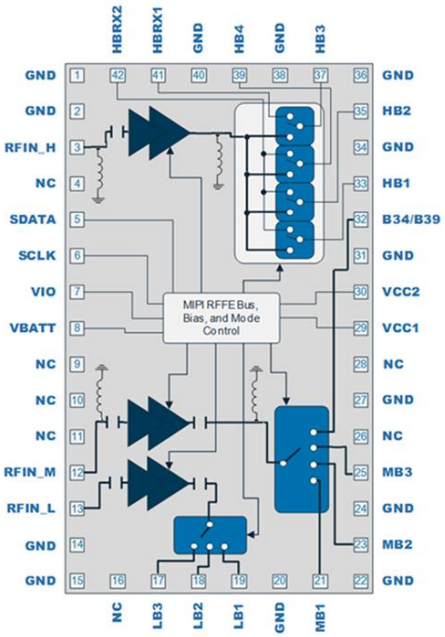
RFMD + TriQuint = Qorvo

RF5410

LTE MMMB PA Module

RF5410 is a multi-mode, multi-band (MMMB) linear Power Amplifier Module (PAM) designed for use as the final amplification stage in multi-mode WCDMA, CDMA2000, TD-SCDMA, and LTE mobile cellular equipment. The high efficiency PAM contains three amplifier paths for Low, Mid, and High Band frequencies followed by switch outputs for multi-band coverage. RF5410 band select and bias are programmed through a Mobile Industry Processor Interface (MIPI). RF5410 supports Average Power Tracking (APT) for current consumption optimization at various power levels and modulations.



Functional Block Diagram

Ordering Information

RF5410PCK-410	Evaluation Board Sample Kit
RF5410SB	5-Piece Sample Bag
RF5410SQ	25-Piece Sample Bag
RF5410SR	100-Piece 7 inch Sample Reel
RF5410TR13	5000-Piece 13” Reel
RF5410DK	Design Kit, RF5410PCK-410 + RD2000 Communication Bd

Package Style: Module, 42-Pin
4.00mm x 6.80mm x 0.9mm

Features

- Multi-mode and Multi-band Capabilities.
- Integrated Switch Supports Multiple TX and RX Paths
- Integrated Blocking and Decoupling Capacitors
- MIPI RFFE Digital Control Interface
- Optimized use with DC-DC Converter Operation
- Average Power Tracking
- Programmable Bias Level Control
- High Efficiency: 43%
- Rel 99 POUT +28.5dBm

Applications

- WCDMA, CDMA2000, TD-SDMA, FDD, TDD, LTE Mobile Devices
- WCDMA Bands :
- 1,2,3,4,5,8
- CDMA Bands :
- BC 0, BC 1
- TD-SCDMA Bands :
- 34,39,40
- FDD LTE Bands :
- 1,2,3,4,5,7,8,20
- TDD LTE Bands :
- 38,39,40,41
- LTE Channel Bandwidths

  5 to 20MHz

RF Micro Devices Inc. 7628 Thorndike Road, Greensboro, NC 27409-9421
For sales or technical support, contact RFMD at +1.336.678.5570 or customerservice@rfmd.com.
DS20160809

Absolute Maximum Rating

Parameter	Rating	Unit
Supply Voltage VBATT	-1.2 to 6.0	V
Supply Voltage VCC	0 to 4.6	V
VIO and Digital control signals (SCLK, SDATA)	2.0	V
RF Input Power	+10	dBm
Output Load VSWR (Ruggedness)	10:1	See Note 1
Operating Temperature	-30 to +85	°C
Storage Temperature	-40 to +150	°C
ESD (HBM)	1000	V
Note 1: Ruggedness is guaranteed with closed loop condition, constant forward POUT = Pmax Over all conditions: VCC = 3.1 to 4.6V, Temperature = -20 to +85°C.		

Caution! ESD sensitive device.

RFMD Green: RoHS status based on EU Directive 2011/65/EU (at time of this document revision), halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

Power vs Modulation Table

Power vs Modulation Table				WCDMA					TD-SCDMA	LTE			
				Modulation: WCDMA						Modulation: QPSK		Modulation: 16 QAM	
Band	Band	Freq	Freq	R99	HSDPA ST 1,2 HSUPA ST 1,5	HSDPA ST 3,4	HSUPA ST 3	HSUPA ST 2,4	TDS	5 MHZ / 8 RB 10 MHz / 12 RB 20 MHz / 18 RB	5 MHZ / 25 RB 10 MHz / 50 RB 20 MHz / 100 RB	5 MHZ / 8 RB 10 MHz / 12 RB 20 MHz / 18 RB	5 MHZ / 25 RB 10 MHz / 50 RB 20 MHz / 100 RB
1	MB	1920	1980	28.0	27.0	26.5	26.0	25.0	NA	27.0	26.0	26.0	25.0
2	MB	1850	1910	28.5	27.5	27.0	26.5	25.5	NA	27.5	26.5	26.5	25.5
3	MB	1710	1785	28.5	27.5	27.0	26.5	25.5	NA	27.5	26.5	26.5	25.5
4	MB	1710	1755	28.0	27.0	26.5	26.0	25.0	NA	27.0	26.0	26.0	25.0
34	MB	2010	2025	NA					28.0	NA			
39	MB	1880	1920	NA					28.0	27.0	26.0	26.0	25.0
5	LB	824	849	28.5	28.0	27.5	27.0	26.0	NA	27.5	26.5	26.5	25.5
8	LB	880	915	28.5	28.0	27.5	27.0	26.0	NA	27.5	26.5	26.5	25.5
20	LB	832	862	NA					NA	27.5	26.5	26.5	25.5
7	HB	2500	2570	NA					NA	27.5	26.5	26.5	25.5
38	HB	2570	2620	NA					NA	27.5	26.5	26.5	25.5
40	HB	2300	2400	NA					28.0	27.5	26.5	26.5	25.5
41	HB	2496	2690	NA					NA	27.5	26.5	26.5	25.5

Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
General Requirements					
Supply Voltage, VBATT	3.1	3.8	4.6	V	See Note 1
Supply Voltage, VCC1, VCC2	0.5	3.4	4.6	V	See Note 1
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	
VIO Rise Time	0.1		450	µS	Required for device reset
Current (MIPI Digital Inputs)			50	µA	
Leakage Current			10	µA	
Operating Ambient Temperature (T_A)	-20	25	+85	°C	

Note 1:
V_{CC} down to 0.5V may be used for backed-off power levels when using a DC-DC converter to reduce low power current drain.
For operation at V_{BATT} = 3.1V, de-rate Max P_{OUT} by 1.0dB if V_{CC} also equals 3.1V.
The LPM switch point is recommended at +13.5dBm.
LPM can be operated at higher power levels with different bias states and VCC.

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
MB: Band 1, 2, 3, 4 WCDMA						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V; Mode=HPM Modulation: Rel99**
Frequency		1920		1980	MHz	Band 1
		1850		1910	MHz	Band 2
		1710		1785	MHz	Band 3
		1710		1755	MHz	Band 4
Maximum Linear Output Power	Band 1, 4	28.0			dBm	HPM, V_{CC} = 3.4V
	Band 2, 3	28. 5			dBm	HPM, Vcc = 3.4V
	Band 1, 2, 3, 4	13.5			dBm	LPM, V_{CC} = 1.15V
	Band 1, 2, 3, 4	0			dBm	LPM, V_{CC} = 0.7V
Gain	Band 1 2, 3, 4	25.5	27.0		dB	HPM, P_{OUT} = 28.0dBm, V_{CC} = 3.4V
			22.0		dB	LPM, P_{OUT} = 13.5dBm, V_{CC} = 1.15V
			17.0		dB	LPM, P_{OUT} = 0dBm, V_{CC} = 0.7V
PA Current			575		mA	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
			110		mA	LPM, P_{OUT} = 13.5dBm, V_{CC} = 1.15V
			30		mA	LPM, P_{OUT} = 0dBm, V_{CC} = 0.7V
PA Efficiency (PAE)			35		%	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
ACLR1 (±5MHz)			-45	-37	dBc	HPM, P_{OUT} =28.5dBm, V_{CC} = 3.4V
			-45	-38	dBc	LPM, P_{OUT} = 13.5dBm, V_{CC} = 1.15V
ACLR2 (±10MHz)			-56	-48	dBc	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
			-58	-48	dBc	LPM, P_{OUT} = 13.5dBm, V_{CC} = 1.15V
EVM			1.0		%	Pout ≤ Pmax
Noise Power	B1 Rx Band		-135		dBm/Hz	Measure power at Rx Duplex Freq 2110MHz to 2170MHz
	B2 Rx Band		-132		dBm/Hz	Measure power at Rx Duplex Freq 1930MHz to 1990MHz
	B3 Rx Band		-130		dBm/Hz	Measure power at Rx Duplex Freq 1805MHz to 1880MHz
	B4 Rx Band		-135		dBm/Hz	Measure power at Rx Duplex Freq 2110MHz to 2155MHz
	GPS Band		-140		dBm/Hz	Measure power at Rx Band Freq = 1574MHz to 1577MHz
	ISM Band		-143		dBm/Hz	Measure power at Rx Band Freq = 2400MHz to 2484MHz

