NEW!

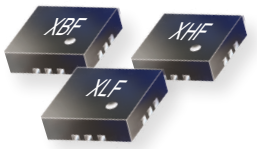
MMIC

REFLECTIONLESS FILTERS

50Ω DC to 21 GHz

The Big Deal

- Patented design eliminates in band spurs
- Pass band cut-off up to 21 GHz
- Stop band up to 35 GHz
- Excellent repeatability through IPD* process



X-Series

Available in Low Pass, High Pass and Band Pass designs

Product Overview

Mini-Circuits' *X-Series* reflectionless filters employs a novel filter topology which absorbs and terminates stop band signals internally rather than reflecting them back to the source. This new capability enables unique applications for filter circuits beyond those suited to traditional approaches. Traditional filters are reflective in the stop band, sending signals back to the source at 100% of the power level which interact with neighboring components and often result in intermodulation and other interferences. Reflectionless filters eliminate stop band reflections, allowing them to be paired with sensitive devices and used in applications that otherwise require circuits such as isolation amplifiers or attenuators.

Key Features	Advantages
Easy integration with sensitive reflective components, e.g. mixers, multipliers	Reflectionless filters absorb unwanted signals, preventing reflections back to the source. This reduces generation of additional unwanted signals without the need for extra components like attenuators, improving system dynamic range and saving board space.
Enables stable integration of wideband amplifiers	Because reflectionless filters maintain good impedance in the stop band; they can be integrated with high gain, wideband amplifiers without the risk of creating instabilities in these out of band regions.
Cascadable	Reflectionless filters can be cascaded in multiple sections to provide sharper and higher attenuation, while also preventing any standing waves that could affect pass band signals.
Excellent power handling in a tiny surface mount device	High power handling extends the usability of these filters to the transmit path for inter-stage filtering.
Small size, 3x3mm QFN	Allows replacement of filter/attenuator pairs with a single reflectionless filter, saving board space.
Excellent repeatability of RF performance	Through semiconductor IPD process, X-series filters are inherently repeatable for large volume production.
Excellent stability over temperature	With ±0.3 dB variation over temperature ideal for use in wide temperature range applications without the need for additional temperature compensation.
Operating temperature up to 105˚C	Suitable for operation close to high power components.

*IPD – Integrated Passive Device, is a GaAs semiconductor process

Reflectionless

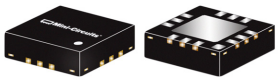
High Pass Filter

XHF-652M+

50Ω 6600 to 16200 MHz

Features

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent Power handling
- Temperature stable, up to 105°C
- Small size, 3 x 3 mm
- Protected by US Patents 8,392,495; 9,705,467, additional patent pending
- Protected by China Patent 201080014266.1
- Protected by Taiwan Patent I581494



Generic photo used for illustration purposes only

CASE STYLE: DQ1225

+RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7”	20, 50, 100, 200, 500, 1000, 2000

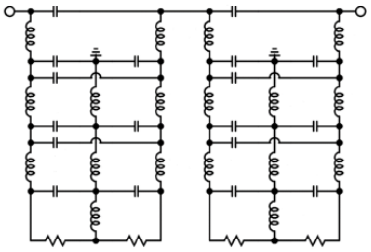
Applications

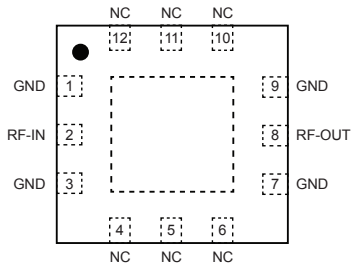
- Wi-Fi
- WiMax
- Microwave Radio
- Military & Space

General Description

Mini-Circuits’ XHF-652M+ two-section reflectionless filter employs a patented filter topology which absorbs and terminates stop band signals internally rather than reflecting them back to the source. This new capability enables unique applications for filter circuits beyond those suited to traditional approaches. Traditional filters are reflective in the stop band, sending signals back to the source at 100% of the power level. These reflections interact with neighboring components and often result in inter-modulation and other interferences. Reflectionless filters eliminate stop band reflections, allowing them to be paired with sensitive devices and used in applications that otherwise require circuits such as isolation amplifiers or attenuators.

simplified schematic and pad description





Function	Pad Number	Description
RF-IN	2	RF Input Pad
RF-OUT	8	RF Output Pad
GND	1,3,7,9, Paddle	Connected to ground
NC (GND Externally)	4,5,6,10,11,12	No internal connection

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Electrical Specifications[1] at 25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Stop Band	Rejection	DC-F[1]	DC-4000	22	38	—	dB
		F[1]-F1	4000-5000	20	30	—	dB
	Frequency Cut-Off	F2	6230	—	3.0	—	dB
	VSWR	DC-F[1]	DC-4000	—	1.2	—	:1
		F[1]-F1	4000-5000	—	1.1	—	
Pass Band	Insertion Loss	F3-F5	6600-16200	—	1.5	3.0	dB
	VSWR	F3-F5	6600-16200	—	1.1	—	:1

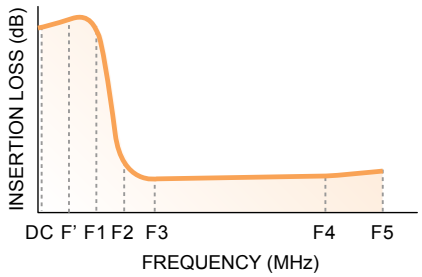
[1] Measured on Mini-Circuits Characterization Test Board TB-844-652MC+

Absolute Maximum Ratings[4]

Parameter	Ratings
Operating Temperature	-55°C to +105°C
Storage Temperature	-65°C to +150°C
RF Power Input, Passband (F3-F5)[2]	1.3W at 25°C
RF Power Input, Stopband (DC-F3)[3]	1.6W at 25°C

[2] Passband rating derates linearly to 0.6W at 105°C ambient
[3] Stopband rating derates linearly to 0.8W at 105°C ambient
[4] Permanent damage may occur if any of these limits are exceeded.

