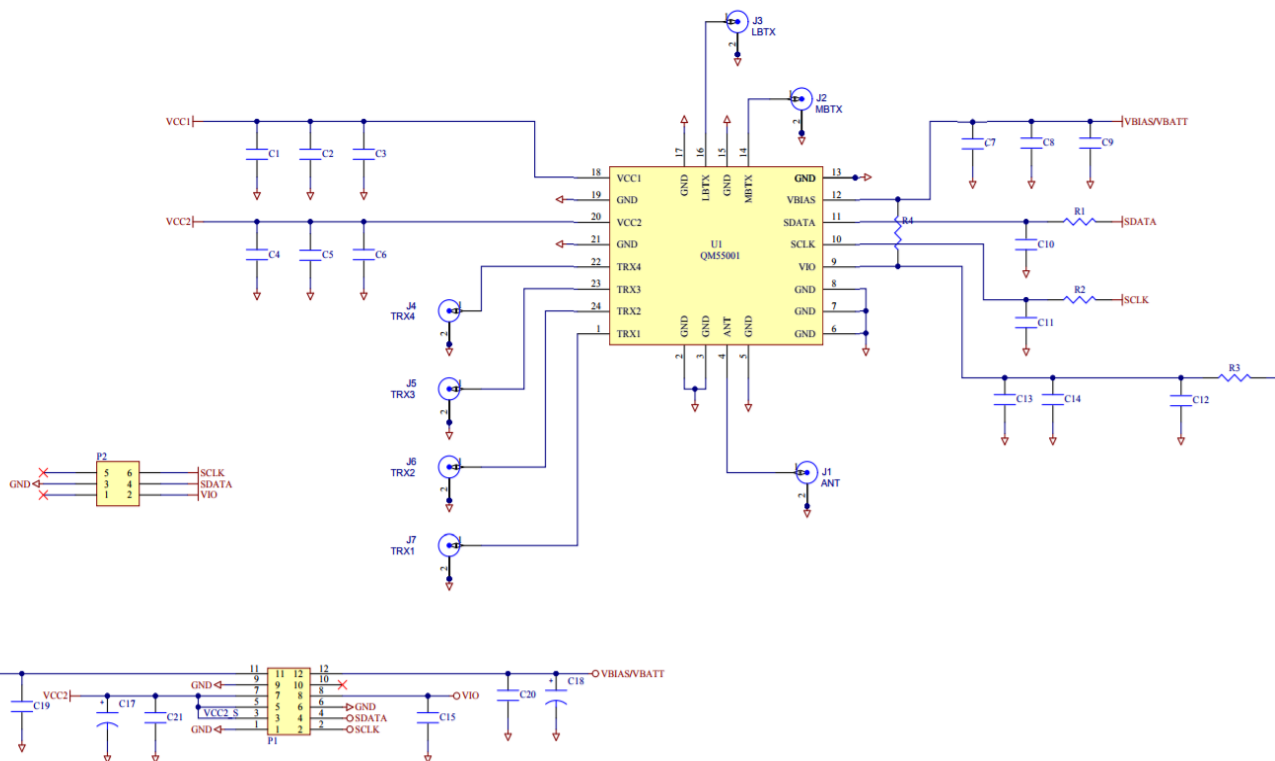
| BIT(S) | FIELD NAME    | DEFAULT | DESCRIPTION                                                                                                                                                                                                                                                                                            | R/W | B/G | TRIG. |
|--------|---------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 7      | SW_RESET_2[7] | 0b0     | 0: Normal operation<br>1: Software reset (reset of all configurable registers to default values, except for USID)<br>There is only 1 register for RFFE_STATUS, but this register can be accessed from either Reg26 or Reg35. This means that write to Reg35 will reflect in Reg27 also, and vice versa | R/W | No  | No    |
| 6      | Reserved[6]   | 0b0     | Reserved                                                                                                                                                                                                                                                                                               |     |     |       |
| 5      | Reserved[5]   | 0b0     | Reserved                                                                                                                                                                                                                                                                                               |     |     |       |
| 4      | Reserved[4]   | 0b0     | Reserved                                                                                                                                                                                                                                                                                               |     |     |       |
| 3      | Reserved[3]   | 0b0     | Reserved                                                                                                                                                                                                                                                                                               |     |     |       |
| 2      | Reserved[2]   | 0b0     | Reserved                                                                                                                                                                                                                                                                                               |     |     |       |
| 1      | Reserved[1]   | 0b0     | Reserved                                                                                                                                                                                                                                                                                               |     |     |       |
| 0      | Reserved[0]   | 0b0     | Reserved                                                                                                                                                                                                                                                                                               |     |     |       |

