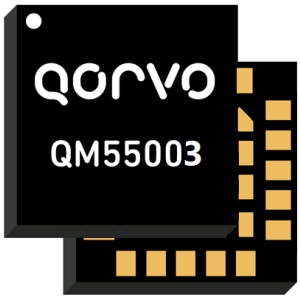
QM55003

Mid-Band Low-Band NB-IoT TxM

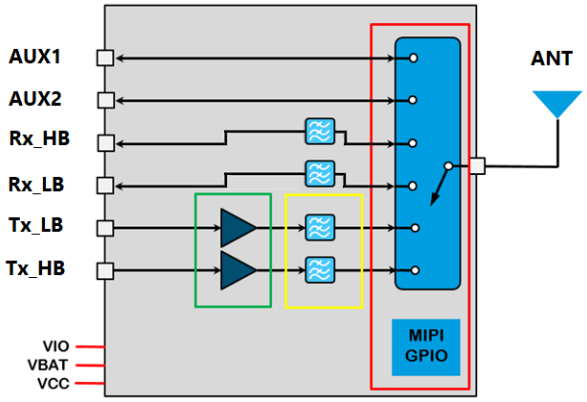


Package: Module, 20-Pin 4.00 x 4.00 x 0.64 mm

Product Overview

QM55003 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). It has integrated harmonic rejection LPF, antenna switch and auxillary TX/RX path. QM55003 band select and bias are programmed through a Mobile Industry Processor Interface (MIPI).

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
- Integrated Rx LPF for out-of-band rejection
- AUX paths
- 2.5V 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
QM55003PCK	Evaluation Board Sample Kit
QM55003SB	5-Piece Sample Bag
QM55003SQ	25-Piece Sample Bag
QM55003SR	100-Piece 7inch Sample Reel
QM55003TR13	5000-Piece 13inch Reel
QM55003DK	Design Kit: QM55003PCK +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
- 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	1.8	3.0	4.5	V
Supply Voltage, Vcc	0.5(1)	2.5	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(2)	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, VIO = 1.8V, Vbatt = 3.0V, Vcc = 2.5V.

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	24
3tone@position0..2		15	3	0..2	0.5	23.5
3tone@position3..5		15	3	3..5	0	24
3tone@position9..11		15	3	9..11	0.5	23.5
6tone@position0..5		15	6	0..5	1	23
6tone@position6..11		15	6	6..11	1	23
12tone@position0..11		15	12	0..11	2	22
1tone@positon0	BPSK	3.75	1	0	0	24
1tone@positon47		3.75	1	47	0	24

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

(Temp = +25°C, Vbatt =3.0V, VCC = 2.5V, VIO= +1.8V, 50 Ω system, Modulation used: QPSK 1tone@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	24	-	-	dBm
Gain	Band 1	HPM, Pout = Prated	-	27	-	dB
	Bands 2, 25		-	27	-	
	Bands 3, 4, 66, 70		-	28	-	
GSM ACLR	Bands 3, 4, 66, 70	HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC	-	-45	-29	dBc
	Band 1		-	-42		
	Bands 2, 25		-	-44		
UTRA ACLR			-	-64	-46	
PA Total Current	Bands 3, 4, 66, 70	HPM, Pout = Prated	-	347	-	mA
	Band 1		-	386	-	
	Bands 2, 25		-	375	-	
PAE	Bands 3, 4, 66, 70	HPM, Pout = Prated	-	29	-	%
	Band 1		-	26	-	
	Bands 2, 25		-	27	-	
EVM		HPM, Pout = Prated	-	5	-	%
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	-	-60	-	dBm
	Bands 2, 25		-	-55	-	
	Bands 3, 4, 66		-	-41	-	
	Band 70		-	-42	-	
Harmonic suppression, 3fo	Band 1	Pout ≦ Prated	-	-51	-	
	Band 2, 25		-	-50	-	
	Band 3, 4, 66, 70		-	-56	-	

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

(Temp = +25°C, Vbatt = 3.0V, VCC = 2.5V, VIO= +1.8V, 50 Ω system, Modulation used: QPSK 1tone@position0, 15 KHz subcarrier spacing, 1 tone with MPR=0, unless otherwise specified.)