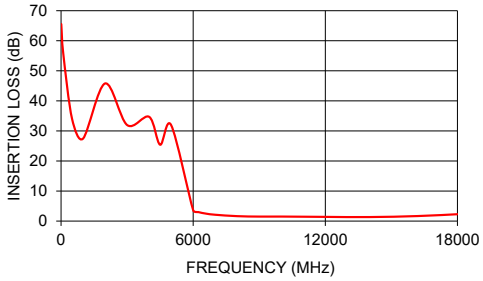
SPECIFICATION DEFINITION



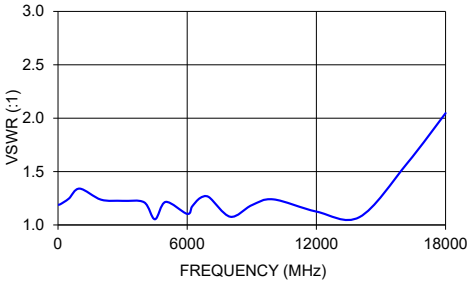
Typical Performance Data at 25°C

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)
10	65.56	1.19
100	55.77	1.19
500	33.99	1.25
1000	27.46	1.34
2000	45.80	1.24
3000	31.96	1.23
4000	34.69	1.21
4500	25.40	1.05
5000	31.92	1.22
6000	3.61	1.10
6230	3.01	1.17
6600	2.46	1.25
7000	2.11	1.26
8000	1.64	1.08
9000	1.49	1.19
10000	1.50	1.24
12000	1.40	1.13
14000	1.34	1.07
16200	1.67	1.57
18000	2.28	2.05

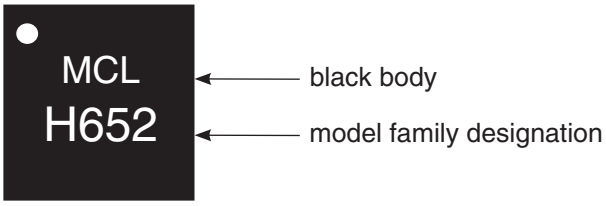
XHF-652M+
INSERTION LOSS



XHF-652M+
VSWR



Product Marking

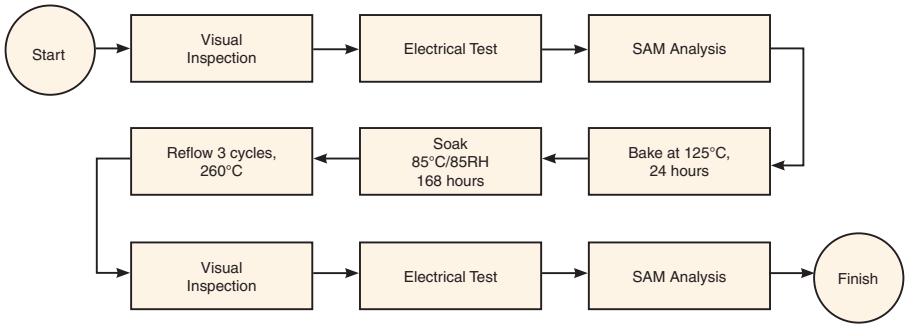


Additional Detailed Technical Information *additional information is available on our dash board. To access this information click here*	
Performance Data	Data Table
	Swept Graphs
	S-Parameter (S2P Files) Data Set (.zip file)
Case Style	DQ1225 *Plastic package, exposed paddle* *lead finish: matte-tin*
Tape & Reel **Standard quantities available on reel**	F66 *7" reels with 20, 50, 100, 200, 500 or 1K devices*
Suggested Layout for PCB Design	PL-451
Evaluation Board	TB-844-652M+ (without connectors), TB-844-652MC+ (with connectors)
Environmental Ratings	ENV82

ESD Rating

Human Body Model (HBM): Class 2 (Pass 2000V) in accordance with ANSI/ESD STM 5.1 - 2001

