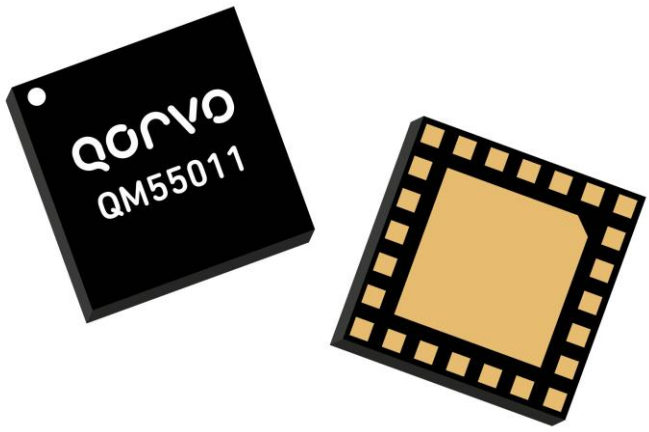
QM55011

Mid-Band Low-Band NB-IoT TxM

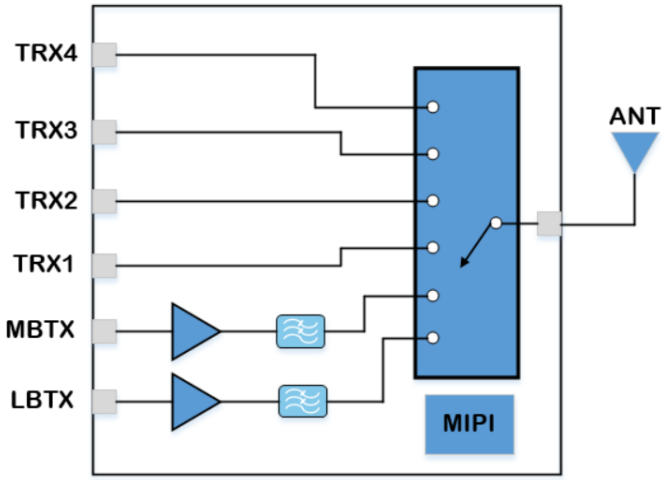
Product Overview

QM55011 is a multi-mode RF front-end (RFFE) module supporting for NB-IoT1/2, Cat-M1/2 and NTN Non-Terrestrial-Networks application. The module supports LB (663MHz – 915MHz) and MB (1695MHz – 2010MHz). It includes integrated TX harmonic rejection LPFs and an antenna switch with an auxiliary TX/RX paths which can support 2G power handling and a broad frequency range for bolt-on power amplifiers(PAs). QM55011 band select and bias are programmed through a Mobile Industry Processor Interface (MIPI).



Package: Module, 24-Pin 3.00 x 3.00 x 0.60 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
- TRX switch ports support 2G power level
- Optimized use with DC/DC Converter Operation
- Average Power Tracking
- Optimized for Narrow-Band IoT1/2 and Cat-M1/2
- Programmable Bias Level Control
- 2.5V and 3.0V supplies

Ordering Information

Part Number	Description
QM55011EVB	Evaluation Board Sample Kit
QM55011SB	5-Piece Sample Bag
QM55011SR	100-Piece 7inch Sample Reel
QM55011TR13	5000-Piece 13inch Reel

Applications

- Operating mid-bands: 1, 2, 3, 4, 25, 39, 65, 66, 70
- Operating low-bands: 5, 8, 12, 13, 14, 17, 18, 19, 20, 26, 27, 28, 71, 85
- Narrow-Band IoT1/2 and Cat-M1/2

Absolute Maximum Ratings

Parameter	Conditions	Rating
Supply Voltage, VCC	Standby, Idle, Operating Mode	5.5 V
Supply Voltage, Vbatt	Standby, Idle, Operating Mode	5.5 V
VIO and Digital control signals (SCLK, SDATA)		2.0 V
RF Input Power		10dBm
TRX RF Input Power		37dBm
Output Load VSWR (Ruggedness)	Ruggedness isguaranteed with RFIN=+10dBm, VSWR=10:1, Vbat=6.0V, Vcc = 4.5V – 5.0V.	10:1
Operating Temperature		-40 to +105 °C
Storage Temperature		-50 to 150 °C
ESD	HBM	2kV
ESD	CDM	1kV

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	2.5	2.5	5.5	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 (Module OFF)	0	0.3(2)		uA
VIO Rise Time (required for device reset)	50		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 = 3.25V, VIO = 0V

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

Power vs CatM1/2 Modulation Table

BANDWIDTH (MHZ)	Modulation	RB	START @RB	MPR (dB)	Rated Pout (dBm)
1.4MHz	QPSK	1	0	0	24
1.4MHz	QPSK	6	0	2	22
5MHz	16QAM	1	0	0	24
5MHz	QPSK	25	0	1	23

Electrical Specifications: NB-IoT : Band 1, 2, 3, 4, 25, 39, 65, 66, 70

(Temp = +25°C, Vbatt = 2.5V, 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 70	1695	1702.5	1710	
	Band 3, 66	1710	1747.5	1785	
	Band 4	1710	1732.5	1755	
	Band 65	1920	1965	2010	
Maximum Linear Output Power	HPM, NTC	24	-	-	dBm
	LPM, NTC	14	-	-	
Gain	HPM, Pout = Prated, Vcc = 2.5V	-	29	-	dB
	LPM, Pout = 14dBm, Vcc = 1.2V	-	19	-	
GSM ACLR	HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC	-	-39	-29	dBc
UTRA ACLR		-	-64	-46	
PA Total Current	HPM, Pout = Prated	-	325	-	mA
PAE	HPM, Pout = Prated	-	26	-	%
EVM	HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC	-	2.5	-	%
Harmonic, 2fo	Pout ≦ Prated	-	-44	-	dBm
Harmonic, 3fo		-	-54	-	
Harmonic, 4fo		-	-60	-	
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

