



MMIC REFLECTIONLESS

# Low Pass Filter

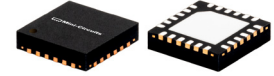
## XLF-172H+

Mini-Circuits

50Ω DC to 2000 MHz

### THE BIG DEAL

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent stopband rejection, 47 dB typ.
- Temperature stable, up to +105°C
- Small size, 4 x 4 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: DG1847

**+RoHS Compliant**

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

### APPLICATIONS

- Cellular, PCS
- GPS
- Radio astronomy
- Telemetry

### PRODUCT OVERVIEW

Mini-Circuits' XLF-172H+ three-section reflectionless filter 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. 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.

### KEY FEATURES

Features	Advantages
Reflectionless Technology	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.
50Ω Match in Stopband	Reflectionless filters maintain good impedance matching in the stopband, allowing for integration with high gain, wideband amplifiers without the risk of creating out-of-band instabilities.
Excellent RF Performance Repeatability	Fabricated on a GaAs process, X-series filters are inherently repeatable for large-volume production.
Excellent Stability over temperature	With ±0.3 dB variation over temperature, is ideal for use in wide temperature range applications without the need for additional temperature compensation.
Excellent Power Handling in a Compact Package	High power handling extends the usability of these filters to the transmit path for inter-stage filtering.

REV. B  
ECO-020598  
XLF-172H  
MCL NY  
240117





### ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C

Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit		
Passband	Insertion Loss	DC - F1	DC - 2000	—	1.7	3.0	dB	
	Frequency Cut-off	F2	2350	—	3.0	—		
	VSWR	DC - F1	DC - 2000	—	1.3	—		:1
Stopband	Rejection	F3 - F3'	3600 - 3800	16	28	—	dB	
		F3' - F4	3800 - 11000	32	47	—		
		F4 - F5	11000 - 20000	—	46	—		
	VSWR	F3 - F3'	3600 - 3800	—	1.2	—		:1
		F3' - F4	3800 - 11000	—	1.4	—		
		F4 - F5	11000 - 20000	—	1.5	—		

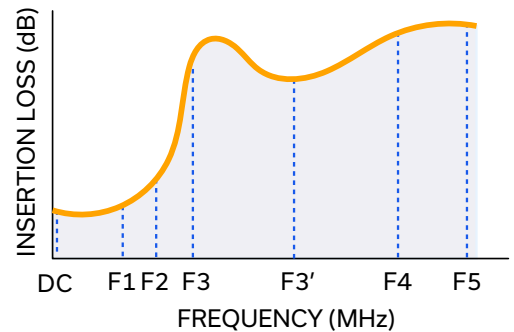
1. Measured on Mini-Circuits Characterization Test Board TB-952-172H+

### ABSOLUTE MAXIMUM RATINGS<sup>2</sup>

Parameter	Ratings
Operating Temperature	-55°C to +105°C
Storage Temperature	-65°C to +150°C
RF Power Input, Passband (DC-F1) <sup>2</sup>	7.9 W at 25°C
RF Power Input, Stopband (F2-F5) <sup>3</sup>	1.58 W at 25°C

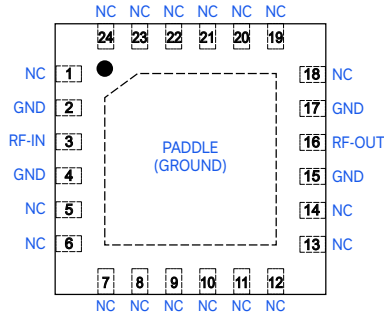
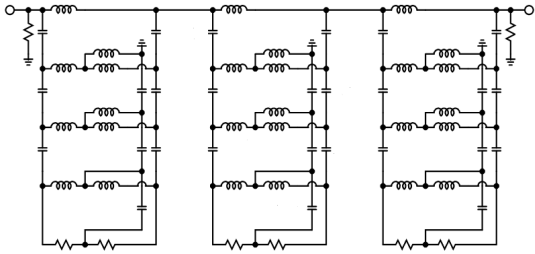
2 Passband rating derates linearly to 3.9 W at 105°C ambient  
 3 Stopband rating derates linearly to 0.75 W at 105°C ambient  
 4 Permanent damage may occur if any of these limits are exceeded.

