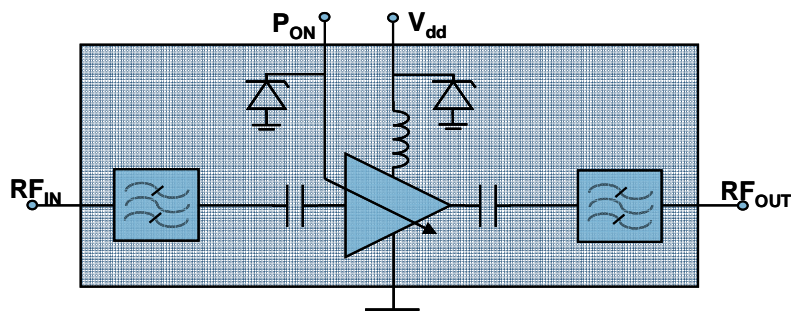


GPS LNA-Filter Receive Module

Functional Block Diagram



Product Description

TQM640002 RF front end module (FEM) is an active device for GPS applications (center frequency 1575.42 MHz). It is designed for simultaneous GPS + voice in multi-function handsets. The FEM is comprised of a low-power flip-chip LNA die, a pair of high-performance SAW filters, and integrated passive matching circuitry. The module will operate at 1.8v or 2.8v bias and its current consumption – typically 5.0 mA – is not changed by DC supply, making it suitable for use in low-power applications & during low-battery situations. The FEM performance exhibits high in-band gain and excellent rejection in all the key cellular & WLAN/Bluetooth bands. The device also exhibits both a high intercept point & a low noise figure, which optimally addresses today's most stringent GPS front end receiver requirements.

Electrical Specifications

Typical performance, 1.8v bias

Parameter	Typ	Units	Comments / Conditions
Gain	16	dB	Under standard conditions
Noise Figure	1.56	dB	50 Ω system
Out of band Input P1dB	>23	dBm	GSM800 / GSM900
	>16	dBm	PCS / DCS / WCDMA
Rejection			
5 --- 980MHz	78	dBc	All Rejection measurements are referenced to 1575 MHz peak Gain and network analyzer power set to -30 dBm.
1620 --- 1720 MHz	74	dBc	
1720 --- 1785 MHz	70	dBc	
1850 --- 1980 MHz	70	dBc	
2400 --- 2500 MHz	68	dBc	

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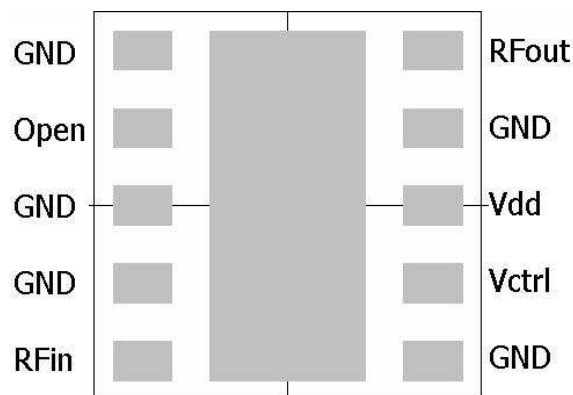
Features

- Low noise figure & high associated gain for high IP3 receiver stages for 1575 MHz
- NF = 1.56 dB; Gain=16 dB @ 1.8V
- No external matching components required
- Low current consumption & low voltage operation
- High immunity against inband compression due to out-of-band interferers during simultaneous GPS + voice operation
- Input and output internally pre-matched to 50 Ω
- Low cost miniature package 3 x 3 x 1.0 mm – suitable for low profile handset applications
- Power-up control for the LNA
- Designed to operate at 1.8V, with enhanced linearity performance at 2.8V
- Halogen-free

Applications

- 1575.42 MHz, L1 band GPS applications
- Personal Navigation Devices
- Cellular Handsets: Simultaneous GPS + voice calls

Package Style



GPS LNA-Filter Receive Module

Absolute Maximum Ratings

Symbol	Parameter	Absolute Maximum Value	Units
V_{dd}	Power Supply Voltage, no RF Applied RF Applied	-0.5 to +5.0	VDC
V_{CTRL}	Bias reference voltages (V_{dd}) and bias control voltage (V_{CTRL}).	-0.5 to +5.0	VDC
P_{DISS}	Power Dissipation	50	mW
T_c	Case Temperature, Survival	-30 to +85	°C
T_{STG}	Storage Temperature	-55 to +125	°C
RF_{IN}	DC Grounded RF input, 50ohm RF impedance	+10	VDC
RF_{OUT}	DC Blocked RF output, 50 ohm RF impedance	+10	VDC
RF_{IN}	CW RF input power at GPS in band	+5	dBm
ESD (all pins)	Human Body Model	500	V

Note: The part may not survive all maximums applied simultaneously.