Electrical Specifications: Cat-M1 : Band 1, 2, 3, 4, 25, 39, 65, 66, 70

(Temp = +25°C, Vbatt = 2.5V, 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 70	1695	1702.5	1710	
	Band 3, 66	1710	1747.5	1785	
	Band 4	1710	1732.5	1755	
	Band 39	1880	1900	1920	
	Band 65	1920	1965	2010	
Maximum Linear Output Power	HPM, NTC	24	-	-	dBm
	LPM, NTC	14	-	-	
Gain	HPM, Pout = Prated, Vcc = 2.5V	-	29	-	dB
	LPM, Pout = 14dBm, Vcc = 1.2V	-	19	-	
ACLR1 - EUTRA	HPM, Prated – 2dB (MPR), Modulation = 1.4MHz 6RB QPSK	-	-40	-33	dBc
ACLR1 - UTRA		-	-44	-36	
ACLR2 - UTRA		-	-62	-39	
PA Total Current	HPM, Pout = Prated	-	320	-	mA
PAE	HPM, Pout = Prated	-	26	-	%
EVM	HPM, Pout ≦ Prated	-	3.5	-	%
Harmonic, 2fo	Pout ≦ Prated	-	-43	-	dBm
Harmonic, 3fo	Pout ≦ Prated	-	-54	-	
Harmonic, 4fo	Pout ≦ Prated	-	-62	-	

Electrical Specifications: Cat-M2 : Band 1, 2, 3, 4, 25, 39, 65, 66, 70

(Temp = +25°C, Vbatt = 3.0V, VIO= +1.8V, Vcc = 3.0V, 50 Ω system, Modulation used: LTE 16QAM, 5MHz 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 70	1695	1702.5	1710	
		Band 3, 66	1710	1747.5	1785	
		Band 4	1710	1732.5	1755	
		Band 39	1880	1900	1920	
		Band 65	1920	1965	2010	
Maximum Linear Output Power		HPM, NTC	24	-	-	dBm
		LPM, NTC	14	-	-	
Gain		HPM, Pout = Prated, Vcc = 3.0V	-	29	-	dB
		LPM, Pout = 14dBm, Vcc = 1.2V	-	20	-	
ACLR1 - EUTRA		HPM, Prated – 1dB (MPR), Modulation = 5MHz 25RB QPSK	-	-40	-33	dBc
ACLR1 - UTRA			-	-41	-36	
ACLR2 - UTRA			-	-54	-39	
PA Total Current		HPM, Pout = Prated	-	320	-	mA
PAE		HPM, Pout = Prated	-	26	-	%
EVM		HPM, Pout ≦ Prated	-	3	-	%
Harmonic, 2fo		Pout ≦ Prated	-	-41	-	dBm
Harmonic, 3fo		Pout ≦ Prated	-	-54	-	
Harmonic, 4fo		Pout ≦ Prated	-	-56	-	
Rx Band Noise	Band 1 Rx	RX frequency 2110 – 2170 MHz	-	-138	-	dBm/Hz
	Band 2/25 Rx	RX frequency 1930 – 1995 MHz	-	-136	-	
	Band 3 Rx	RX frequency 1805 – 1880 MHz	-	-136	-	
	Band 4 Rx	RX frequency 2110 – 2155 MHz	-	-139	-	
	Band 66 Rx	RX frequency 2110 – 2200 MHz	-	-139	-	
GPS band noise power		Pout = Prated, 1574 – 1577MHz	-	-137	-	
WiFi Band Noise		Pout = Prated, 2400 – 2447MHz	-	-140	-	
		Pout = Prated, 5150 – 5850MHz	-	-160	-	
Stability, Spurious Output Levels		Load VSWR = 6:1, all phase angles with closed loop.	-	-	-36	dBm

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

(Temp = +25°C, Vbatt = 2.5V, 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	668	707	716	
Maximum Linear Output Power		HPM, NTC	24	-	-	dBm
		LPM, NTC	14	-	-	
Gain	B12,17,28,71,85	HPM, Pout = Prated, Vcc = 2.5V	-	30	-	dB
	All other bands		-	28	-	
	All bands	LPM, Pout = 14dBm, Vcc = 1.2V	-	19	-	
GSM ACLR		HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC	-	-39	-29	dBc
UTRA ACLR			-	-62	-46	
PA Total Current	B12,17,28,71,85	HPM, Pout = Prated	-	310	-	mA
	Band 8		-	350	-	
	All other bands		-	320	-	
PAE	Band 8	HPM, Pout = Prated	-	23	-	%
	All other bands		-	26	-	
EVM		HPM, Prated – 2dB (MPR), Vcc = 2.5V, Modulation = QPSK 12tone@positon0..11, 15 KHz SC	-	3	-	%
Harmonic, 2fo	Bands 71, 85	Pout ≦ Prated	-	-51	-	dBm
	Band 13		-	-50	-	
	Band 28		-	-51	-	
	All other bands		-	-53	-	
Harmonic, 3fo	All other bands	Pout ≦ Prated	-	-50	-	
	Band 28		-	-61	-	
Harmonic, 4fo		Pout ≦ Prated	-	-48	-	
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

