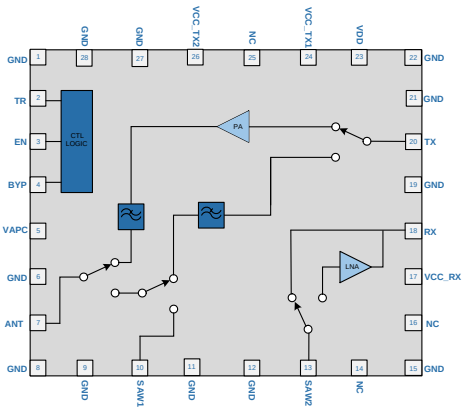
RFMD + TriQuint = Qorvo

RFFM6406

2.5V to 4.2V, ISM Band, 1 1/2W, 408MHz to 455MHz Transmit/Receive Module

Package: LGA, 28-pin,
6.0mm x 6.0mm x 0.975mm

The RFFM6406 is a single-chip front end module (FEM) for applications in the 400MHz ISM Band. The RFFM6406 addresses the need for aggressive size reduction for typical portable equipment RF front-end design and greatly reduces the number of components outside of the core chipset, thus minimizing the footprint and assembly cost of the overall solution. The RFFM6406 contains an integrated 1 1/2 Watt PA, SP2T antenna switch, integrated Tx harmonic filter, LNA with bypass mode, and matching components. The RFFM6406 is packaged in a 28-pin, 6.0mm x 6.0mm x 0.975mm over-molded laminate package with backside ground which greatly minimizes next level board space and allows for simplified integration.



Functional Block Diagram

Features

- Integrated 50Ω Input/Output Match
- Tx Output Power: 32dBm
- Separate Tx/Rx 50Ω Transceiver Interface
- Integrated PA + filtering and PA Bypass Mode and LNA with Bypass Mode

Applications

- 400MHz ISM Bands
- Single Chip RF Front End Module
- Wireless Automatic Metering
- Portable Battery Powered Equipment
- Smart Energy

Ordering Information

RFFM6406SB	5-piece bag
RFFM6406SQ	25-piece bag
RFFM6406SR	Standard 100-piece reel
RFFM6406TR13	Standard 2500-piece reel
RFFM6406PCK-410	Fully assembled eval board + 5 loose pieces

Absolute Maximum Ratings

Parameter	Rating	Unit
Voltage	5.25	V
Storage Temperature Range	-40 to +150	°C
Operating Temperature Range	-40 to +70 (100% Duty Cycle)	°C
	+70 to +85 (≤80% Duty Cycle)	°C
Receive RF Input Power (SAW2)	+25	dBm
Transmit RF Input Power (PA Enabled)	+15	dBm
Transmit RF Input Power (PA Bypass)	+20	dBm
Receive RF Input Power (ANT)	+33	dBm
T/R Port Load VSWR in Transmit Mode	10:1	
ESD, HBM	500	V
ESD, CDM	500	V
Moisture Sensitivity Level	MSL3	

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.

Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Frequency	408		455	MHz	
RF Port Impedance		50		Ω	
Leakage Current					**V_{CC}Tx1 = 4.2V, V_{CC}Tx2 = 4.2V, V_{DD} = 4.2V, V_{CC}Rx = 4.2V, V_{APC} = 0.0V, EN = 0.0V, TR = 0.0V, BYP = 0.0V, RF = Off, Temperature = 25ºC**
V_{DD}		0.05	0.15	µA	
V_{CC} TX		0.05	0.40	µA	
V_{CC} RX		0.05	0.40	µA	
Operating Voltages					
V_{CC} TX1/2	2.5	3.9	4.2	V	
V_{CC} RX	2.5	3.3	4.2	V	
V_{DD}	2.5	3.9	4.2	V	
Tx Output Power Control (V_{APC})	0.00	2.25	2.50	V	V_{APC} operates such that the transmitter output power is saturated at a level lower than 1.9V and minimal variation in output power of the device occurs above that level
Transmit High Power Mode					**V_{CC}Tx1 = 3.9V, V_{CC}Tx2 = 3.9V, V_{DD} = 3.9V, V_{APC} = 2.3V, EN = 1.8V, T_R = 1.8V, BYP = 0.2V, Measured Path=TX to ANT, Temperature = 25ºC**
Nominal Power	30.0	31.0	31.5	dBm	P_{IN} = +3.5dBm, Temp = 25ºC
	30.0	31.0	31.5	dBm	P_{IN} = +1.5dBm, Temp = -30ºC
	30.0	31.0	31.5	dBm	P_{IN} = +4.5dBm, Temp = 60ºC
Saturated Power	32.0	32.5		dBm	P_{IN} = +10.0dBm, Temp = 25ºC
	32.0	32.5		dBm	P_{IN} = +10.0dBm, Temp = -30ºC
	31.5	32.2		dBm	P_{IN} = +10.0dBm, Temp = 60ºC
Input Return Loss	12			dB	
Output Return Loss Small Signal		7		dB	