GPS LNA-Filter Receive Module

Electrical Characteristics at 1.8v Bias 1,2,3,4

Parameter	Exceptions / Conditions	Min	Typical Performance	Max	Units
Insertion Gain	50 Ω system	14.0	16.2		dB
Noise Figure	50 Ω system		1.56	2.0	dB
Input return loss	50 Ω system		11		dB
Output return loss	50 Ω system		14		dB
Reverse Isolation	LNA on mode	25	35		dB
Input In band P1dB	F = 1575.42 MHz		-13		dBm
Input Third order intercept point (IIP3)	2-tones @ PCS & DCS		-6		dBm
Input Third order intercept point (IIP3)	2-tones @ L1 + 138MHz (1713 MHz) L1 + 276MHz (1851 MHz)		+9		dBm
Output Third order intercept point (OIP3)	2-tones @ $f_c \pm 2.5$ MHz		10		dBm
Out-of-band Input P1dB	Interference signal level at 824 MHz	18	>23		dBm
Out-of-band Input P1dB	Interference signal level at 849 MHz	18	>23		dBm
Out-of-band Input P1dB	Interference signal level at 890 MHz	18	>23		dBm
Out-of-band Input P1dB	Interference signal level at 915 MHz	18	>23		dBm
Out-of-band Input P1dB	Interference signal level at 935 MHz	18	20		dBm
Out-of-band Input P1dB	Interference signal level at 1710 MHz	13	20		dBm
Out-of-band Input P1dB	Interference signal level at 1785 MHz	15	20		dBm
Out-of-band Input P1dB	Interference signal level at 1850 MHz	15	20		dBm
Out-of-band Input P1dB	Interference signal level at 1910 MHz	15	20		dBm
Out-of-band Input P1dB	Interference signal level at 2100 MHz	15	-		dBm
Out-of-band Input P1dB	Interference signal level at 2400 MHz	15	-		dBm
Stability K factor	100 MHz to 6 GHz	--	>1	--	
Rejection	5 --- 980 MHz	70	80		dBc
Rejection	1620 --- 1720 MHz	65	74		dBc
Rejection	1720 --- 1785 MHz	65	70		dBc
Rejection	1850 --- 1980 MHz	60	70		dBc
Rejection	2400 --- 2500 MHz	60	68		dBc
Total current drain $I_{dd} + I_{ctrl}$	LNA on		5.2		mA
V_{ctrl} current drain	LNA on		0.55	0.6	mA

Note 1: Test Conditions: $V_{dd} = 1.8V$, $V_{ctrl} = 1.8V$

Note 2: Min./Max. limits are at +25°C case temperature unless otherwise specified.

Note 3: TriQuint Test Board.

Note 4: All Rejection measurements are referenced to 1575 MHz peak Gain and network analyzer power set to -30 dBm.

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GPS LNA-Filter Receive Module

Electrical Characteristics at 2.8v Bias ^{1,2,3,4}

Parameter	Exceptions / Conditions	Min	Typical Performance	Max	Units
Insertion Gain	50 Ω system	14	16.4		dB
Noise Figure	50 Ω system		1.56	2.0	dB
Input return loss	50 Ω system		11		dB
Output return loss	50 Ω system		15		dB
Reverse Isolation	LNA on mode	25	35		dB
Input In band P1dB	F = 1575.42 MHz		-9		dBm
Input Third order intercept point (IIP3)	2-tones @ $f_c \pm 2.5$ MHz		1		dBm
Input Third order intercept point (IIP3)	2-tones @ L1 + 138MHz (1713 MHz) L1 + 276MHz (1851 MHz)	+5	+9		dBm
Output Third order intercept point (OIP3)	2-tones @ $f_c \pm 2.5$ MHz		17		dBm
Out-of-band Input P1dB	Interference signal level at 824 MHz	20	>23		dBm
Out-of-band Input P1dB	Interference signal level at 849 MHz	20	>23		dBm
Out-of-band Input P1dB	Interference signal level at 890 MHz	20	>23		dBm
Out-of-band Input P1dB	Interference signal level at 915 MHz	20	>23		dBm
Out-of-band Input P1dB	Interference signal level at 935 MHz	20	>23		dBm
Out-of-band Input P1dB	Interference signal level at 1710 MHz	18	>20		dBm
Out-of-band Input P1dB	Interference signal level at 1785 MHz	18	>20		dBm
Out-of-band Input P1dB	Interference signal level at 1850 MHz	18	>20		dBm
Out-of-band Input P1dB	Interference signal level at 1910 MHz	18	>20		dBm
Out-of-band Input P1dB	Interference signal level at 2100 MHz	18	>20		dBm
Out-of-band Input P1dB	Interference signal level at 2400 MHz	18	-		dBm
Stability K factor	100 MHz to 6 GHz		>1		
Rejection	5 --- 980 MHz	70	80		dBc
Rejection	1620 --- 1720 MHz	65	74		dBc
Rejection	1720 --- 1785 MHz	65	70		dBc
Rejection	1850 --- 1980 MHz	60	70		dBc
Rejection	2400 --- 2500 MHz	60	68		dBc
Total current drain $I_{dd} + I_{ctrl}$	LNA on		5.2		mA
Vctrl current drain	LNA on		0.55	0.6	mA

Note 1: Test Conditions: $V_{dd} = 2.8V$, $V_{ctrl} = 2.8V$

Note 2: Min./Max. limits are at +25 °C case temperature unless otherwise specified.

Note 3: TriQuint Test Board.

Note 4: All Rejection measurements are referenced to 1575 MHz peak Gain and network analyzer power set to -30 dBm.