MSL Test Flow Chart



Additional Notes

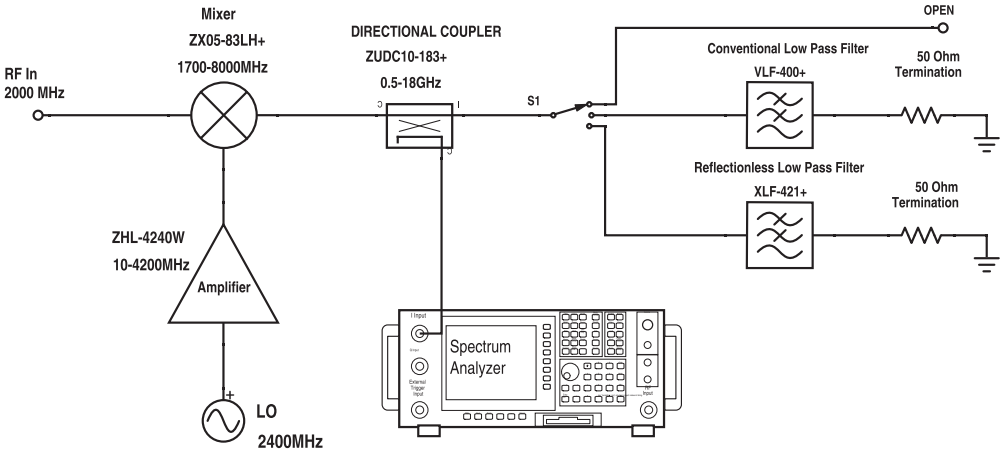
A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.

C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

Application Circuit Example

Pairing mixers with reflectionless filters to improve system dynamic range



Test block diagram: IF output reflection spectrum with single input frequency

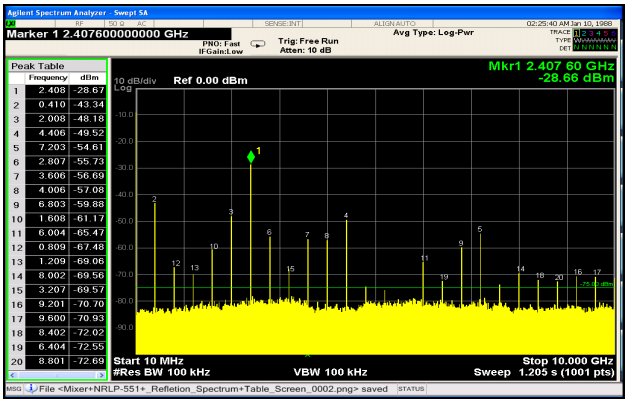


Figure 1. IF output reflection spectrum without filter

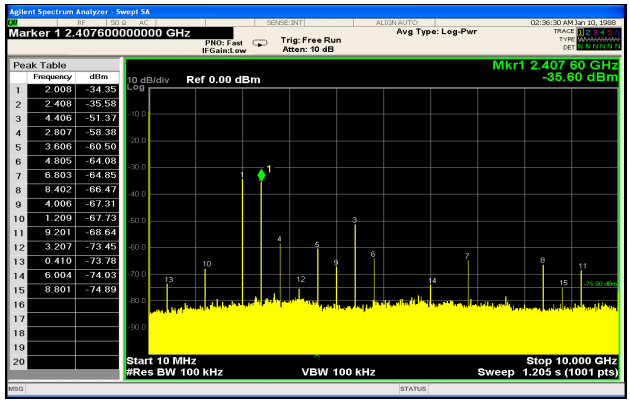


Figure 2. IF output reflection spectrum with conventional filter

An application circuit was assembled to measure the IF reflection spectrum at the output of a mixer when the mixer was paired with a conventional filter versus a reflectionless filter.

While the conventional filter reduces the reflections present when the mixer is used alone (no filter), the reflectionless filter virtually eliminates those reflections altogether.

The reflected signal at marker 1 in the figures above exhibits a reduction of more than 20 dB from -28.7 dBm to -50.3 dBm when the reflectionless filter is used as compared to the conventional filter, thus eliminating unwanted spurious mixing products and improving-system dynamic range.

For more information, refer to application note AN-75-007

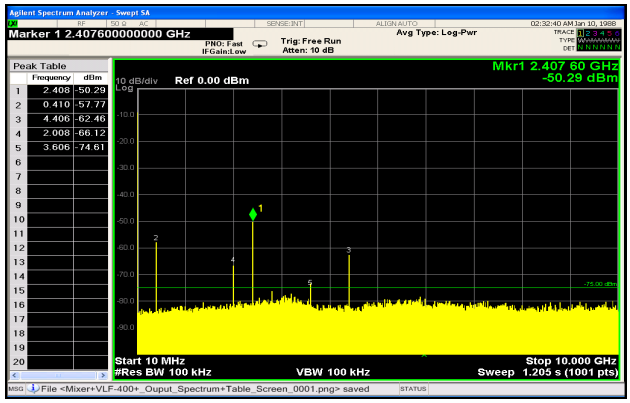


Figure 3. IF output reflection spectrum with reflectionless filter

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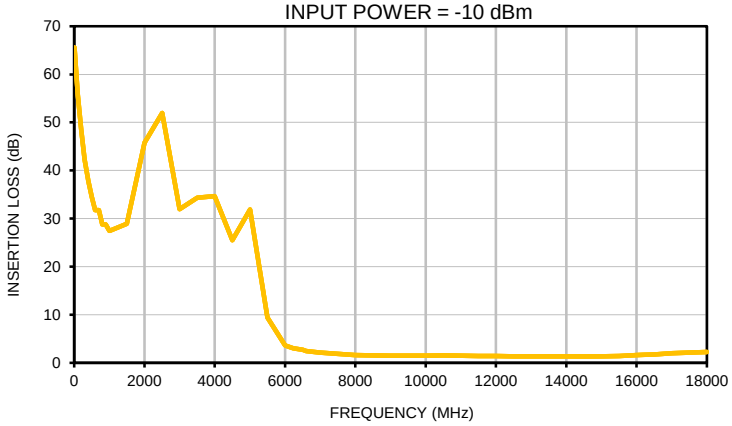
MMIC Reflectionless High Pass Filter XHF-652M+

