QM48184

2.4 & 5 GHz WiFi Front End Module

Applications

- IEEE 802.11ac, 802.11n WLAN Applications
- Single-Chip RF Front-end Module
- Dualband Wireless LAN Systems
- Portable Battery-Powered Equipment

Product Features

- Fully Integrated, high performance 802.11ac front-end module including highly selective BAW filter achieving low insertion loss and high attenuation over full bandwidth and operating conditions
- 2.4 GHz PA, SPDT Switch, and Bypass LNA.
- 5.0 GHz PA, SPDT Switch, and Bypass LNA.
- Integrated coupler for high accuracy power control.
- Internally matched RF input/output to 50Ω.
- Temperature Compensated Bias Network
- Single battery voltage.

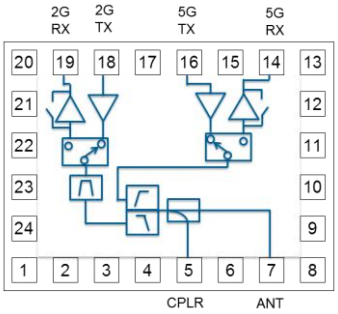
General Description

The QM48184 is a WLAN dualband, integrated front end module that consists of a dualband diplexer + coupler, 2.4 GHz BAW WiFi coexistence filter, 2.4 GHz PA, LNA, and Switch, and 5 GHz PA, LNA, and Switch. The dual band coupler at the antenna pin allows for monitoring of power in both 2.4 GHz and 5 GHz paths.

The QM48184 integrated front-end module in an ultra-small, 4.0mm x 3.0mm footprint package for 802.11ac applications. The architecture and interface are optimized for next generation WLAN integration into handset and tablet devices.

The front-end module features chipset-specific compatible control voltages to facilitate ease of use. With its low power dissipation, the front-end Module contributes to the extended battery life of next generation WLAN solutions

Functional Block Diagram



Top View

Pin Configuration - Single Ended

Pin No.	Label
2	PDET
5	CPLR
7	ANT
9	5G LNA_EN
10	5G PA_EN
11	5G VCC
12	5G VCC
14	5G RX
16	5G TX
18	2G TX
19	2G RX
21	2G VCC
22	2G VCC
23	2G PA_EN
24	2G LNA_EN
1,3,4,6,8,13,15,17, 20,25,26	Ground

Ordering Information

Part No.	Description
QM48184SB	5 pcs on tape in sample bag
QM48184SQ	25 pcs on tape in sample bag
QM48184SR	100 pcs on tape in 7” reel
QM48184TR7	2500 pcs on tape in 7” reel
QM48184TR13-5K	5000 pcs on tape in 13” reel
QM48184TR7X	Custom qty on tape in 7” reel
QM48184PCBA-410	Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	-40 to150 °C
Case Temperature, Survival	-40 to100 °C
RF Input Power, CW, 50Ω,T = 25°C	+12 dBm
Device Voltage, Vcc spikes	-0.5 to +6.0 V
Control Voltage	-0.5 to +5.0 V

Recommended Operating Conditions

Parameter	Comments	Min	Nom	Max	Units
Operating Temperature		-40	25	85	°C
Operating Voltage	Vphone	3.3	3.7	4.6	V
Extended Operating Voltage		3.0		4.8	V
RF Impedance	All RF ports (single ended)		50		Ohms
Control Voltage (Vhigh)	PA_EN/LNA_EN	2.75	3	Vcc	V
Control Current (Ihigh)	PA_EN/LNA_EN		200		uA
Control Voltage (Vlow)	PA_EN/LNA_EN	0		0.4	V
Control Current (Ilow)	PA_EN/LNA_EN		0.1		uA
Leakage Current	PA_EN/LNA_EN = Vlow		20		uA

Notes:
1. Degraded performance at extended operating range.
2. Control Pin Impedance is Hi-Z.

Logic Truth Table

Mode	2G PA_EN	2G LNA_EN	5G PA_EN	5G LNA_EN
Sleep / LNA Bypass	0	0	0	0
2.4GHz Nom TX	1	0	0	0
2.4GHz LNA On	0	1	0	0
5GHz Nom TX	0	0	1	0
5GHz LNA On	0	0	0	1

Electrical Specifications – 5GHz Band

5GHz TX Parameter	Conditions	Min	Typical	Max	Units
Frequency Range		5150		5925	MHz
Small Signal Gain			28		dB
Gain Flatness	For any 80MHz bandwidth (for 11ac signals) over freq. range	-0.25		+0.25	dB
Part to Part	Pout variation at 25C	-0.5		+0.5	dB
Part to Part	Pout variation over entire temp range	-0.75		+0.75	dB
Spectrum Emission Mask Margin, Relative to 11a Standard, Nom TX mode	FEM Pout=20.5dBm 11a, 20MHz OFDM		3.0		dB
Spectrum Emission Mask Margin, Relative to 11a Standard, Nom TX mode	FEM Pout=19.5dBm 11n, 20MHz OFDM MCS0		3.0		dB
EVM, 11a, OFDM54 20MHz	Nom TX Mode FEM Pout = 17.0 dBm		-34		dB
EVM, 11n, MCS7 HT20	Nom TX Mode FEM Pout = 17.5 dBm		-34		dB
EVM, 11ac, MCS9 VHT40	Nom TX Mode FEM Pout = 13.0 dBm		-39		dB
EVM, 11ac, MCS9 VHT80	Nom TX Mode FEM Pout = 12.5 dBm		-39		dB
TX Harmonics ($2f_0$)	FEM Pout = 17.0dBm		-50		dBm / 1 MHz
TX Harmonics ($3f_0$)	FEM Pout = 17.0dBm		-50		dBm / 1 MHz
TX turn on/off rise/fall time			200		ns
TX Current	FEM Pout=20.5dBm 11a, 20MHz OFDM		290		mA