### SPECIFICATION DEFINITION



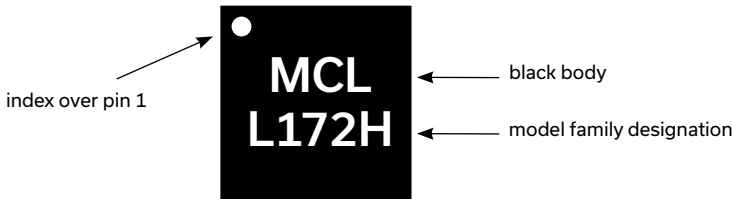


### SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



Function	Pad Number	Description
RF-IN	3	RF Input Pad
RF-OUT	16	RF Output Pad
GND	2,4,15,17 & paddle	Connected to ground
NC (GND Externally)	1, 5-14,18-24	No internal connection

### PRODUCT MARKING

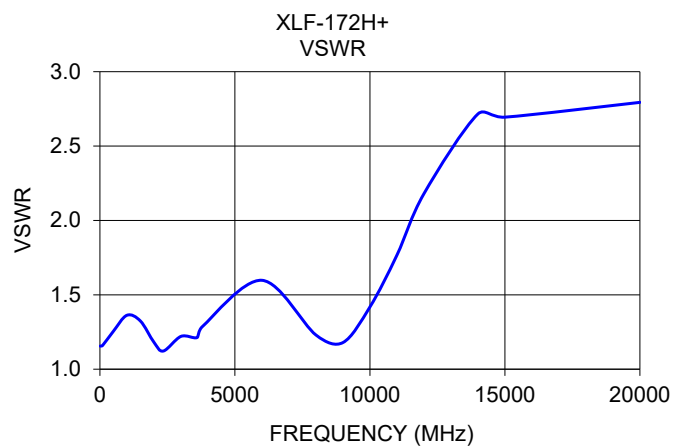
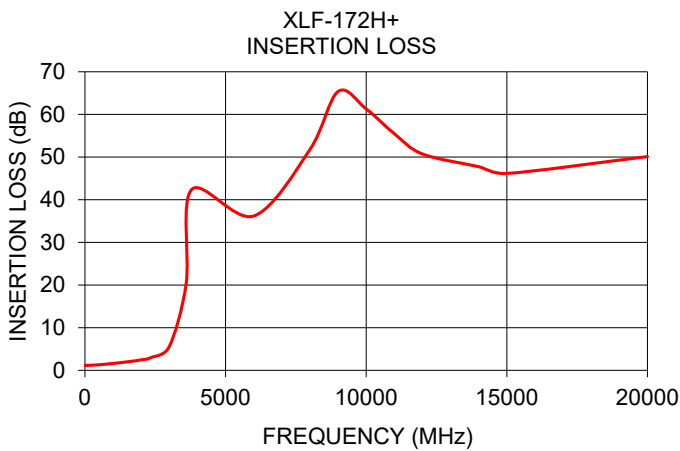


Marking may contain other features or characters for internal lot control



### TYPICAL PERFORMANCE DATA AT +25°C

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)
10	1.15	1.16
100	1.16	1.16
500	1.30	1.26
1000	1.61	1.36
1500	1.98	1.32
2000	2.45	1.18
2350	2.99	1.12
3000	5.58	1.22
3600	20.35	1.21
3800	42.42	1.29
6000	36.18	1.60
8000	51.77	1.23
9000	65.37	1.18
10000	61.29	1.42
11000	55.48	1.77
12000	50.73	2.18
14000	47.75	2.72
15000	46.17	2.69
20000	50.12	2.79





ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS [CLICK HERE](#)

Performance Data and Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file)
Case Style	DG1847 Plastic package, exposed paddle lead finish: matte-tin
Tape & Reel Standard quantities available on reel	F68 7" reels with 20, 50, 100, 200, 500 ,1000 devices 13" reels with 2000, 3000, 4000 devices
Suggested Layout for PCB Design	PL-519
Evaluation Board	TB-952-172H+
Environmental Ratings	ENV82

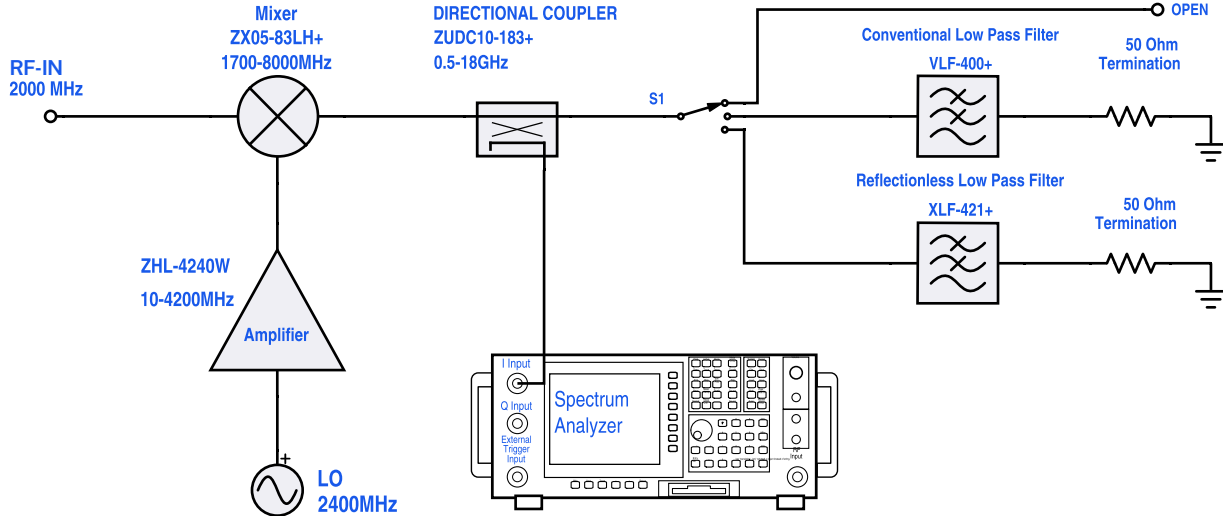
### ESD RATING

Human body model (HBM): Class 1A (Pass 250V) in accordance with ANSI/ESD 5.1-2001