Typical Performance Data

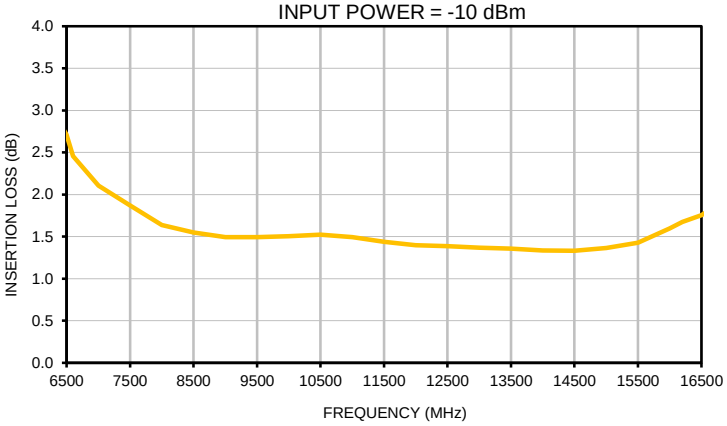
FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT VSWR (:1)	OUTPUT VSWR (:1)
10	65.56	1.19	1.19
50	61.41	1.19	1.19
100	55.77	1.19	1.19
200	48.54	1.20	1.20
300	42.25	1.21	1.21
400	37.83	1.23	1.22
500	34.52	1.24	1.24
600	31.74	1.27	1.26
700	31.74	1.27	1.26
800	28.76	1.31	1.30
900	28.76	1.31	1.30
1000	27.46	1.34	1.34
1500	28.91	1.36	1.36
2000	45.80	1.23	1.24
2500	51.95	1.13	1.13
3000	31.96	1.22	1.23
3500	34.34	1.29	1.30
4000	34.69	1.21	1.21
4500	25.48	1.08	1.08
5000	31.92	1.20	1.22
5500	9.40	1.17	1.16
6000	3.61	1.10	1.10
6230	3.06	1.17	1.16
6500	2.71	1.22	1.20
6600	2.46	1.25	1.24
7000	2.11	1.26	1.24
7500	1.87	1.21	1.19
8000	1.64	1.08	1.06
8500	1.55	1.02	1.07
9000	1.49	1.12	1.19
9500	1.49	1.16	1.23
10000	1.50	1.16	1.24
10500	1.52	1.15	1.22
11000	1.49	1.12	1.16
11500	1.44	1.11	1.10
12000	1.40	1.13	1.08
12500	1.39	1.13	1.10
13000	1.37	1.11	1.12
13500	1.36	1.08	1.12
14000	1.34	1.02	1.07
14500	1.33	1.04	1.01
15000	1.36	1.15	1.12
15500	1.43	1.25	1.24
16000	1.60	1.44	1.49
16200	1.67	1.52	1.57
16500	1.76	1.59	1.66
17000	2.01	1.82	1.91
17500	2.15	1.93	2.02
18000	2.28	1.98	2.05

Typical Performance Curves

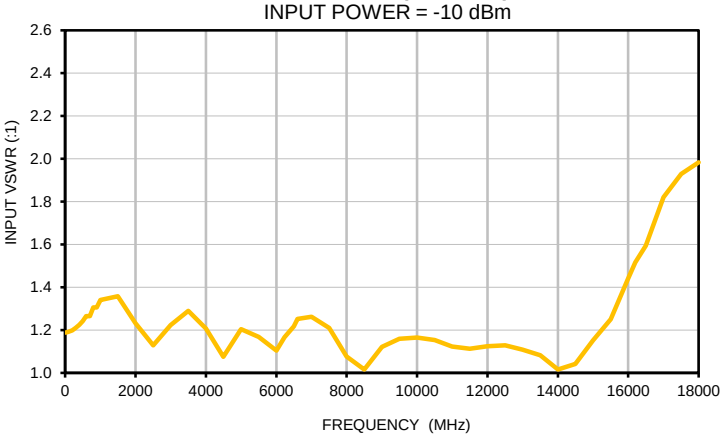
INSERTION (Full Band)
INPUT POWER = -10 dBm



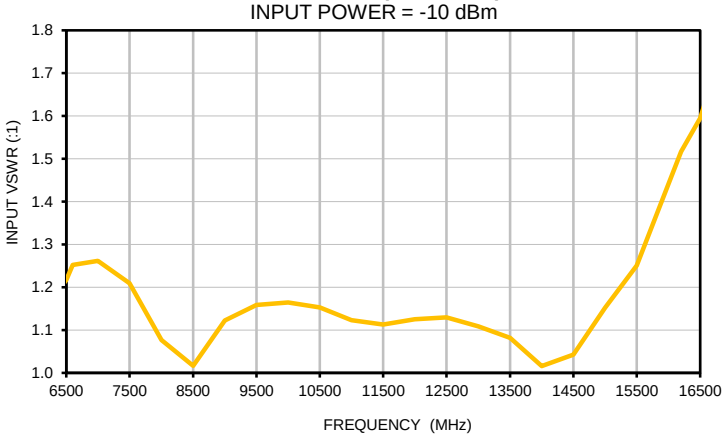
INSERTION (Pass Band)
INPUT POWER = -10 dBm