5GHz RX Parameter	Conditions	Min	Typical	Max	Units
Frequency Range		5150		5925	MHz
Gain	LNA Enabled – to also be met at band edges		10.0		dB
Gain – Bypass mode	LNA Disabled		-6.0		dB
Gain Flatness	For any 80 MHz bandwidth over the frequency range	-0.25		+0.25	dB
Noise Figure	LNA Enabled, Vcc=+3.7V		4.0		dB
Noise Figure	LNA Bypass Mode, Vcc=+3.7V		6.0		dB
LNA Current	LNA Enabled, Vcc=+3.7V		10		mA
LNA Current	LNA Bypass Mode, Vcc=+3.7V		0.02		mA
IIP2	LNA Enabled, 2500 - 2700 MHz		55		dBm
IIP3	LNA Enabled		6		dBm
IIP3	LNA Bypass Mode		20		dBm
IIP3	LNA Enabled, 1700 – 2000 MHz		15		dBm

5GHz PDET	Conditions	Min	Typical	Max	Units
PDET Voltage – low	At Pout = 5.0 dBm		0.2		V
PDET Voltage – high	At Pout = 22.0 dBm		0.8		V

Notes:
1. Typical is +25degC at 3.7V.
2. Degraded performance at extended operating range.

Electrical Specifications – 2.4GHz Band

2.4GHz TX Parameter	Conditions	Min	Typical	Max	Units
Frequency Range		2402.5		2481.5	MHz
Small Signal Gain			28		dB
Gain Flatness	For any 40 MHz bandwidth (for 11ac signals) over freq. range	-0.25		+0.25	dB
Part to Part	Pout variation at 25C	-0.5		+0.5	dB
Part to Part	Pout variation over entire temp range	-0.75		+0.75	dB
Spectrum Emission Mask Margin, Relative to 11b Standard, Nom TX mode	FEM Pout= 22.0 dBm 11b, 20MHz OFDM		3.0		dB
Spectrum Emission Mask Margin, Relative to 11g Standard, Nom TX mode	FEM Pout= 19.5 dBm 11g, 20MHz OFDM		3.0		dB
Spectrum Emission Mask Margin, Relative to 11n Standard, Nom TX mode	FEM Pout= 19.5 dBm 11n, 20MHz OFDM MCS0		3.0		dB
EVM, 11g, OFDM54 20MHz	Nom TX Mode FEM Pout = 17.5 dBm		-32		dB
EVM, 11n, MCS7 HT20	Nom TX Mode FEM Pout = 17.0 dBm		-34		dB
EVM, 11ac, MCS8 VHT20	Nom TX Mode FEM Pout = 15.0 dBm		-39		dB
EVM, 11ac, MCS9 VHT40	Nom TX Mode FEM Pout = 15.0 dBm		-39		dB
TX Harmonics ($2f_0$)	FEM Pout = 19.5dBm,		-50		dBm / 1 MHz
TX Harmonics ($3f_0$)	FEM Pout = 19.5dBm,		-50		dBm / 1 MHz
TX turn on/off rise/fall time			200		ns
TX Current	FEM Pout=22.0dBm 11b, 20MHz OFDM		300		mA
TX Current	FEM Pout = 15.0dBm 11ac, MCS9, VHT40		180		mA

2.4GHz RX Parameter	Conditions	Min	Typical	Max	Units
Frequency Range		2402.5		2481.5	MHz
Gain	LNA Enabled – to also be met at band edges		10.5		dB
Gain – Bypass mode	LNA Disabled		-3.25		dB
Gain Flatness	For any 40 MHz bandwidth over the frequency range	-0.25		+0.25	dB
Noise Figure	LNA Enabled, Vcc=+3.7V		4.0		dB
Noise Figure	LNA Bypass Mode, Vcc=+3.7V		3.25		dB
LNA Current	LNA Enabled, Vcc=+3.7V		8		mA
LNA Current	LNA Bypass Mode, Vcc=+3.7V		0.02		mA
IIP2	LNA Enabled, 2500 - 2700 MHz		55		dBm
IIP3	LNA Enabled		6		dBm
IIP3	LNA Bypass Mode		26		dBm
IIP3	LNA Enabled, 1700 – 2000 MHz		15		dBm

