QPF4239

Wi-Fi 7 Front End Module

Product Overview

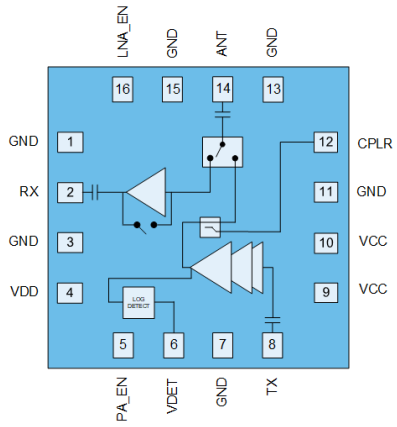
The Qorvo® QPF4239 is an integrated front end module (FEM) designed for Wi-Fi 7 (802.11be) systems. The compact form factor and integrated matching minimizes layout area in the application.

Performance is focused on optimizing the PA for a 3.3V supply voltage that conserves 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 5 GHz rejection for DBDC operation are included. A coupler with RF output as well as a broad range, constant slope voltage logarithmic power detector is provided for application feedback.

The QPF4239 integrates a 2.4 GHz power amplifier (PA), single pole two throw switch (SP2T) and by-passable low noise amplifier (LNA) into a single device.

Functional Block Diagram



Top View

16 Pad 3 x 3 mm Laminate Package

Key Features

- 2412-2484 MHz
- P_{OUT} = +14 dBm MCS13 EHT40 -47dB Dynamic EVM
- P_{OUT} = +16 dBm MCS11 HE40 -43dB Dynamic EVM
- P_{OUT} = +18 dBm MCS8 VHT40 -35dB Dynamic EVM
- P_{OUT} = +20.5 dBm MCS0 HT20 Spectral Mask Compliance
- Optimized for +3.3 V Operation
- 30 dB Tx Gain
- 1.7 dB Noise Figure
- 15.5 dB Rx Gain & 7 dB Bypass Loss
- -18 dB 5-7 GHz Out of Band Gain on Rx Path
- Integrated RF & DC Logarithmic Power Detector

Applications

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

Ordering Information

Part Number	Description
QPF4239SB	Sample bag with 5 pieces
QPF4239SR	7” reel with 100 pieces
QPF4239TR13	13” reel with 5,000 pieces
QPF4239EVB01	Assembled Evaluation Board

Absolute Maximum Ratings

Parameter	Conditions	Rating
DC Supply Voltage		-0.3 to +5.5 V
Control Voltage	PA_EN & LNA_EN (With V_{DD} on)	-0.3 to +5.25 V
External DC Voltage	ANT & RX_OUT	<3.2 V
Storage Temperature		-40 to 150 °C
Junction Temperature	MTTF > $1.0x10^5$ hours	125 °C
RF Input Power at TX	Into 50 Ω Load for 802.11a-be (No Damage), Transmit Mode	+ 10 dBm
RF Input Power at TX	Into 10:1 VSWR for 802.11a-be (No Damage), Transmit Mode;	+ 5 dBm
RF Input Power at ANT	(No Damage), Receive LNA On Mode	+ 15 dBm
RF Input Power at ANT	(No Damage), Receive Bypass Mode	+ 28 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.

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Frequency	2412		2484	MHz
Extended Operating Frequency^	2400		2500	MHz
Device Voltage (V_{CC} & V_{DD})	+3	+3.3	+3.6	V
Extended Device Voltage (V_{CC} & V_{DD}) ^	+3		+5.25	V
Control Voltage – High	+1.2	+1.8	3.5	V
Control Voltage - Low	0		+0.4	V
$T_{OPERATING}$*	-40		+85	°C

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions. ^Extended operating conditions may have degraded performance for some specifications. * $T_{OPERATING}$ is temperature at package ground.

Electrical Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
Transmit (TX-ANT) Mode	**Unless otherwise noted: $V_{CC/DD}$=3.3V, T=+25ºC, PA_EN=High, LNA_EN=Low**				
Wi-Fi 7 EHT20(1) Output Power			14		dBm
Dynamic EVM	MCS13 4096QAM 11be			-47	dB
Wi-Fi 7 HE20(1) Output Power		14.5	16		dBm
Dynamic EVM	MCS11 1024QAM 11ax			-43	dB
Wi-Fi 7 VHT20 Output Power		16.5	18		dBm
Dynamic EVM	MCS9 256QAM 11ac			-35	dB
Wi-Fi 7 HT20 Output Power		17.5	19		dBm
Dynamic EVM	MCS7 64QAM 11n			-30	dB
Margin to HE20 Spectral Mask	P_{OUT} = +20.5 dBm, 11n MCS0		-3	0	dBc
Gain		28.5	30		dB
Gain Flatness	Across any 40 MHz Channel	-0.25		+0.25	dB