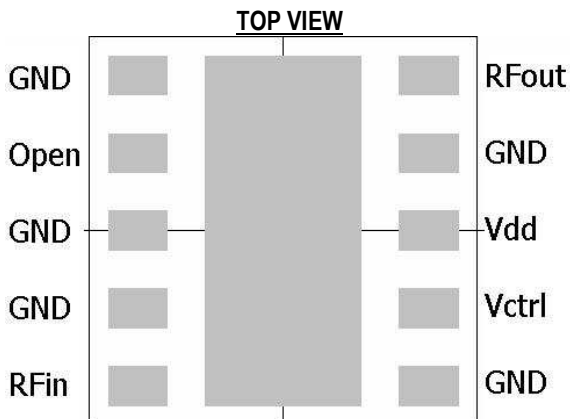
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GPS LNA-Filter Receive Module

Pin Out and Assignments



Pin	Label	Description
1	GND	Ground
2	Open	Open
3	GND	Ground
4	GND	Ground
5	RF _{in}	RF input
6	GND	Ground
7	V _{ctrl}	LNA
8	V _{dd}	DC supply
9	GND	Ground
10	RF _{out}	RF out
11	GND	Center Ground Pad

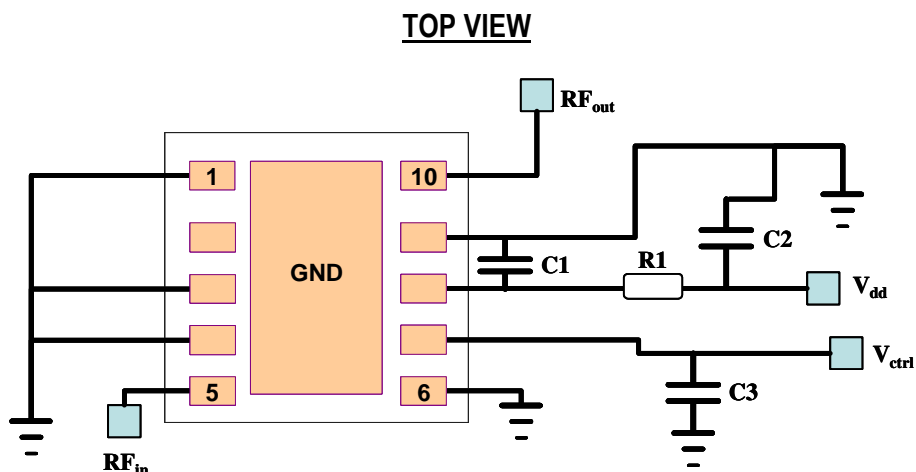
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GPS LNA-Filter Receive Module

Typical Test Circuit



Qty Per	Ref Design	Type	Size	Value	Description	Brand (Vendor)
1	C1	Capacitor	0402	12 pF	± 5%, 25V	muRata
1	C2	Capacitor	0402	1000 pF	± 5%, 25V	muRata
1	C3	Capacitor	0402	1000 pF	± 5%, 25V	muRata
1	R1	Resistor	0402	10 Ohm	± 5%	KOA

Notes:

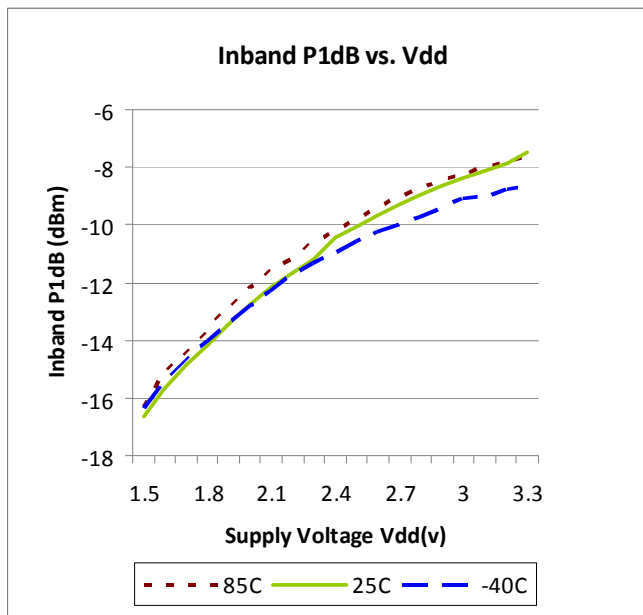
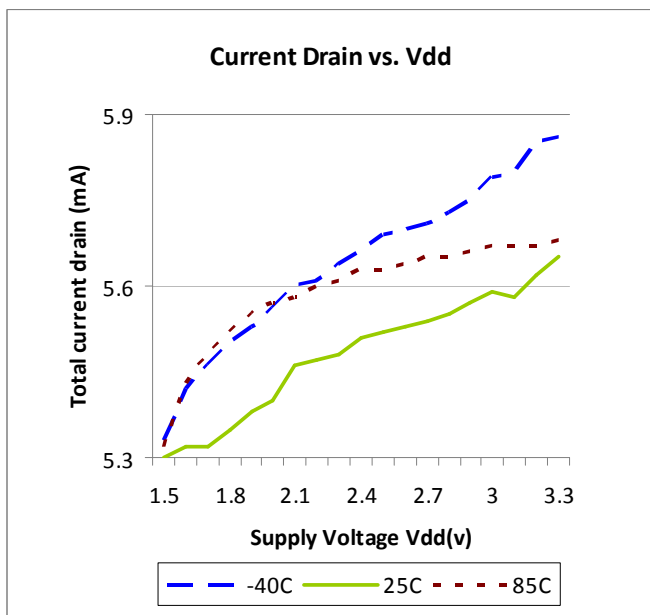
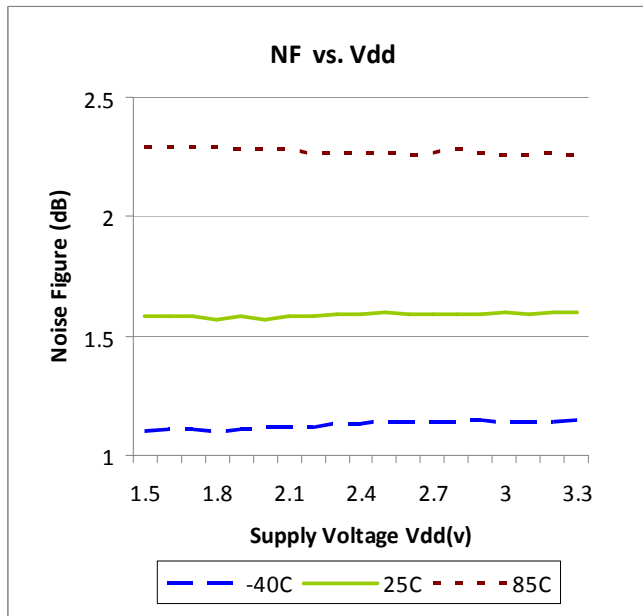
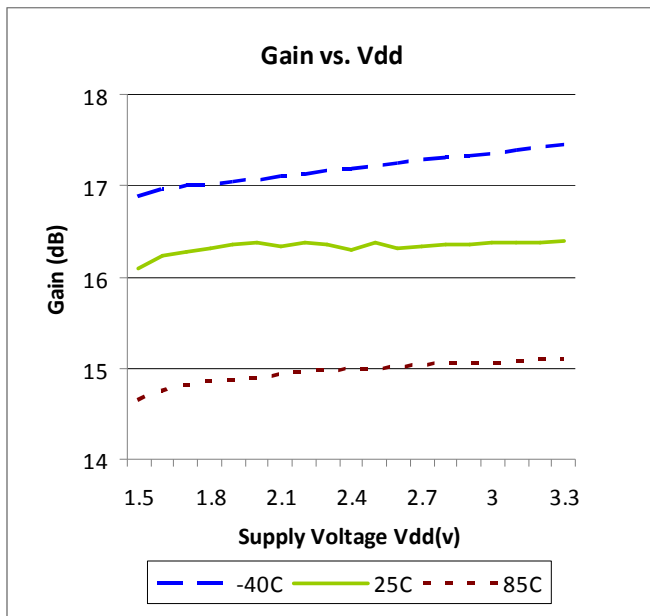
- The Module has built in DC blocking Capacitors at input and output.
- C1 and C2 are DC decoupling Capacitors for V_{dd}. In the actual application, it is advised that C1 will be placed as close to module as possible, changing the value of C1 will affect module Gain, NF and S22.
- C3 is a decoupling Capacitor for V_{ctrl} DC supply.
- The RF input port ESD and matching can be further improved with the use of a shunt capacitor and inductor.