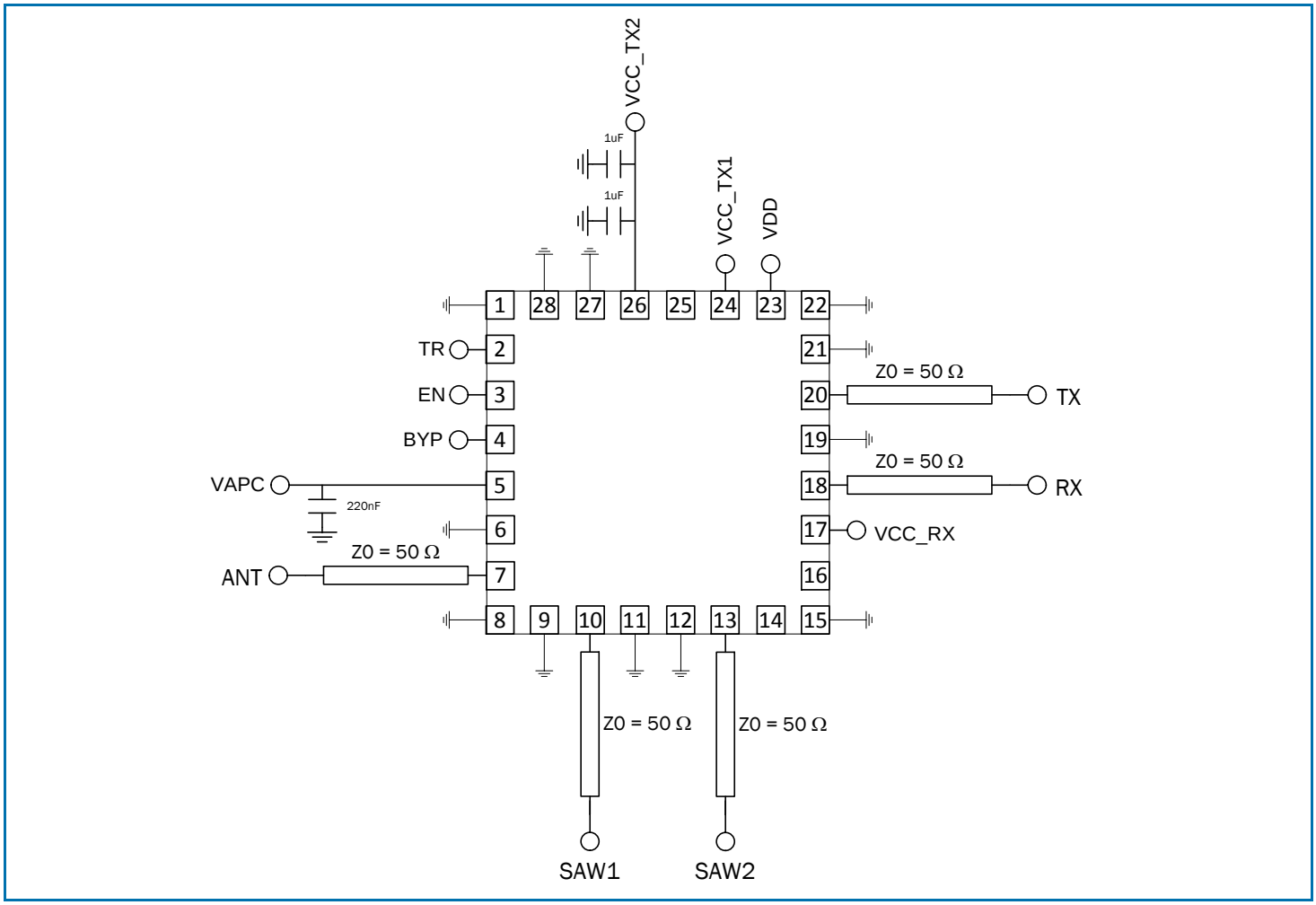
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Transmit High Power Mode					**V_{CC}Tx1 = 3.9V, V_{CC}Tx2 = 3.9V, V_{DD} = 3.9V, V_{APC} = 2.3V, EN = 1.8V, T_R = 1.8V, BYP = 0.2V, Measured Path=TX to ANT, Temperature = 25ºC**
Nominal Power	30.0	31.0	31.5	dBm	P_{IN} = +3.5dBm, Temp = 25ºC
	30.0	31.0	31.5	dBm	P_{IN} = +1.5dBm, Temp = -30ºC
	30.0	31.0	31.5	dBm	P_{IN} = +4.5dBm, Temp = 60ºC
Saturated Power	32.0	32.5		dBm	P_{IN} = +10.0dBm, Temp = 25ºC
	32.0	32.5		dBm	P_{IN} = +10.0dBm, Temp = -30ºC
	31.5	32.2		dBm	P_{IN} = +10.0dBm, Temp = 60ºC
Input Return Loss	12			dB	
Output Return Loss Small Signal		7		dB	
Operating Current		770	1000	mA	P_{OUT} = 31.0dBm, I_{CC} TX1 + I_{CC} TX2
Worst-Case Operating Current, 6:1 VSWR			1200	mA	I_{CC} TX1 + I_{CC} TX2, Over Temperature, at nominal power input drive
Quiescent Current		80		mA	I_{CC} TX1 + I_{CC} TX2, RF = Off
			35	µA	I APC, RF = Off
I_{DD}			15	mA	P_{OUT} = 31.0dBm
I_{APC}		30	60	µA	P_{OUT} = 31.0dBm
Second Harmonic		-45	-30	dBc	P_{OUT} = 31.0dBm
Third - Tenth Harmonic			-60	dBc	P_{OUT} = 31.0dBm
Gain	25.0			dB	V_{CC}Tx1, V_{CC}Tx2 = 3.9V, PIN = +6dBm
	22.0			dB	V_{CC}Tx1, V_{CC}Tx2= 2.7V, PIN = +6dBm
Output Power Variation	-0.4		-0.4	dB	Over frequencies and voltage
Module PAE		40		%	V_{CC}Tx1, V_{CC}Tx2 = 3.9V, P_{OUT} = 31dBm (takes into account filter and switches)
PA PAE		62		%	V_{CC}Tx1, V_{CC}Tx2 = 3.9V, P_{OUT} = 31dBm (Excludes losses of module filter and switches)
Power on RX Port (Pin 18)			-20	dBm	P_{OUT} = 31.0dBm
Transmit Bypass Mode					**V_{CC}Tx1 = 3.9V, V_{CC}Tx2 = 3.9V, V_{DD} = 3.9V, V_{APC} = 0.0V, EN = 1.8V, T_R = 1.8V, BYP = 1.8V, Measured Path=TX to ANT, Temperature = 25ºC**
