QPF4538

Wi-Fi Front End Module

Product Overview

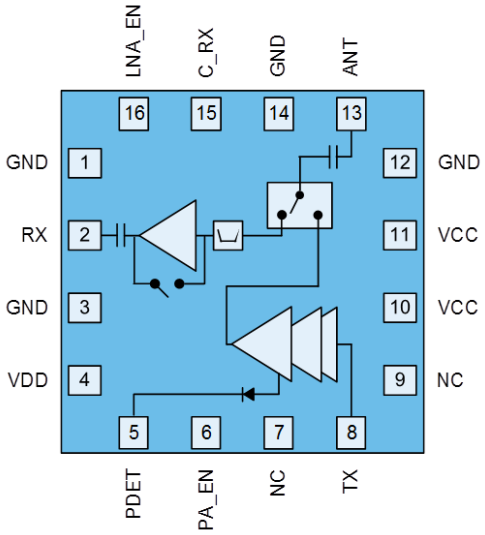
The Qorvo® QPF4538 is an integrated front end module (FEM) designed for Wi-Fi 802.11a/n/ac systems. The compact form factor and integrated matching minimizes layout area in the application.

Performance is focused on optimizing the PA for PoE applications by centering on 0.5W power consumption while maintaining the highest linear output power and leading edge throughput.

Integrated die level filtering for 2nd and 3rd harmonics as well as 2.4 GHz rejection for DBDC operation are included.

The QPF4538 integrates a 5 GHz power amplifier (PA), single pole two throw switch (SP2T) and bypassable low noise amplifier (LNA) into a single device.

Functional Block Diagram



Top View

16-Pin, 2.5x2.5 mm Module Package

Key Features

- 4900 – 5925 MHz
- P_{OUT} = +17.5dBm MCS9 VHT80 -35dB Dynamic EVM
- P_{OUT} = +18.5dBm MCS7 HT20/40 -30dB Dynamic EVM
- P_{OUT} = +21dBm MCS0 HT20 Spectral Mask Compliance
- 160MHz Bandwidth and MCS11 Capable
- Optimized for +3.3 V Operation
- Low Power Consumption ~ 0.5W
- 30 dB Tx Gain
- 2.5 dB Noise Figure
- 14.5 dB Rx Gain & 6 dB Bypass Loss
- 15 dB 2.4 GHz Rejection on Rx Path
- Integrated DC Power Detector

Applications

- Access Points
- Wireless Routers
- Residential Gateways
- Set-Top Boxes
- Customer Premise Equipment
- Internet of Things

Ordering Information

Part Number	Description
QPF4538SB	Sample bag with 5 pieces
QPF4538SQ	Sample bag with 25 pieces
QPF4538SR	7” reel with 100 pieces
QPF4538TR7	7” reel with 2,500 pieces
QPF4538TR13	13” reel with 10,000 pieces
QPF4538PCK-01	Assembled Evaluation Board + 5 pcs

Absolute Maximum Ratings

Parameter	Conditions	Rating
DC Supply Voltage		-0.5 to +6 V
Control Voltage		-0.5 to +6 V
Storage Temperature		-40 to 150 °C
Junction Temperature	MTTF > $1.5x10^6$ hours MTTF > $1.0x10^6$ hours	160 °C 170 °C
RF Input Power at TX_IN	Into 50 Ω Load for 802.11a/n/ac (No Damage), Transmit Mode	+10 dBm
RF Input Power at ANT	(No Damage), Receive LNA On Mode	+10 dBm
RF Input Power at ANT	(No Damage), Receive Bypass Mode	+25 dBm

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. This is an InGaP device designed for high duty cycle applications with Tj>30 °C over ambient.

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Frequency	5180		5925	MHz
Extended Operating Frequency	4900		5925	MHz
Device Voltage (V_{CC} & V_{DD})	+3	+3.3	+3.6	V
Control Voltage – High (PA_EN, LNA_EN & C_RX)	+2.8	+3.1	V_{CC}	V
Control Voltage – Low (PA_EN, LNA_EN & C_RX)	0		+0.2	V
$T_{OPERATING}$*	-40		+85	°C

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions. * $T_{OPERATING}$ is temperature at package ground.