Parameter	Conditions	Min.	Typ.	Max.	Units
Out of Band Gain	*f* = 1600-1666 MHz		20		dB
	f = 3200-3333 MHz		20		dB
TX Port Return Loss			15		dB
ANT Port Return Loss			7		dB
Quiescent Current	RF Off		85	105	mA
Operating Current	P_{OUT} = +14 dBm		105	125	mA
	P_{OUT} = +16 dBm		120	140	mA
	P_{OUT} = +20.5 dBm		160	185	mA
2nd Harmonics	P_{OUT} = +20.5 dBm 11b 1Mbps		-33		dBm/MHz
3rd Harmonics	P_{OUT} = +20.5 dBm 11b 1Mbps		-60		dBm/MHz
ANT-RX Isolation			55		dB
Coupling Factor (CF)			18		dB
DC Power Detect Voltage	P_{OUT} = No RF		0.15		V
	P_{OUT} = +6 dBm		0.30		V
	P_{OUT} = +22 dBm		0.75		V
Power Detector Slope	P_{OUT} = +6-21 dBm		30		mV/dB
Receive (ANT-RX) LNA On Mode	**Unless otherwise noted: $V_{CC/DD}$=3.3V, T=+25ºC, PA_EN=Low, LNA_ EN=High**				
Gain		14.5	15.5		dB
Gain Flatness	Across any 40 MHz Channel	-0.25		+0.25	dB
Out of Band Gain	*f* = 5150-7125 MHz		-18		dB
Noise Figure			1.7	2.2	dB
RX Port Return Loss			9		dB
ANT Port Return Loss			8		dB
Input P_{1dB}			-5		dBm
Input IP3	2-tone CW, 1MHz spacing		+7		dBm
Rx Operating Current			14	20	mA
Receive (ANT-RX) Bypass Mode	**Unless otherwise noted: $V_{CC/DD}$=3.3V, T=+25ºC, PA_EN=Low, LNA_ EN=Low**				
Bypass Loss			7	8	dB
Loss Flatness	Across any 40 MHz Channel	-0.1		+0.1	dB
Out of Band Gain	*f* = 5150-7125 MHz		-15		dB
RX Port Return Loss		10	12		dB
ANT Port Return Loss		10	12		dB
Input P_{1dB}			+28		dBm
Input IP3	2-tone CW, 1MHz spacing		+37		dBm
General Specifications	**Unless otherwise noted: $V_{CC/DD}$=3.3V, T=+25ºC, Switching Time Power Accuracy +/- 1dB**				
Control Current - High				100	µA
Control Current - Low				5	µA
TX Output P_{1dB}	CW		+25		dBm
Switching Time	Transmit to LNA On or Bypass Mode			400	nS
	LNA On to Bypass Mode			200	nS
	Bypass to LNA On Mode			200	nS

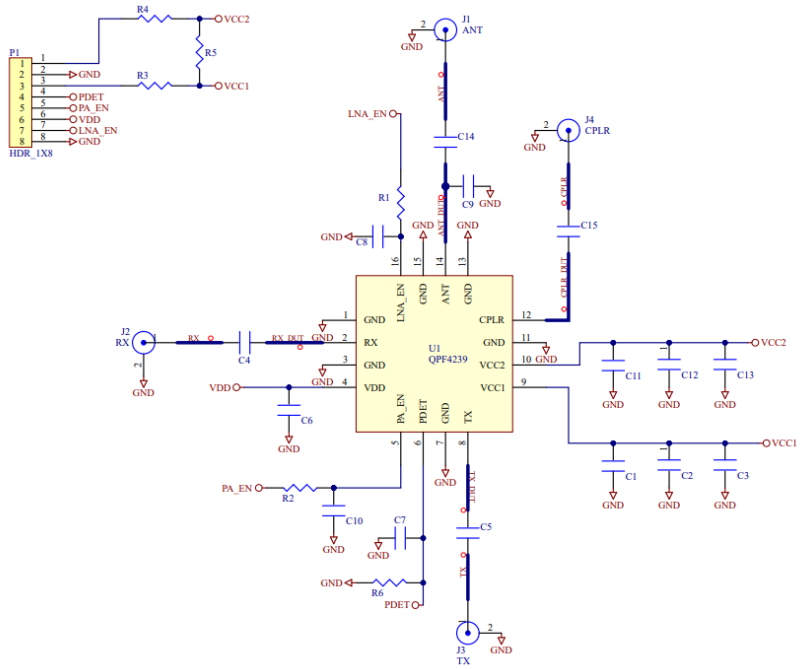
Parameter	Conditions	Min.	Typ.	Max.	Units
	LNA On or Bypass to Transmit Mode			400	nS
PA Stability - Output VSWR	CW No Spurious above -41.25 dBm/MHz, P_{OUT} = 0-22 dBm		10:1		
Thermal Resistance, θ_{jc}	Junction to case		35		°C/W