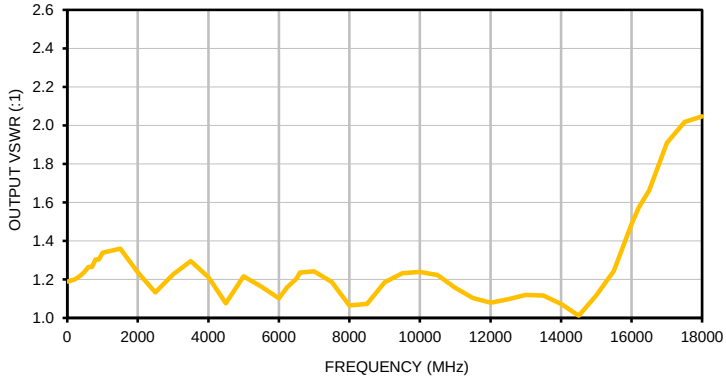
INPUT VSWR (Full Band)
INPUT POWER = -10 dBm



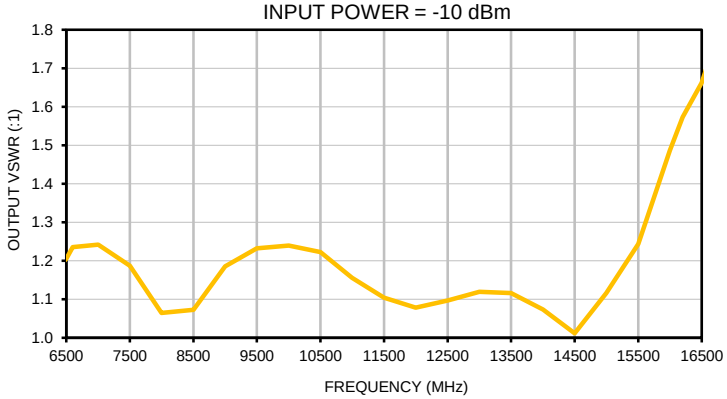
INPUT VSWR (Pass Band)
INPUT POWER = -10 dBm



OUTPUT VSWR (Full Band)
INPUT POWER = -10 dBm



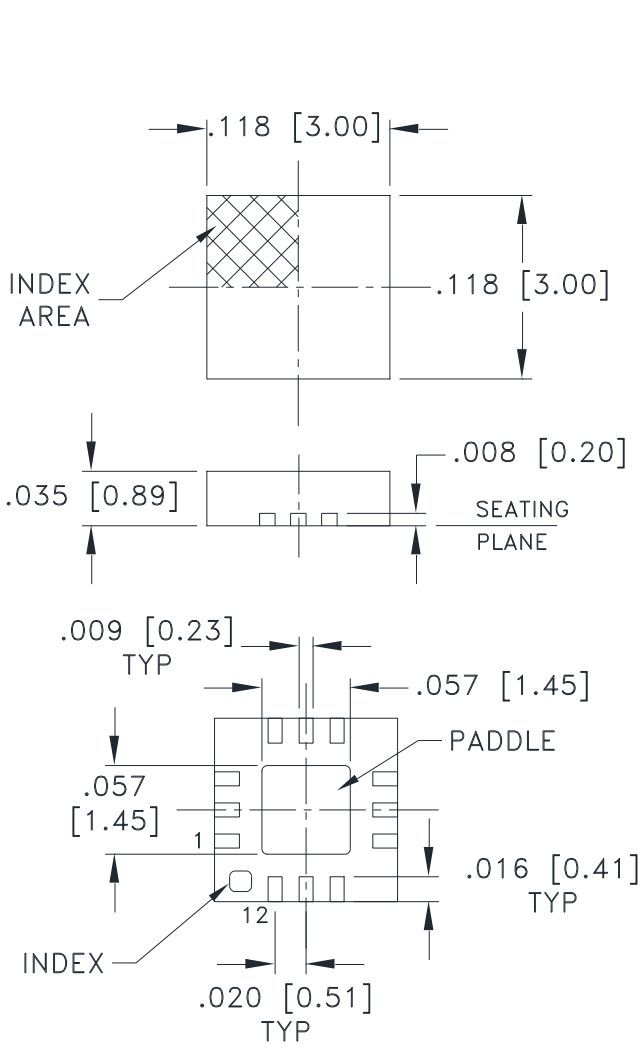
OUTPUT VSWR (Pass Band)
INPUT POWER = -10 dBm