Insertion Loss		2.5	3.0	dB	
Input P1dB	26	30		dBm	
Input IP3	43	45		dBm	
Input Return Loss	15			dB	
Output Return Loss	15			dB	
Second Harmonic Attenuation	30			dB	Second Harmonic Insertion Loss
Third - Tenth Harmonic Attenuation	50			dB	Third-Tenth Harmonic Insertion Loss
Receive Mode					**V_{CC}Tx1 = 3.3V, V_{CC}Tx2 = 3.3V, V_{DD} = 3.3V, V_{CC}Rx = 3.3V, V_{APC} = 0.0V, EN = 1.8V, T_R = 0.2V, BYP = 0.2V, Measured Path = SAW2 to RX, Temperature = 25ºC**
IP1dB	-12			dBm	
Gain	14	15	16	dB	
Operating Current	4	5	7	mA	
I_{DD}		1		mA	
Noise Figure		1.9	2.7	dB	
IIP3	1	3	5	dBm	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Receive Mode					**V_{CC}Tx1 = 3.3V, V_{CC}Tx2 = 3.3V, V_{DD} = 3.3V, V_{CC}Rx = 3.3V, V_{APC} = 0.0V, EN = 1.8V, T_R = 0.2V, BYP = 0.2V, Measured Path = SAW2 to RX, Temperature = 25ºC**
Input Return Loss	10			dB	
Output Return Loss	10			dB	
Receive Bypass Mode					**V_{CC}Tx1 = 3.3V, V_{CC}Tx2 = 3.3V, V_{DD} = 3.3V, V_{CC}Rx = 3.3V, V_{APC} = 0.0V, EN = 1.8V, T_R = 0.2V, BYP = 1.8V, Measured Path = SAW2 to RX, Temperature = 25ºC**
Insertion Loss		2		dB	
I_{DD} Quiescent		200		µA	
IP1dB		19		dBm	
IIP3	42	44		dBm	
Input Return Loss	7.5			dB	
Output Return Loss	7			dB	
Antenna Switch					**Measured ANT to SAW1, RX & RX BYPASS Modes**
Insertion Loss		0.5	0.6	dB	
Input Return Loss	15.5	16.0		dB	
Output Return Loss	15.5	16.0		dB	
Isolation					
Isolation	30			dB	ANT to SAW1, module in Transmit Bypass Mode
	50			dB	ANT to SAW1, module in Transmit High Power Mode
Logic					**EN, TR, BYP**
Control Logic HIGH	1.6		4.0	V	Max Control Logic High = V_{DD} ± 0.5VDC
Control Logic LOW		0.2	0.3	V	
Control Logic HIGH Current			0.4	µA	
Control Logic LOW Current		0.1		µA	