### REFLECTIONLESS FILTER APPLICATION NOTE

Application Circuit Example: Pairing mixers with reflectionless filters to improve system dynamic range



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

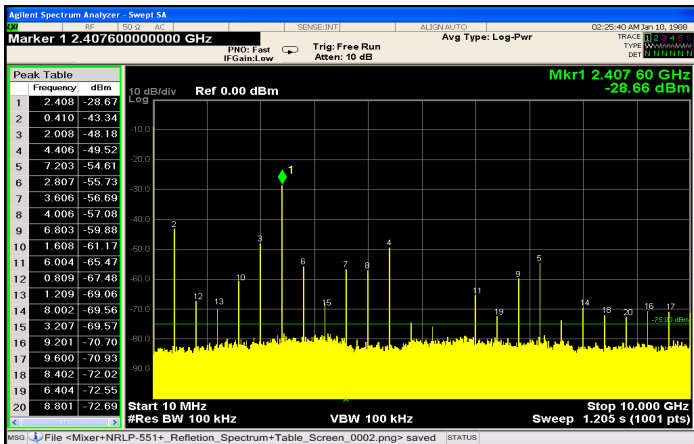


Figure 1. IF output reflection spectrum without filter

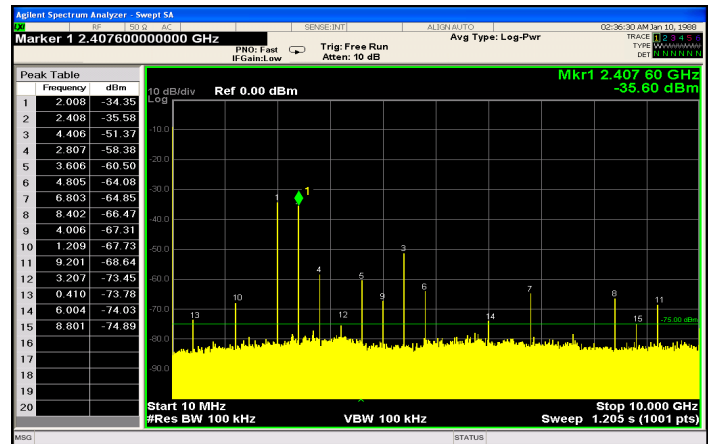
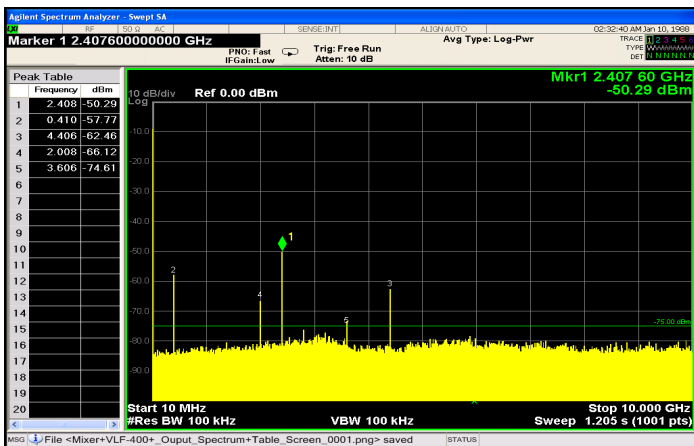


Figure 2. IF output reflection spectrum with conventional filter



An application circuit was assembled to measure the IF reflection spectrum at the output of a mixer when the mixer is 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](#)