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
MB: Band 1, 2, 3, 4 WCDMA P.2					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V Mode=HPM; Modulation: Rel99**
Harmonics, 2fo		-48		dBc	P_{OUT} ≤ Pmax, all power outs
Harmonics, 3fo		-49		dBc	P_{OUT} ≤ Pmax, all power outs
Harmonics, 4fo and higher		-60		dBc	P_{OUT} ≤ Pmax, all power outs
Input impedance VSWR		1.8:1		VSWR	No External matching
Gain Switching Time			10	µS	Time required for output power to settle to within ±1dB of the final output power for any gain mode transition.
Insertion Phase Shift		5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels			-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness	No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
LB: Band 5, 8 WCDMA						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM Modulation: Rel99**
Frequency		824		849	MHz	Band 5
		880		915	MHz	Band 8
Maximum Linear Output Power		28.5			dBm	HPM, V_{CC} = 3.4V
		13.5			dBm	LPM, V_{CC} = 1.15V
		0			dBm	LPM, V_{CC} = 0.7 V
Gain		29.5	31.5		dB	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
			22		dB	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
			13.5		dB	LPM, P_{OUT} ≤ 0dBm, V_{CC} = 0.7V
PA Current			490		mA	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
			97		mA	LPM, P_{OUT} = 13.5dBm, V_{CC} = 1.15V
			25		mA	LPM, P_{OUT} = 0dBm, V_{CC} = 0.7V
PA Efficiency (PAE)			41		%	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
ACLR1 (±5MHz)			-41	-37	dBc	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
			-48	-38	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
ACLR2 (±10MHz)			-55	-48	dBc	HPM, P_{OUT} = 28.5dBm, V_{CC} = 3.4V
			-60	-48	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
EVM			1.0		%	Pout ≤ Pmax
Noise Power	B5 Rx Band		-131		dBm/Hz	Measure power at Rx Duplex Freq 869MHz to 894MHz
	B8 Rx Band		-132		dBm/Hz	Measure power at Rx Duplex Freq 925MHz to 960MHz
	GPS Band		-163		dBm/Hz	Measure power at Rx Band Freq = 1574MHz to 1577MHz
	ISM Band		-162		dBm/Hz	Measure power at Rx Band Freq = 2400MHz to 2484MHz

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
LB: Band 5, 8 WCDMA P.2					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V Mode=HPM; Modulation: Rel99**
Harmonics, 2fo		-52		dBc	P_{OUT} ≤ Pmax, all power outs
Harmonics, 3fo		-53		dBc	P_{OUT} ≤ Pmax, all power outs
Harmonics, 4fo and higher		-60		dBc	P_{OUT} ≤ Pmax, all power outs
Input impedance VSWR		1.6:1		VSWR	No External matching
Gain Switching Time			10	µS	Time required for output power to settle to within ±1dB of the final output power for any gain mode transition.
Insertion Phase Shift		5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels			-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness	No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
CDMA Band Class 0					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V Modulation: Rel99 1xRtt RC1**
Frequency	824		849	MHz	
Maximun Linear Output Power	28			dBm	
Gain		27.5		dB	
CDMA ACPR (+/- .885 MHz)		-45		dBc	
CDMA ACPR (+/- 1.98 MHz)		-55		dBc	
PA Current		450		mA	
PA Efficiency (PAE)		40		%	
CDMA Band Class 1					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V Modulation: Rel99 1xRtt RC1**
Frequency	1850		1910	MHz	
Maximun Linear Output Power	28.5			dBm	
Gain		27.5		dB	
CDMA ACPR (+/- .885 MHz)		-42		dBc	
CDMA ACPR (+/- 1.98 MHz)		-52		dBc	
PA Current		625		mA	
PA Efficiency (PAE)		35		%	

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
MB: Band 1, 2, 3, 4 FDD LTE						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Frequency		1920		1980	MHz	Band 1
		1850		1910	MHz	Band 2
		1710		1785	MHz	Band 3
		1710		1755	MHz	Band 4
Maximum Linear Output Power	Band 1, 4	27.0			dBm	HPM, V_{CC} = 3.4V
	Band 2, 3	27.5			dBm	HPM, V_{CC} = 3.4V
	Band 1, 2, 3, 4	13.5			dBm	LPM, V_{CC} = 1.15V
	Band 1, 2, 3, 4	0			dBm	LPM, V_{CC} = 0.7V
Gain	Band 1, 2, 3, 4	26.0	27.5		dB	HPM, P_{OUT} = 28.0dBm, V_{CC} = 3.4V
			23.5		dB	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
			17		dB	LPM, P_{OUT} ≤ 0 dBm, V_{CC} = 0.7V
PA Current			525		mA	HPM, P_{OUT} = 27.25dBm, V_{CC} = 3.4V
			110		mA	LPM, P_{OUT} = 13.5dBm, V_{CC} = 1.15V
			30		mA	LPM, P_{OUT} = 0 dBm, V_{CC} = 0.7V
PA Efficiency (PAE)			32		%	HPM, P_{OUT} = 27.25dBm, V_{CC} = 3.4V
ACLR – E-UTRA			-40	-33	dBc	HPM, P_{OUT} = 27.25dBm, V_{CC} = 3.4V
			-44	-33	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
ACLR1 – UTRA			-42	-36	dBc	HPM, P_{OUT} = 27.25dBm, V_{CC} = 3.4V
			-44	-36	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
ACLR2 – UTRA			-60	-39	dBc	HPM, P_{OUT} = 27.25dBm, V_{CC} = 3.4V
			-60	-39	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
EVM			2		%	Pout ≤ Pmax
Noise Power	B1 Rx Band		-136		dBm/Hz	Measure power at Rx Duplex Freq FTXB1+190MHz (2110 to 2170 MHz)
	B2 Rx Band		-131		dBm/Hz	Measure power at Rx Duplex Freq FTXB2+80MHz (1930 to 1990 MHz)
	B3 Rx Band		-131		dBm/Hz	Measure power at Rx Duplex Freq FTXB3+95MHz (1805 to 1880 MHz)
	B4 Rx Band		-131		dBm/Hz	Measure power at Rx Duplex Freq FTXB4+400MHz (2110 to 2155 MHz)
	ISM Band		-144		dBm/Hz	Measure power at Rx Band Freq = 2400MHz to 2484MHz
	GPS Band		-134		dBm/Hz	Measure power at Rx Band Freq = 1574MHz to 1577MHz

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
MB: Band 1, 2, 3, 4, FDD LTE P.2					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Harmonics, 2fo		-40		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Harmonics, 3fo		-41		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Harmonics, 4fo and higher		-55		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Input impedance VSWR		1.8:1		VSWR	No External matching
Gain Switching Time			10	µS	Time required for output power to settle to within ±1dB of the final output power for any gain mode transition.
Insertion Phase Shift		5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels			-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness	No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
LB: Band 5, 20, 8 FDD LTE						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Frequency		824		849	MHz	Band 5
		832		862	MHz	Band 20
		880		915	MHz	Band 8
Maximum Linear Output Power		27.5			dBm	HPM, Vcc = 3.4V
		13.5			dBm	LPM, Vcc = 1.15V
		0			dBm	LPM, Vcc = 0.7V
Gain		30.0	32.0		dB	HPM, P_{OUT} = 27.5dBm, V_{CC} = 3.4V
			20		dB	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
			13.5		dB	LPM, P_{OUT} ≤ 0dBm, V_{CC} = 0.7V
PA Current			425		mA	HPM, P_{OUT} = 27.5dBm, V_{CC} = 3.4V
			90		mA	LPM, P_{OUT} = 13.5dBm, V_{CC} = 1.15V
			25		mA	LPM, P_{OUT} = 0dBm, V_{CC} = 1.15V
PA Efficiency (PAE)			38		%	HPM, P_{OUT} = 27.5dBm, V_{CC} = 3.4V
ACLR – E-UTRA			-39	-33	dBc	HPM, P_{OUT} = 27.5dBm, V_{CC} = 3.4V
			-45	-33	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
ACLR1 (±5MHz)			-39	-36	dBc	HPM, P_{OUT} = 27.5dBm, V_{CC} = 3.4V
			-46	-36	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
ACLR2 (±10MHz)			-60	-39	dBc	HPM, P_{OUT} = 27.5dBm, V_{CC} = 3.4V
			-60	-39	dBc	LPM, P_{OUT} ≤ 13.5dBm, V_{CC} = 1.15V
EVM			2		%	Pout ≤ Pmax
Noise Power	B5 Rx Band		-132		dBm/Hz	Measure power at Rx Duplex Freq FTXB5 + 45MHz
	B8 Rx Band		-133		dBm/Hz	Measure power at Rx Duplex Freq FTXB8 + 95MHz
	GPS Band		-164		dBm/Hz	Measure power at Rx Band Freq = 1574MHz to 1577MHz
	ISM Band		-163		dBm/Hz	Measure power at Rx Band Freq = 2400MHz to 2484MHz