Electrical Specifications

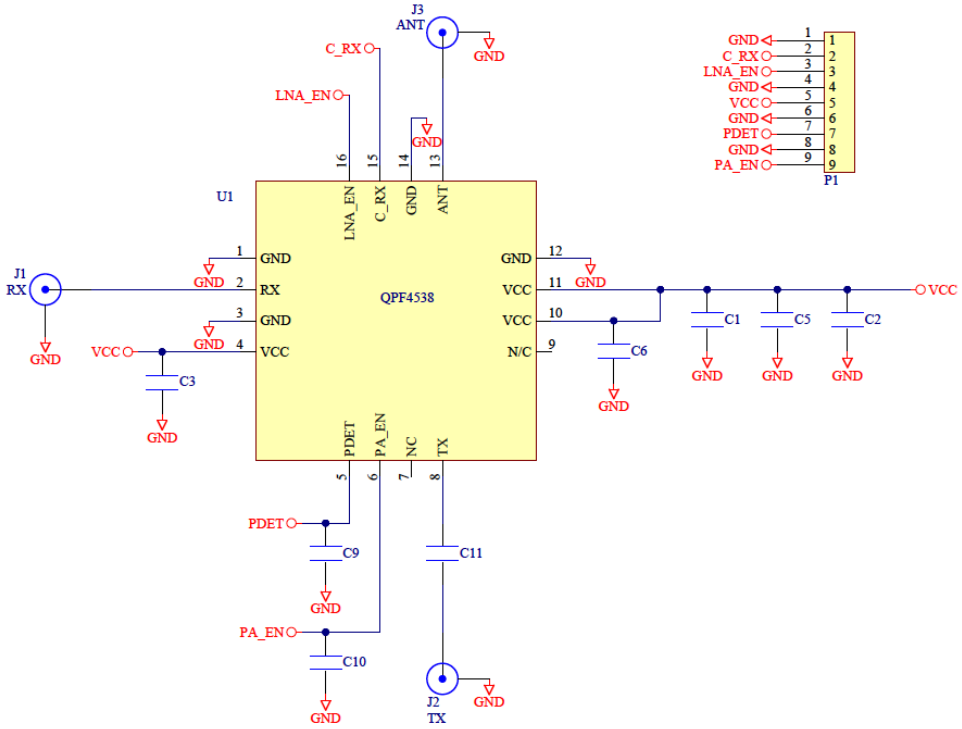
Parameter	Conditions	Min.	Typ.	Max.	Units
Transmit (TX-ANT) Mode	**Unless otherwise noted: V_{CC}=3.3V, T=+25ºC, PA_EN=High, LNA_EN=Low, C_RX=Low**				
11ac VHT80 Output Power	MCS11 1024QAM		15		dBm
Dynamic EVM				-40	dB
11ac VHT160 Output Power	MCS9 256QAM		16		dBm
				-35	dB
11ac VHT80 Output Power	MCS9 256QAM	16.5	17.5		dBm
Dynamic EVM				-35	dB
11n HT20/40 Output Power	MCS7 64QAM	17.5	18.5		dBm
Dynamic EVM				-30	dB
Margin to VHT80 Spectral Mask	P_{OUT} = +19 dBm, 11ac MCS0		3	0	dBc
Margin to VHT20 Spectral Mask	P_{OUT} = +21 dBm, 11n MCS0		3	0	dBc
Gain		29	30		dB
Gain Flatness	Across any 80 MHz Channel	-0.25		+0.25	dB