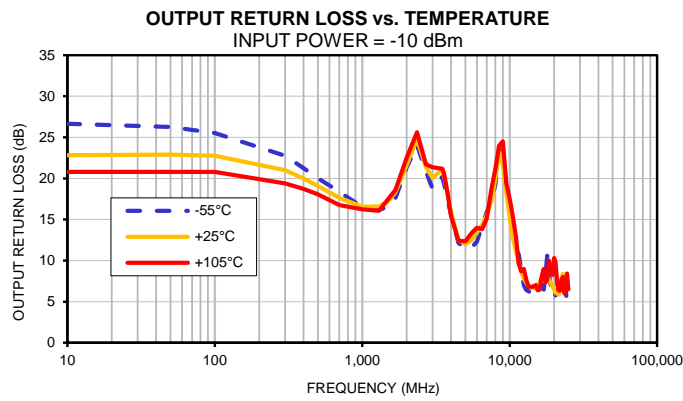
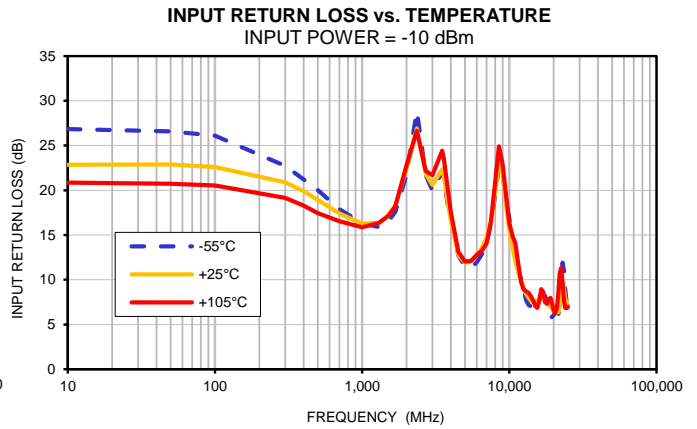
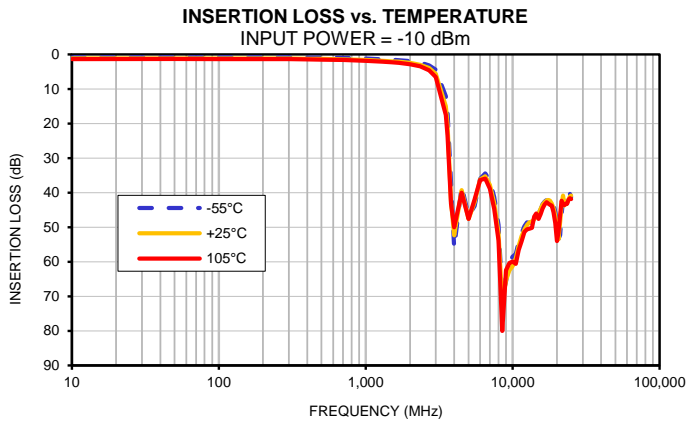
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  - B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
  - C. The parts covered by this specification 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](http://www.minicircuits.com/MCLStore/terms.jsp)