**Register 36 (0x24) – ERR\_SUM (RFFE\_STATUS3)**

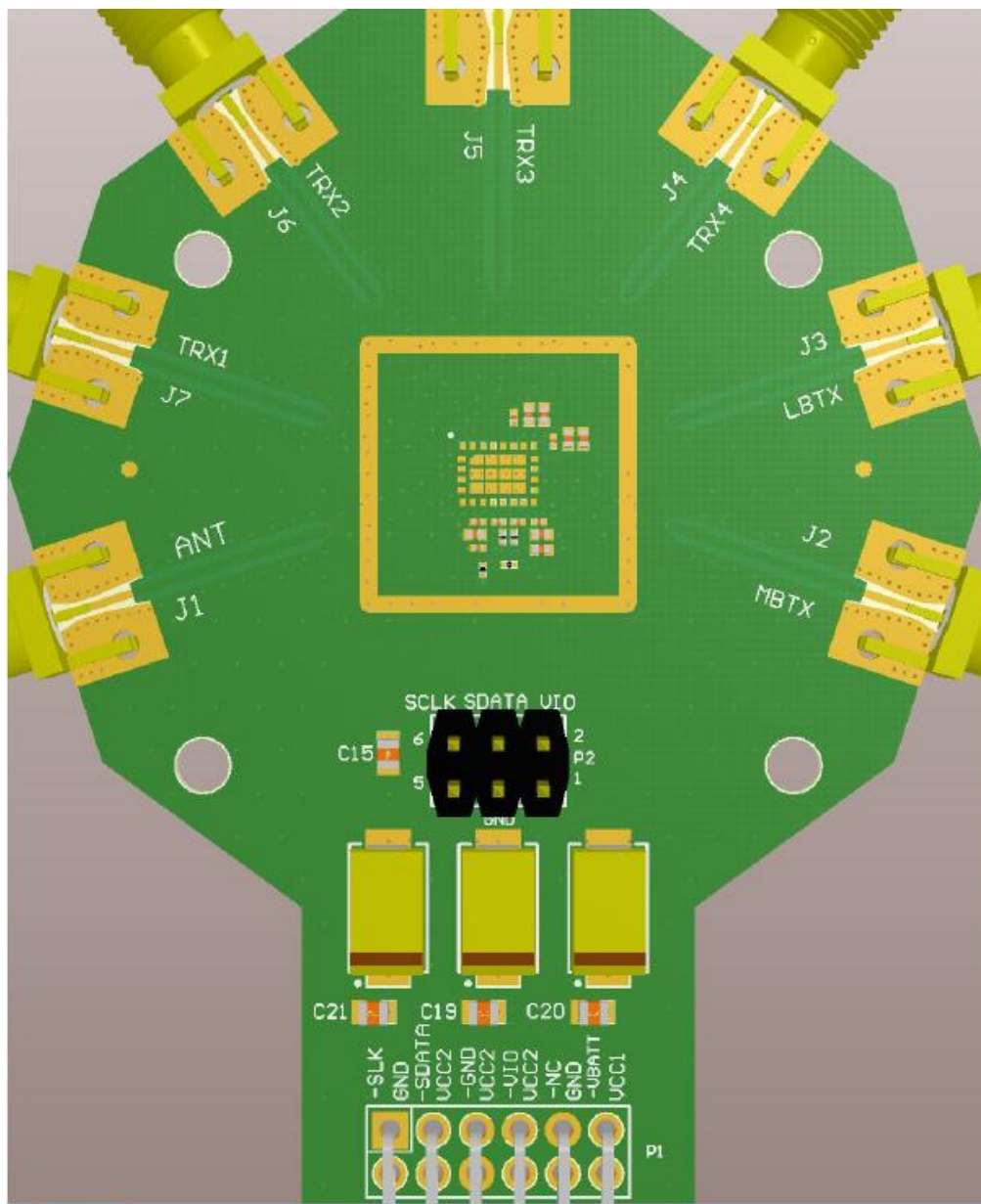
| BIT(S) | FIELD NAME            | DEFAULT | DESCRIPTION                                                    | R/W | B/G | TRIG. |
|--------|-----------------------|---------|----------------------------------------------------------------|-----|-----|-------|
| 7      | Reserved[7]           | 0b0     | Reserved                                                       | R/W | No  | No    |
| 6      | CMD_FRAME_P_ERR_2[6]  | 0b0     | Command sequence received with parity error – discard command. |     |     |       |
| 5      | CMD_LEN_ERR_2[5]      | 0b0     | Command length error                                           |     |     |       |
| 4      | ADDR_FRAME_P_ERR_2[4] | 0b0     | Address frame parity error = 1                                 |     |     |       |
| 3      | DATA_FRAME_P_ERR_2[3] | 0b0     | Data frame with parity error                                   |     |     |       |
| 2      | READ_UNUSED_REG_2[2]  | 0b0     | Read command to an invalid address                             |     |     |       |
| 1      | WRITE_UNUSED_REG_2[1] | 0b0     | Write command to an invalid address                            |     |     |       |
| 0      | BID_GID_ERR_2[0]      | 0b0     | Read command with a Broadcast_ID or GROUP_ID                   |     |     |       |