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
LB: Band 5, 20, 8 FDD LTE P.2					Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB
Harmonics, 2fo		-45		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Harmonics, 3fo		-44		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Harmonics, 4fo and higher		-48		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Input impedance VSWR		1.5:1		VSWR	No External matching
Gain Switching Time			10	µS	Time required for output power to settle to within ±1dB of the final output power for any gain mode transition.
Insertion Phase Shift		5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels			-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness	No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
HB: Band 7 FDD LTE						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Frequency		2500		2570	MHz	Band 7
Maximum Linear Output Power		27.5			dBm	HPM; V_{CC} = 3.4V
		13.5			dBm	LPM; V_{CC} = 1.15V
		0			dBm	LPM; V_{CC} = 0.7V
Gain		25.5	27.5		dB	HPM; Pout = 27.5dBm; V_{CC} = 3.4V
			23		dB	LPM; Pout = 13.5dBm; V_{CC} = 1.15V
			18.5		dB	LPM; Pout = 0dBm; V_{CC} = 0.7V
PA Current			550		mA	HPM; Pout = 27.5dBm; V_{CC} = 3.4V
			120		mA	LPM; Pout = 13.5dBm; V_{CC} = 1.15V
			35		mA	LPM; Pout = 0dBm; V_{CC} = 0.7V
PA Efficiency (PAE)			29		%	HPM; Pout = 27.5dBm; V_{CC} = 3.4V
ACLR- E-UTRA			-40	-33	dBc	HPM; Pout = 27.5dBm; V_{CC} = 3.4V
			-43	-33	dBc	LPM; Pout = 13.5dBm; V_{CC} = 1.15V
ACLR1 -UTRA			-40	-36	dBc	HPM; Pout = 27.5dBm; V_{CC} = 3.4V
			-44	-36	dBc	LPM; Pout = 13.5dBm; V_{CC} = 1.15V
ACLR2 -UTRA			-62	-39	dBc	HPM; Pout = 27.5dBm; V_{CC} = 3.4V
			-60	-39	dBc	LPM; Pout = 13.5dBm; V_{CC} = 1.15V
EVM			2.0		%	Pout ≤ Pmax
Noise Power	Band 7 RX		-138		dBm/Hz	HPM; Pout = 27.5dBm; V_{CC} = 3.4V 2620MHz to 2690MHz
	GPS		-156		dBm/Hz	HPM; Pout = 27.5dBm; V_{CC} = 3.4V 1574MHz to 1577MHz
	ISM Band		-123		dBm/Hz	HPM; Pout = 27.5dBm; V_{CC} = 3.4V 2400MHz to 2452MHz Modulation: 20MHz,100RB
			-121		dBm/Hz	HPM; Pout = 27.5dBm; V_{CC} = 3.4V 2452MHz to 2484MHz Modulation: 20MHz,100RB

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
HB: Band 7 FDD LTE P.2					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Harmonics, 2fo		-25		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Harmonics, 3fo		-48		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Harmonics, 4fo and higher		-66		dBc	HPM; Pout = Pmax; V_{CC} = 3.4V LTE waveform: QPSK; 10MHz; 1RB
Input VSWR		2:1		VSWR	No External matching
Gain Switching Time			10	µS	Time required for output power to settle to within ±1dB of the final output power for any gain mode transition.
Insertion Phase Shift		5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels			-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness	No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
MB: Band 39 TDD - LTE						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Frequency		1880		1920	MHz	Band 39
Maximum Linear Output Power		27.0			dBm	HPM, V_{CC} = 3.4V
		13.5			dBm	LPM, V_{CC} = 1.15V
		0			dBm	LPM, V_{CC} = 0.7V
Gain		26.5	28.5		dB	HPM, Pout = 27.0dBm, V_{CC} = 3.4V
			24		dB	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
			17		dB	LPM, Pout = 0dBm, V_{CC} = 0.7V
PA Current			425		mA	HPM, Pout = 27.0dBm, V_{CC} = 3.4V
			100		mA	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
			30		mA	LPM, Pout = 0dBm, V_{CC} = 0.7V
PA Efficiency (PAE)			34.5		%	HPM, Pout = 27.0dBm, V_{CC} = 3.4V
ACLR- E-UTRA			-43	-33	dBc	HPM, Pout = 27.0dBm, V_{CC} = 3.4V
			-47	-33	dBc	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
ACLR1 -UTRA			-42	-36	dBc	HPM, Pout = 27.0dBm, V_{CC} = 3.4V
			-47	-36	dBc	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
ACLR2 -UTRA			-53	-39	dBc	HPM, Pout = 27.0dBm, V_{CC} = 3.4V
			-57	-39	dBc	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
EVM			2.0		dBc	Pout ≤ Pmax
Noise Power	Band 1 RX		-140		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2110MHz to 2170MHz Modulation: 20MHz,100RB
	GPS		-142		dBm/Hz	HPM, Pout = 27.0dBm, V_{CC} = 3.4V 1574MHz to 1577MHz Modulation: 20MHz,100RB
	ISM Band		-147		dBm/Hz	HPM, Pout = 27.0dBm, V_{CC} = 3.4V 2400 to 2484 MHz Modulation: 20MHz,100RB

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
MB: Band 39 TDD – LTE P.2					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Harmonics, 2fo		-44		dBc	HPM, Pout = 27.0dBm, V_{CC} = 3.4V Modulation: 10MHz, QPSK, 1RB
Harmonics, 3fo		-40		dBc	HPM, Pout = 27.0dBm, V_{CC} = 3.4V Modulation: 10MHz, QPSK, 1RB
Harmonics, 4fo and higher		-51		dBc	HPM, Pout = 27.0dBm, V_{CC} = 3.4V Modulation: 10MHz, QPSK, 1RB
Input VSWR		2:1		VSWR	No External matching
Gain Switching Time			10	µS	Time required for output power to settle to within ±1dB of the final output power for any gain mode transition.
Insertion Phase Shift		5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels			-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness	No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
HB: Band 38, 40, 41 TDD - LTE						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Frequency		2570		2620	MHz	Band 38
		2300		2400	MHz	Band 40
		2496		2690	MHz	Band 41
Maximum Linear Output Power		27.5			dBm	HPM, V_{CC} = 3.4V
		13.5			dBm	LPM, V_{CC} = 1.15V
		0			dBm	LPM, V_{CC} = 0.7V
Gain		26.0	27.5		dB	HPM, Pout = 27.5dBm, V_{CC} = 3.4V
			22		dB	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
			18.5		dB	LPM, Pout = 0dBm, V_{CC} = 0.7V
PA Current			500		mA	HPM, Pout = 27.5dBm, V_{CC} = 3.4V
			110		mA	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
			35		mA	LPM, Pout = 0dBm, V_{CC} = 0.7V
PA Efficiency (PAE)			32		%	HPM, Pout = 27.5dBm, V_{CC} = 3.4V
ACLR- E-UTRA			-38	-33	dBc	HPM, Pout = 27.5dBm, V_{CC} = 3.4V
			-45	-33	dBc	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
ACLR1 -UTRA			-38	-36	dBc	HPM, Pout = 27.5dBm, V_{CC} = 3.4V B41 max limit = -35 dBc
			-47	-36	dBc	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
ACLR2 -UTRA			-50	-39	dBc	HPM, Pout = 27.5dBm, V_{CC} = 3.4V
			-55	-39	dBc	LPM, Pout = 13.5dBm, V_{CC} = 1.15V
EVM			3.0		dBc	Pout ≤ Pmax
Noise Power	Band 1 RX		-138		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2110MHz to 2170MHz Modulation: 20MHz,100RB
	Band 34		-143		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2010MHz to 2025MHz Modulation: 20MHz,100RB
	GPS		-157		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 1574MHz to 1577MHz Modulation: 20MHz,100RB