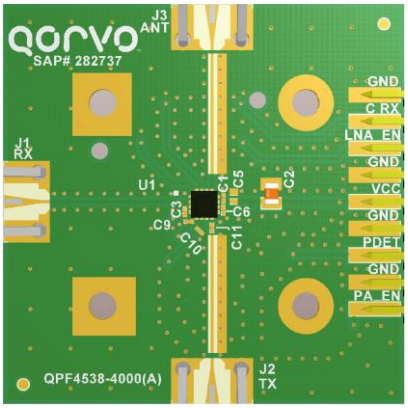
Parameter	Conditions	Min.	Typ.	Max.	Units
Out of Band Gain	*f* = 1600-1950MHz			-30	dB
	f = 3300-3800MHz			-5	dB
	f > 7000MHz			10	dB
TX Port Return Loss		6	12		dB
ANT Port Return Loss		8	15		dB
Quiescent Current	RF Off		90	100	mA
Operating Current	P_{OUT} = +17.5 dBm		155	180	mA
	P_{OUT} = +21 dBm		200	220	mA
2nd Harmonics	P_{OUT} = +21 dBm 802.11a 6 MBps		-35	-30	dBm/MHz
3rd Harmonics	P_{OUT} = +21 dBm 802.11a 6 MBps		-45	-40	dBm/MHz
ANT-RX Isolation		35			dB
DC Power Detect Voltage	RF Off		0.21		V
	P_{OUT} = +17.5 dBm		0.45		V
	P_{OUT} = +21dBm		0.60		V
RECEIVE (ANT-RX) LNA ON MODE	**Unless otherwise noted: V_{CC}=3.3V, T=+25ºC, PA_EN=Low, LNA_EN=High, C_RX=High**				
Gain		12	14.5		dB
Gain Flatness Across any 80 MHz Channel		-0.25		+0.25	dB
Out of Band Gain	*f* = 2400-2500 MHz		-15	-12	dB
Noise Figure			2.5	3	dB
RX Port Return Loss		6	10		dB
ANT Port Return Loss		4	5		dB
Input P_{1dB}		-7	-5		dBm
Input IP3			+2		dBm
Rx Operating Current			15	20	mA
RECEIVE (ANT-RX) BYPASS MODE	**Unless otherwise noted: V_{CC}=3.3V, T=+25ºC, PA_EN=Low, LNA_EN=Low, C_RX=High**				
Bypass Loss			6	9	dB
Loss Flatness Across any 80 MHz Channel		-0.25		+0.25	dB
Out of Band Gain	*f* = 2400-2500 MHz		-20	-15	dB
RX Port Return Loss		10	20		dB
ANT Port Return Loss		10	14		dB
Input P_{1dB}		+18	+20		dBm
Input IP3			+25		dBm
GENERAL SPECIFICATIONS	**Unless otherwise noted: V_{CC}=3.3V, T=+25ºC**				
FEM Leakage Current			70	150	µA
PA_EN Control Current - High			0.2	2	µA
LNA_EN Control Current - High			160	225	µA
C_RX Control Current - High			10	15	µA
TX Output P_{1dB}	CW		+27		dBm
Ramp ON/OFF Time	10<->90% Ref from Control Voltage to RF Power		200		nS
PA Stability - Output VSWR	CW No Spurious above -41.25dBm/MHz		4:1		
Output Power Range		0		25	dBm
Thermal Resistance, θ_{jc}	Junction to case, MCS0 P_{OUT}		60		°C/W

Logic Truth Table

Mode	PA_EN	LNA_EN	C_RX
Standby	Low	Low	Low
Transmit	High	Low	Low
LNA On	Low	High	High
Bypass	Low	Low	High

Evaluation Board Schematic and Layout

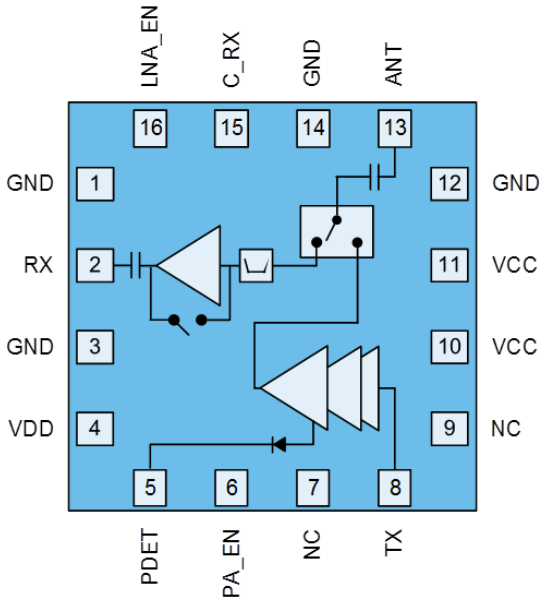




Bill of Material

Ref. Des.	Value	Description	Manuf.	Part number
-	-	Printed Circuit Board		
U1	-	5GHz Wi-Fi Front End Module	Qorvo	QPF4538
C5	1 µF	Capacitor, Chip, 10%, 6.3V, X5R, 0402	Taiyo Yuden	JMK105BJ105KV-F
C2	4.7 µF	Capacitor, Chip, 10%, 16V, STD, 0805	AVX/Kyocera	0805YC475KAT2A
C1, C3	1 nF	Capacitor, Chip, 10%, 25V, X7R, 0201		
C11	10 pF	Capacitor, Chip, +/-0.5pF, 25V, C0G, 0201		
C6	33 pF	Capacitor, Chip, 5%, 25V, C0G, 0201		
C9, C10	-	Do Not Install		