## Evaluation Board Schematic



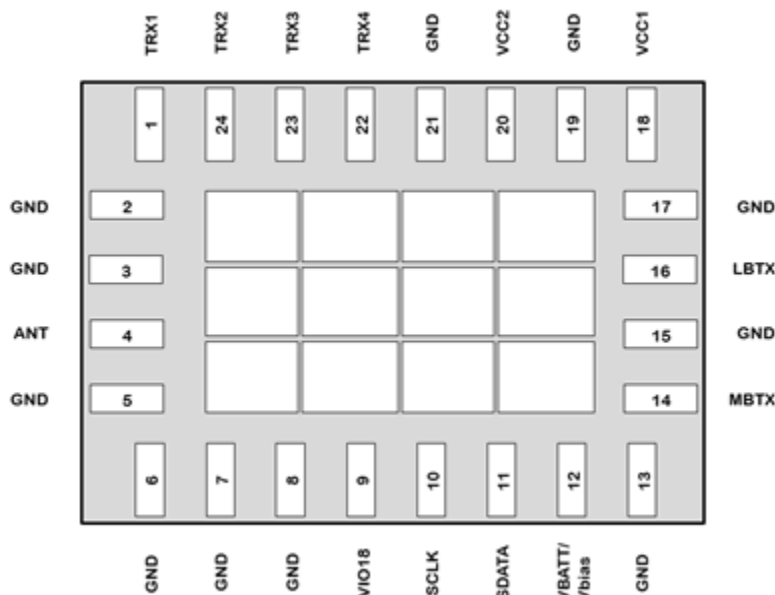
## Evaluation Board Layout



## Evaluation Board Bill of Material

| Designator                 | Description                              | Manuf.                              | Part number        |
|----------------------------|------------------------------------------|-------------------------------------|--------------------|
| C16, C17, C18              | CAP, 100uF, 20%, 10V, TANT-D             | AVX/KYOCERA ASIA LTD.               | TAJD107M010RNJ     |
| C19, C21, C15, C20         | CAP, 10uF, 10%, 6.3V, X5R, 0805          | TAIYO YUDEN (SINGAPORE) PTE LTD     | CE JMK212BJ106KG-T |
| R3                         | RES, 0 OHM, 5%, 1/20W, 0201              | Kamaya, Inc                         | RMC1/20JPPA15      |
| R1, R2                     | RES, 49.9 OHM, 1%, 1/20W, 0201           | Kamaya, Inc                         | RMC1/20-49R9FPA15  |
| C10, C11                   | CAP, 10pF, 5%, 25V, C0G, 0201            | AVX/KYOCERA ASIA LTD.               | 02013A100JAT2A     |
| C2, C5, C8, C14            | 5600 PF,10%,X7R,LF,0402, 25V,LEAD FREE   | MURATA ELECTRONICS SINGAPORE PTE LT | GRM155R71E562KA01D |
| C3, C6, C7, C12            | CAP, 100pF, 5%, 25V, C0G, 0201           | MURATA ELECTRONICS SINGAPORE PTE LT | GRM0335C1E101JA01D |
| P1                         | CONN, HDR, SHRD, RT-ANG, 2x6, 0.100",T/H | MOLEX                               | 90130-3212         |
| P2                         | CONN, HDR, ST, 2X3, 0.100"               | SAMTEC INC.                         | TSW-103-07-G-D     |
| J1, J2, J3, J4, J5, J6, J7 | CONN, SMA, EL FLT VIPER, MAT-21-1038     | Aliner Industries, Inc.             | 20-001CH-T         |
| C1, C4, C9                 | -                                        | -                                   | -                  |
| C13                        | -                                        | -                                   | -                  |
| R4                         | -                                        | -                                   | -                  |