GPS LNA-Filter Receive Module

Typical Performance over Temperature: -40 °C, 25 °C, 85 °C

Test Conditions (unless otherwise specified $V_{dd} = V_{ctrl}$, $F = 1575.42$ MHz, $T_C = 25^\circ\text{C}$)



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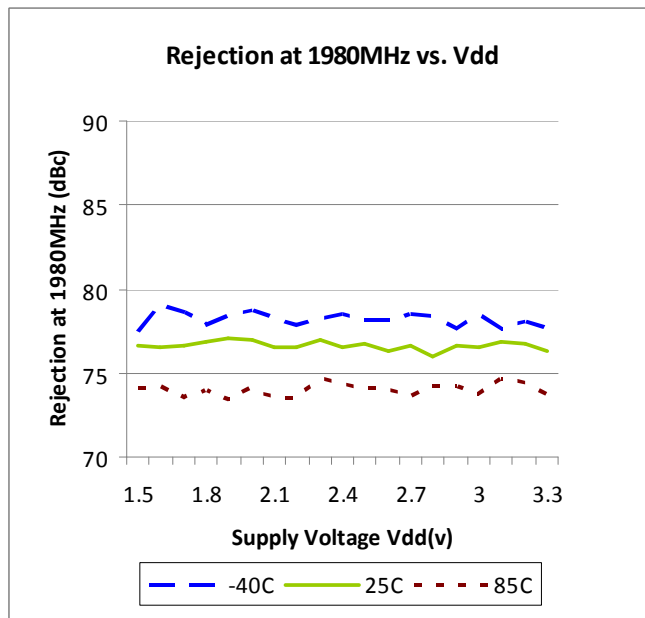
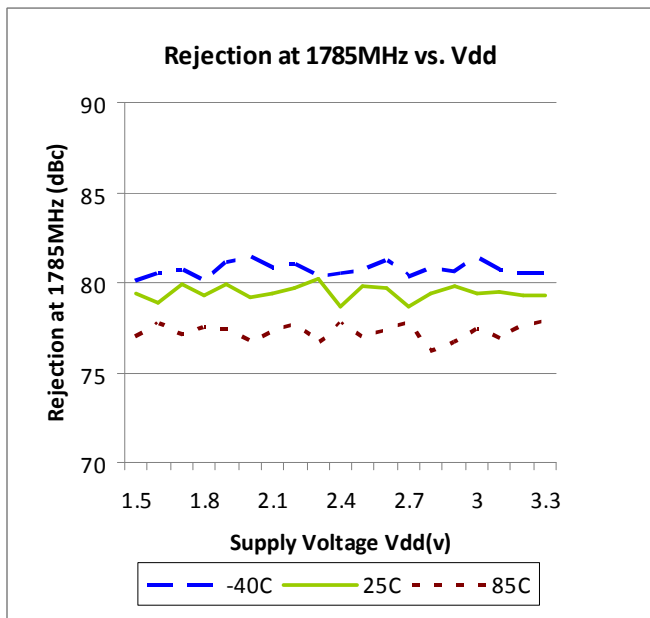
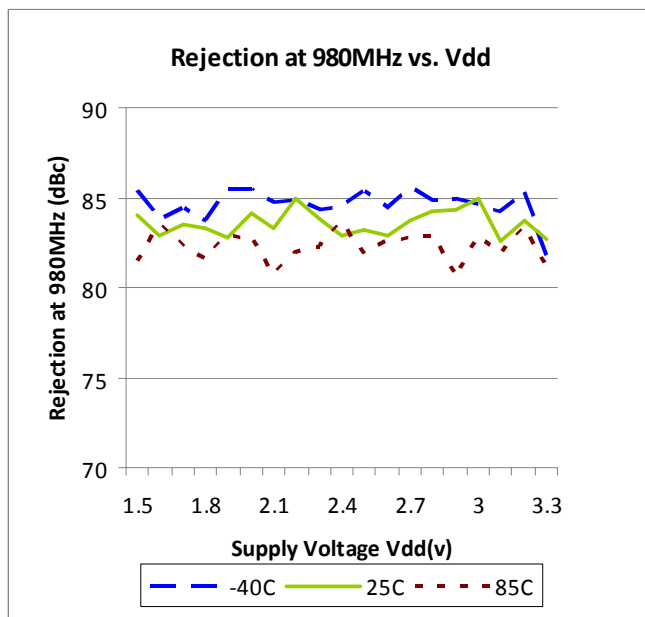
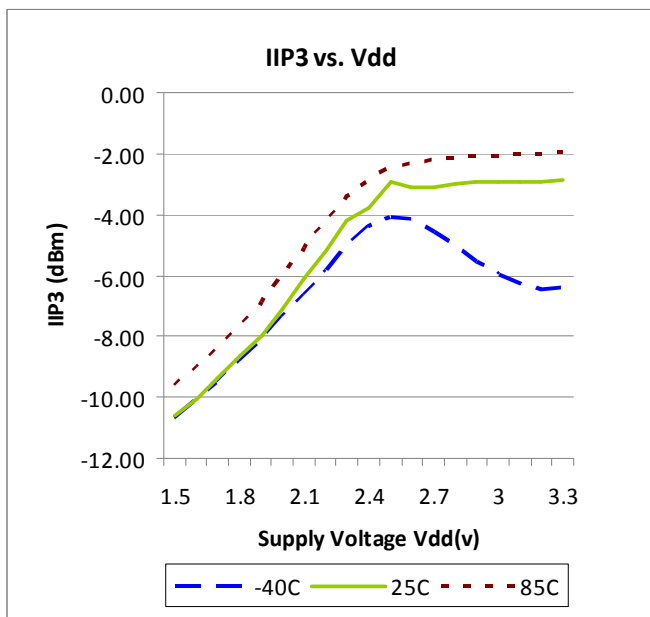