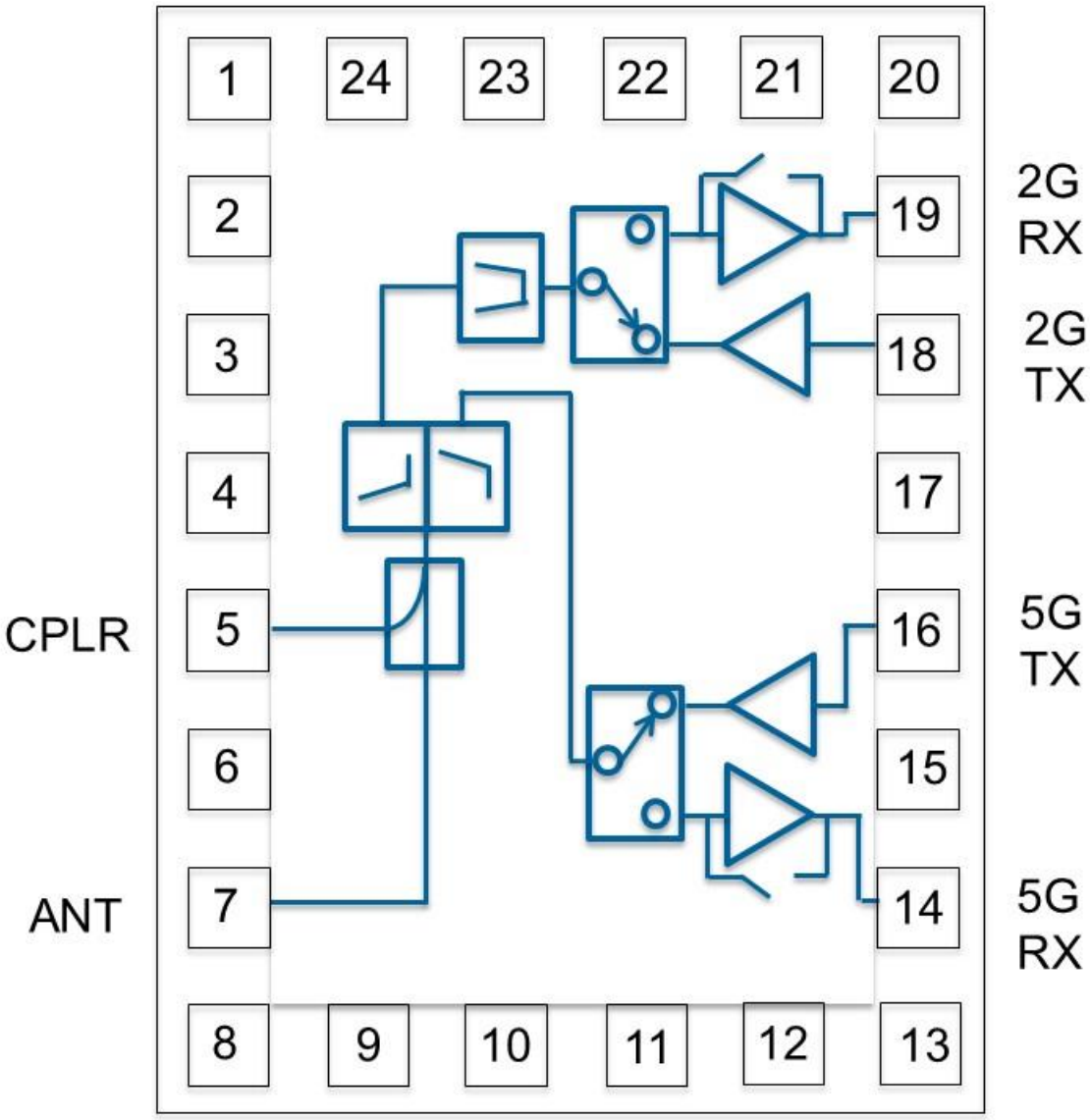
2.4GHz PDET	Conditions	Min	Typical	Max	Units
PDET Voltage – low	At Pout = 5.0 dBm		0.2		V
PDET Voltage – high	At Pout = 22.0 dBm		0.8		V

Coupler

Coupler	Conditions	Min	Typical	Max	Units
Low Freq. f1		2402.5		2481.5	MHz
High Freq. f2		5150		5950	MHz
Coupling Factor f1			19.0		dB
Coupling Factor f2			15.0		dB
Directivity f1			15.0		dB
Directivity f2			12.0		dB

Notes:
1. Typical is +25degC at 3.7V.
2. Degraded performance at extended operating range.