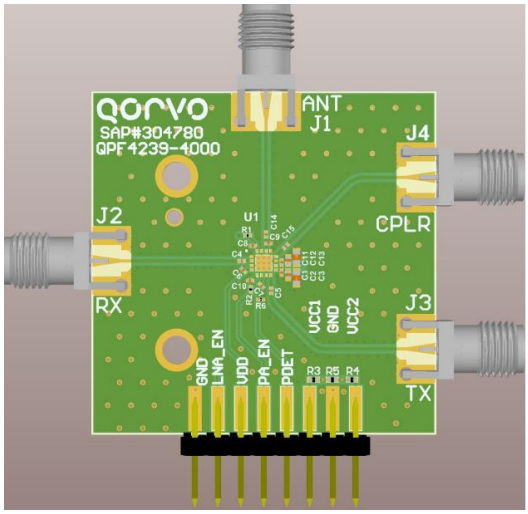
Notes:
1. Normalized to -50dB source

Logic Truth Table

Mode	STATE	PA_EN	LNA_EN
Transmit On	1	High	Low
LNA On	2	Low	High
LNA Bypass	3	Low	Low
Not Used	4	High	High

Evaluation Board Schematic

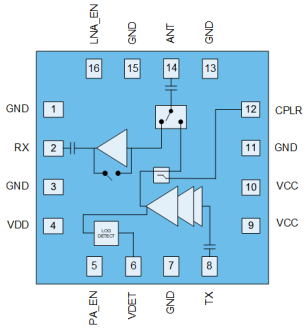




Bill of Material

REF. DES.	VALUE	DESCRIPTION	MANUF.	PART NUMBER
-	-	Printed Circuit Board		
U1	-	2.4GHz Wi-Fi 7 Front End Module	Qorvo	QPF4239
C3, 13	4.7 µF	Capacitor, Chip, 20%, 16V, X7R, 0603	Murata	GRM188Z71C475ME21D
C1, C11	1000 pF	Capacitor, Chip, 10%, 16V, X7R, 0201		
C4, C5, C8, C10, C14, C15	100 pF	Capacitor, Chip, 5%, 25V, C0G, 0201		
C2, C12	1 µF	Capacitor, Chip, 10%, 25V, X6S, 0402	Murata	GRM155C81E105KE11D
C6	1 uF	Capacitor, Chip, 20%, 10V, X6S, 0201W	Murata	GRM033C81A105ME05D
R3, R4	0 Ω	Resistor, Chip, 1/10W, 0402	Kamaya	RMC1/16SJPTH
R1, R2	0 Ω	Jumper, 0201	Kamaya	RMC1/20JPPA15
R6	27 kΩ	Resistor, Chip, 5%, 1/16W, 0201	Kamaya	RMC1/20-273JPA15
C7, C9, R5	-	Not Populated Item	-	-