Parameter		Conditions	Min.	Typ.	Max.	Units
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	-	
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 Pout = 24dBm into 50Ω load	-	-	-36	dBm

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

(Temp = +25°C, Vbatt = 3.0V, Vcc = 2.5V, VIO= +1.8V, 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	24	-	-	dBm
Gain	Band 1	HPM, Pout = Prated	-	27	-	dB
	Bands 2, 25, 39		-	27	-	
	Bands 3, 4, 66, 70		-	27.5	-	
ACLR1 - EUTRA	Band 1	HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = 1.4MHz 6RB QPSK	-	-39	-33	dBc
	Bands 2, 25, 39		-	-40		
	Bands 3, 4, 66, 70		-	-42		
ACLR1 - UTRA	Band 39		-	-42	-36	
	Band 1		-	-45		
	Bands 2, 3, 4, 25, 66, 70		-	-46		
ACLR2 - UTRA			-	-63	-39	
PA Total Current	Band 1	HPM, Pout = Prated	-	386	-	mA
	Bands 2, 25, 39		-	375	-	
	Bands 3, 4, 66, 70		-	341	-	
PAE	Band 1	HPM, Pout = Prated	-	26	-	%
	Bands 2, 25, 39		-	26.5	-	
	Bands 3, 4, 66, 70		-	29	-	
EVM		HPM, Pout ≦ Prated	-	5	-	%
Harmonic suppression, 2fo	Band 1	Pout ≦ Prated	-	-60	-	dBm
	Bands 2, 25, 39		-	-55	-	
	Bands 3, 4, 66, 70		-	-47	-	
Harmonic suppression, 3fo	Band 1	Pout ≦ Prated	-	-47.5	-	
	Bands 2, 25, 39		-	-50	-	
	Bands 3, 4, 66, 70		-	-54	-	

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

(Temp = +25°C, Vbatt = 3.0V, Vcc = 2.5V, VIO= +1.8V, 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
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 = 6:1, all phase angles, Pin adjusted for Pout = 24dBm 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 = 3.0V, VCC = 2.5V, 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	698	707	716	
Maximum Linear Output Power		HPM	24	-	-	dBm
Gain	Bands 5, 8, 18, 19, 20, 26	HPM, Pout = Prated	-	27.5	-	dB
	Bands 12, 13, 14, 17, 28, 71, 85			26.5		
GSM ACLR	Bands 5, 8, 20, 26, 18, 19	HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC	-	-40	-29	dBc
	Bands 12, 13, 14, 17, 28, 71, 85		-	-44		
UTRA ACLR			-	-60	-46	
PA Total Current	Band 8	HPM, Pout = Prated	-	445	-	mA
	Bands 5, 18,19, 20, 26		-	408	-	
	Bands 12, 13, 14, 17, 28, 71, 85		-	389	-	
PAE	Band 8	HPM, Pout ≦ Prated	-	23	-	%
	Bands 5, 18,19, 20, 26		-	24.5	-	
	Band 12, 13, 14, 17, 28, 71, 85		-	26	-	
EVM		HPM, Pout ≦ Prated	-	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, 28, 71, 85 - continued