Functional Block Diagram

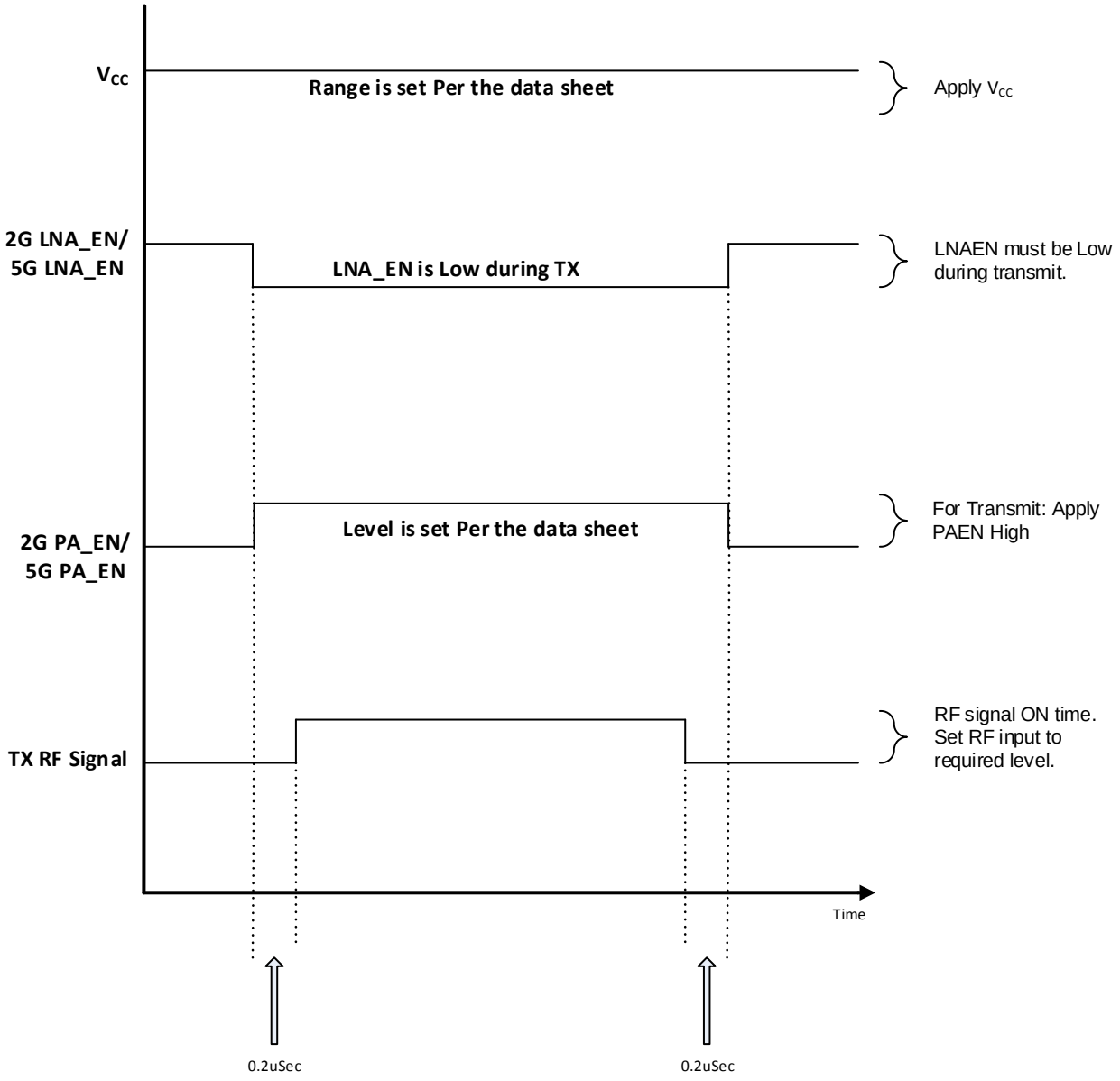


Pin Descriptions

Pin	Name	Description
1	GND	Ground connection
2	PDET	Detector output voltage
3	GND	Ground connection
4	GND	Ground connection
5	CPLR	Coupler RF output
6	GND	Ground connection
7	ANT	Antenna RF output
8	GND	Ground connection
9	5G LNA_EN	5GHz FEM LNA EN control voltage
10	5G PA_EN	5GHz FEM PA EN control voltage
11	5G VCC	VCC bias supply for 5GHz
12	5G VCC	VCC bias supply for 5GHz
13	GND	Ground connection
14	5G RX	5GHz LNA RF output
15	GND	Ground connection
16	5G TX	5GHz PA RF input
17	GND	Ground connection
18	2G TX	2GHz PA RF input
19	2G RX	2GHz LNA RF output
20	GND	Ground connection
21	2G VCC	VCC bias supply for 2GHz
22	2G VCC	VCC bias supply for 2GHz
23	2G PA_EN	2GHz FEM PA EN control voltage
24	2G LNA_EN	2GHz FEM LNA EN control voltage
Pkg Base	GND	Ground connection. The backside of the package should be connected to the ground plane through a short path, so PCB vias under the device are recommended.

Timing Diagram

Transmit Timing Diagram
Power ON / OFF Sequence



Note:
1. RF Signal for each specific mode is applied after the DC bias is applied.
2. Total ON/OFF time includes from 10% of control switching to 90% of RF power.
3. Listed values on diagram are typical. Tx/Rx simultaneous transition is allowed.
4. For DC voltage levels use the values indicated in the datasheet.

Timing Sequence Notes

802.11a/n/ac Transmit Biasing Instructions

1. Connect the FEM to a signal generator at the input and a spectrum analyzer at the output. Terminate unused ports with 50 Ohms
2. Set the power supply (V_{CC}) voltage to 3.0-4.4V first with PA_EN ≤ 0.4V. Leakage current will be <20uA typical.
3. Turn on PA_EN with levels indicated in the datasheet. PA_EN controls the current drawn by the 802.11a/n/ac power amplifier and the current should quickly rise to ~200mA +/- 20mA for a typical part but the actual operating current will be based on the output power desired. Be extremely careful not to exceed 5.0V on the PA_EN pin or the part may exceed device current limits.

802.11a/n/ac Transmit Turn ON Sequence (See Transmit Timing Diagram)