*Typical Performance Data*

FREQ.  (MHz)	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
	(dB)			(dB)			(dB)		
	@-55°C	@25°C	@+105°C	@-55°C	@+25°C	@+105°C	@-55°C	@+25°C	@+105°C
10	0.87	1.15	1.32	26.85	22.85	20.87	26.65	22.84	20.79
50	0.85	1.15	1.31	26.60	22.88	20.74	26.28	22.89	20.79
100	0.85	1.16	1.31	26.09	22.61	20.53	25.53	22.76	20.80
300	0.88	1.21	1.37	22.74	20.90	19.16	22.75	21.00	19.40
400	0.91	1.25	1.42	21.23	19.89	18.29	21.25	20.00	18.72
500	0.94	1.30	1.48	20.01	18.92	17.46	20.01	19.08	18.04
700	1.03	1.41	1.61	17.89	17.42	16.53	18.36	17.64	16.78
1000	1.21	1.61	1.83	16.29	16.28	15.87	16.51	16.56	16.24
1300	1.40	1.83	2.10	15.90	16.35	16.34	16.16	16.59	16.06
1500	1.54	1.98	2.26	16.53	17.12	17.12	16.54	17.23	17.50
1680	1.66	2.13	2.44	17.57	18.33	18.20	17.62	18.30	18.58
2000	1.92	2.45	2.82	21.73	22.41	22.79	21.32	21.60	22.51
2350	2.36	2.99	3.45	28.84	26.90	26.65	24.04	24.79	25.62
2700	3.16	3.96	4.60	21.70	21.83	22.15	20.85	21.35	21.71
3000	4.47	5.58	6.50	19.96	20.61	21.70	18.71	20.06	21.34
3500	12.14	15.04	17.49	22.11	22.33	24.44	20.20	21.06	21.17
3600	16.58	20.35	23.42	21.18	21.51	23.46	19.33	20.34	20.57
3800	37.01	42.42	43.18	18.65	18.92	20.48	17.31	18.02	17.98
4000	56.00	52.33	50.03	16.88	16.58	17.55	15.61	15.90	15.45
4500	38.14	39.23	40.00	12.72	12.79	13.12	12.12	12.53	12.41
5000	46.77	47.59	47.60	11.49	11.92	12.02	11.47	12.00	12.33
5500	43.88	42.81	41.98	11.38	12.07	12.12	11.59	12.50	13.33
6000	36.01	36.18	36.38	11.93	12.76	12.79	12.32	13.40	14.01
6500	34.45	35.27	35.94	12.87	13.59	13.25	14.20	14.33	13.82
7000	36.55	37.79	38.87	14.10	14.72	14.05	15.88	15.53	15.12
7500	41.26	43.06	44.68	16.29	16.62	16.40	17.32	17.19	18.64
8000	49.34	51.77	53.83	19.41	19.73	20.97	19.24	19.98	21.14
8500	70.11	72.05	80.03	22.77	23.18	24.90	23.37	23.29	23.99
9000	65.67	65.37	62.46	21.99	21.87	22.85	23.42	21.71	24.50
9500	59.93	62.41	60.39	18.69	18.33	19.34	18.71	18.22	19.42
10000	58.52	61.29	59.95	16.82	15.62	16.35	16.70	15.24	17.48
10500	57.76	59.06	60.62	14.50	13.61	14.91	13.33	12.87	15.53
11000	54.30	55.41	56.64	12.28	12.06	14.05	11.47	11.15	13.02
11500	51.79	52.60	54.11	11.07	10.86	11.78	10.77	9.74	9.64
12000	49.66	50.73	51.35	10.08	9.84	9.74	8.83	8.61	8.69
12500	48.59	49.38	50.63	8.87	9.03	8.88	6.98	7.77	8.99
13000	48.80	48.59	50.47	7.71	8.44	8.74	6.40	7.26	7.53
13500	48.42	48.37	50.20	7.17	7.99	8.53	6.27	6.88	6.81
14000	46.92	47.71	46.92	7.02	7.69	8.15	5.90	6.71	6.80
14500	45.73	46.88	46.01	7.17	7.57	7.67	6.05	6.64	6.83
15000	45.74	46.16	47.57	7.72	7.59	7.09	6.21	6.77	7.01
15500	44.98	44.65	46.26	8.26	7.69	6.85	6.39	7.01	6.38
16000	43.39	43.50	44.63	8.29	7.82	7.63	7.12	7.46	6.44
16500	42.58	42.76	43.42	8.02	7.94	8.96	6.88	7.90	8.05
17000	42.08	42.25	42.77	8.08	7.91	8.60	6.45	8.20	8.98
17500	41.53	42.12	43.18	8.22	7.77	7.50	8.21	8.25	7.34
18000	41.33	42.38	43.50	7.60	7.55	7.30	10.58	8.07	7.60
18500	42.10	43.19	43.76	6.55	7.25	7.79	8.31	7.70	10.01
19000	43.53	44.51	45.73	5.90	6.97	8.00	7.00	7.31	8.53
19500	45.64	46.69	48.74	5.83	6.75	7.40	7.47	6.89	8.24
20000	48.50	50.12	54.00	6.02	6.51	6.58	6.28	6.51	10.32
20500	53.42	53.55	51.60	6.36	6.35	6.27	5.74	6.09	9.79
21000	52.27	48.40	46.47	6.47	6.33	6.80	6.30	5.98	7.12
21500	46.20	43.42	42.35	6.19	6.36	8.41	6.48	5.87	6.36
22000	42.41	40.86	43.24	6.64	7.04	10.71	7.09	6.56	6.34
22500	41.32	43.65	43.64	8.60	8.87	11.32	7.91	7.96	7.73
23000	42.70	43.19	43.16	11.92	9.90	9.56	7.45	8.38	7.98
23500	42.06	43.05	43.24	11.02	8.90	7.65	7.59	7.51	5.99
24000	40.60	41.93	42.08	9.03	7.96	6.87	6.68	6.88	6.73
24500	40.39	41.11	41.59	7.43	7.43	6.82	4.52	6.53	8.42
25000	41.29	40.83	41.84	6.12	7.14	6.97	4.50	6.61	6.48
25500	41.00	40.82	40.82	5.98	6.88	7.37	5.67	6.69	5.94
26000	40.50	41.33	42.01	6.16	6.87	6.72	5.47	6.94	7.36