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

(Temp = +25°C, Vbatt = 2.5V, 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	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, NTC	24	-	-	dBm
		LPM, NTC	14	-	-	
Gain	B12,17,28,71,85	HPM, Pout = Prated, Vcc = 2.5V	-	30	-	dB
	All other bands		-	29	-	
	All bands	LPM, Pout = 14dBm, Vcc = 1.2V	-	21	-	
ACLR1 – EUTRA		HPM, Prated – 2dB (MPR), Modulation = 1.4MHz 6RB QPSK	-	-41	-33	dBc
ACLR1 - UTRA			-	-45	-36	
ACLR2 – UTRA			-	-61	-39	
PA Total Current	B12,17,28,71,85	HPM, Pout = Prated	-	300	-	mA
	Band 8			340		
	All other bands			310		
PAE	Band 8	HPM, Pout = Prated	-	24	-	%
	All other bands		-	27.5	-	
EVM	B8,14,18,20,26	HPM, Pout ≦ Prated	-	4	-	%
	B12,17,28,71,85		-	2.2	-	%
Harmonic, 2fo	All other bands	HPM, Pout ≦ Prated	-	-49	-	dBm
	Band 13		-	-48	-	
	Band 28		-	-52	-	
	Band 71		-	-51	-	
Harmonic, 3fo	All other bands	Pout ≦ Prated	-	-48	-	dBm
	Band 28		-	-52	-	
Harmonic, 4fo		Pout ≦ Prated	-	-45	-	dBm

Electrical Specifications: Cat-M2 : Band 5, 8, 12, 13, 14, 18, 19, 20, 26, 27, 28, 71, 85

(Temp = +25°C, Vbatt = 3.0V, VIO= +1.8V, Vcc = 3.0V, 50 Ω system, Modulation used: FDD-LTE 16QAM, 5MHz 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	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, NTC	24	-	-	dBm
		LPM, NTC	14	-	-	
Gain	B12,17,28,71,85	HPM, Pout = Prated, Vcc = 3.0V	-	30	-	dB
	All other bands		-	29	-	
	All bands	LPM, Pout = 14dBm, Vcc = 1.2V	-	21	-	
ACLR1 – EUTRA		HPM, Prated – 1dB (MPR), Modulation = 5MHz 25RB QPSK	-	-41	-33	dBc
ACLR1 - UTRA			-	-42	-36	
ACLR2 – UTRA			-	-54	-39	
PA Total Current	B12,17,28,71,85	HPM, Pout = Prated	-	305	-	mA
	Band 8			340		
	All other bands			310		
PAE	Band 8	HPM, Pout = Prated	-	24	-	%
	All other bands		-	27.5	-	
EVM		HPM, Pout ≦ Prated	-	3	-	%
Harmonic, 2fo	All other bands	HPM, Pout ≦ Prated	-	-47	-	dBm
	Band 13		-	-48	-	
	Band 28		-	-52	-	
	Band 71		-	-50	-	

Electrical Specifications: Cat-M2 : Band 5, 8, 12, 13, 14, 18, 19, 20, 26, 27, 28, 71, 85 - continued

(Temp = +25°C, Vbatt = 3.0V, VIO= +1.8V, Vcc = 3.0V, 50 Ω system, Modulation used: FDD-LTE 16QAM, 5MHz channel, 1 Resource Block with MPR=0, unless otherwise specified.)

Parameter		Conditions	Min.	Typ.	Max.	Units
Harmonic, 3fo	All other bands	Pout ≦ Prated	-	-48	-	dBm
	Band 28		-	-58	-	
Harmonic, 4fo		Pout ≦ Prated	-	-52	-	dBm
Rx Band Noise	Band 71 Rx	617 - 652 MHz	-	-135	-	dBm/Hz
	Band 85 Rx	728 - 746 MHz	-	-134	-	
	Band 12 Rx	729 – 746 MHz	-	-133	-	
	Band 13 Rx	746 – 756 MHz	-	-133	-	
	Band 14 Rx	758 – 768 MHz	-	-132	-	
	Band 28 Rx	758 – 803 Mhz	-	-134	-	
	Band 27 Rx	852 – 869 MHz	-	-135	-	
	Band 26 Rx	859 – 894 MHz	-	-135	-	
	Band 20 Rx	791 – 821 MHz	-	-132	-	
	Band 8 Rx	925 – 960 MHz	-	-136	-	
GPS band noise power		Pout = Prated, 1574 – 1577MHz	-	-170	-	
WiFi Band Noise		Pout = Prated, 2400 – 2447MHz	-	-167	-	
		Pout = Prated, 5150 – 5850MHz	-	-164	-	
Stability, Spurious Output Levels		Load VSWR = 6:1, all phase angles with closed loop	-	-	-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 TRX1-4, 410 – 960MHz	-	0.5	-	dB
	ANT to TRX1-4, 960MHz – 1550MHz	-	0.5	-	
	ANT to TRX1-4, 1550 – 2100MHz	-	0.6	-	
	ANT to TRX1-4, 2100 – 2690MHz	-	0.8	-	
Return Loss	TRX1 – TRX4, 410MHz – 2690Mhz	-	12	-	
ISO between ANT and TRX	ANT to TRX1-4, 410 – 960MHz	-	50	-	
	ANT to TRX1-4, 960 – 1550MHz	-	45	-	
	ANT to TRX1-4, 1550 – 2100MHz	-	29	-	
	ANT to TRX1-4, 2100 – 2690MHz	-	26	-	
ISO between TRXs, n≠m	TRXn – TRXm, 410 – 960MHz	-	36	-	
	TRXn – TRXm, 960 – 1550MHz	-	34	-	
	TRXn – TRXm, 1550 – 2100MHz	-	29	-	
	TRXn – TRXm, 2100 – 2690MHz	-	27	-	
Harmonics	2fo, TRX – ANT, input power 37dBm	-	-85	-	dB
	3fo, TRX – ANT, input power 37dBm	-	-81	-	
	4fo and up, TRX – ANT, input power 37dBm	-	-111	-	

Table 1: RFFE MIPI Register Map (1 of 5)

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	reserved_reg00_b7	1b0	reserved	R0	No	T0
6:4	PA_TUNE[2:0]	3b000	This field will be Band dependent and programmed by the radio.	R/W		T0
3:1	PA_BAND_SEL[2:0]	3b000	0x00: PA cores are disabled. 0x01: VLB 0x02: LB 0x03: MB_lo 0x04: MB_hi	R/W		T0
0	GAIN_MODE	1b0	0x0: HPM 0x1: LPM	R/W		T0