Parameter			Specification			Unit	Condition
			Min	Typ	Max		
HB: Band 38, 40, 41 TDD – LTE P.2							**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V;Mode=HPM. Modulation: QPSK, 10MHz BW, 12 RB**
Noise Power	ISM Band	B38		-126		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2400MHz to 2484MHz (B38) Modulation: 20MHz,100RB
		B40		-122		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2400 MHz to 2437MHz (B40) Modulation: 20MHz,100RB
		B40		-127		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2438 MHz to 2484MHz (B40) Modulation: 20MHz,100RB
		B41		-123		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2400MHz to 2452MHz (B38,41) Modulation: 20MHz,100RB
		B41		-105		dBm/Hz	HPM, Pout = 27.5dBm, V_{CC} = 3.4V 2452 MHz to 2484MHz (B38,41) Modulation: 20MHz,100RB
Harmonics, 2fo				-25		dBc	HPM, Pout = 27.5dBm, V_{CC} = 3.4V Modulation: 10MHz, QPSK, 1RB
Harmonics, 3fo				-41		dBc	HPM, Pout = 27.5dBm, V_{CC} = 3.4V Modulation: 10MHz, QPSK, 1RB
Harmonics, 4fo and higher				-60		dBc	HPM, Pout = 27.5dBm, V_{CC} = 3.4V Modulation: 10MHz, QPSK, 1RB
Input VSWR				2:1		VSWR	No External matching
Gain Switching Time					10	µS	Time required for output power to settle to within ±1dB of the final output power for any gain mode transition.
Insertion Phase Shift				5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels					-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness			No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter		Specification			Unit	Condition
		Min	Typ	Max		
MB: Band 34, 39 HB: Band 40 TD-SCDMA						**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V; Mode=HPM. Modulation: TD-SCDMA**
Frequency		2010		2025	MHz	Band 34
		1880		1920	MHz	Band 39
		2300		2400	MHz	Band 40
Maximum Output Power		28			dBm	HPM, V_{CC} = 3.4V
		13.5			dBm	LPM, V_{CC} = 1.15V
		0			dBm	LPM, V_{CC} = 0.7V
Gain		26.5	28.5		dB	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V
			24		dB	LPM, P_{OUT} = 13.5dBm; V_{CC} = 1.15V
			18.5		dB	LPM, P_{OUT} = 0dBm; V_{CC} = 1.15V
PA Current			550		mA	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V
			125		mA	LPM, P_{OUT} = 13.5dBm; V_{CC} = 1.15V
			35		mA	LPM, P_{OUT} = 0dBm; V_{CC} = 0.7V
PA Efficiency (PAE)			34		%	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V
ACLR 1			-45	-38	dBc	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V
			-45	-38	dBc	LPM, P_{OUT} = 13.5dBm; V_{CC} = 1.15V
ACLR 2			-62	-48	dBc	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V
			-62	-48	dBc	LPM, P_{OUT} = 13.5dBm; V_{CC} = 1.15V
EVM			2		%	Pout ≤ Pmax
Noise Power	Band 40		-144		dBm/Hz	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V 2300MHz to 2400MHz
	GPS		-142		dBm/Hz	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V 1574MHz to 1577MHz,
	ISM Band		-145		dBm/Hz	HPM, P_{OUT} = 28dBm; V_{CC} = 3.4V 2400MHz to 2484MHz

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
MB: Band 34, 39 HB: Band 40 TD-SCDMA P.2					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C; VBATT=3.8V; VCC=3.4V; Mode=HPM. Modulation: TD-SCDMA**
Harmonics, 2fo		-33		dBc	P_{OUT} = Pmax; V_{CC} = 3.4V
Harmonics, 3fo		-42		dBc	P_{OUT} = Pmax; V_{CC} = 3.4V
Harmonics, 4fo and higher		-60		dBc	P_{OUT} = Pmax; V_{CC} = 3.4V
Input VSWR		2:1		VSWR	No External matching
Gain Switching Time			10	µS	Time required for output power to settle to within ±1dB of the
Insertion Phase Shift		5		°	Phase shift at 13.5dBm when switching from HPM to LPM
Stability, Spurious Output Levels			-70	dBc	Output Load VSWR = 6:1, All phase angles P_{IN} ≤ 10dBm, P_{FWD} ≤ Max Pout Temp -20 to +85C, Vbatt = Vcc = 3.0 to 4.6V
Ruggedness	No damage or permanent degradation to device				Output Load VSWR = 10:1, All phase angles P_{FWD} ≤ Max Pout, Closed Loop Conditions Temp -20 to +85C, Vbatt = Vcc = 4.6V

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
HB: Band 7, 40, 41 HB Switch Specification					**Nominal test conditions unless otherwise stated. All unused ports terminated in 50Ω. T_A=+25°C**
Frequency	2300		2690	MHz	B7, B40, B41
Insertion Loss, IL		0.6	1.1	dB	HB1 – HBRX2
		0.6	1.1	dB	HB2 – HBRX2
		0.6	1.1	dB	HB3 – HBRX1
		0.6	1.1	dB	HB4 – HBRX2
Isolation	28	30.5		dB	LB1 – LB2
	30	35.0		dB	LB1 – LB3
	30	32.5		dB	LB2 – LB3
	30	35.5		dB	MB1 – MB2
	27	29.0		dB	MB1 – MB3
	30	32.0		dB	MB2 – MB3
	30	34.0		dB	HB1 – HB2
	30	37.5		dB	HB1 – HB3
	30	34.0		dB	HB1 – HB4
	30	37.0		dB	HB1 – B34_39
	30	42.0		dB	HB1 – HBRX1
	30	43.0		dB	HB1 – HBRX2
	30	37.5		dB	HB2 – HB3
	28	30.0		dB	HB2 – HB4
	30	50.0		dB	HB2 – B34_39
	30	37.0		dB	HB2 – HBRX1
	30	42.5		dB	HB2 – HBRX2
	27	29.5		dB	HB3 – HB4
	30	62.0		dB	HB3 – B34_39
	30	39.0		dB	HB3 – HBRX1
	30	35.5		dB	HB3 – HBRX2
	30	68.0		dB	HB4 – B34_39
	27	29.5		dB	HB4 – HBRX1
	30	36.0		dB	HB4 – HBRX2
	23	25.0		dB	HBRX1 – HBRX2

MIPI RFFE Registers

Register Address	Register Name	Data Bit	Field Name	Description	Default	Special Support	R/W
Reg 00	PA_CTRL0	7:3	PA_BAND	PA Logic State Selection 00000 = STDBY 10000 = STDBY 00001 = RFIN_L-LB1 10001 = STDBY 00010 = RFIN_L-LB2 10010 = STDBY 00011 = RFIN_L-LB3 10011 = STDBY 00100 = N/A 10100 = STDBY 00101 = N/A 10101 = STDBY 00110 = RFIN_M-MB1 10110 = STDBY 00111 = RFIN_M-MB2 10111 = STDBY 01000 = RFIN_M-MB3 11000 = STDBY 01001 = N/A 11001 = STDBY 01010 = RFIN_M-B34/39 11010 = STDBY 01011 = RFIN_H-HB1 11011 = HB1-HBRX2 01100 = RFIN_H-HB4 11100 = HB4- HBRX2 01101 = RFIN_H-HB3 11101 = HB3- HBRX1 01110 = RFIN_H-HB2 11110 = HB2- HBRX2 01111 = STDBY 11111 = STDBY	0b00000	T0, T1, T2	R/W
Reg 00	PA_CTRL0	2	OSW_EN	Output Switch Enable 0 = High Isolation 1 = Configured State (as set by PA_BAND)	0b0	T0, T1, T2	R/W
Reg 00	PA_CTRL0	1:0	MODE	PA Power Mode 00 = HPM – ET (Set ET signal to GaAs - Reserved for Future Use) 01 = HPM - APT 10 = LPM - APT 11 = Reserved for Future use	0b00	T0, T1, T2	R/W
Reg 01	PA_CTRL1	7:0	PA_BIAS	Sets PA Bias Current (See separate table for detail)	0b00000_0000	T0, T1, T2	R/W
Reg 02	PA_CTRL2	7:0	Reserved	Must remain 0 for proper operation	0b00000_0000	T0, T1, T2	R/W
Reg 26	RFFE_STATUS	7	SOFTWARE RESET	0: Normal operation 1: Software reset - All configurable registers set to default values, except for USID. This bit will always read 0	0b0	No	R/W
Reg 26	RFFE_STATUS	6	COMMAND_FRAME_PARITY_ERR	Command Frame received with parity error – discard command	0b0	No	R/W
Reg 26	RFFE_STATUS	5	COMMAND_LENGTH_ERR	Command Sequence received with an incorrect length	0b0	No	R/W
Reg 26	RFFE_STATUS	4	ADDRESS_FRAME_PARITY_ERR	Address Frame received with a parity error	0b0	No	R/W
Reg 26	RFFE_STATUS	3	DATA_FRAME_PARITY_ERR	Data Frame received with a parity error	0b0	No	R/W
Reg 26	RFFE_STATUS	2	READ_UNUSED_REG	Read Command Sequence received with an invalid address	0b0	No	R/W
Reg 26	RFFE_STATUS	1	WRITE_UNUSED_REG	Write Command Sequence received with an invalid address	0b0	No	R/W