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GPS LNA-Filter Receive Module

Typical Performance over Temperature: -40 °C, 25 °C, 85 °C (cont'd)

Test Conditions (unless otherwise specified $V_{dd} = V_{ctrl}$, $F = 1575.42$ MHz, $T_C = 25^\circ\text{C}$)



Preliminary Data Sheet: Subject to change without notice

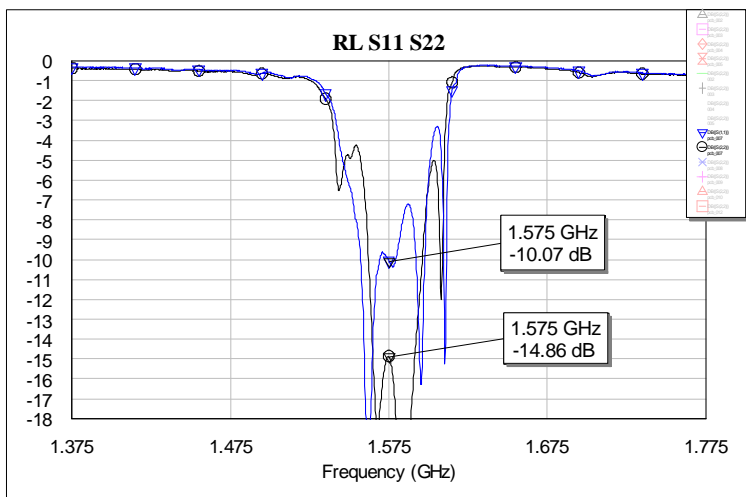
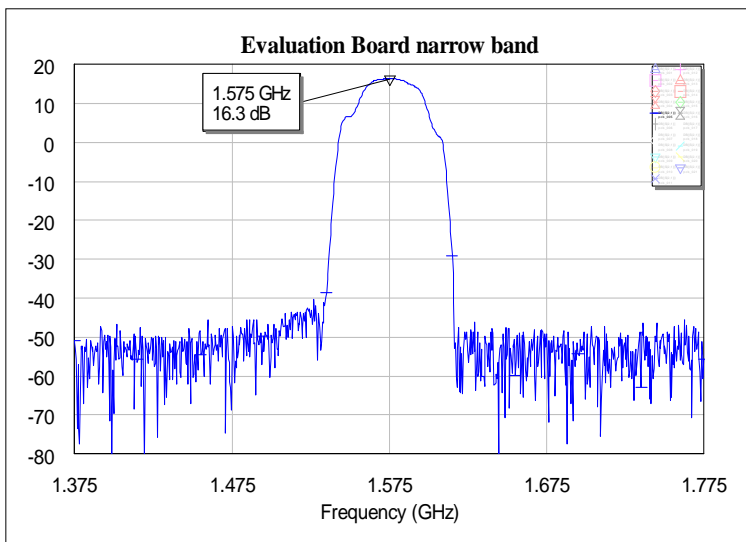
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GPS LNA-Filter Receive Module