Register 1 (0x01) – PA_CTRL1

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7:4	DRIVER_BIAS[3:0]	4b0000	0 to 2250uA in 150uA steps	R/W	No	T0
3:0	OUTPUT_BIAS[3:0]	4b0000	0 to 2250uA in 150uA steps	R/W	No	T0

Register 2 (0x02) – PA_CTRL2

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7:0	reserved_reg02_b7_b0	8b0000	reserved	R0	No	T0

Register 3 (0x01) – OUTPUT_SW

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7:4	reserved_reg03_b7_b4	4b0000	reserved	R0	No	T0
3:0	OUT_SW[3:0]	4b0000	Switch throw selected to the antenna port 0x0: High isolation 0x1: 50 Ohm 0x2: LB_TX 0x3: MB_TX 0x4: TRX1 0x5: TRX2 0x6: TRX3 0x7: TRX4	R/W	No	T0

Table 1: RFFE MIPI Register Map (2 of 5)

Register 28 (0x1C) – PM_TRIG

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7	PWR_MODE[7]	1b1	0: Normal operation (ACTIVE) 1: Secondary mode (LOW POWER)	R/W	BG01	Yes
6	PWR_MODE[6]	1b0	0: Normal operation 1: initialization state note - this bit always reads 0. Writing a 1 to this bit forces a reset.	R/W	BG01	Yes
5:3	TriggerMask[2:0]	3b000	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	R/W	No	Yes
2:0	Trigger[2:0]	3b000	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	R/W	BG01	Yes

Register 29 (0x1D) – PRODUCT_ID

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7:0	PRODUCT_ID[7:0]	8b01101100	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]	8b11000110	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]	R	No	No

Table 1: RFFE MIPI Register Map (3 of 5)

Register 31 (0x1F) – 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 (customer specified).	RM	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]	8b00000000	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.	RM	No	No

Register 33 (0x21) – REVISION_ID

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7:0	REVISION_ID[7:0]	8b00000000	This is an RFFE2 register to contain information about the revision of this module. The intent here is to use this as a type of scratch register -- to contain various information or serialization.	R	No	No

Register 34 (0x22) – GROUP_ID

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7:4	GSID0[3:0]	4b0000	Group slave ID 0 There is only 1 register for GSID0 & GSID1	R/W	No	No
3:0	GSID[3:0]	4b0000	Group slave ID 1 There is only 1 register for GSID0 & GSID1			

Table 1: RFFE MIPI Register Map (4 of 5)

Register 35 (0x23) – UDR_RST

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7	SW_RESET_2	1b0	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	BG01	No
6	Reserved_reg35_b6	1b0	Reserved			
5	Reserved_reg35_b5	1b0	Reserved			
4	Reserved_reg35_b4	1b0	Reserved			
3	Reserved_reg35_b3	1b0	Reserved			
2	Reserved_reg35_b2	1b0	Reserved			
1	Reserved_reg35_b1	1b0	Reserved			
0	Reserved_reg35_b0	1b0	Reserved			

Register 36 (0x24) – ERR_SUM

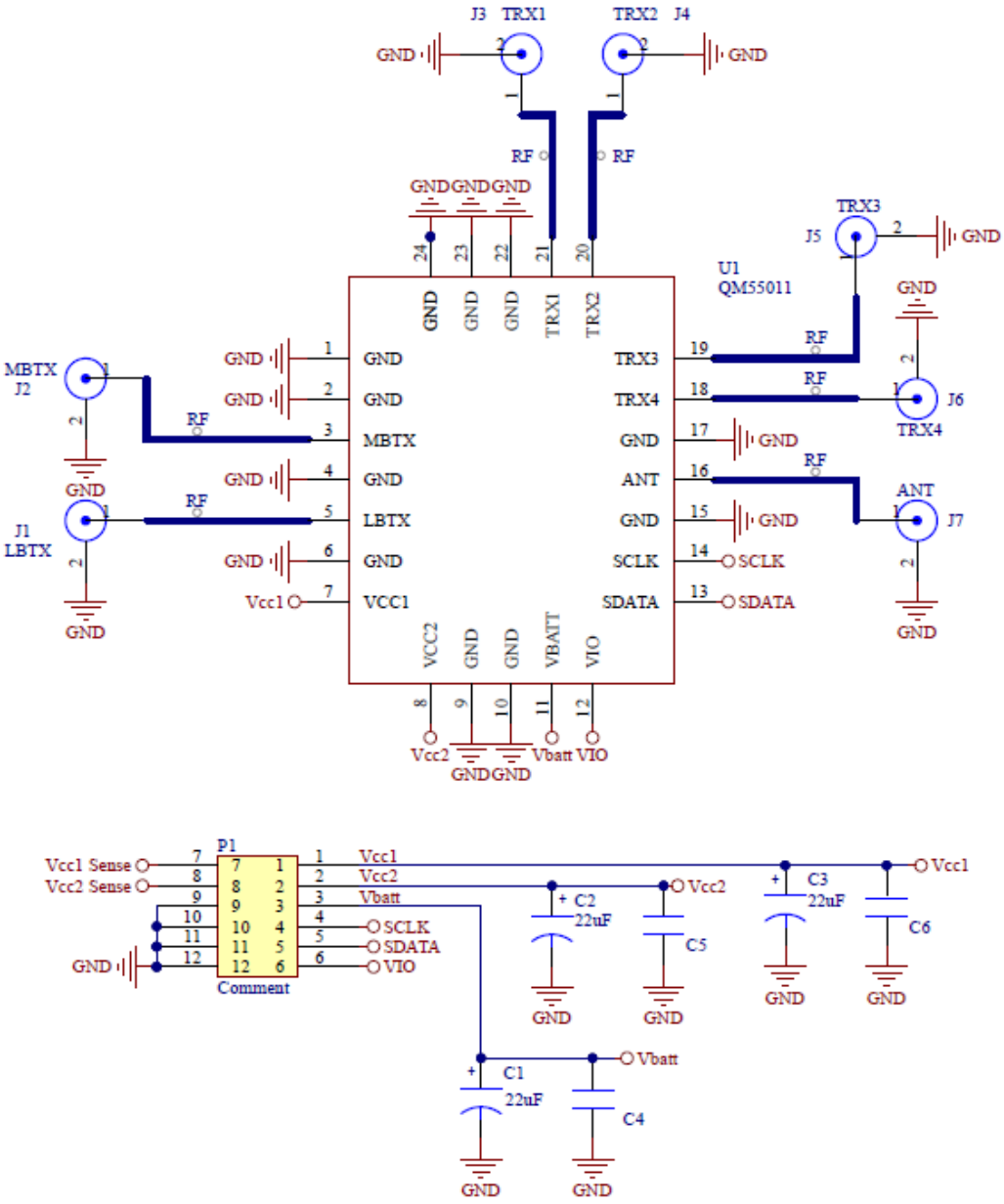
BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7	Reserved_reg36_b7	1b0	Reserved	R/W	No	No
6	CMD_FRAME_P_ERR	1b0	Command sequence received with parity error – discard command.			
5	CMD_LEN_ERR	1b0	Command length error			
4	ADDR_FRAME_P_ERR	1b0	Address frame parity error			
3	DATA_FRAME_P_ERR	1b0	Data frame with parity error			
2	READ_UNUSED_REG	1b0	Read command to an invalid address			
1	WRITE_UNUSED_REG	1b0	Write command to an invalid address			
0	BID_GID_ERR	1b0	Read command with a Broadcast_ID or GROUP_ID			