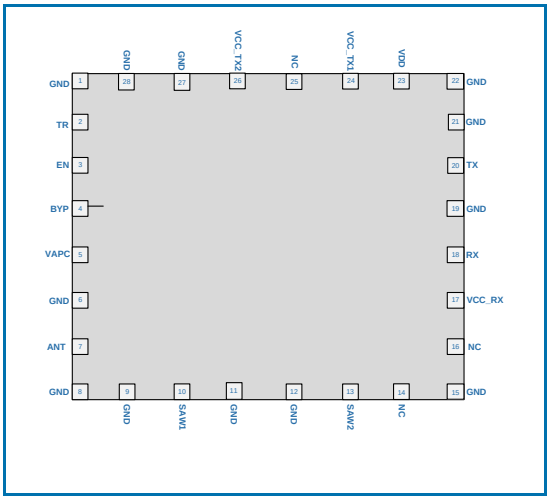
Switch Control Truth Table

Operating Mode	TR	EN	BYP	PA	LNA
	(Pin2)	(Pin3)	(Pin4)		
Transmit	High	High	Low	ON	OFF
Transmit Bypass	High	High	High	OFF	OFF
Receive	Low	High	Low	OFF	ON
Receive Bypass	Low	High	High	OFF	OFF
Shutdown	X	Low	X	OFF	OFF