Typical S-parameter Plots

Test Conditions: F = 1575.42 MHz, T_C = 25°C



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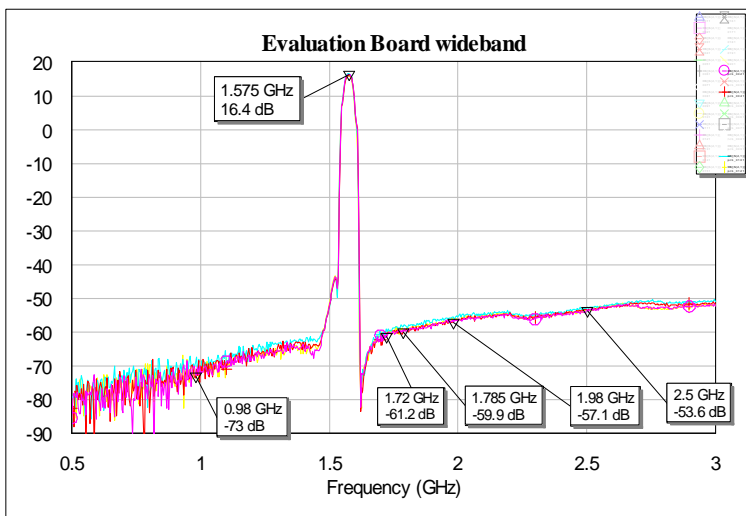
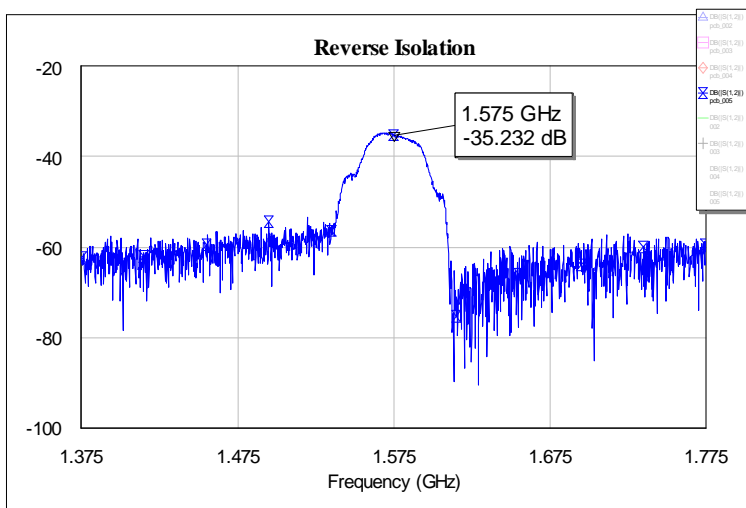
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GPS LNA-Filter Receive Module

Typical S-parameter Plots (cont'd)

Test Conditions: F = 1575.42 MHz, T_C = 25°C



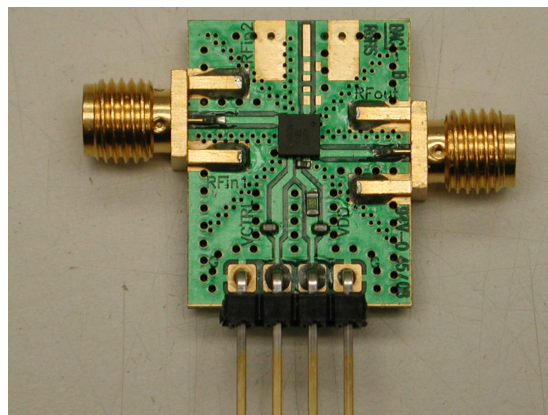
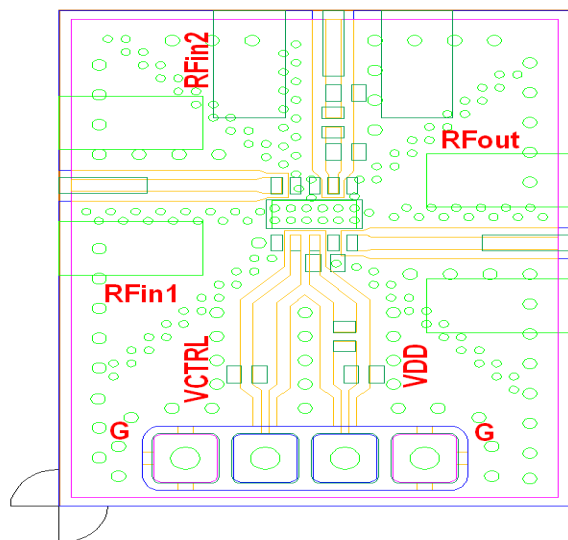
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GPS LNA-Filter Receive Module