Table 1: RFFE MIPI Register Map (5 of 5)

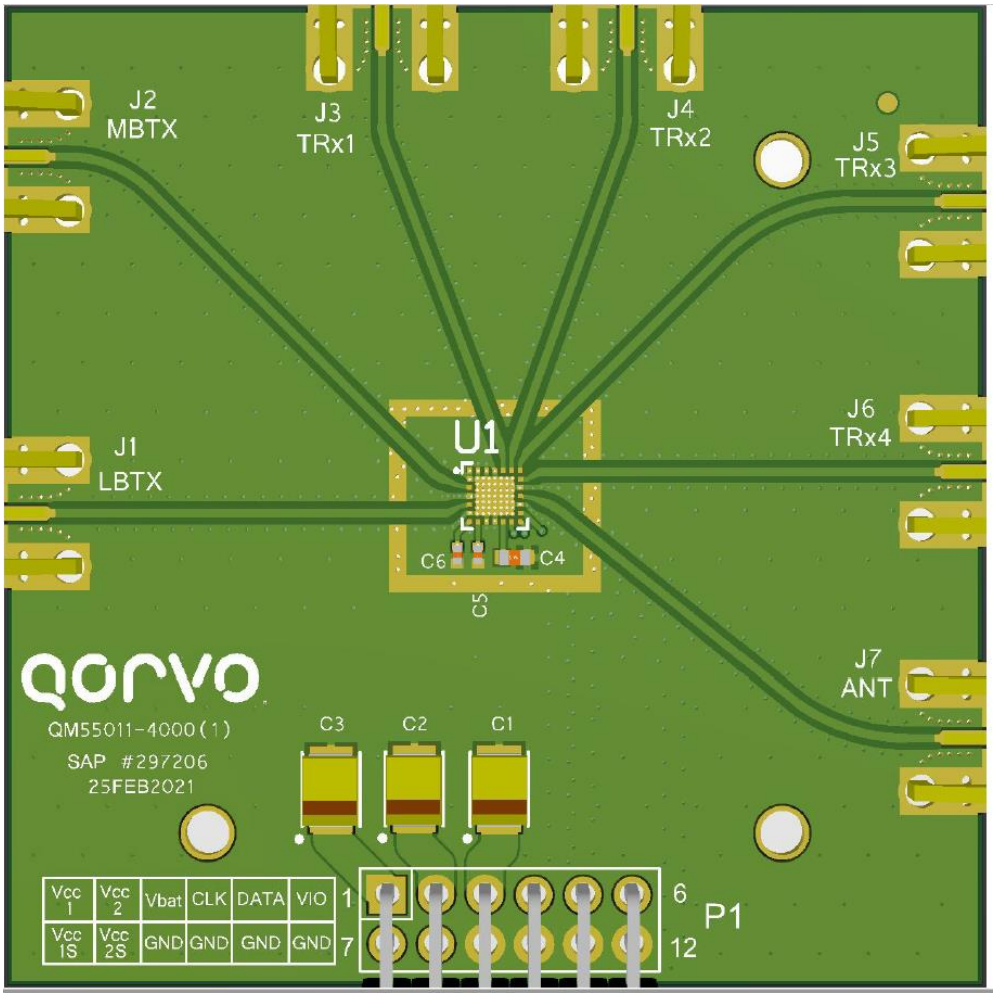
Register 43 (0x2B) – BUS_LOAD

BIT(S)	FIELD NAME	DEFAULT	DESCRIPTION	R/W	B/G	TRIG.
7:4	Reserved_re43_b7_b4	4b0000	Reserved	R/W	No	No
3:0	BUS_LOAD[3:0]	4b0000	SDATA Driver strength in Readback Mode 0x0: 10 pF 0x1: 20 pF 0x2: 30 pF 0x3: 40 pF 0x4: 50 pF 0x5: 60 pF 0x6: 80 pF 0x7: 100 pF 0x8: 120 pF 0x9: 140 pF 0xA: 160 pF 0xB: 180 pF 0xC: 200 pF 0xD: 250 pF 0xE-0xF: reserved			