1. Turn ON power supply (V_{CC}).
2. Turn ON PA_EN.
3. Apply RF.

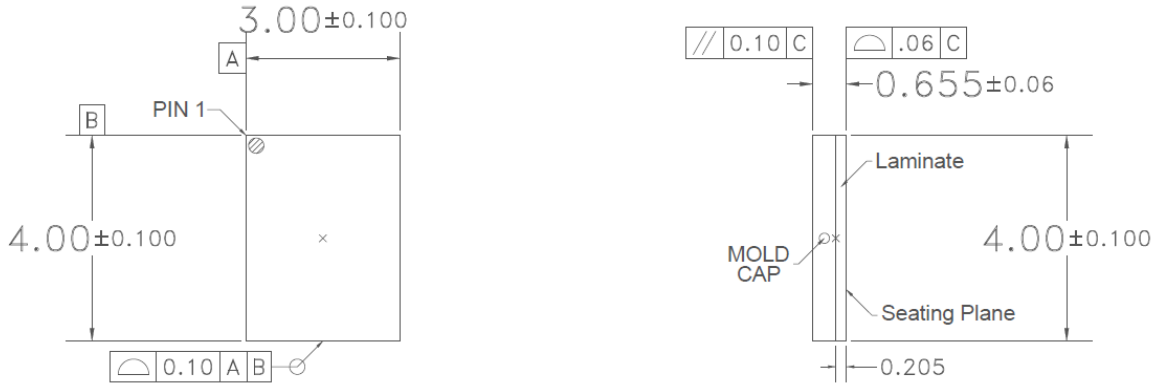
802.11a/n/ac Transmit Turn OFF Sequence

1. Turn OFF RF.
2. Turn OFF PA_EN.
3. Turn OFF power supply (V_{CC}).

802.11a/n/ac Receive

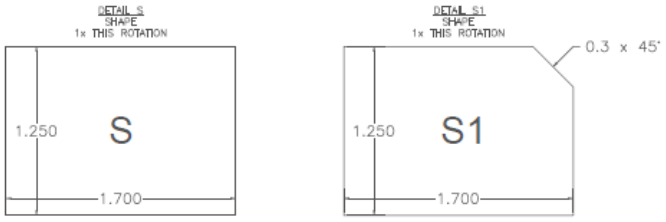
1. To receive WiFi set the LNA_EN control lines per the truth table.
2. Antenna port is input and RX port is output for this test.