(Temp = +25°C, Vbatt = 3.0V, VCC = 2.5V, 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	Pout ≦ Prated	-	-52	-	dBm
	Band 8		-	-49	-	
	Bands 5, 14, 18, 19, 20, 26		-	-52	-	
	Band 28		-	-53	-	
	Band 13		-	-58	-	
Harmonic suppression, 3fo	Bands 12, 17, 71, 85	Pout ≦ Prated	-	-46	-	
	Band 8		-	-42	-	
	Bands 5, 14, 18, 19, 20, 26		-	-43	-	
	Band 28			-44		
	Band 13		-	-41	-	
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	-	-131	-	
	Band 28 Rx	758 – 803 Mhz	-	-125	-	
	Band 26 Rx	859 – 894 MHz	-	-125	-	
	Band 20 Rx	791 – 821 MHz	-	-128	-	
	Band 8 Rx	925 – 960 MHz	-	-128	-	
WiFi Band Noise		Pout = Prated, 2400 – 2495MHz	-	-156	-	
		Pout = Prated, 5150 – 5850MHz	-	-150	-	
GPS band noise power		Pout = Prated, 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 Pout = 24dBm 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 = 3.0V, Vcc = 2.5V, VIO= +1.8V, 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	835.5	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	24	-	-	dBm
Gain	Bands 5, 8, 18, 19, 20, 26, 27, 28	HPM, Pout = Prated	-	27	-	dB
	Bands 13, 14		-	27	-	
	Bands 12, 17, 71, 85		-	26.5	-	
ACLR1 – EUTRA	Bands 5, 8, 18, 19, 20, 26, 27	HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = 1.4MHz 6RB QPSK	-	-38	-33	dBc
	Bands 13, 14		-	-37		
	Bands 12, 17, 28, 71, 85		-	-43		
ACLR1 - UTRA	Bands 5, 8, 13, 14, 18, 19, 20, 26, 27		-	-41	-36	
	Bands 12, 17, 28, 71, 85		-	-43		
ACLR2 - UTRA			-	-63	-39	
PA Total Current	Band 8	HPM, Pout = Prated	-	428	-	mA
	Bands 5, 13, 14, 18, 19, 20, 26, 27		-	396	-	
	Bands 12, 17, 28, 71, 85		-	380	-	
PAE	Band 8	HPM, Pout ≦ Prated	-	23	-	%
	Bands 5, 13, 14, 18, 19, 20, 26, 27		-	25	-	
	Band 12, 17, 28, 71, 85		-	26	-	
EVM		HPM, Pout ≦ Prated	-	5	-	%
Harmonic suppression, 2fo	Band 8	Pout ≦ Prated	-	-52	-	dBm
	Band 13		-	-56	-	
	Band 28		-	-53	-	
	Bands 12, 17, 71, 85		-	-50	-	
	Bands 5, 14, 18, 19, 20, 26, 27		-	-53	-	

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

(Temp = +25°C, Vbatt = 3.0V, Vcc = 2.5V, VIO= +1.8V, 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
Harmonic suppression, 3fo	Band 8	Pout ≦ Prated	-	-44	-	dBm
	Band 13		-	-41	-	
	Bands 5, 14, 18, 19, 20, 26, 27, 28		-	-43	-	
	Bands 12, 17, 71, 85		-	-44	-	
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	-	-132	-	
	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		Pout = Prated, 1574 – 1577MHz	-	-166	-	
Stability, Spurious Output Levels		Load VSWR = 6:1, all phase angles, Pin adjusted for Pout = 24dBm into 50Ω load	-	-	-36	dBm

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 Rx_LB, 600 – 960MHz	-	2	-	dB
	ANT to Rx_HB, 1805 – 2200MHz	-	1.7	-	
	ANT to AUX1, 600 – 2200MHz	-	1.5	-	
	ANT to AUX2, 600 – 2200MHz	-	1	-	
Isolation, ISO	ANT to Rx_LB, 600 – 960MHz	-	43	-	
	ANT to Rx_LB, 1805 – 2200MHz	-	57	-	
	ANT to Rx_HB, 600 – 960MHz	-	42	-	
	ANT to Rx_HB, 1805 – 2200MHz	-	27	-	
	ANT to AUX1, 600 – 2200MHz	-	30	-	
	ANT to AUX2, 600 – 2200MHz	-	30	-	
2nd Harmonic	ANT to Rx_LB, 1458 – 1920MHz	-	-30	-	dBc
	ANT to Rx_HB, 3610 – 4400MHz	-	-35	-	
3rd Harmonic	ANT to Rx_LB, 2187 – 2880MHz	-	-40	-	
	ANT to Rx_HB, 5415 – 6510MHz	-	-43	-	
Rx port return loss	Rx_LB, 600 – 960MHz	-	16	-	dB
	Rx_HB, 1805 – 2200MHz	-	15	-	
	AUX1, 600 – 2200MHz	-	10	-	
	AUX2, 600 – 2200MHz	-	12	-	
ANT port return loss	ANT to Rx_LB, 600 – 960MHz	-	15	-	
	ANT to Rx_HB, 1805 – 2200MHz	-	16	-	
	ANT to AUX1, 600 – 2200MHz	-	9	-	
	ANT to AUX2, 600 – 2200MHz	-	10	-	