Pin Configuration and Description

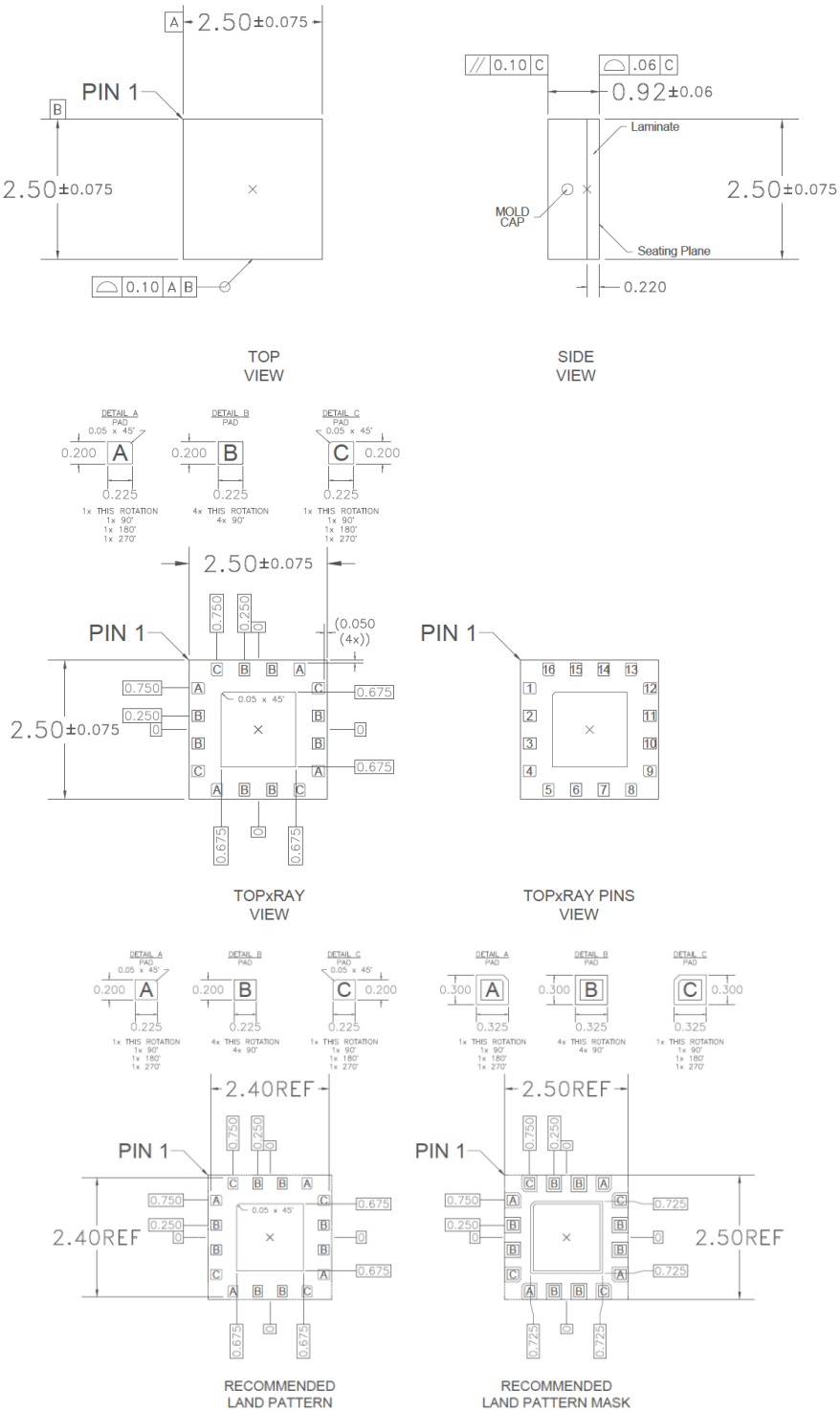


Top View

Pin Number	Label	Description
1	GND	Ground connection.
2	RX	RF output from the low noise amplifier. Internally matched to 50 Ω and DC blocked.
3	GND	Ground connection.
4	VDD	LNA supply voltage
5	PDET	DC power detector. Provides an output voltage proportional to the RF output power level
6	PA_EN	Input enable bias voltage (Regulated internally)
7	NC	No electrical connection. It may be left floating or connected to ground.
8	TX	RF input. Internally matched to 50 Ω and DC Shorted.
9	NC	No electrical connection. It may be left floating or connected to ground.
10	VCC	1st and 2nd stage supply voltage
11	VCC	3rd stage supply voltage
12	GND	Ground connection.
13	ANT	RF bi-directional antenna port. Internally matched to 50 Ω and DC blocked.
14	GND	Ground connection.
15	C_RX	Transmit-receive control voltage.
16	LNA_EN	LNA enable bias voltage
Backside Paddle	GND	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.

Mechanical Information

Dimensions and PCB Mounting Pattern



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ANSI/ESD/JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C3	JESD22-C101
MSL – Moisture Sensitivity Level	Level 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:

- Lead free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_40_2$) Free
- SVHC Free

Contact Information

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

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