Pin Configuration and Description



Top View

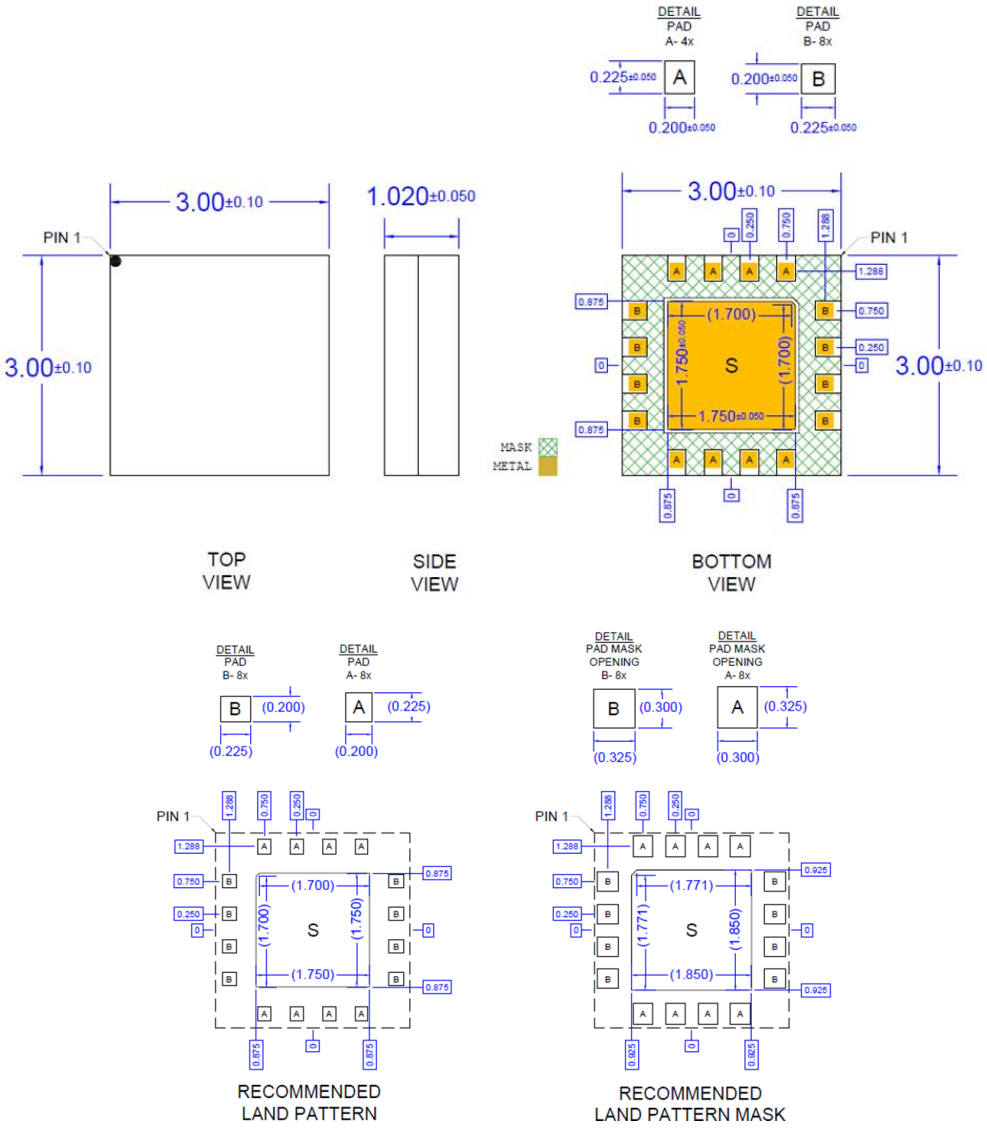
Pin Number	Label	Description
1	GND	Ground connection.
2	RX	RF output from the low noise amplifier. Internally matched to 50 Ω and DC blocked. (1)
3	GND	Ground connection.
4	VDD	Supply voltage.
5	PA_EN	Control pin
6	VDET	DC power detector. Provides an output voltage proportional to the RF output power level
7	GND	Not internally connected. Recommend connecting to ground or leave floating
8	TX	RF input. Internally matched to 50 Ω and DC blocked. (1)
9	VCC	Supply voltage.
10	VCC	Supply voltage.
11	GND	Ground connection.
12	CPLR	RF power detector. Provides a coupled RF output power proportional to the RF output power level
13	GND	Ground connection.
14	ANT	RF bi-directional antenna port. Internally matched to 50 Ω and DC blocked. (1)
15	GND	Ground connection.
16	LNA_EN	Control pin
Backside Paddle	GND	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.

Notes:

1. Pin is DC blocked internally. There is no DC present on these ports. If connected to an external component with DC present, a 10pF blocking capacitor is recommended.