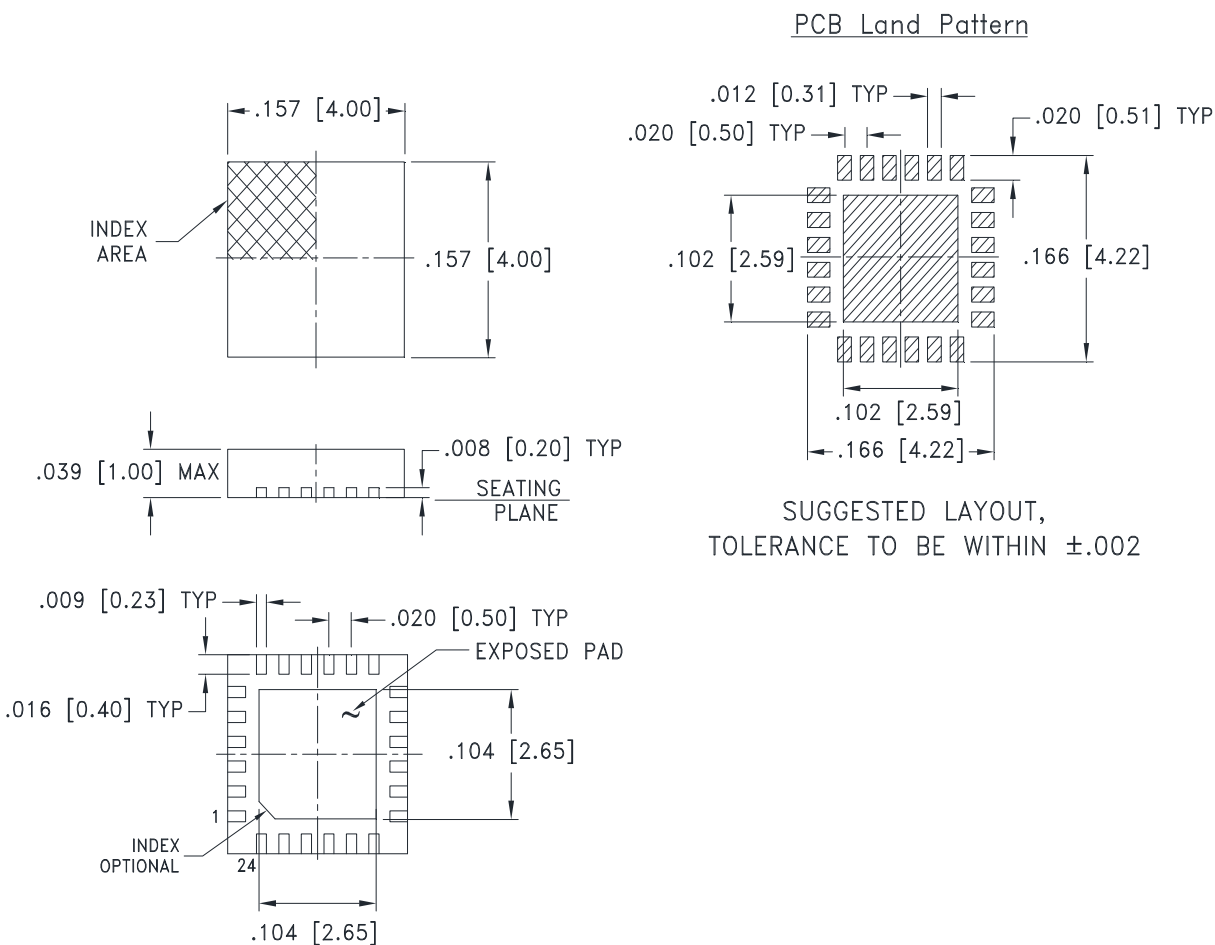


## Typical Performance Curves





### Outline Dimensions



**Weight: .04 Grams**

**Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm$  .01; 3 Pl.  $\pm$  .005**

#### 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 model Data sheet.
  - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

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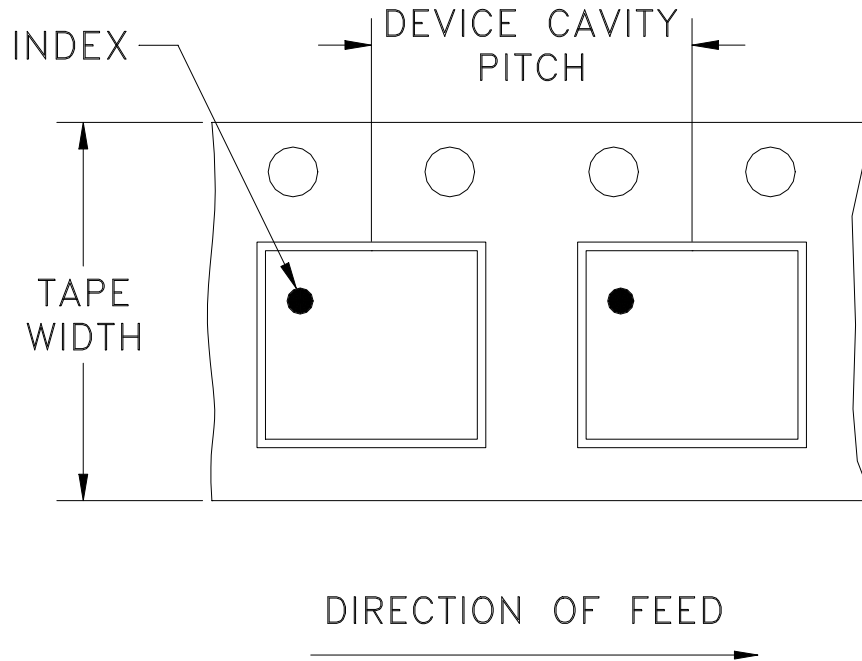
RF/IF MICROWAVE COMPONENTS

DG1847 Rev.: AH (16 FEB 23) ECO-016811 File: DG1847

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# Tape & Reel Packaging TR-F68

## DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
12	8	7	Small quantity standard	20
				50
				100
				200
				500
		7	Standard	1000
		13	Standard	2000
				3000
				4000

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](http://www.minicircuits.com/pages/pdfs/tape.pdf)



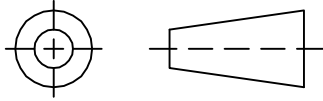
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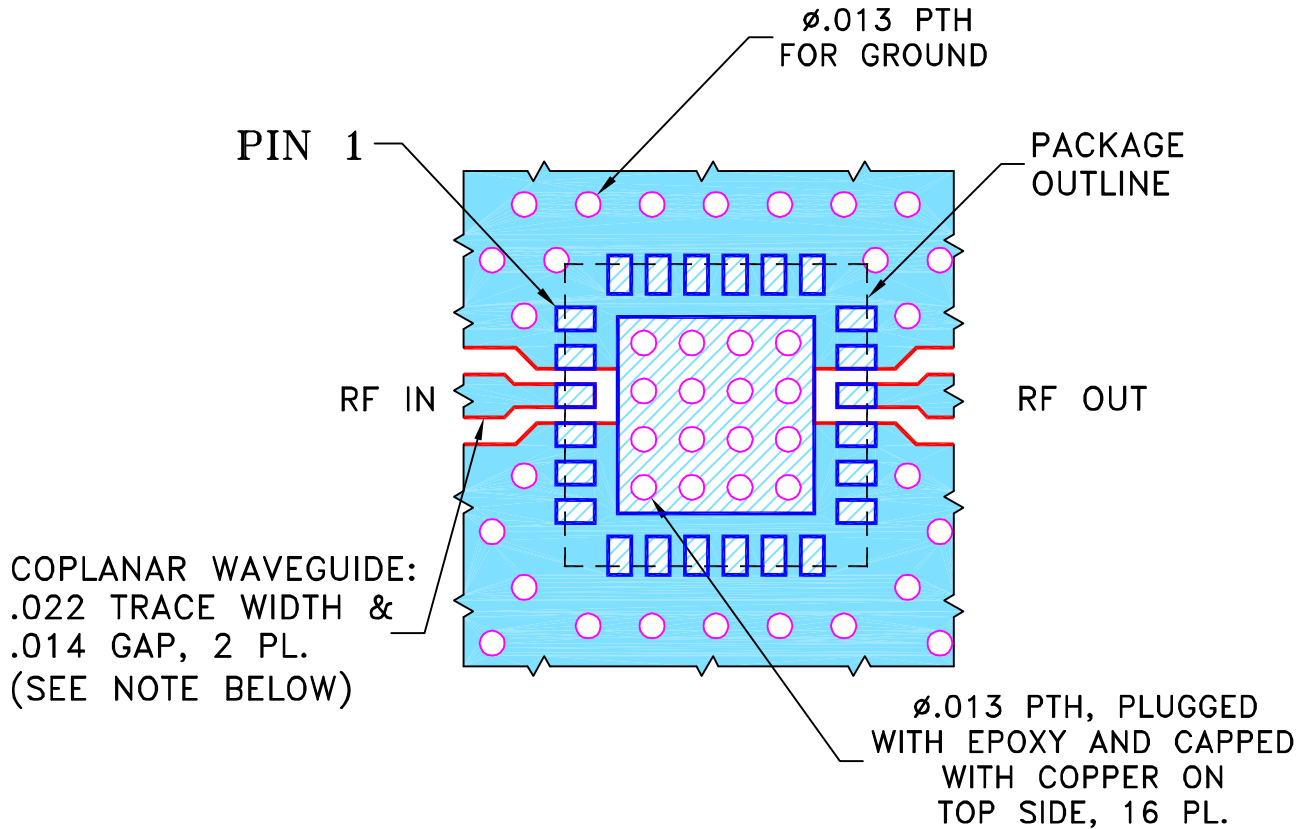
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M162496	NEW RELEASE	06/15/17	GF	RS

SUGGESTED MOUNTING CONFIGURATION FOR  
DG1847 CASE STYLE, "24FL01" PIN CONNECTION



**NOTES:**

- TRACE WIDTH & GAP ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010" ± .001"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
- 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 GF	06/14/17
TOLERANCES ON:	CHECKED IL	06/15/17
2 PL DECIMALS ±	APPROVED RS	06/15/17
3 PL DECIMALS ± .005		
ANGLES ±		
FRACTIONS ±		