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

BIT(S)	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 000: off 001: AUX2 010: AUX1 011: RX_HB 100: LB_TX 101: Reserved 110: MB_TX 111: RX_LB	R/W		T012
2	TX_EN[2]	0b0	Transmit Enable 0 = Transmit mode disabled 1 = Transmit mode enabled 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 0 = HPM 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

BIT(S)	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

BIT(S)	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 1: Software reset (reset of all configurable registers to default values, except for USID&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) 1: Secondary mode (LOW POWER)	R/W	Yes	No
6	PWR_MODE_LSB[6]	0b0	RFFE State machine vector. 0: active mode 1: in reset state 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). TriggerMask[2] = TriggerMask_2, TriggerMask[1] = TriggerMask_1,&TriggerMask[0] = TriggerMask_0 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 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

BIT(S)	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

BIT(S)	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] Qorvo Manufacturer ID = 0x3C6 = 0011_1100_0110	R	No	No

Register 31 (0x1F) – MAN_US_ID

BIT(S)	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

BIT(S)	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

BIT(S)	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 There is only 1 register for GSID0&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 There is only 1 register for GSID0&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			

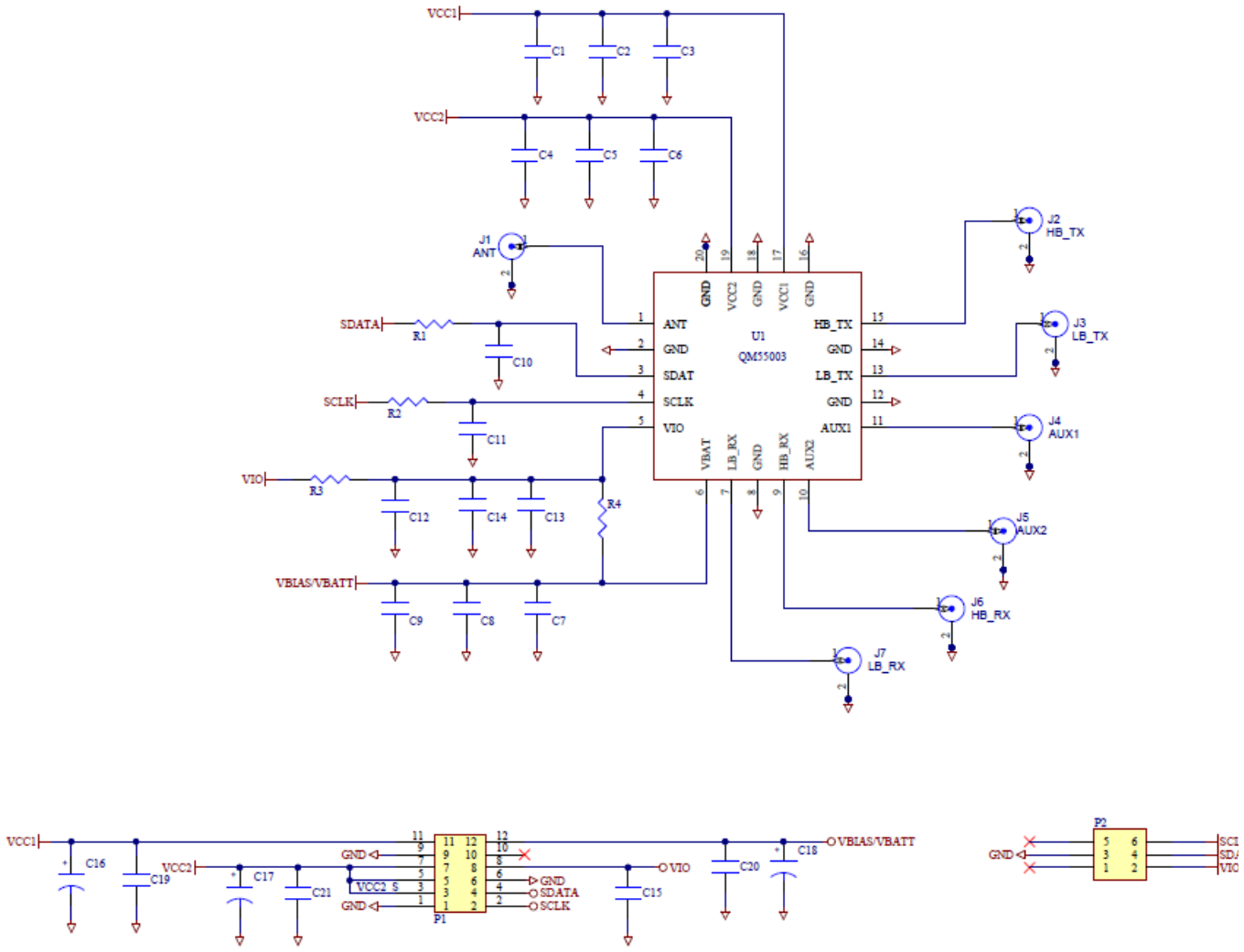
Register 35 (0x23) – RFFE_STATUS2

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7	SW_RESET_2[7]	0b0	0: Normal operation 1: Software reset (reset of all configurable registers to default values, except for USID) 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			

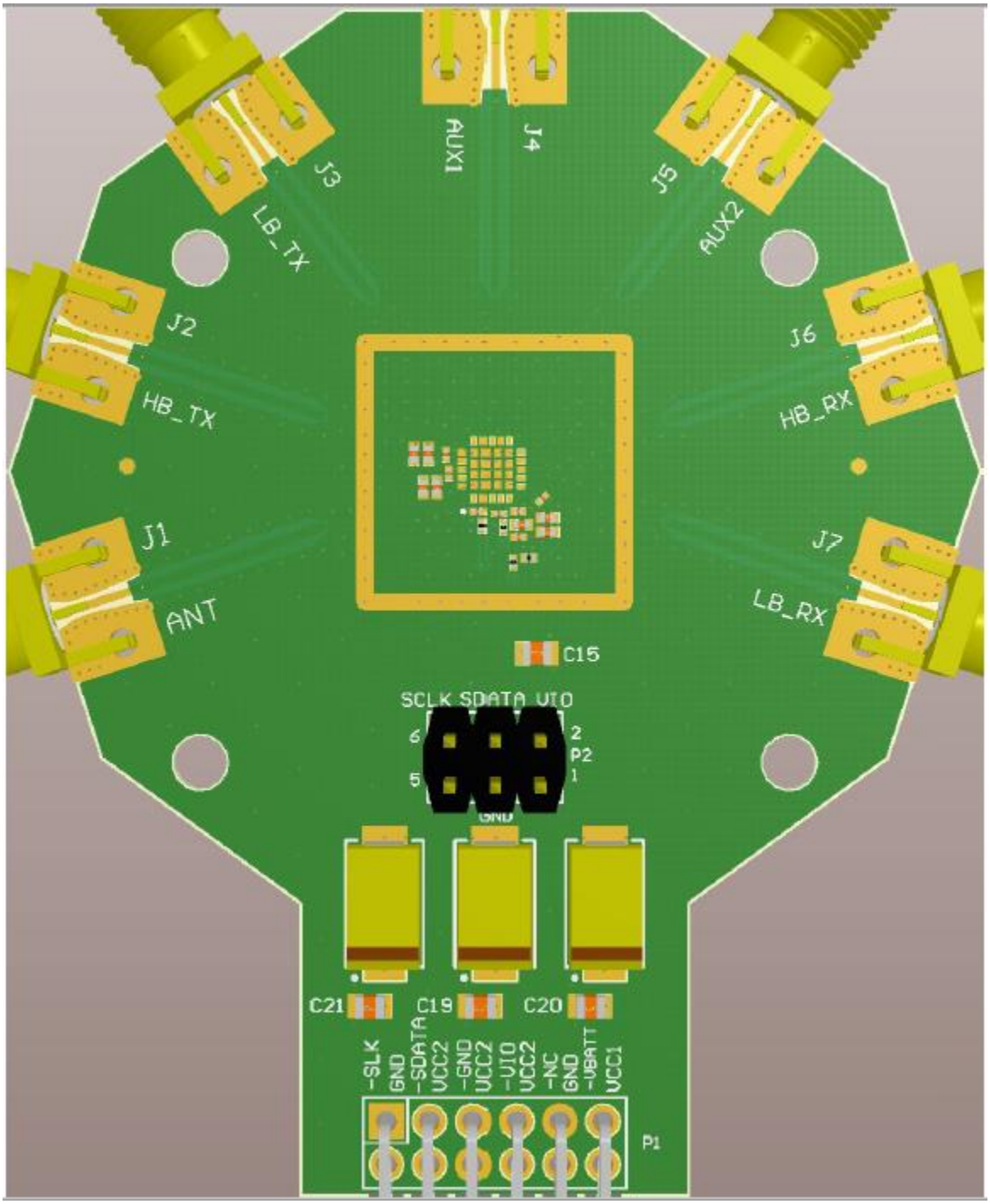
Register 36 (0x24) – ERR_SUM (RFFE_STATUS3)