Evaluation Board Schematic



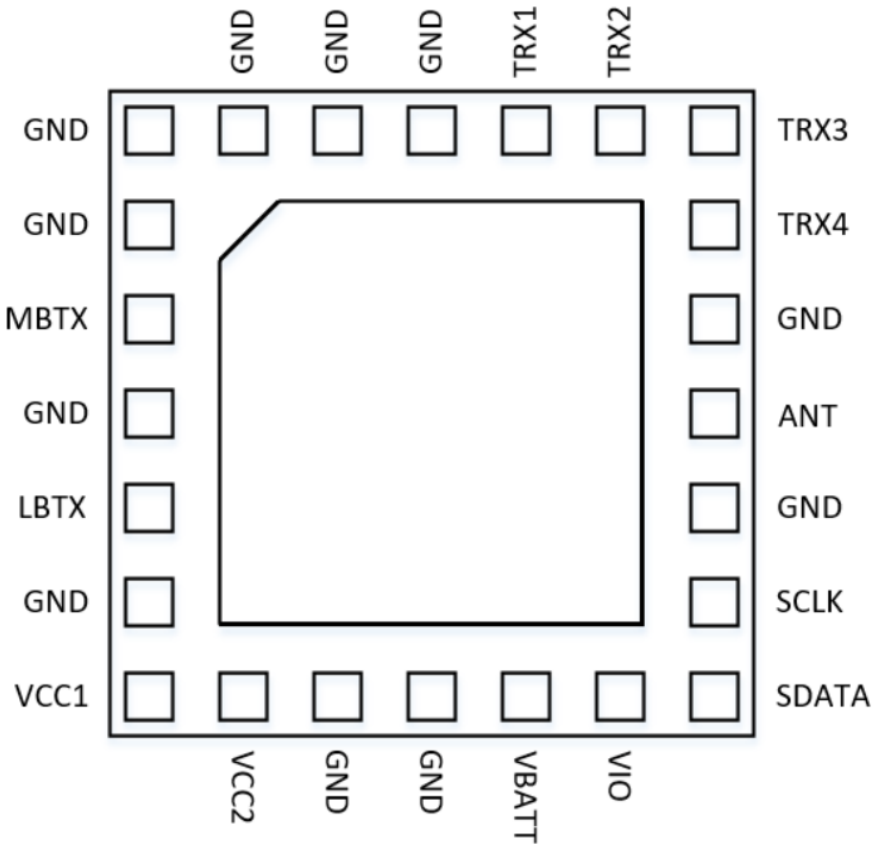
Evaluation Board Layout



Evaluation Board Bill of Material

Designator	Description	Manuf.	Part number
C1,C2,C3	CAP, 10uF, 20%, 20V, TANT-B	AVX Asia Limited	TAJB106M020RNJ
C5,C6	CAP, 10000pF, 10%, 50V, X7R, 0402	Yageo USA	CC0402KRX7R9BB103
C4	CAP, 10000pF, 10%, 50V, X7R, 0603	MURATA ELECTRONICS SINGAPORE PTE LT	GRM188R71H103KA01D
J1,J2,J3,J4,J5,J6,J7	CONN, SMA, EL MINI FLT 0.068" SPE-000303	Aliner Industries, Inc.	20-001CF-T
P1	CONN, HDR, SHRD, RT-ANG, 2x6, 0.100",T/H	MOLEX	90130-3212
U1	NOT POPULATED ITEM-1		DUMMY PART