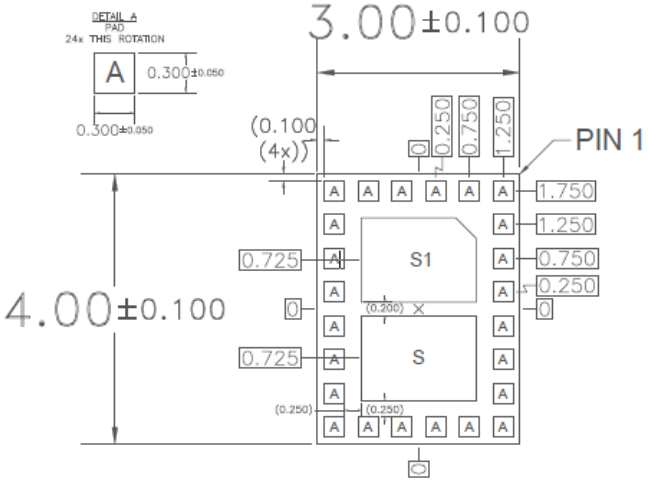
Package Outline Drawing

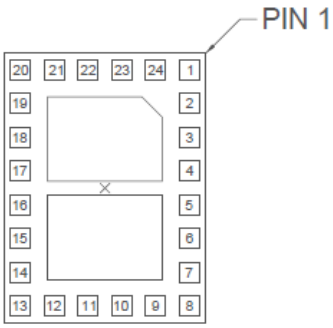


TOP VIEW

SIDE VIEW



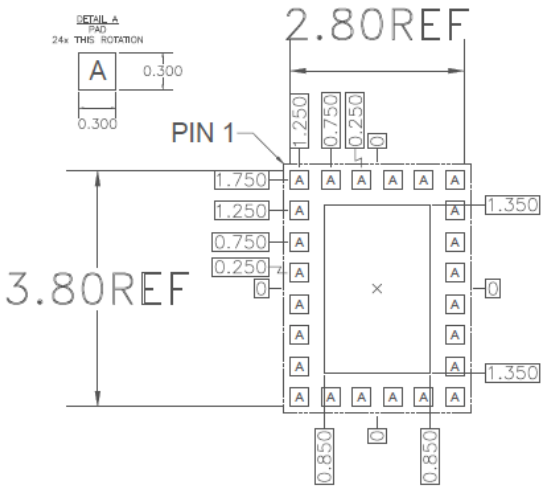




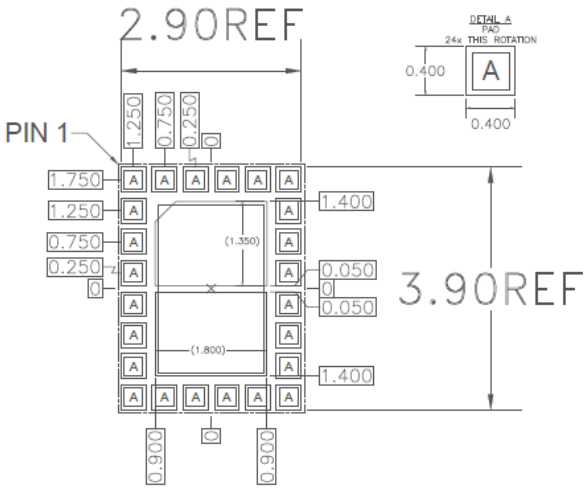
BOTTOM VIEW

BOTTOM PINS VIEW

PCB Mounting Patterns

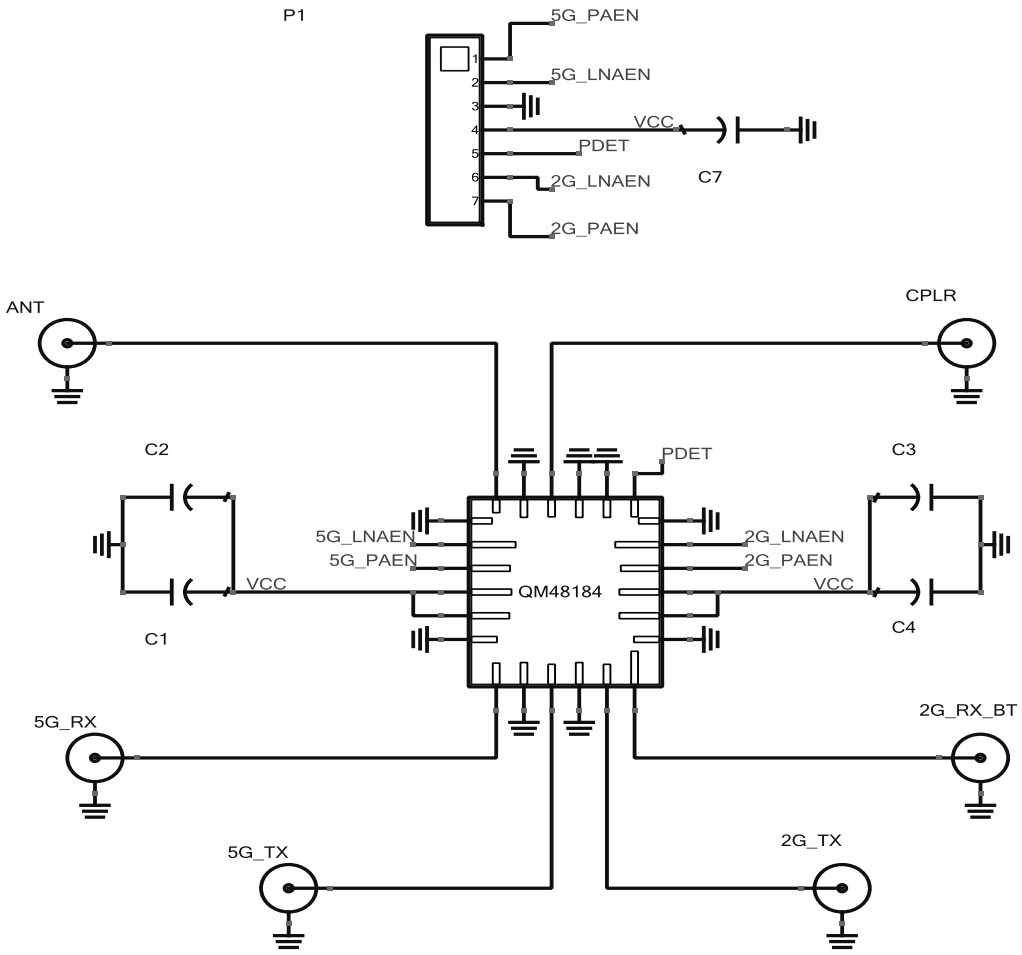


RECOMMENDED
LAND PATTERN



RECOMMENDED
LAND PATTERN MASK

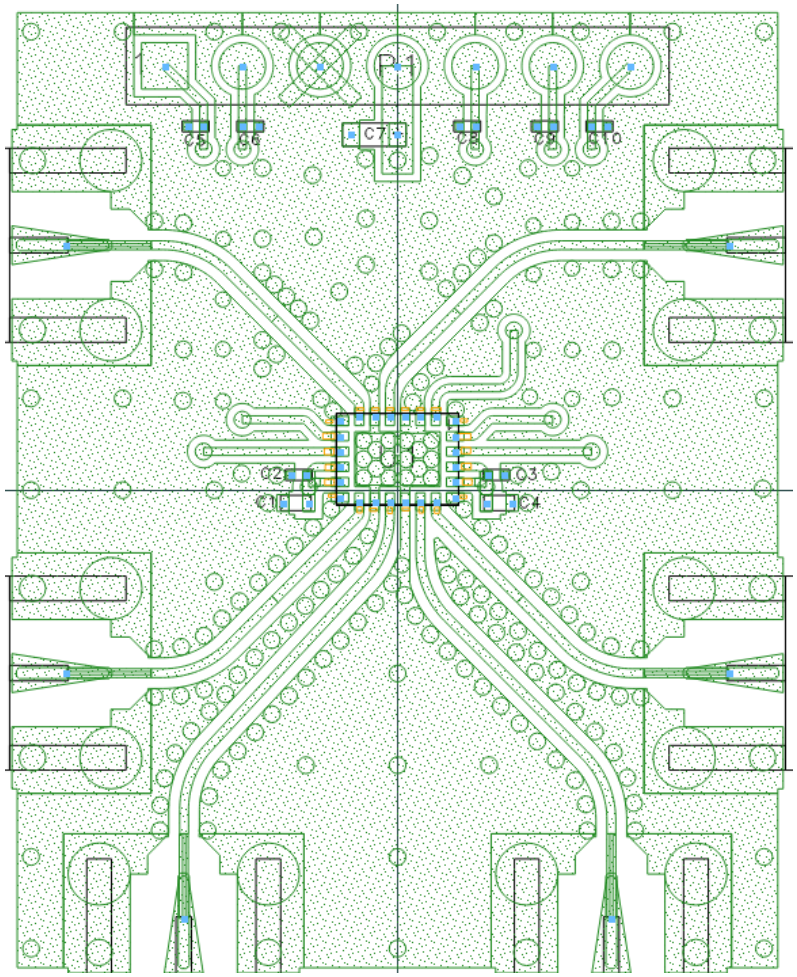
Evaluation Board -Schematic



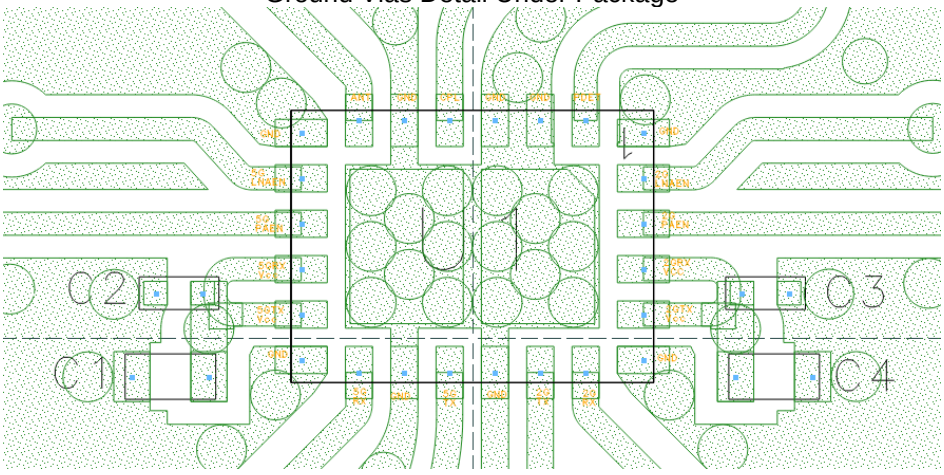
Evaluation Board - Bill of Materials (BOM)

Reference Designation	Value	Description	Manuf.	Part Number
C1, C4	1uF	0402		
C2, C3	1nF	0201		
C7	4.7uF	0603		