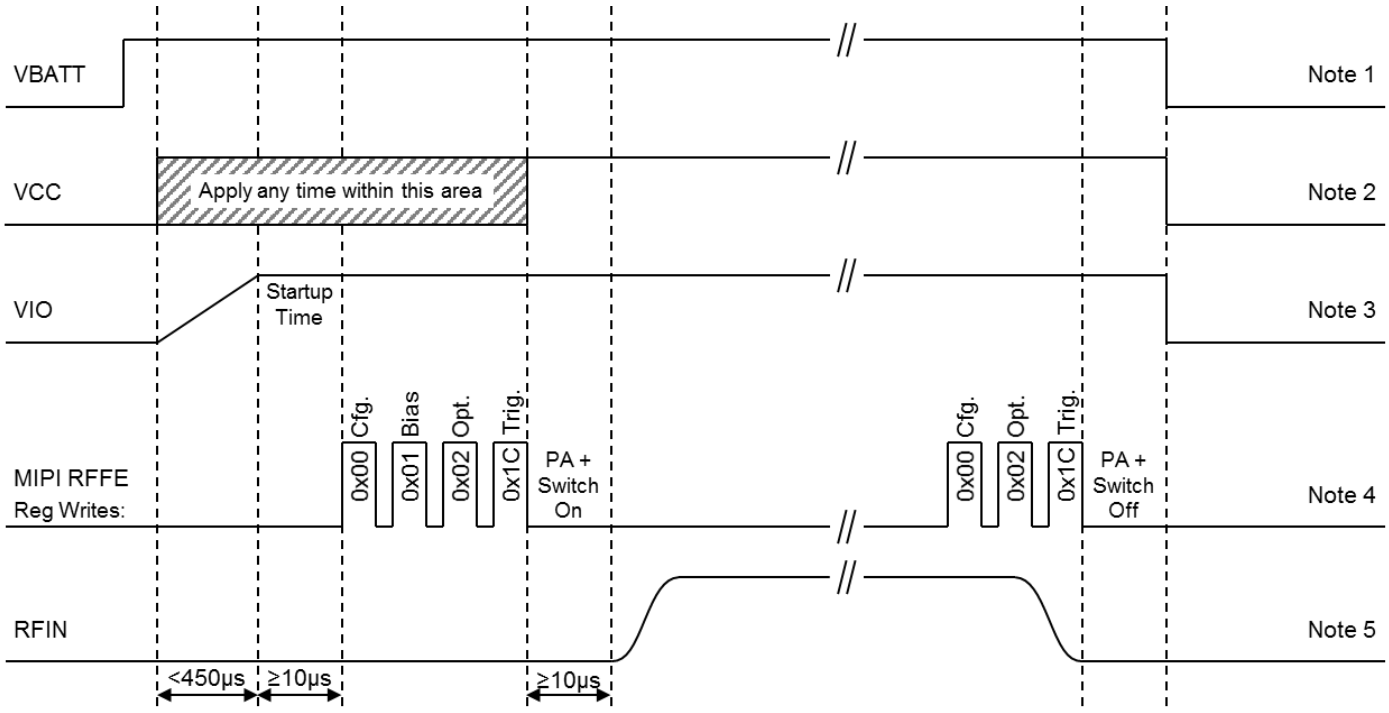
Register Address	Register Name	Data Bit	Field Name	Description	Default	Special Support	R/W
Reg 26	RFFE_STATUS	0	BID_GID_ERR	Read Command Sequence received with a BROADCAST_ID or GROUP_SID.	0b0	No	R/W
Reg 27	GROUP_SID	7:4	RESERVED	Reserved	0b0000	No	R/W
Reg 27	GROUP_SID	3:0	GSID	Group slave ID	0b0000	No	R/W
Reg 28	PM_TRIG	7:6	PWR_MODE	00: ACTIVE – Normal Operation 01: STARTUP – Reset all registers to default settings 10: LOW POWER – Retain register values, Band-Gap off 11: Reserved Note: Setting PWR_MODE to STARTUP is identical to a hardware reset initiated by the VIO signal.	0b00	Bdcst_ID	R/W
Reg 28	PM_TRIG	5	Trigger_Mask_2	If set, Trigger_2 is masked (disabled). When Trigger_Mask_2, Trigger_Mask_1, and Trigger_Mask_0, are all set, data goes directly to the destination (no trigger required).	0b0	No	R/W
Reg 28	PM_TRIG	4	Trigger_Mask_1	If set, Trigger_1 is masked (disabled). When Trigger_Mask_2, Trigger_Mask_1, and Trigger_Mask_0, are all set, data goes directly to the destination (no trigger required).	0b0	No	R/W
Reg 28	PM_TRIG	3	Trigger_Mask_0	If set, Trigger_0 is masked (disabled). When Trigger_Mask_2, Trigger_Mask_1, and Trigger_Mask_0, are all set, data goes directly to the destination (no trigger required).	0b0	No	R/W
Reg 28	PM_TRIG	2	Trigger_2	Write 1 to this bit to load T2 triggered registers.	0b0	Bdcst_ID, GSID	R/W
Reg 28	PM_TRIG	1	Trigger_1	Write 1 to this bit to load T1 triggered registers.	0b0	Bdcst_ID, GSID	R/W
Reg 28	PM_TRIG	0	Trigger_0	Write 1 to this bit to load T0 triggered registers.	0b0	Bdcst_ID, GSID	R/W
Reg 29	PRODUCT_ID	7:0	PRODUCT_ID	Read only. During programming of USID, a write command sequence is performed on this register but does not change its value.	0b1101_1111 (0xDF)	No	R
Reg 30	MANUFACTURER_ID	7:0	MANUFACTURER_ID[7:0]	Read only. During programming of USID, a write command sequence is performed on this register but does not change its value.	0b0011_0100 (0x34)	No	R
Reg 31	MAN_USID	7:6	RESERVED	Reserved	0b00	No	R
Reg 31	MAN_USID	5:4	MANUFACTURER_ID[9:8]	Read only. During programming of USID, a write command sequence is performed on this register but does not change its value.	0b01	No	R
Reg 31	MAN_USID	3:0	USID	USID of the device = “PA Module 1”. Can be changed using the USID write sequence.	0b1111	No	R/W

Note:
Column Special Support: Bdcst_ID = addressable by USID 0000 (Broadcast ID), GSID = addressable by GSID,
T0 = Trigger_0, T1 = Trigger_1, T2 = Trigger_2

Register 0x0001: PA_CTRL1 Details

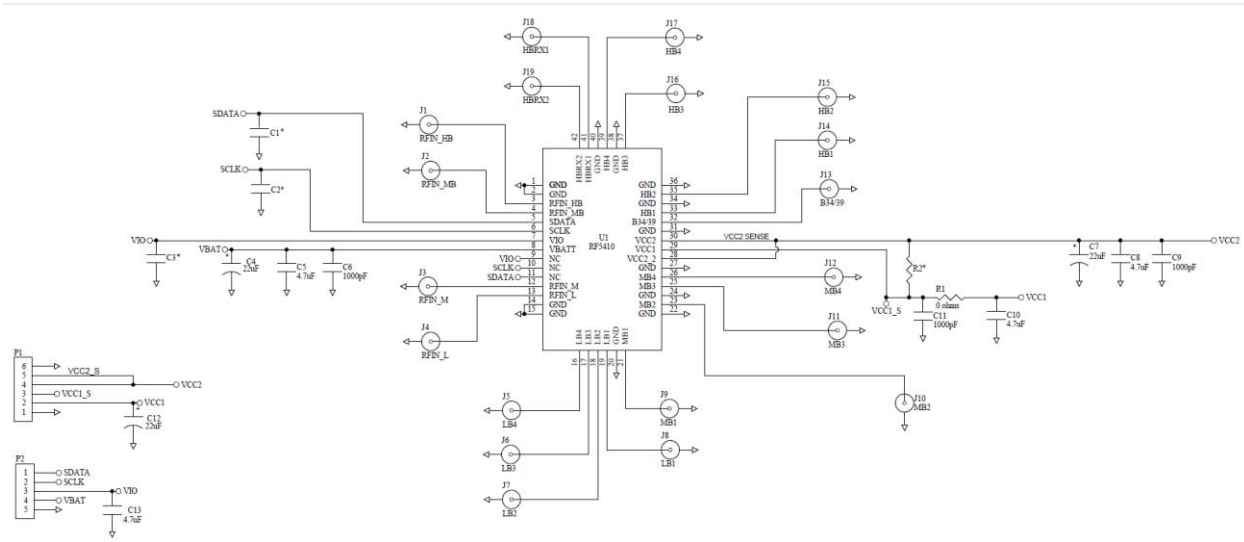
PA_BAND	Bit	Function	Description
RFIN_H-nnn	7:5	PA_BIAS_HB_DRIVER_STAGE	3b000 = Minimum Quiescent Current 3b111 = Maximum Quiescent Current
RFIN_H-nnn	4:0	PA_BIAS_HB_OUTPUT_STAGE	5b00000 = Minimum Quiescent Current 5b11111 = Maximum Quiescent Current
RFIN_M-nnn	7:0	PA_BIAS_MB_ALL_STAGES	8b00000000 = Minimum Quiescent Current 8b11111111 = Maximum Quiescent Current
RFIN_L-nnn	7:0	PA_BIAS_LB_ALL_STAGES	8b00000000 = Minimum Quiescent Current 8b11111111 = Maximum Quiescent Current