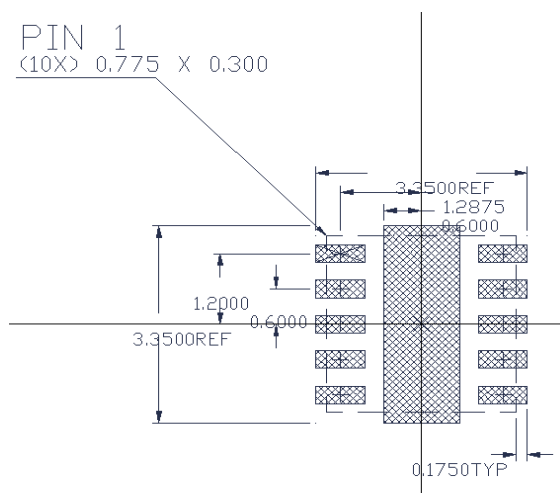
Applications Data

Actual Evaluation Board



PC Board Layout recommendations

Recommended PCB land pattern

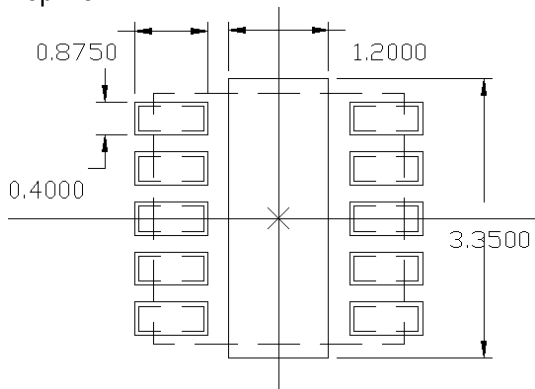


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GPS LNA-Filter Receive Module

Solder Mask Opening

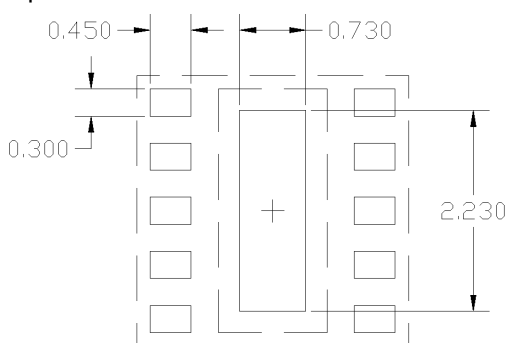
Top view



Notes:
Oversize pads 50um (2mil) per side
Center GND pad 100% of module

Stencil Aperture (Approach 1)

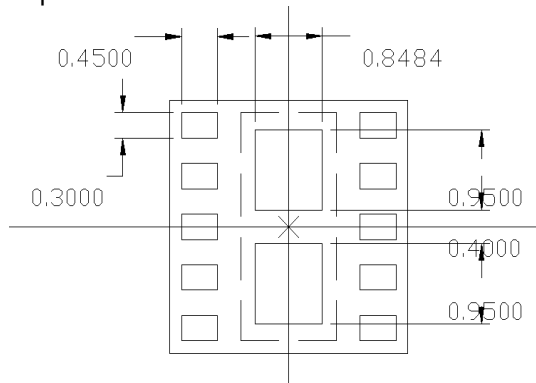
Top view



Notes:
Reference 100% module pads
Stencil opening for GND 50% of exposed GND area

Stencil Aperture (Approach 2)

Top view



Notes:
Reference 80% module pads
Stencil opening for GND 55% of exposed GND area

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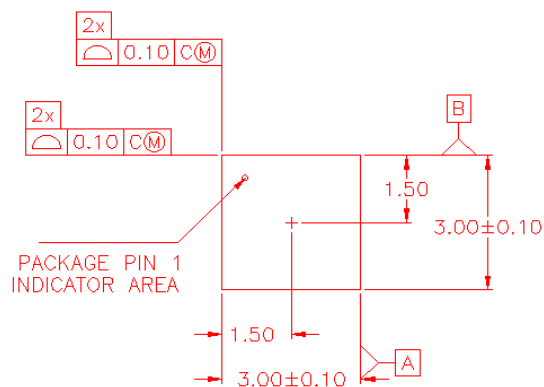
GPS LNA-Filter Receive Module

Packaging and Ordering Information

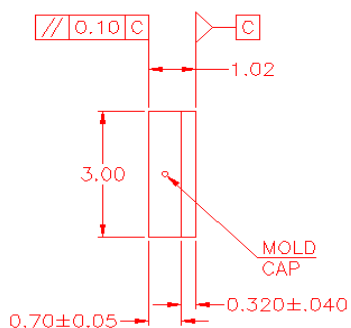
Part#	Qty	Container
TQM640002 GEL	100	Gel Pack
TQM640002 tape&reel	2,500	7" Reel

Package Dimensional Drawing (unit: mm)

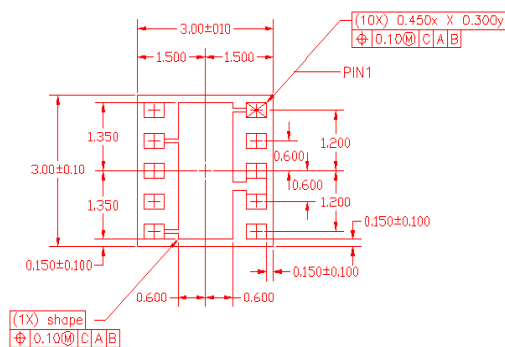
Top view



Side view



Bottom view



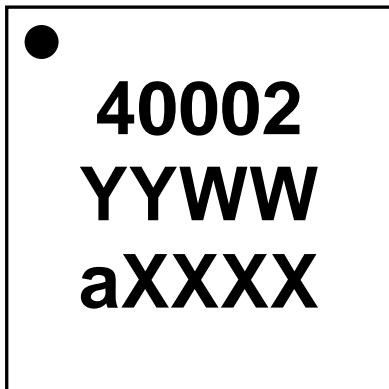
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GPS LNA-Filter Receive Module

Laser Mark

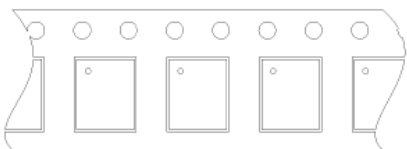


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 Line 2: YYWW = Year and Work Week
 Line 3: aXXXX = a = Vendor code + XXXX = TriQuint Lot Number.