J1 – J6	Viper SMA			
P1	7 Pin Berg			

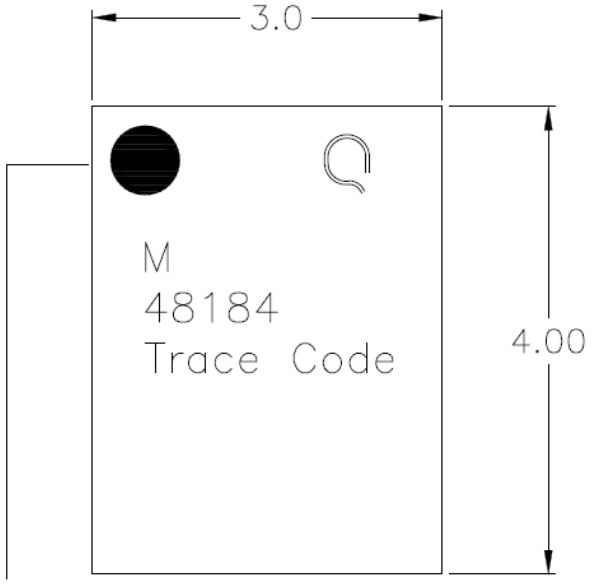
Evaluation Board - PCB Layout



Ground Vias Detail Under Package



Part Marking

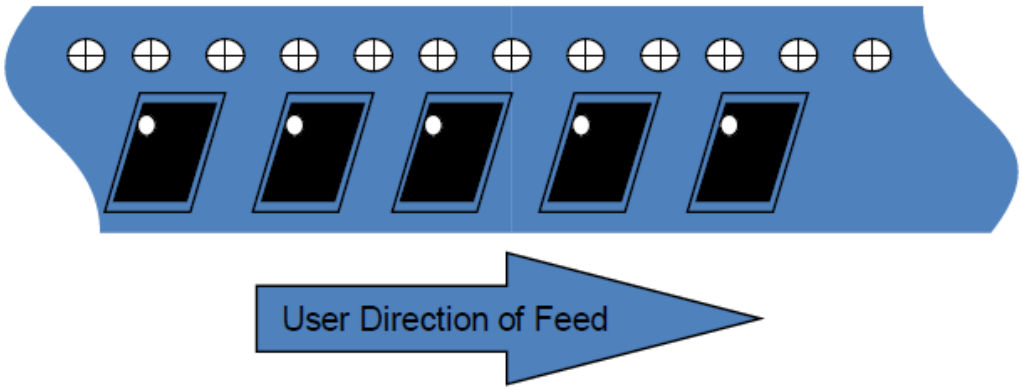


Pin 1 Indicator

Qorvo Logo – Use Q5D

Trace Code to be assigned by SubCon

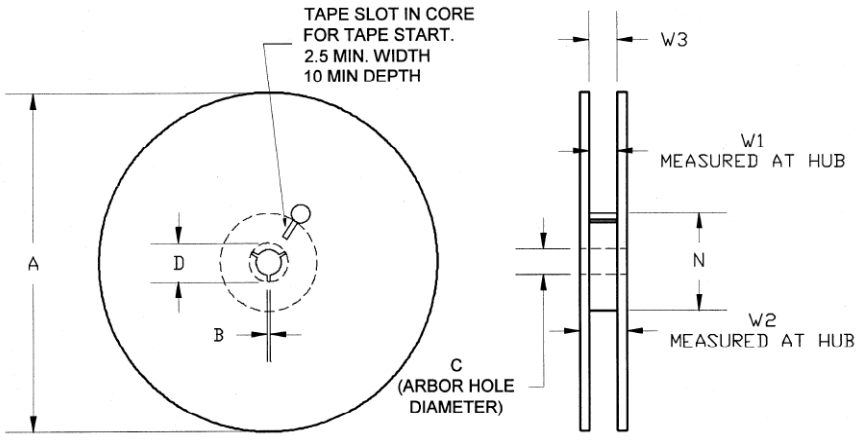
Tape and Reel Information – Carrier and Cover Tape Dimensions



CAVITY (mm)				DISTANCE BETWEEN CENTERLINE (mm)		CARRIER TAPE (mm)	COVER TAPE (mm)
Length (A0)	**Width (B0)**	**Depth (K0)**	**Pitch (P1)**	**Length direction (P2)**	**Width Direction (F)**	**Width (W)**	**Width (W)**
3.20	4.25	1.2	8.0	2.00	5.50	12.0	9.20