Timing Diagram

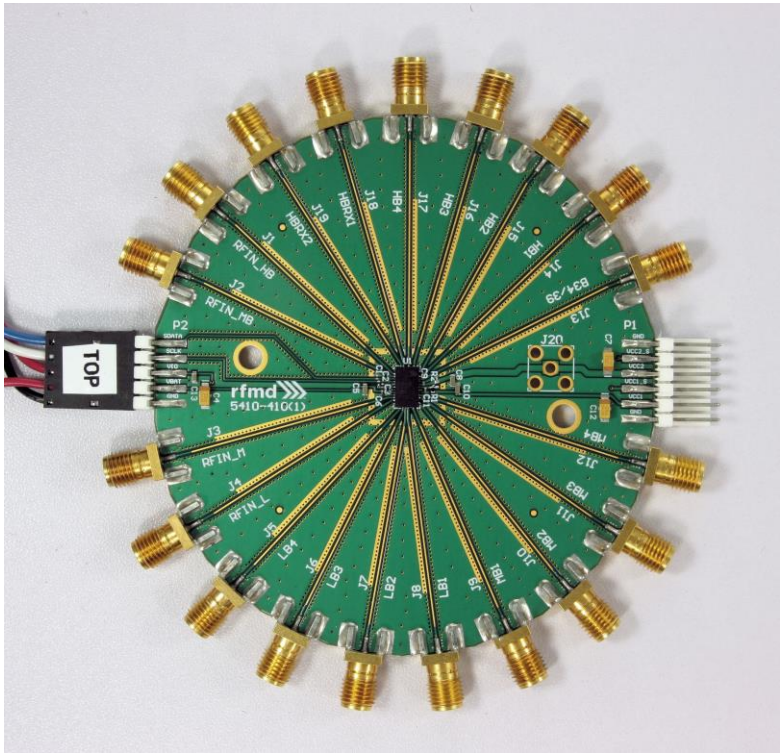


Note 1: VBATT supplies the output switch. It must be applied before the output switch can activate.
Note 2: VCC supplies current to the amplifier. It must be applied before the amplifier can fully bias.
Note 3: RFIN may be applied only after amplifier is configured and output switch has settled.
Note 4: Register Write 0x02 Opt. is only needed if register 2 is used for configuration of the device.
Note 5: Specific turn-off order of supplies VBATT, VCC, and VIO is not required. Register values are retained with only VIO present.