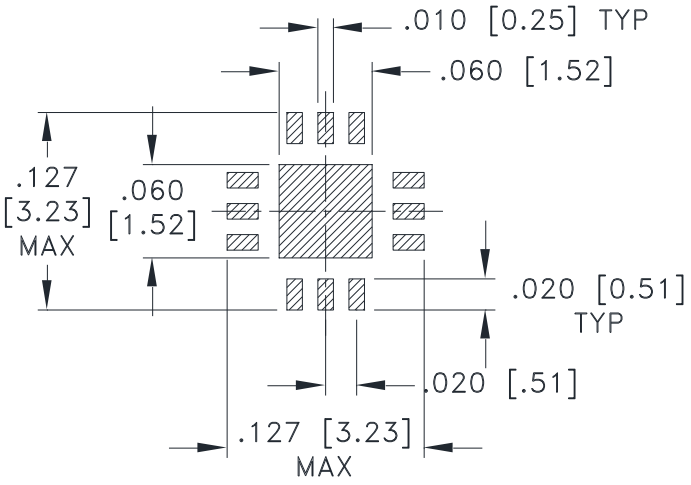
Case Style DQ

DQ1225

Outline Dimensions



PCB Land Pattern



SUGGESTED LAYOUT,
TOLERANCE TO BE WITHIN ±.002

Weight: .02 Grams

Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .004

Notes:

1. Case material: Plastic.
2. Termination finish:
   - For RoHS Case Styles: Tin-Silver alloy plate over Nickel barrier or Matte-Tin. All models, (+) suffix. See Data sheet.
   - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

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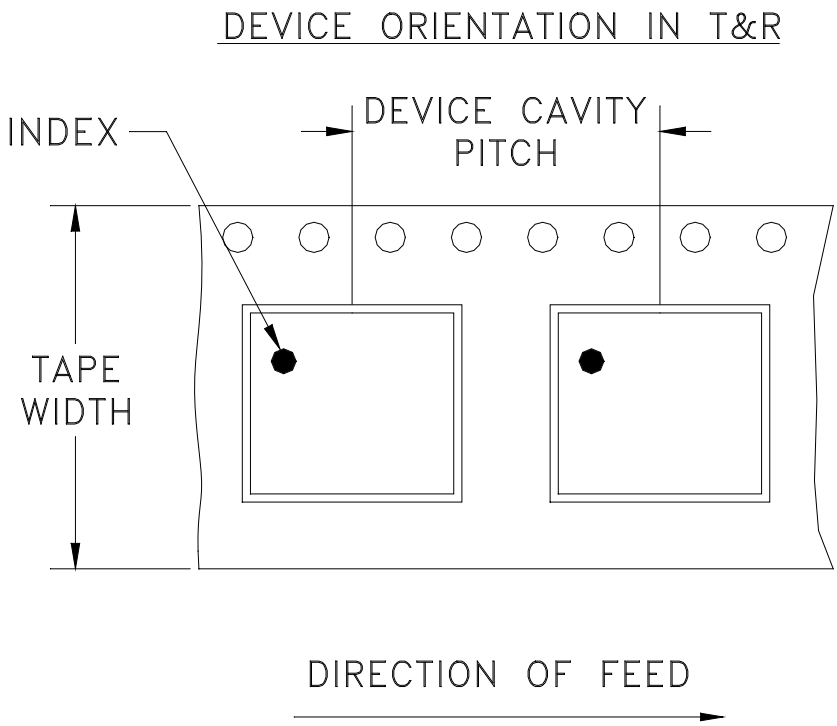
Mini-Circuits ISO 9001 & ISO 14001 Certified

Tape & Reel Packaging TR-F66



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
8	4	7	Small quantity standard	20
				50
				100
				200
				500
		7	Standard	1000, 2000, 3000

Note: Please consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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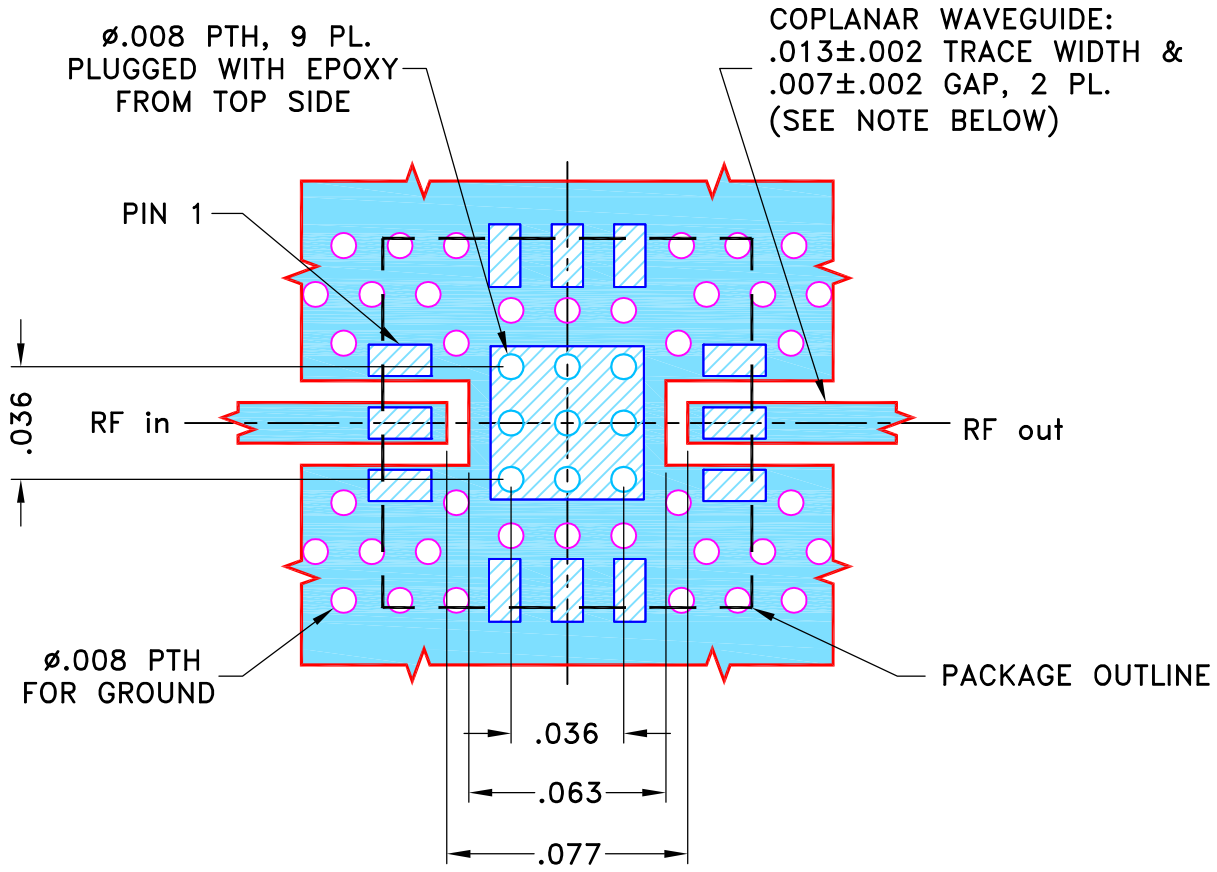
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M152656	NEW RELEASE	09/11/15	ITG	MY