Tape and Reel Information – Reel Dimensions

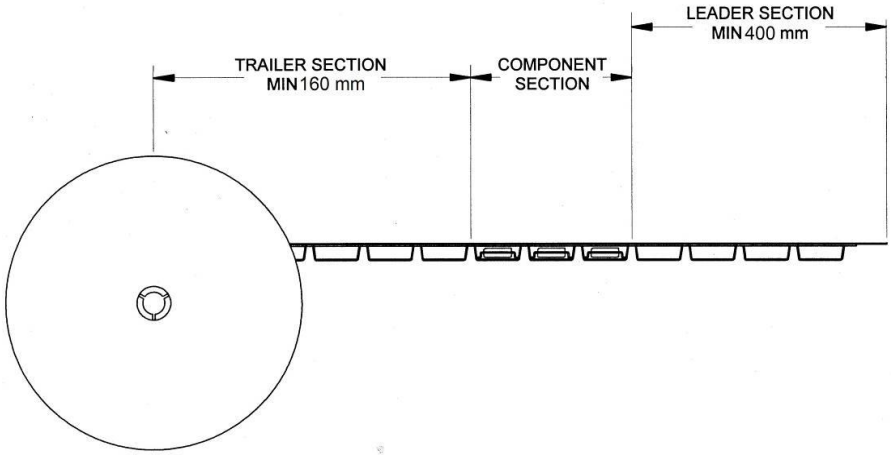
Packaging reels are used to prevent damage to devices during shipping and storage, loaded carrier tape is typically wound onto a plastic take-up reel. The reel size is 13" diameter. The reels are made from high-impact injection-molded polystyrene (HIPS), which offers mechanical and ESD protection to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



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330.0
	Thickness	W2	0.717	18.2
	Space Between Flange	W1	0.504	12.8
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	0.787	20.0

Tape and Reel Information – Tape Length and Label Placement

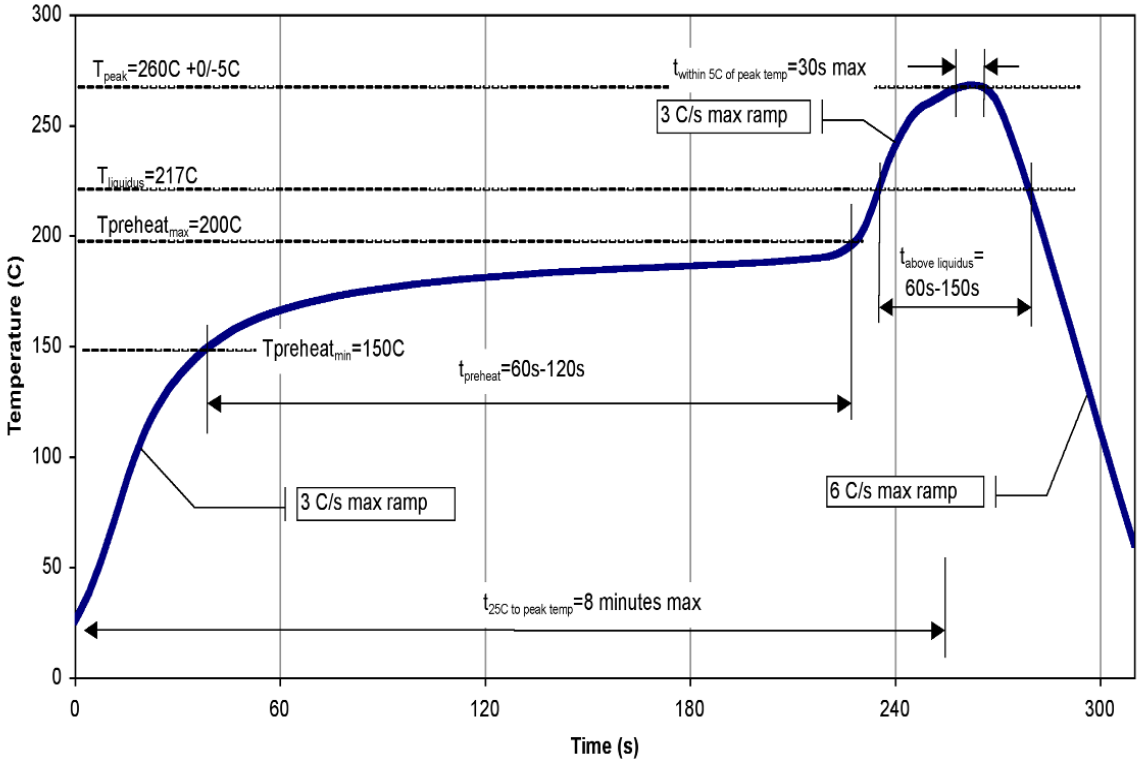
Tape and reel specifications for this part are also available on the Qorvo website.
Standard T/R size = 5000 pieces on a 13” reel.



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.

Recommended Soldering Temperature Profile

Below is a general recommendation for 260ºC reflow. The specific profile used will need to take into account the requirements of the board, other components, and the layout. The following recommendation should only be used as a guideline.



Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: Class 1C (JEDEC JS-001-2012)
Value: Passes = 1000 V
Test: Human Body Model (HBM)

ESD Rating: Class C2 (JEDEC JESD22-C101)
Value: Passes = 500 V
Test: Charged-Device Model (CDM)

MSL Rating

MSL-3

Solderability

Compatible with the latest version of J-STD-020, lead free solder, 260°C

Refer to **Soldering Profile** for recommended guidelines.

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 ($C_{15}H_{12}Br_4O_2$) Free
- SVHC Free

Contact Information

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

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