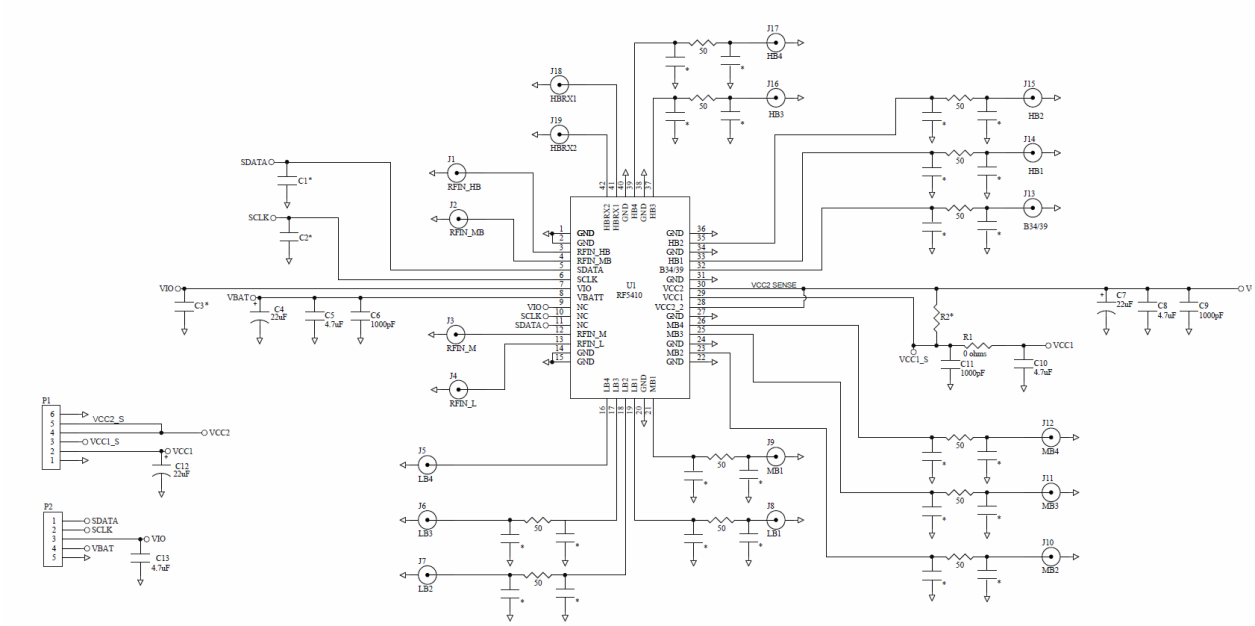
Evaluation Board Schematic



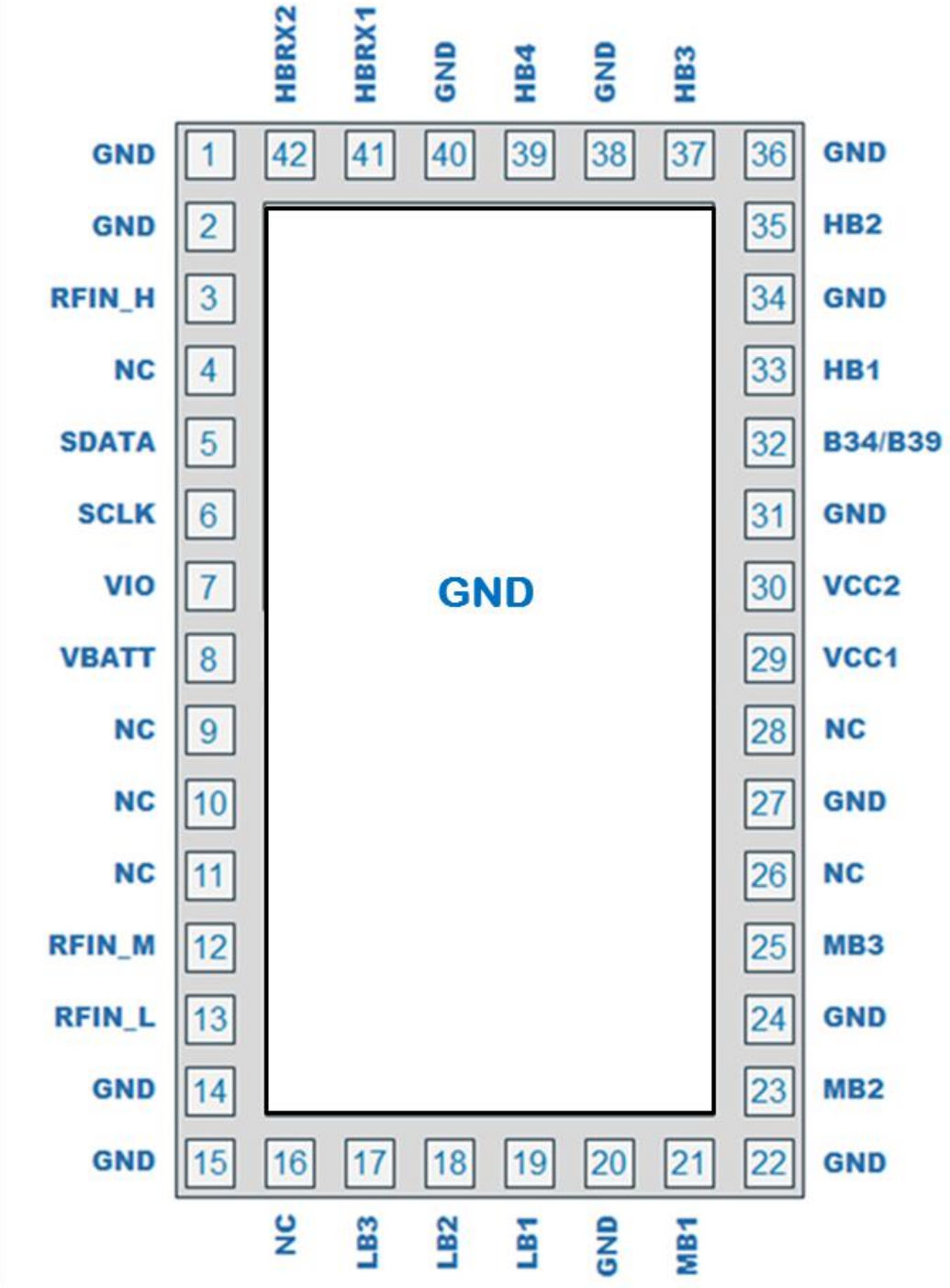
Evaluation Board Assembly Drawing



Application Schematic



Pin Out

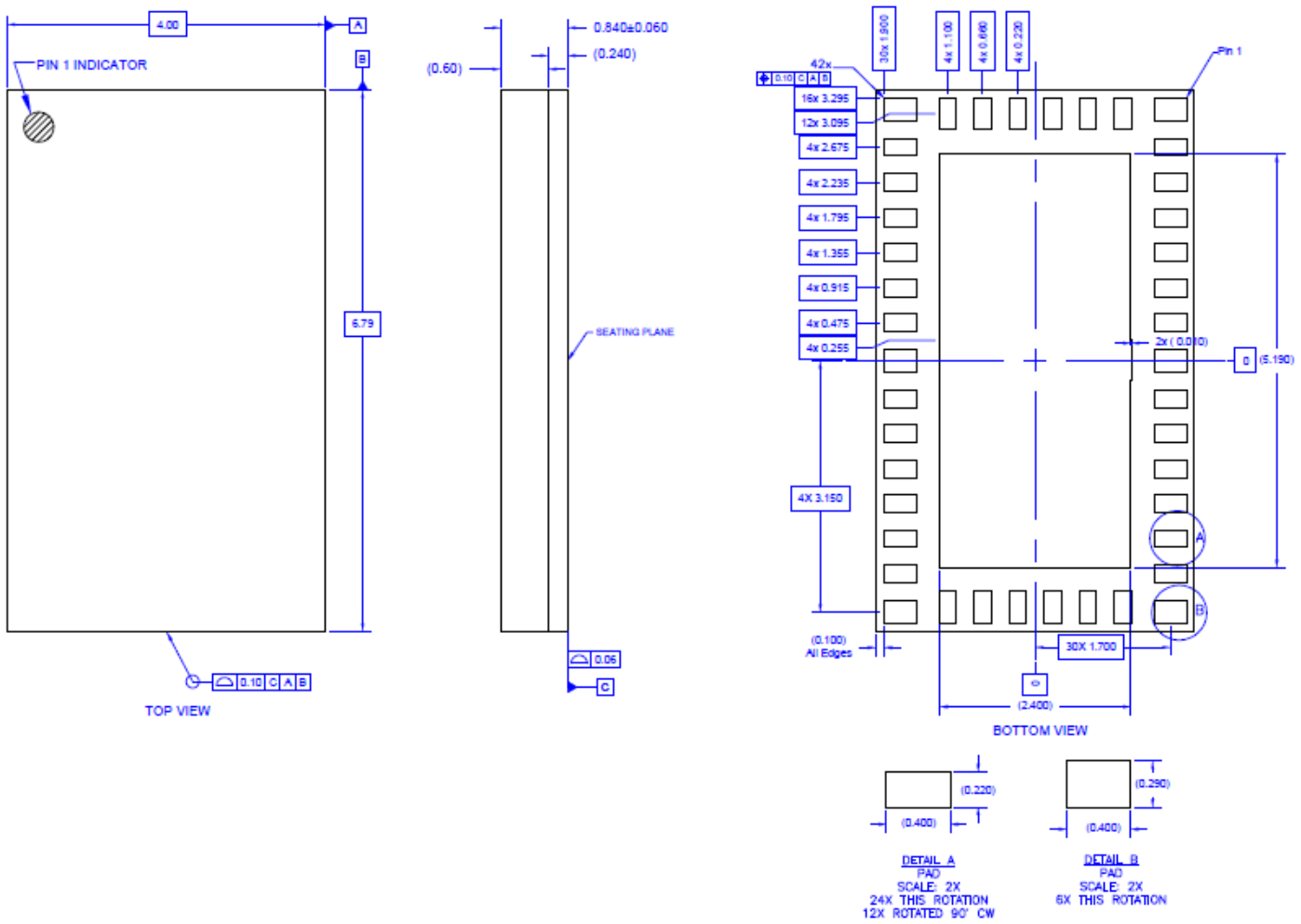


Pin Names and Descriptions

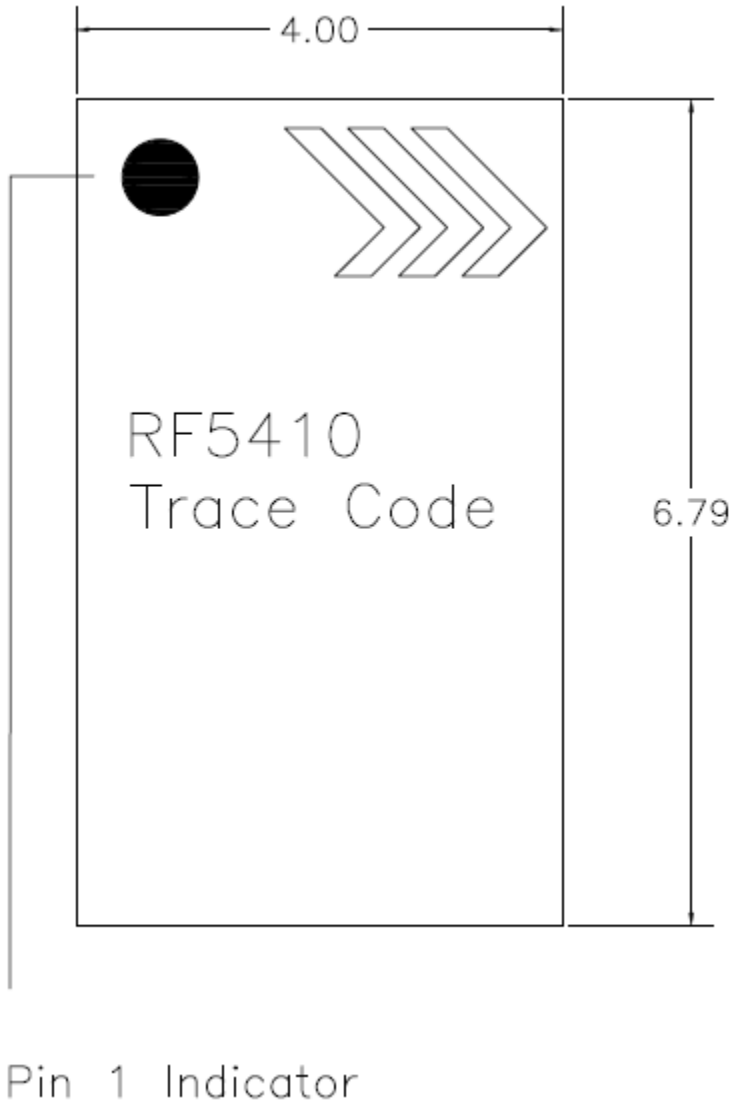
Pin	Name	Description
1	GND	Pin connected to module ground.
2	GND	Pin connected to module ground.
3	RFIN_H	RF input to the high band power amplifier. This is a 50Ω input with DC blocking and ESD shunt L to GND presents as DC short to ground.
4	NC	No Connect.
5	SDATA	Serial interface data I/O signal.
6	SCLK	Serial interface clock input signal.
7	VIO	Supply voltage for the MIPI RFFE serial interface.
8	VBATT	Supply voltage for bias circuitry.
9	NC	No Connect.
10	NC	No Connect.
11	NC	No Connect.
12	RFIN_M	RF input to the mid band power amplifier. This is a 50Ω input with DC blocking and ESD shunt L to GND presents as DC short to ground.
13	RFIN_L	RF input to the low band power amplifier. This is a 50Ω input with DC blocking.
14	GND	Pin connected to module ground.
15	GND	Pin connected to module ground.
16	NC	No Connect.
17	LB3	This is one of three low band RF outputs from low band amplifier. This is a 50Ω output with DC blocking.
18	LB2	This is one of three low band RF outputs from low band amplifier. This is a 50Ω output with DC blocking.
19	LB1	This is one of three low band RF outputs from low band amplifier. This is a 50Ω output with DC blocking.
20	GND	Pin connected to module ground.
21	MB1	This is one of four mid-band RF outputs from mid band amplifier. PA is a DC-blocked, but this output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
22	GND	Pin connected to module ground.
23	MB2	This is one of four mid-band RF outputs from mid band amplifier. PA is a DC-blocked, but this output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
24	GND	Pin connected to module ground.
25	MB3	This is one of four mid-band RF outputs from mid band amplifier. PA is a DC-blocked, but this output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
26	NC	No Connect.
27	GND	Pin connected to module ground.
28	NC	No Connect.
29	Vcc1	Supply voltage for the first stage of the power amplifier circuitry in the module. Typically this pin will connect to the same source used for VCC2.
30	Vcc2	Supply voltage for the final stage of the power amplifier circuitry in the module. Traces running to this pin may have high current during transmit operation. Proper decoupling and routing to handle this condition should be observed. This pin can be connected directly to the output of the DC-DC converter.