SUGGESTED MOUNTING CONFIGURATION
FOR DQ1225 CASE STYLE, "12FL02" PIN CODE



NOTES:

1. TRACE WIDTH PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .0066"±.0007". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	ITG	09/10/15
TOLERANCES ON:	CHECKED	GF	09/11/15
2 PL DECIMALS ±	APPROVED	MY	09/11/15
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

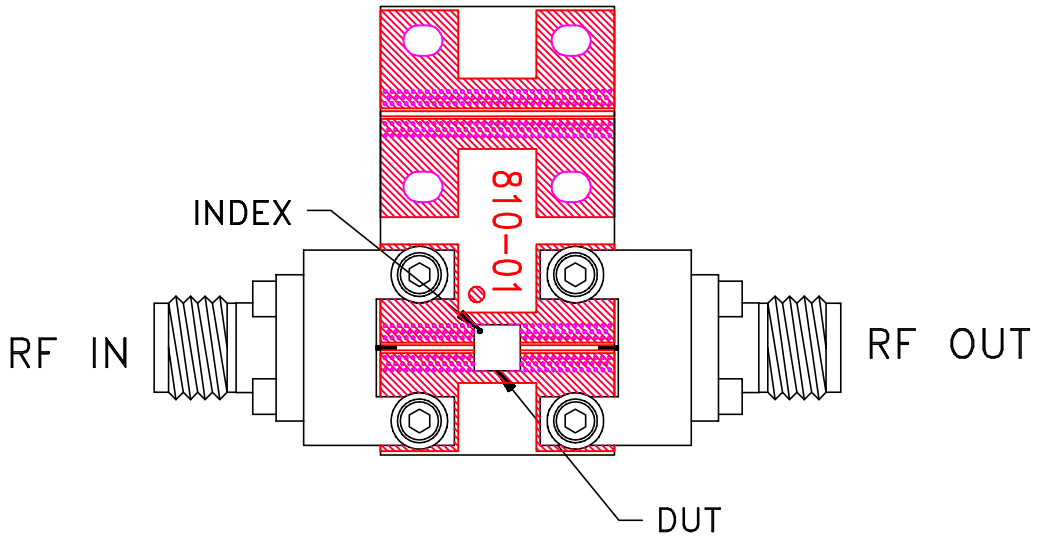
ASHEETA1.DWG REV:A DATE:01/12/95

Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

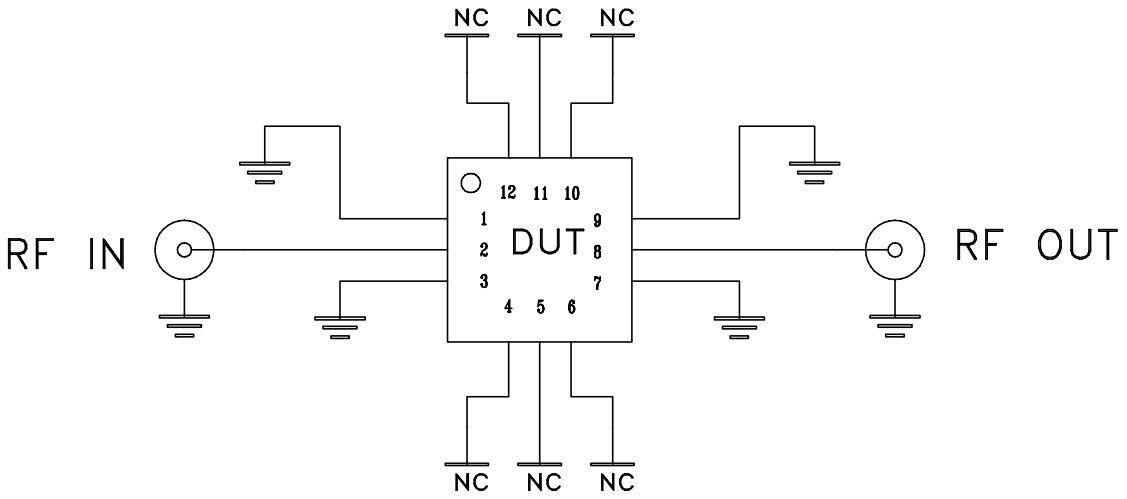
PL, 12FL02, DQ1225, TB-844+

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-451	OR
FILE: 98PL451	SCALE: 16:1	SHEET: 1 OF 1	