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



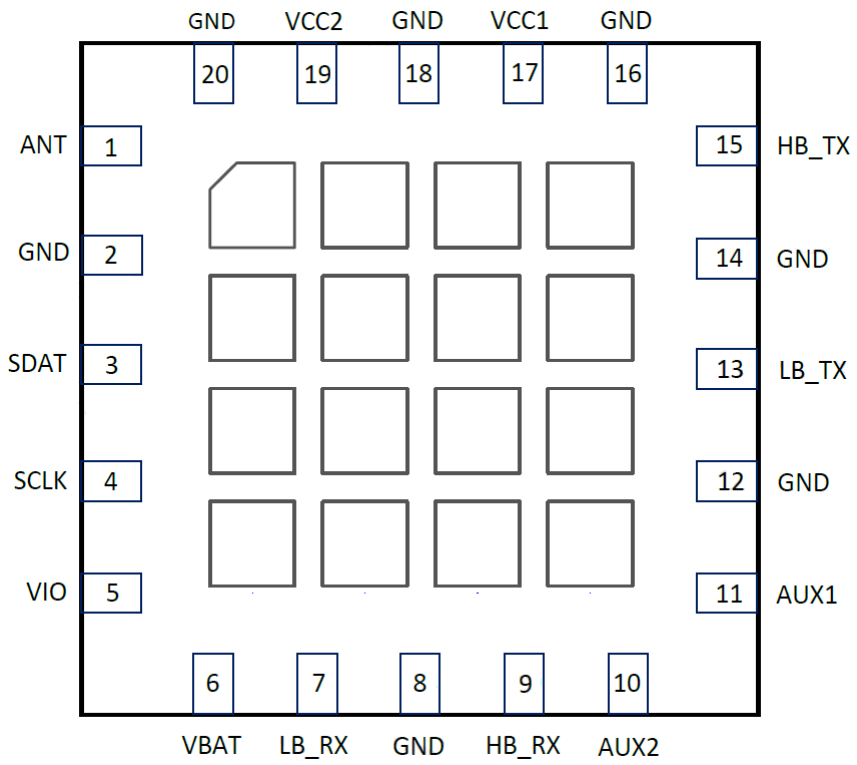
Evaluation Board Layout



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

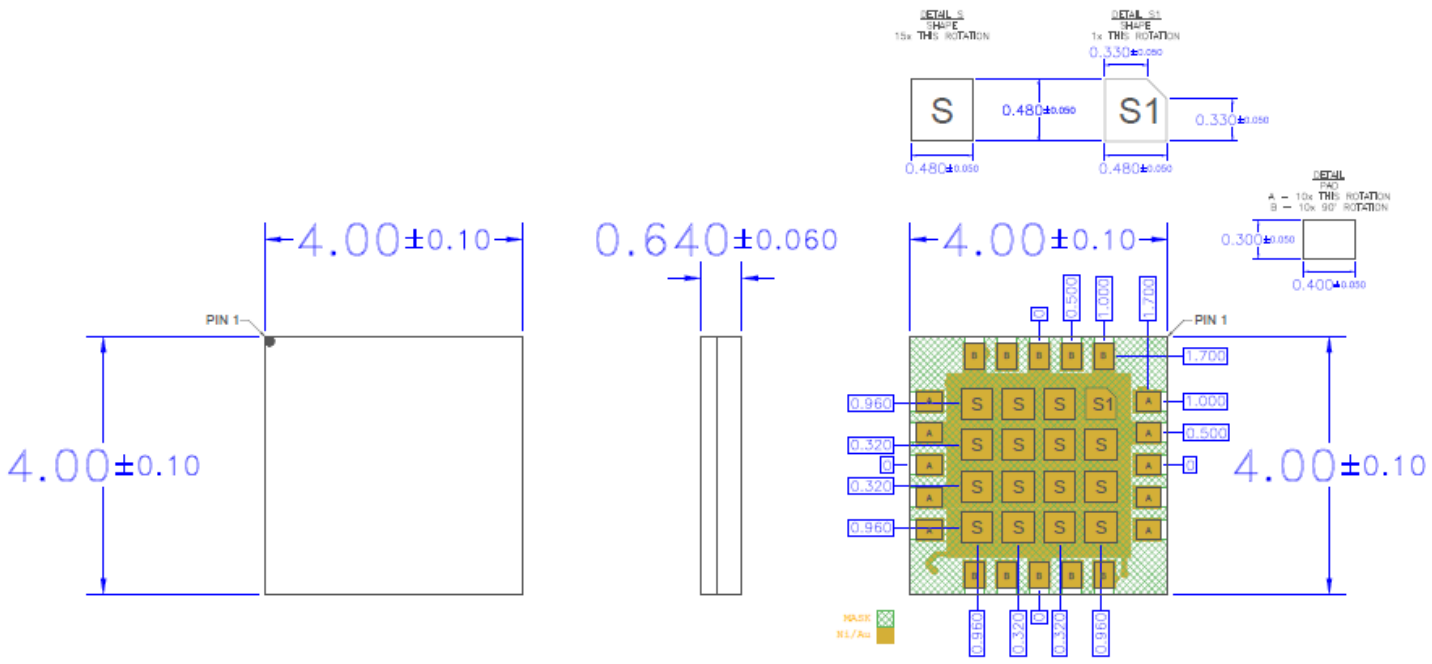


Top View (see through from top)

Pin Description

Pin Number	Label	Description
1	ANT	RF Output port.
2	GND	Connected to module gnd.
3	SDATA	Serial interface data I/O signal.
4	SCLK	Serial interface clock input signal.
5	VIO	Supply voltage for MIPI RFFE.
6	VBAT	Supply voltage for bias circuitry.
7	LB_RX	LB receive port.
8	GND	Connected to module gnd.
9	HB_RX	HB receive port.
10	AUX2	Auxillary transimit port 2.
11	AUX1	Auxillary transimit port 1.
12, 14, 16, 18, 20	GND	Connected to module gnd.
13	LB_TX	LB RF Input
15	HB_TX	HB RF Input
17	VCC1	Driver stage supply of PA.
19	VCC2	Output stage supply of PA.