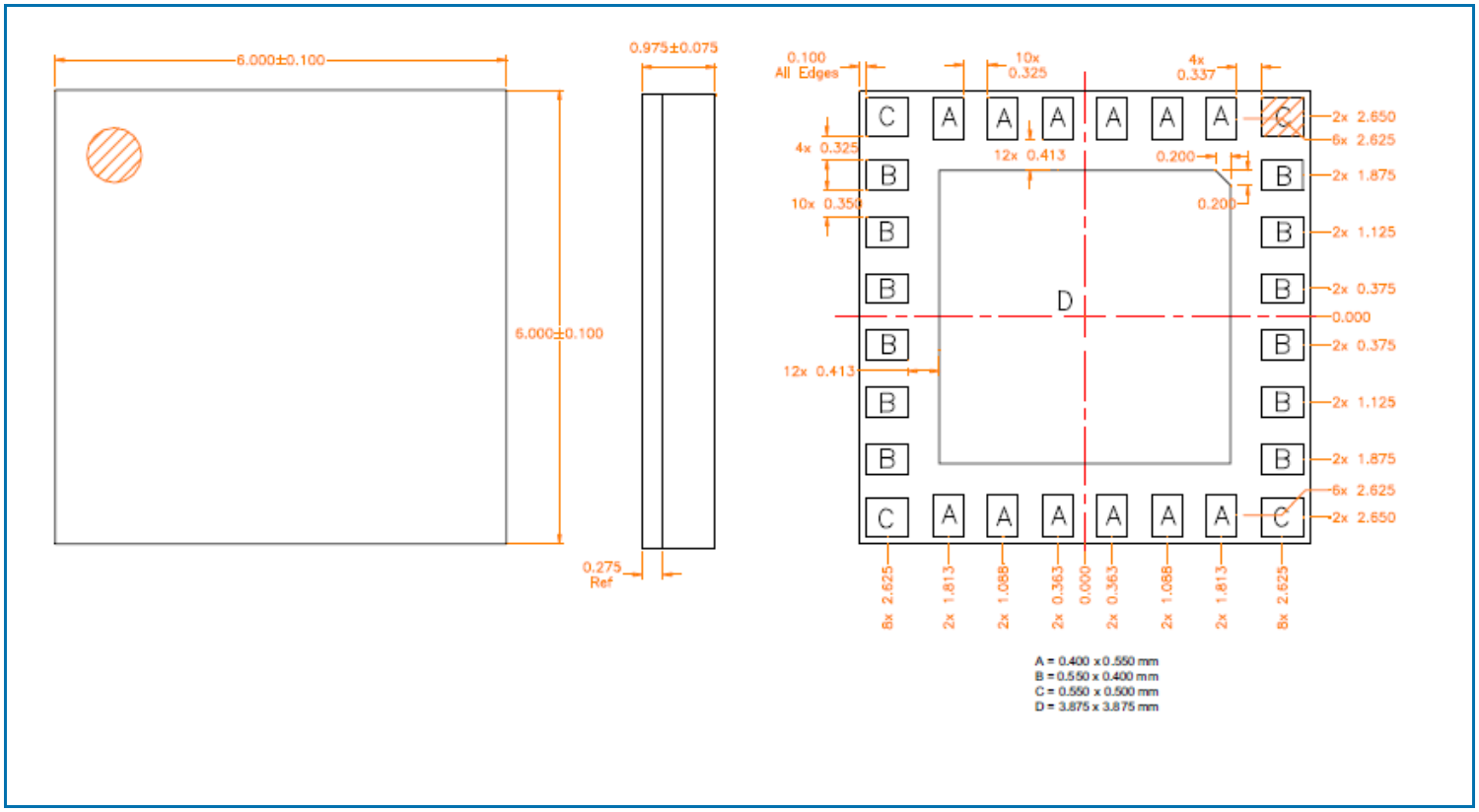
Application Schematic



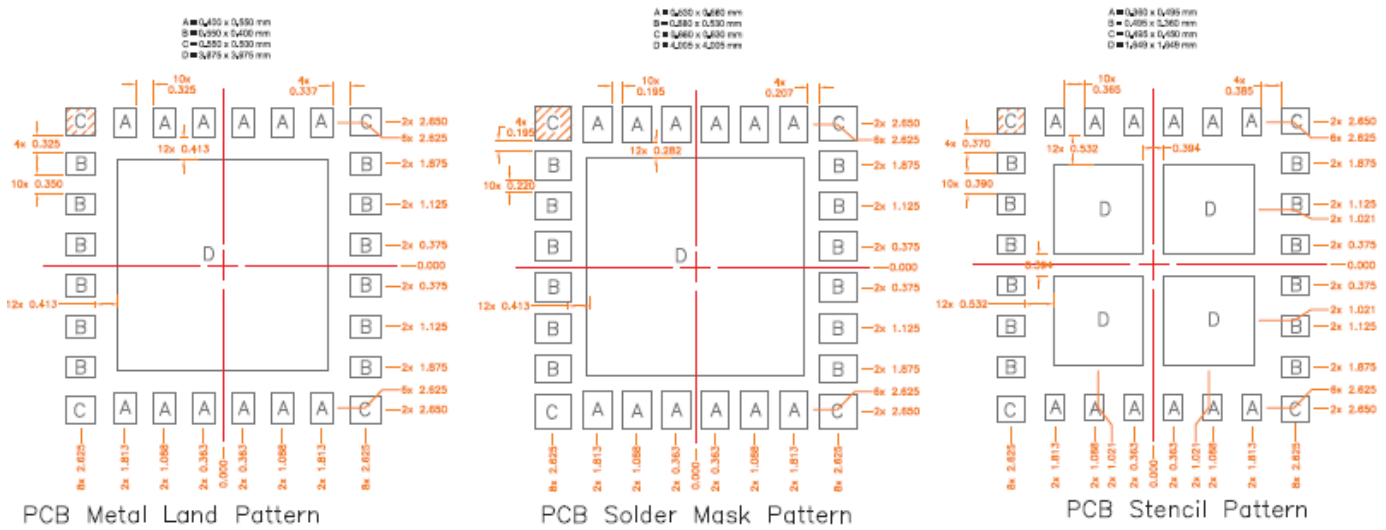
Pin Out



Package Outline and Branding Drawing (Dimensions in millimeters)



PCB Patterns



Notes:
1. Shaded area represents Pin 1 location.

Pin Names and Descriptions

Pin	Name	Description
1	GND	Ground
2	TR	Digital Input: Transmit/Receive
3	EN	Digital Input: Shutdown Mode
4	BYP	Digital Input: RX Bypass Mode
5	VAPC	Analog Input
6	GND	Ground
7	ANT	Antenna Switch Common Port, internally matched to 50Ω, DC Blocked
8	GND	Ground
9	GND	Ground
10	SAW1	Receive side of antenna switch, internally matched to 50Ω, DC Blocked
11	GND	Ground
12	GND	Ground
13	SAW2	RX and RX bypass input port, internally matched to 50Ω, DC Blocked
14	NC	Not internally connected/open
15	GND	Ground
16	NC	Not internally connected/open
17	VCC_RX	3.3V power supply
18	RX	Receive output, internally matched to 50Ω, DC Blocked
19	GND	Ground
20	TX	TX and TX bypass input port, internally matched to 50W, DC Blocked
21	GND	Ground
22	GND	Ground
23	VDD	3.9V power supply
24	VCC_TX1	3.9V power supply
25	NC	Not internally connected/open
26	VCC_TX2	3.9V power supply
27	GND	Ground
28	GND	Ground
Pkg Base	GND	Electrical Ground connection. The back side of the package should be connected to the ground plane through as short a connection as possible, e.g., PCB vias under the device are recommended.