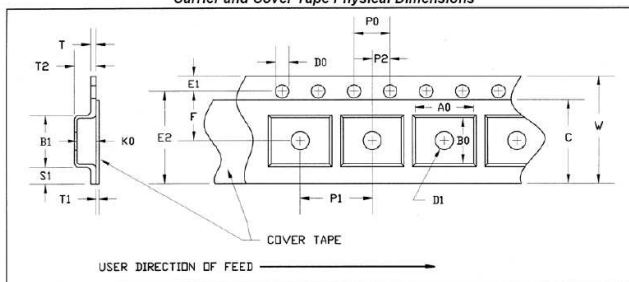
Tape Data

User Direction of Feed →

MODULE 3.5X3.5, 4x4, 5x5 and 6x6
 User Direction of Feed →



Carrier and Cover Tape Physical Dimensions



HP VFQFP-N 3x3 8mm WIDE CARRIER AND COVER TAPE DIMENSIONS

PART	FEATURE	SYMBOL	SIZE (in)	SIZE (mm)
CAVITY	LENGTH	A0	0.134	3.40
	WIDTH	B0	0.126	3.20
	DEPTH	K0	0.055	1.40
	PITCH	P1	0.157	4.00
DISTANCE BETWEEN CENTERLINE	CAVITY TO PERFORATION LENGTH DIRECTION	P2	0.079	2.00
	CAVITY TO PERFORATION WIDTH DIRECTION	F	0.138	3.50
COVER TAPE	WIDTH	C	0.213	5.40
CARRIER TAPE	WIDTH	W	0.315	8.00

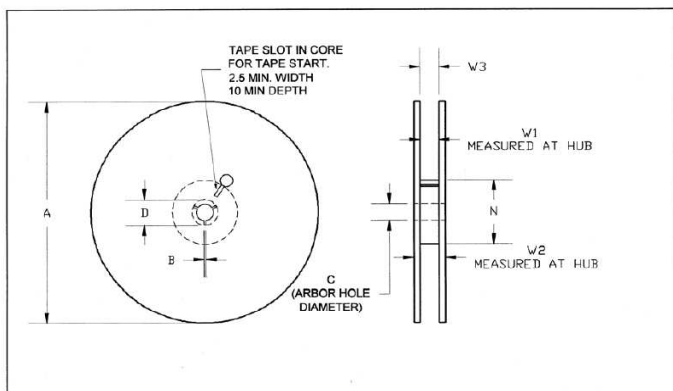
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GPS LNA-Filter Receive Module

Tape Data (Cont'd)

Reel Physical Dimensions



Reel Dimensions for 8mm Carrier Tape – 7" Reel

SOT 23-6 & 8, HP VFQFP-N 2X2, 3X3, MW-6, SCT-598, SC 70-4 & 6, SLIM 7, 13 & 17, VQFN 6 3x2			7" Reel	
PART	FEATURE	SYMBOL	SIZE (in)	SIZE (mm)
FLANGE	DIAMETER	A	6.969	177.0
	THICKNESS	W2	0.559	14.2
	SPACE BETWEEN FLANGE	W1	0.346	8.8
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

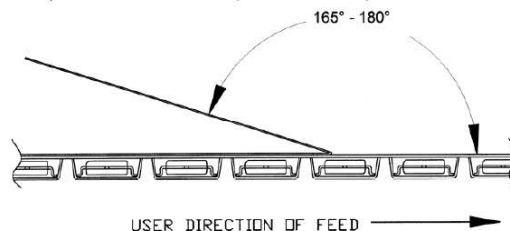
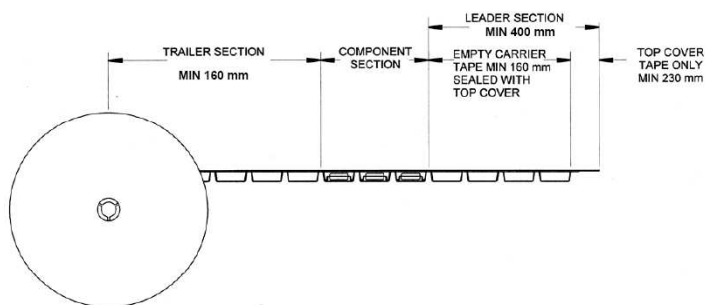


FIGURE 6

Peel strength 0.1 N to 1.0 N for 8 mm Carrier Tape
Peel strength 0.1 N to 1.3 N for 12 mm Carrier Tape
Pull velocity 300 +/- 10 mm/min

GPS LNA-Filter Receive Module

Additional Information¹

This part is compliant with RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This part will be Halogen-free by March, 2009.

The part is rated Moisture Sensitivity Level 3 at 260°C per JEDEC standard IPC/JEDEC J-STD-020.

¹ For latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

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Fax: (503) 615-8902

For technical questions and additional information on specific applications:

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