Package Outline Drawing

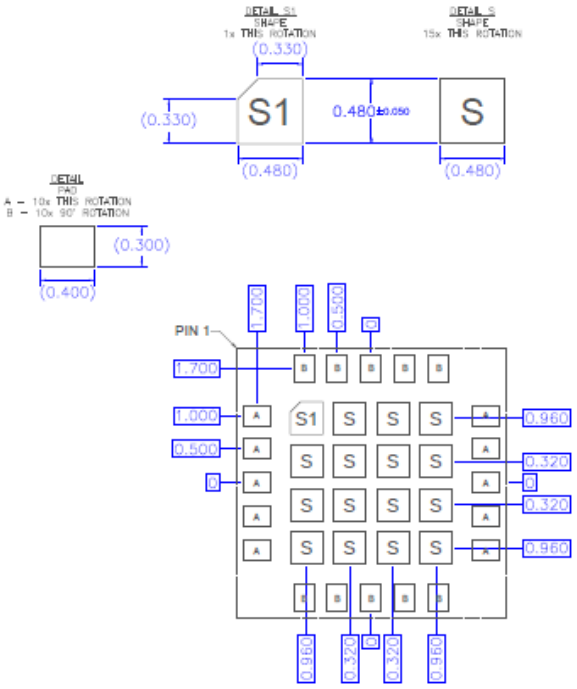


TOP VIEW

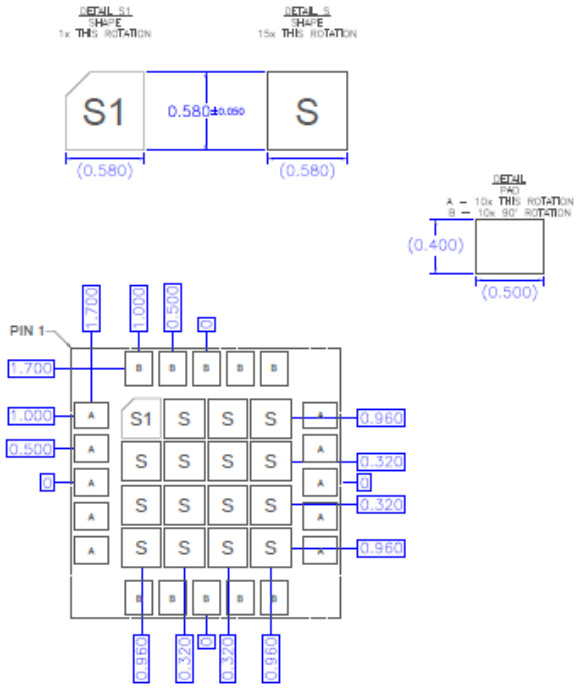
SIDE VIEW

BOTTOM VIEW

Package Land Pattern



RECOMMENDED
LAND PATTERN

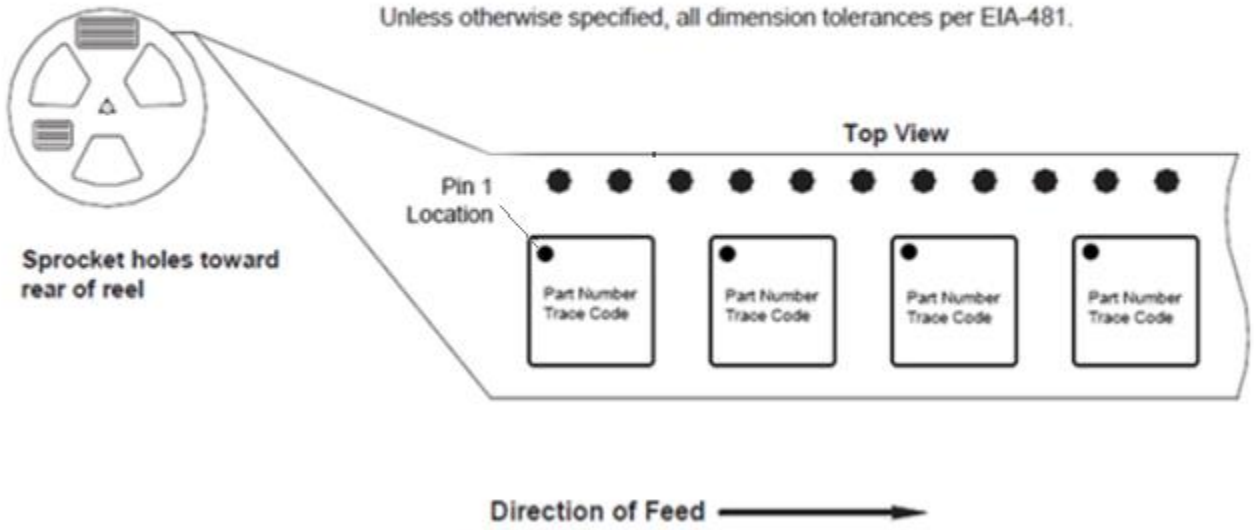


RECOMMENDED
LAND PATTERN MASK

Tape and Reel Information

Table 1. Tape and Reel

Qorvo Part Number	Reel Diameter Inch (mm)	Hub Diameter Inch (mm)	Width (mm)	Pocket Pitch (mm)	Feed	Units Per Reel
QM55003TR13	13 (330)	4 (102)	12	8	Single	5000



Note: 4.00 mm x 4.00 mm (Carrier Tape Drawing with Part Orientation).

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 ($C_{15}H_{12}Br_4O_2$) Free
- SVHC Free

REVISION HISTORY

REVISION	DATE	DESCRIPTION OF CHANGE
A	11/25/2019	Initial version
B	04/27/2020	Add explanation for TRIG. in MIPI table. Remove watermark.
C	04/30/2021	Change operating temperature to -40C
D	05/02/2022	Delete Prelimary on page 3-25

Contact Information

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