## Pin Configuration

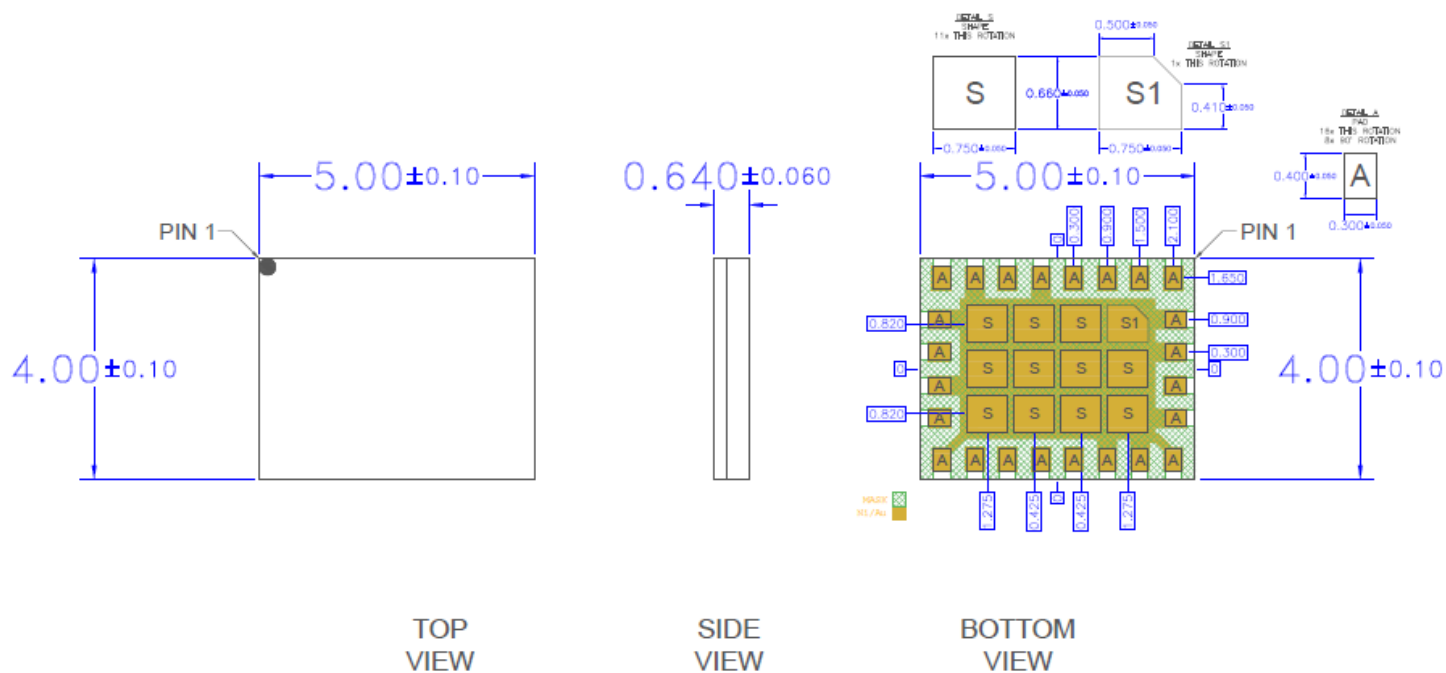


Top View (see through from top)

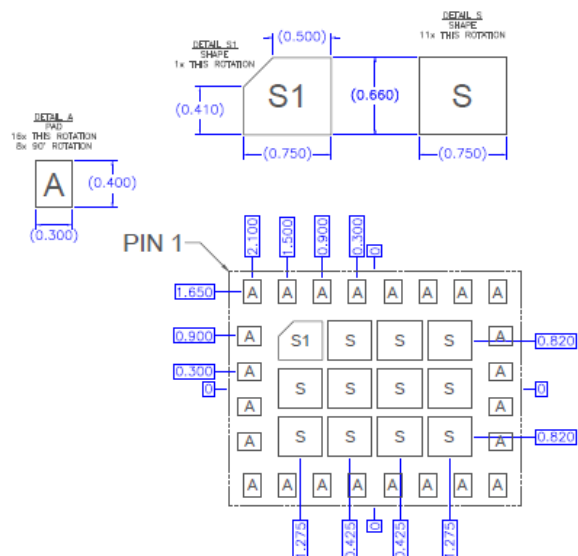
## Pin Description

| Pin Number | Label       | Description                             |
|------------|-------------|-----------------------------------------|
| 1          | TRX1        | Auxillary transimit and receive port 1. |
| 2 - 3      | GND         | Connected to module gnd.                |
| 4          | ANT         | RF Output port.                         |
| 5 - 8      | GND         | Connected to module gnd.                |
| 9          | VIO18       | Supply voltage for MIPI RF FE.          |
| 10         | SCLK        | Serial interface clock input signal.    |
| 11         | SDATA       | Serial interface data I/O signal.       |
| 12         | Vbias/VBATT | Supply voltage for bias circuitry.      |
| 13         | GND         | Connected to module gnd.                |
| 14         | MBTX        | MB RF Input                             |
| 15         | GND         | Connected to module gnd.                |
| 16         | LBTX        | LB RF Input                             |
| 17         | GND         | Connected to module gnd.                |
| 18         | VCC1        | Driver stage supply of PA.              |
| 19         | GND         | Connected to module gnd.                |
| 20         | VCC2        | Output stage supply of PA.              |
| 21         | GND         | Connected to module gnd.                |
| 22         | TRX4        | Auxillary transimit and receive port 4. |
| 23         | TRX3        | Auxillary transimit and receive port 3. |
| 24         | TRX2        | Auxillary transimit and receive port 2. |