Pin Configuration

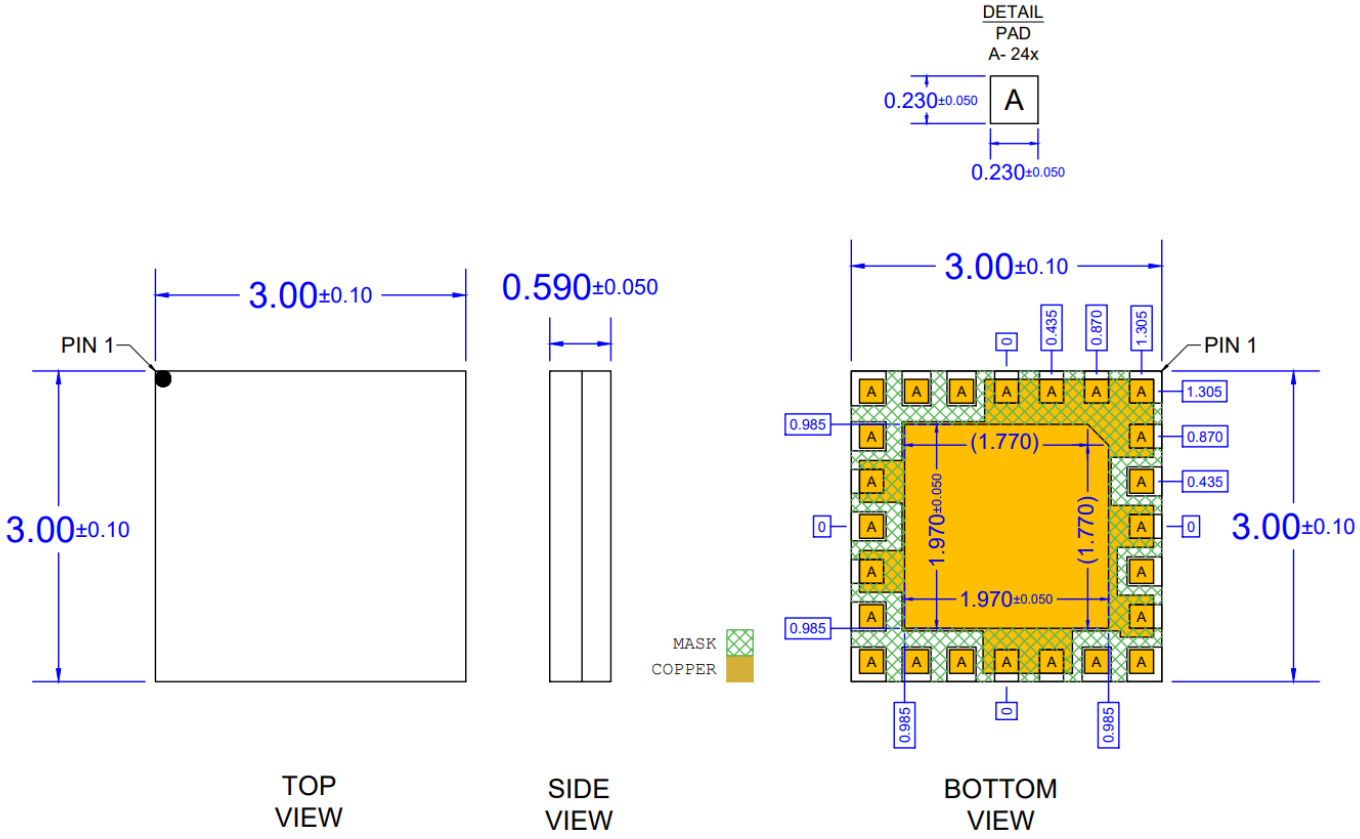


Top View (see through from top)

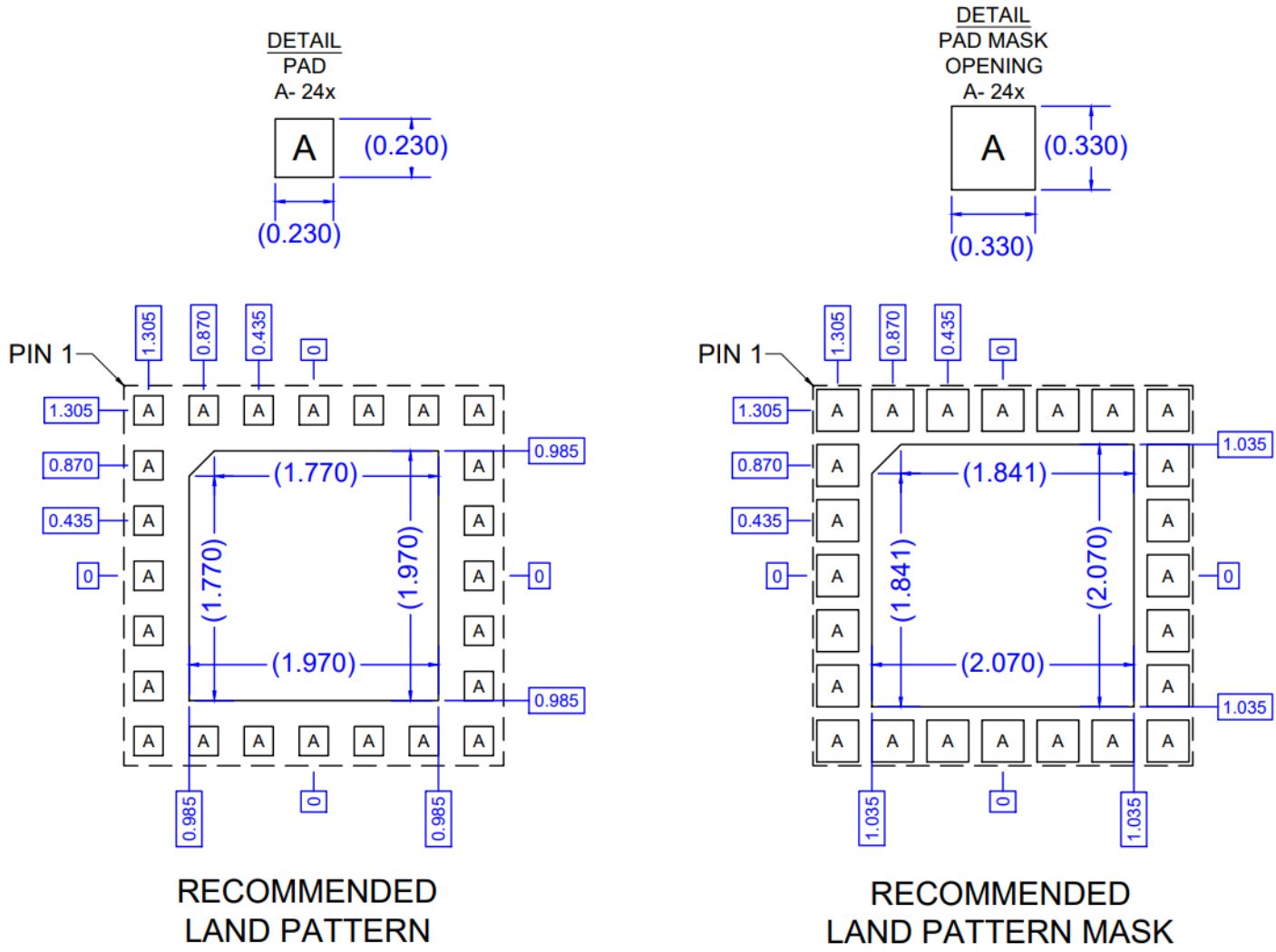
Pin Description

Pin Number	Label	Description
1, 2, 4, 6, 9, 10, 15, 17, 22-24	GND	Connected to module gnd.
3	MBTX	MB RF Input
5	LBTX	LB RF Input
7	VCC1	Driver stage supply of PA.
8	VCC2	Output stage supply of PA.
11	VBAT	Supply voltage for bias circuitry.
12	VIO	Supply voltage for MIPI RFFE.
13	SDATA	Serial interface data I/O signal.
14	SCLK	Serial interface clock input signal.
16	ANT	RF Output port.
18	TRX4	Auxillary transimit and receive port4.
19	TRX3	Auxillary transimit and receive port3.
20	TRX2	Auxillary transimit and receive port2.
21	TRX1	Auxillary transimit and receive port1.