Evaluation Board and Circuit



TB-844-652MC+



Schematic Diagram

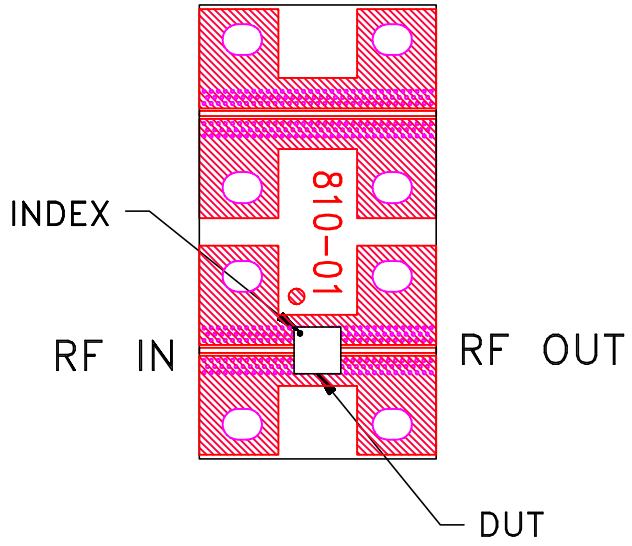
Notes:

1. 50 Ohm 2.92 mm Female connectors.
2. PCB Material: RO4350 or equivalent,
   Dielectric Constant=3.5, Thickness=.0066 inch.

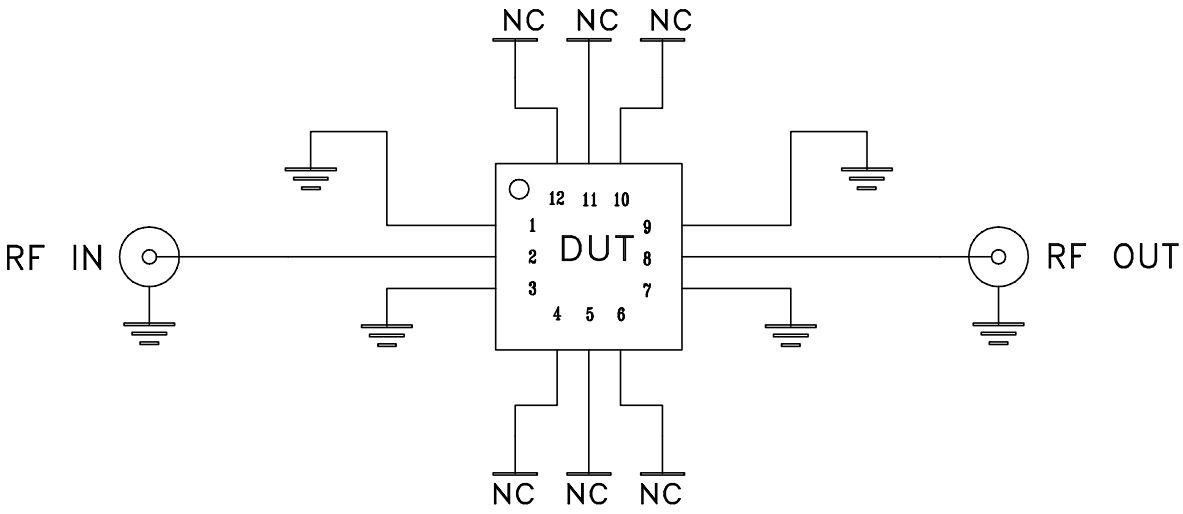
Mini-Circuits®

Evaluation Board and Circuit

To be used with Mini-Circuits 50 Ohm 2.92 connectors B20-118-F1+.
Connectors are sold separately.



TB-844-652M+



Schematic Diagram

Note:

PCB Material: RO4350 or equivalent,
Dielectric Constant=3.5, Thickness=.0066 inch.

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Environmental Specifications ENV82

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-55° to 105°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-65° to 150° C Ambient Environment	Individual Model Data Sheet
Autoclave	15 psig, 100% RH, 121°C, 96 hours	JESD22-A102-C, Condition C
Temperature Cycling	-65° to 150°C, 100 cycles	JESD22-A104
Temperature Humidity	85°C/ 85% RH, 168 hours	JESD22-113
Solder Reflow Heat	Sn-Pb Eutetic Process: 240°C peak Pb-Free Process: 260°C peak	J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1
Moisture Sensitivity: Level 1	Bake at 125°C for 24 hours Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 240°C peak (Non-RoHS) or 260°C (RoHS)	J-STD-020C
Solderability	10X magnification, 95% coverage	JESD22-B102, Method 1: Dip and Look Test
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215