Pin	Name	Description
31	GND	Pin connected to module ground.
32	B34/B39	This is one of four mid-band RF outputs from mid band amplifier (1880 MHz to 2020 MHz). PA is a DC-blocked, but this output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
33	HB1	This is one of four high band transmit and receive ports. RFFE logic controls the switch connected to this port. The switch connects this port to the RF output from the high band power amplifier (2300 MHz to 2690 MHz) or to HBRX2. This output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
34	GND	Pin connected to module ground.
35	HB2	This is one of four high band transmit and receive ports. RFFE logic controls the switch connected to this port. The switch connects this port to the RF output from the high band power amplifier (2300 MHz to 2690 MHz) or to HBRX2. This output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
36	GND	Pin connected to module ground.
37	HB3	This is one of four high band transmit and receive ports. RFFE logic controls the switch connected to this port. The switch connects this port to the RF output from the high band power amplifier (2300 MHz to 2690 MHz) or to HBRX1. This output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
38	GND	Pin connected to module ground.
39	HB4	This is one of four high band transmit and receive ports. RFFE logic controls the switch connected to this port. The switch connects this port to the RF output from the high band power amplifier (2300 MHz to 2690 MHz) or to HBRX2. This output presents as DC short to GND when switch throw is activated. This is a 50Ω output.
40	GND	Pin connected to module ground.
41	HBRX1	This is one of two high band receive ports. RFFE logic controls the switch connected to this port. The switch connects this port to HB3.
42	HBRX2	This is one of two high band receive ports. RFFE logic controls the switch connected to this port. The switch connects this port to HB1, HB2 or HB4.
Pkg Base	G	Main thermal ground. Board must provide a solid topside ground pad connecting to the PCB ground plane with multiple vias. The PCB top layer pad should have a low thermal resistance and low electrical impedance to the ground plane.

Package Outline Drawing (Dimensions in millimeters)



Branding Drawing



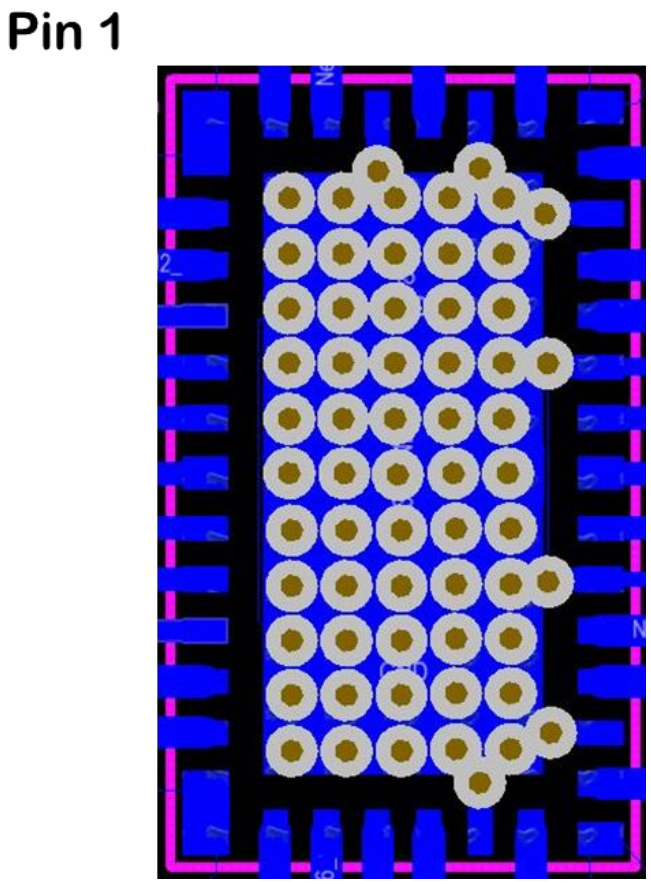
Thermal Pad and Via Design

The PCB land pattern has been designed with a thermal pad that matches the die paddle size on the bottom of the device.

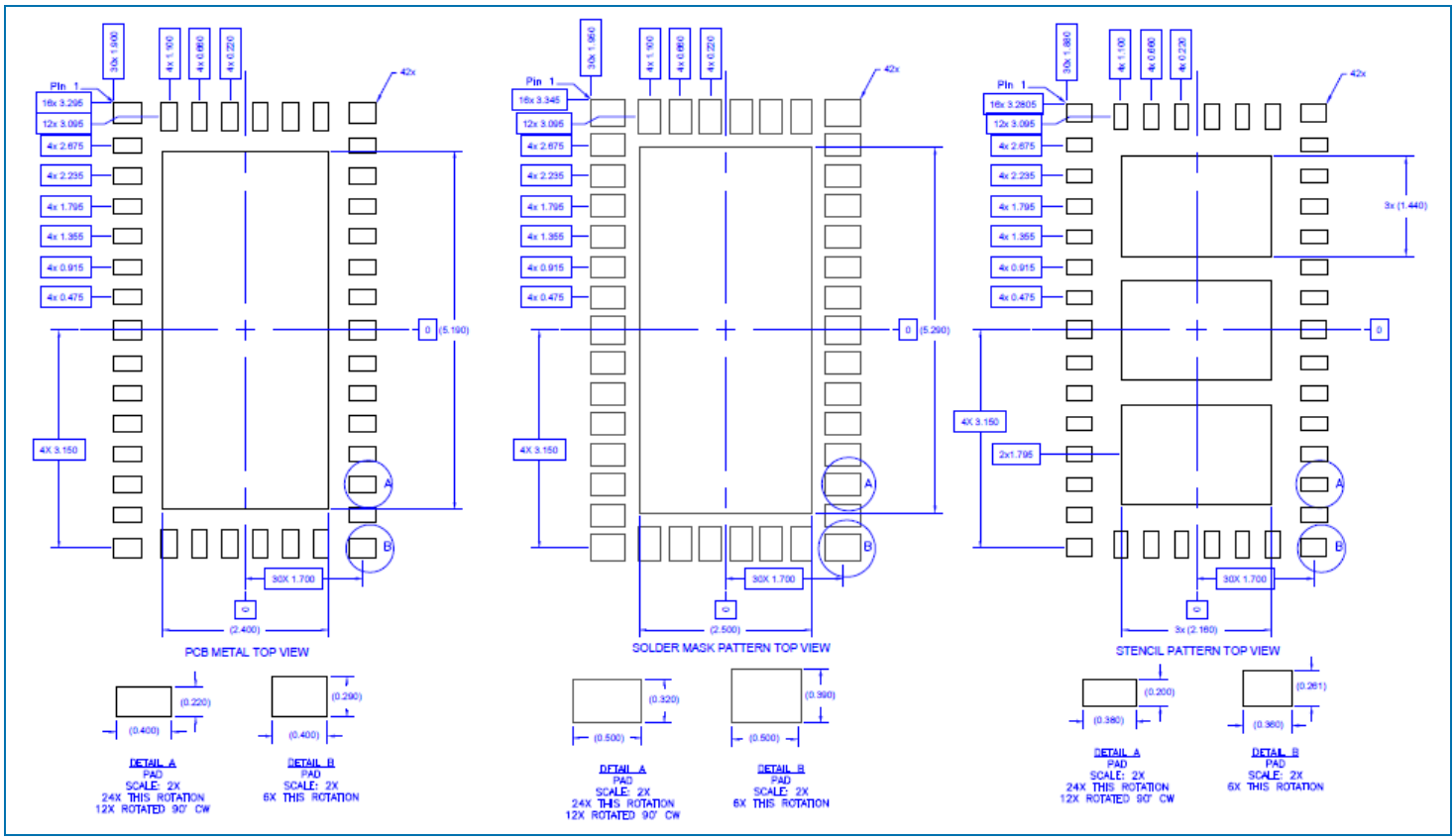
Thermal vias are required in the PCB layout to effectively conduct heat away from the package. The via pattern has been designed to address thermal, power dissipation and electrical requirements of the device as well as accommodating routing strategies.

The via pattern used for the RFMD qualification is based on thru-hole vias with 0.203mm to 0.330mm finished hold size on a 0.5mm to 1.2mm grid pattern with 0.025mm plating on via walls. If micro vias are used in a design, it is suggested that the quantity of vias be increased by a 4:1 ratio to achieve similar results.

GND Slug Via Pattern



PCB Solder Stencil Pattern



Revision History

Revision Date	Description
20150828	Production Release.
20160809	Update Data Sheet Format to RFMD / QORVO