Mechanical Information

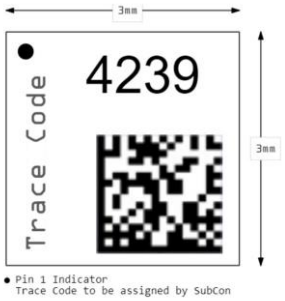
Dimensions and PCB Mounting Pattern



Notes:

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

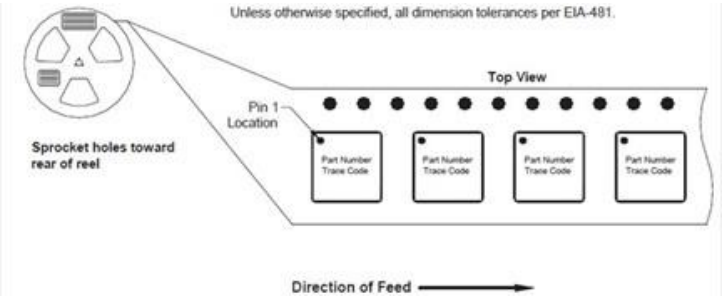
Part Marking



Tape and Reel Information – Carrier and Cover Tape Dimensions

Tape and reel specifications for this part are also available on the Qorvo website.

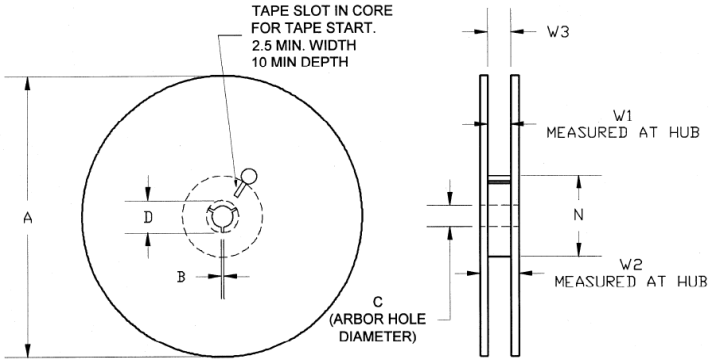
Standard T/R size = 5,000 pieces on a 13” reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.128	3.25
	Width	B0	0.128	3.25
	Depth	K0	0.055	1.40
	Pitch	P1	0.157	4.0
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.0
C2	Cavity to Perforation - Width Direction	F	0.217	5.50
Cover Tape	Width	C	0.362	9.20
Carrier Tape	Width	W	0.472	12.0

Tape and Reel Information – Reel Dimensions

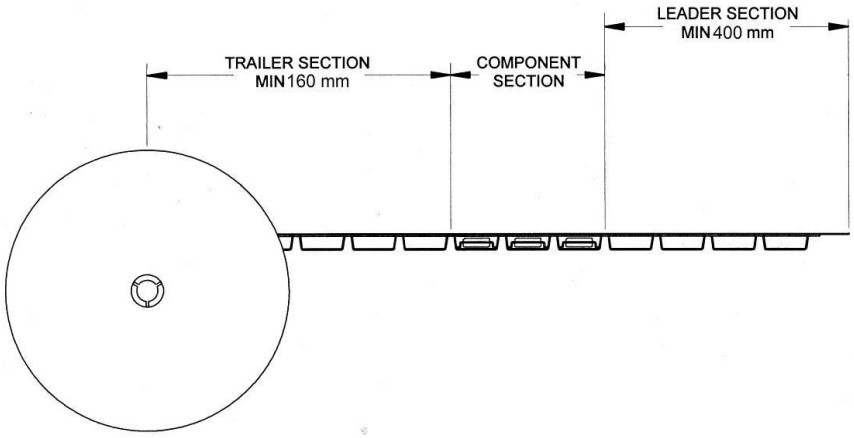
Packaging reels are used to prevent damage to devices during shipping and storage, loaded carrier tape is typically wound onto a plastic take-up reel. The reel size is 13" diameter. The reels are made from high-impact injection-molded polystyrene (HIPS), which offers mechanical and ESD protection to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

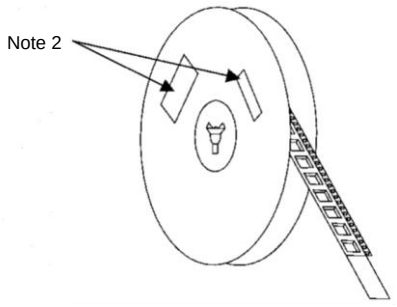


FEATURE	MEASURE	SYMBOL	SIZE (IN)	SIZE (MM)
Flange	Diameter	A	12.992	330.0
	Thickness	W2	0.724	18.4
	Space Between Flange	W1	0.488	12.4
Hub	Outer Diameter	N	4.016	102.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.795	20.2

Tape and Reel Information – Tape Length & Label Placement

Tape and reel specifications for this part are also available on the 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 (2kV)	ANSI/ESD/JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C3 (1kV)	ANSI/ESD/JEDEC JS-002
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: ENEPIG

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
- PFOS Free

Contact Information

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

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