Package Outline Drawing

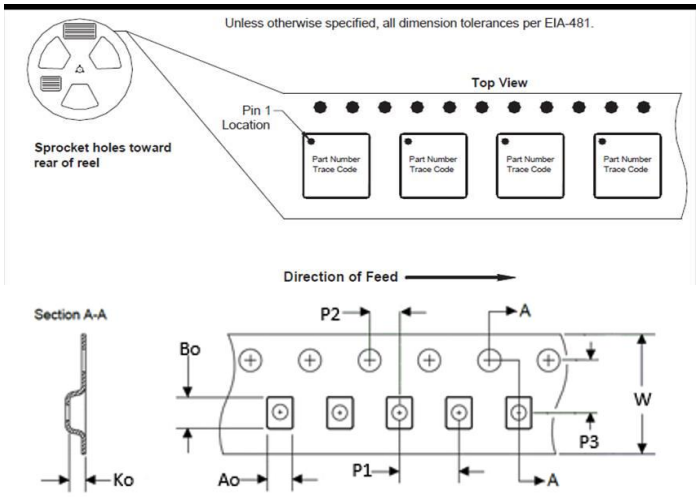


Package Land Pattern



Tape and Reel Information - Carrier and Cover Tape Dimensions

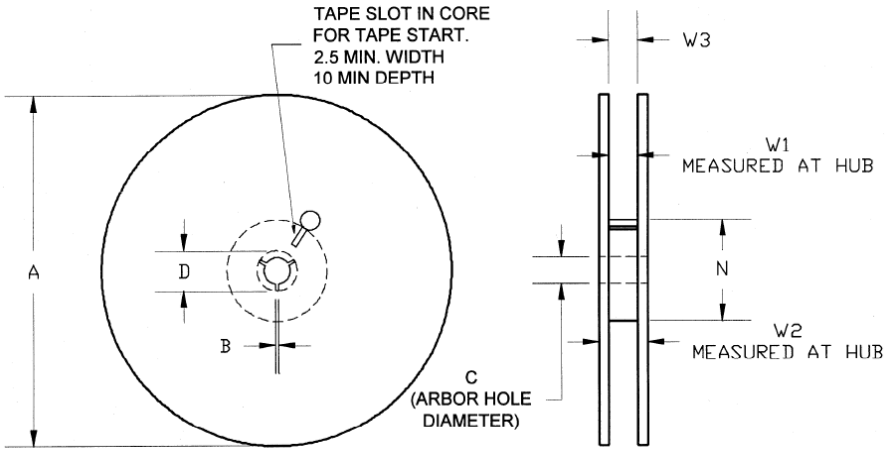
Tape and reel specifications for this part are also available on the Qorvo website.
Standard T/R size = 10000 pieces on a 13” reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
1.02Cavity	Length	A0	0.125	3.18
	Width	B0	0.125	3.18
	Depth	K0	0.040	1.02
	Pitch	P1	0.157	4.0
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

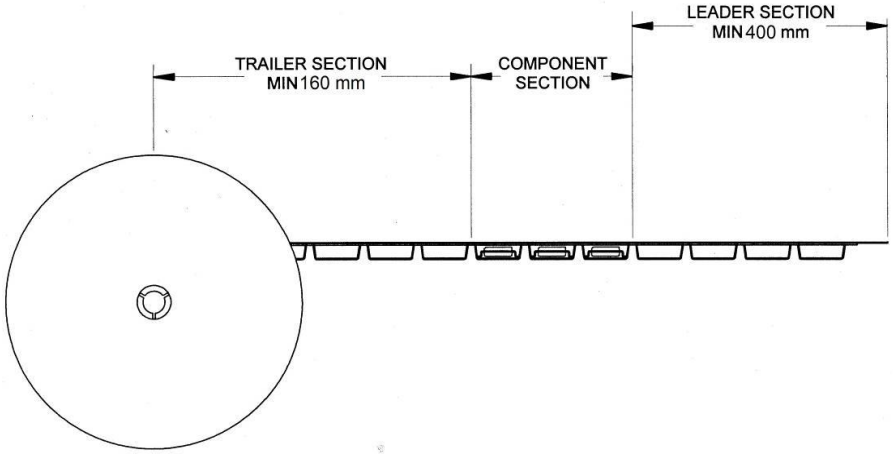
Packaging reels are used t prevent damage to devices during shipping hipping and storage, loaded carrier tape is typically wound onto a plastic take-up reel. The reel size is 13" diameter. The reels are made from high-impact injection-molded polystyrene (HIPS), which offers mechanical and ESD protection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

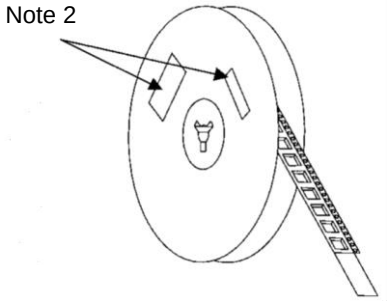


Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330
	Thickness	W2	.724	18.4
	Space Between Flange	W1	.488	12.4
Hub	Outer Diameter	N	4.016	102.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	.795	20.2

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 2	ESDA/JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	MSL3	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

Contact Information

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

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Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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REVISION HISTORY

REVISION	DATE	DESCRIPTION OF CHANGE
A	03/24/2022	Initial data sheet
B	06/15/2022	Add CatM1 table and LPM
B	02/04/2023	Updated Order Information, AMR and ROC table, Switch and Port Isolation Specs, and Linearity Parameters for CAT M1/M2, NB-IOT.
C	05/22/2023	Updated Typ values in Typ Column for CAT M1/M2 and NB-IOT. Added B70 for Mid-Hi Bands.
D	12/05/2023	Updated Tape and Reel information