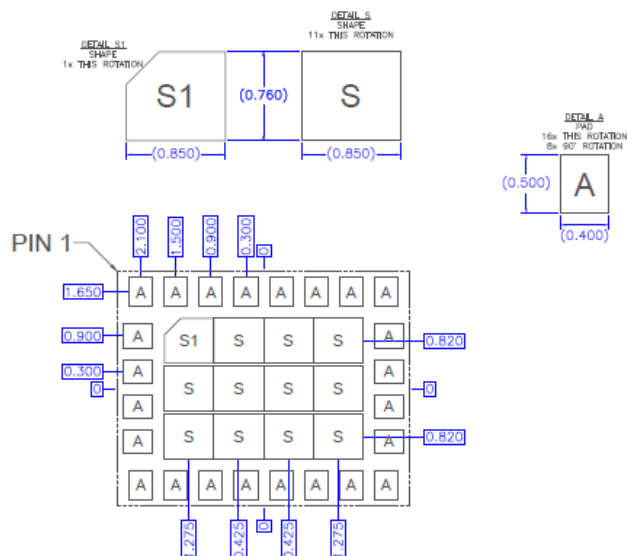
Package Outline Drawing



## Package Land Pattern



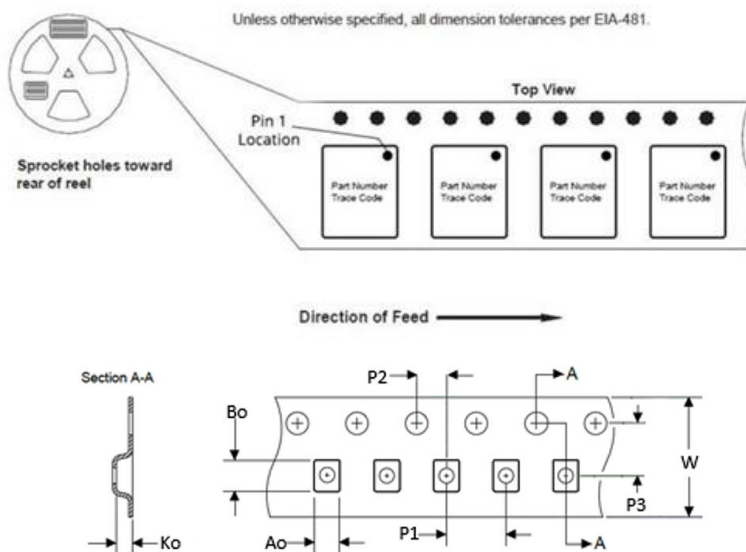
RECOMMENDED  
LAND PATTERN



RECOMMENDED  
LAND PATTERN MASK

## Tape and Reel Information - Carrier and Cover Tape Dimensions

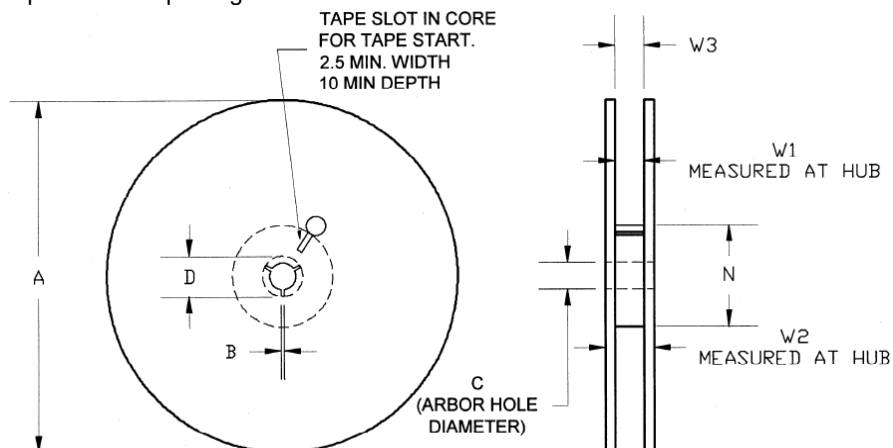
Tape and reel specifications for this part are also available on the Qorvo website.  
Standard T/R size = 5000 pieces on a 13" reel.



| Feature             | Measure                                  | Symbol | Size (in) | Size (mm) |
|---------------------|------------------------------------------|--------|-----------|-----------|
| 1.02Cavity          | Length                                   | A0     | 0.169     | 4.3       |
|                     | Width                                    | B0     | 0.209     | 5.3       |
|                     | Depth                                    | K0     | 0.051     | 1.3       |
|                     | Pitch                                    | P1     | 0.315     | 8         |
| Centerline Distance | Cavity to Perforation - Length Direction | P2     | 0.079     | 2.0       |
|                     | Cavity to Perforation - Width Direction  | P3     | 0.217     | 5.5       |
| Cover Tape          | Width                                    | C      | 0.362     | 9.2       |
| Carrier Tape        | Width                                    | W      | 0.472     | 12        |