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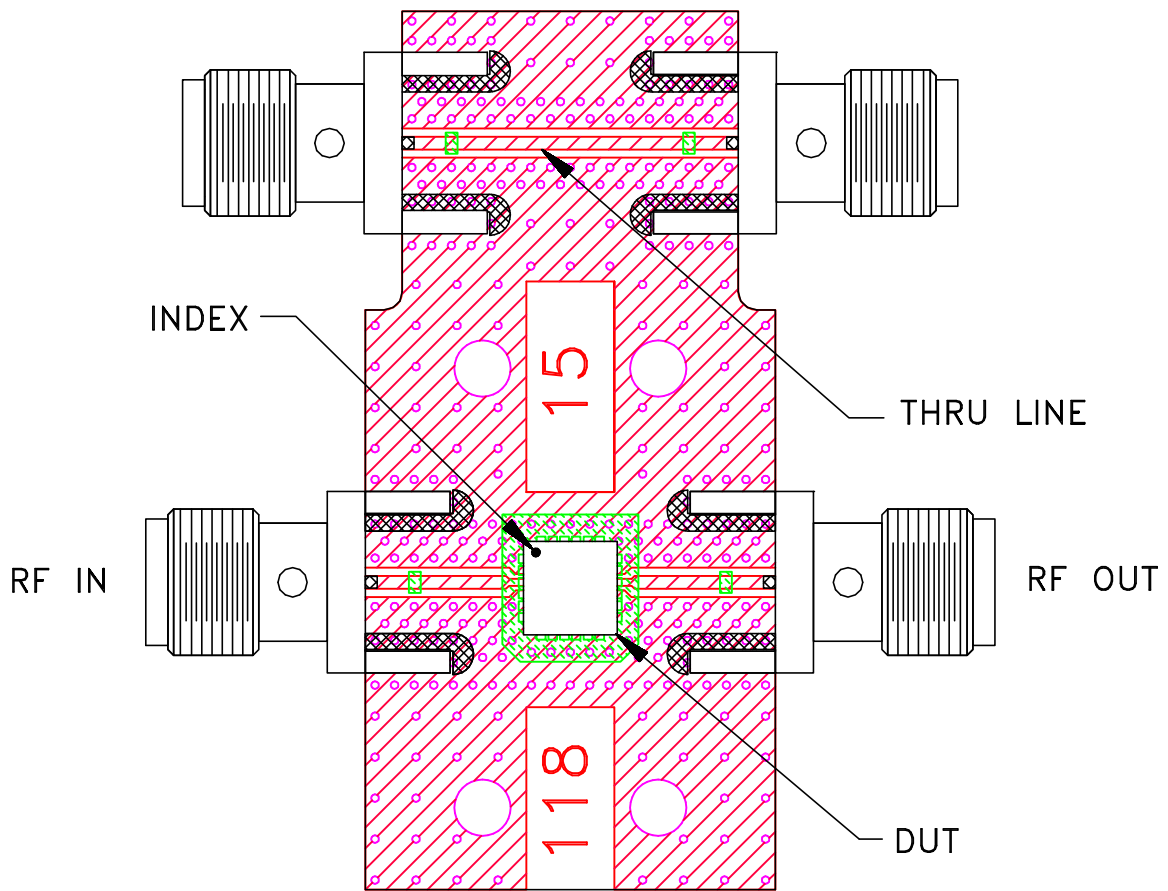
13 Neptune Avenue  
Brooklyn NY 11235

**PL, 24FL01, DG1847, TB-952+**

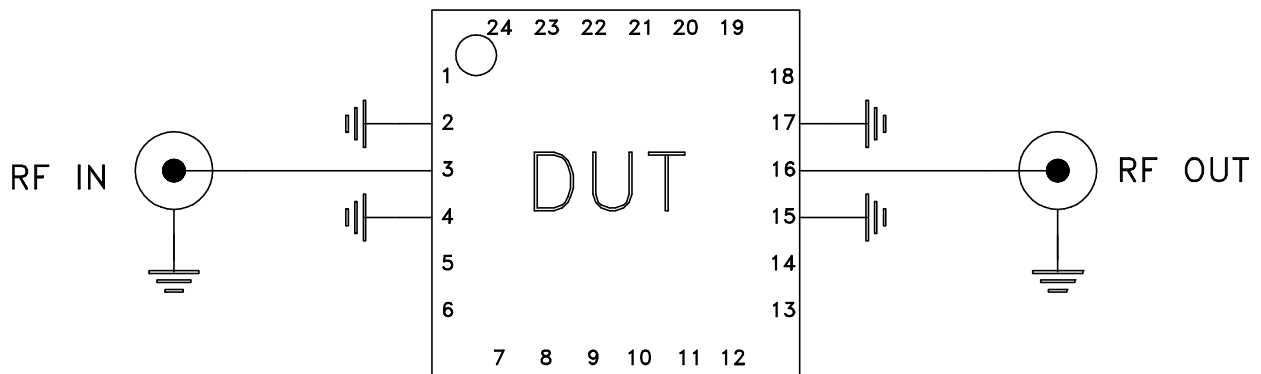
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SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-519	REV: OR
FILE: 98PL519	SCALE: 10:1	SHEET: 1 OF 1	

# Evaluation Board and Circuit



TB-952-172H+




PINS 1,5-14,18-24 - NOT CONNECTED.

Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.010 inch.

 **Mini-Circuits®**



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