## Tape and Reel Information - Reel Dimensions

Packaging reels are used to prevent damage to devices during shipping and storage, loaded carrier tape is typically wound onto a plastic take-up reel. The reel size is 13" diameter. The reels are made from high-impact injection-molded polystyrene (HIPS), which offers mechanical and ESD protection to packaged devices

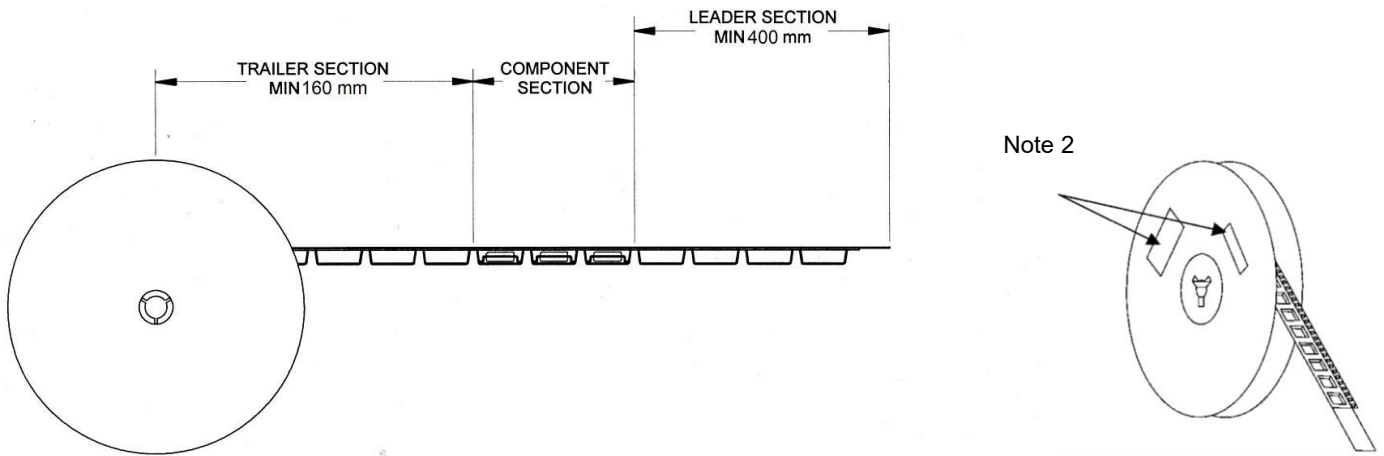


| Feature | Measure              | Symbol | Size (in) | Size (mm) |
|---------|----------------------|--------|-----------|-----------|
| Flange  | Diameter             | A      | 12.992    | 330       |
|         | Thickness            | W2     | .724      | 18.4      |
|         | Space Between Flange | W1     | .488      | 12.4      |
| Hub     | Outer Diameter       | N      | 4.016     | 102.0     |
|         | Arbor Hole Diameter  | C      | 0.512     | 13.0      |
|         | Key Slit Width       | B      | 0.079     | 2.0       |
|         | Key Slit Diameter    | D      | .795      | 20.2      |



## Tape and Reel Information - Tape Length and Label Placement

Tape and reel specifications for this part are on Qorvo website.



**Notes:**

1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481
2. Labels are placed on the flange opposite the sprockets in the carrier tape.

## Handling Precautions

| Parameter                        | Rating   | Standard               |
|----------------------------------|----------|------------------------|
| ESD – Human Body Model (HBM)     | Class 1C | ESDA/JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | Class C3 | JEDEC JESD22-C101F     |
| MSL – Moisture Sensitivity Level | MSL 3    | IPC/JEDEC J-STD-020    |



Caution!

ESD sensitive device

## Solderability

Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.

Package lead plating: Electrolytic plated Au over Ni

## RoHS Compliance

This part is compliant with the 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)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- SVHC Free

## 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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