

# Reflectionless High Pass Filter

## XHF2-Series

50Ω DC to 30 GHz



CASE STYLE: MC1630-1

### The Big Deal

- Patented design eliminates in band spurs
- Pass band cut-off up to 18.3 GHz
- Stop band up to 30 GHz
- Excellent repeatability through IPD\* process

### Product Overview

Mini-Circuits' XHF2-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

Easy integration with sensitive reflective components, e.g. mixers, multipliers

Enables stable integration of wideband amplifiers

Cascadable

Excellent power handling in a tiny surface mount device

Small size, 2x2mm QFN

Excellent repeatability of RF performance

Excellent stability over temperature

Operating temperature up to 105°C

### Advantages

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.

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.

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.

High power handling extends the usability of these filters to the transmit path for inter-stage filtering.

Allows replacement of filter/attenuator pairs with a single reflectionless filter, saving board space.

Through semiconductor IPD process, X-series filters are inherently repeatable for large volume production.

With ±0.3 dB variation over temperature ideal for use in wide temperature range applications without the need for additional temperature compensation.

Suitable for operation close to high power components.

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



# Reflectionless High Pass Filter

XHF2-1832+

50Ω      18.3 to 30 GHz

## Features

- Match to 50Ω in the stop band, eliminates undesired reflections
- Cascadable
- Excellent Power handling
- Temperature stable, up to 105°C
- Small size, 2 x 2 mm
- Protected by US Patent No. 8,392,495



Generic photo used for illustration purposes only

CASE STYLE: MC1630-1

## +RoHS Compliant

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

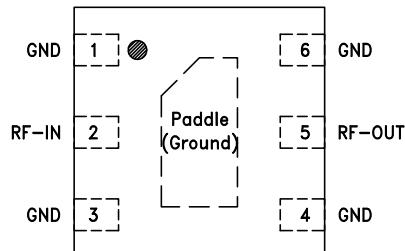
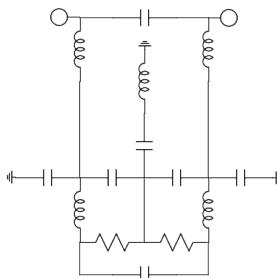
## Applications

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

## General Description

Mini-Circuits' XHF2-1832+ 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.

## simplified schematic and pad description



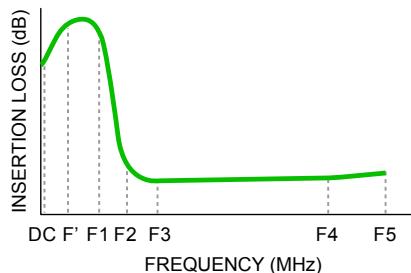
Function	Pad Number	Description
RF-IN	2	RF Input Pad
RF-OUT	5	RF Output Pad
GND	1,3,4,6, Paddle	Connected to ground externally

**Electrical Specifications<sup>1</sup> at 25°C**

Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Stop Band	Rejection	DC - F'	DC - 9000	—	6.7	—
		F' - F1	9000 - 14600	12.9	14.0	—
	Frequency Cut-off	F2	17500	—	3.0	—
Pass Band	VSWR	DC - F'	DC - 9000	—	2.8	—
		F' - F1	9000 - 14600	—	1.7	—
						:1
Pass Band	Insertion Loss	F3 - F4	18300 - 25000	—	2.1	—
		F4 - F5	25000 - 30000	—	1.3	—
	VSWR	F3 - F4	18300 - 25000	—	1.7	—
		F4 - F5	25000 - 30000	—	1.7	—
						:1

<sup>1</sup> Measured on Mini-Circuits Characterization Test Board TB-883-1832+**Absolute Maximum Ratings<sup>4</sup>**

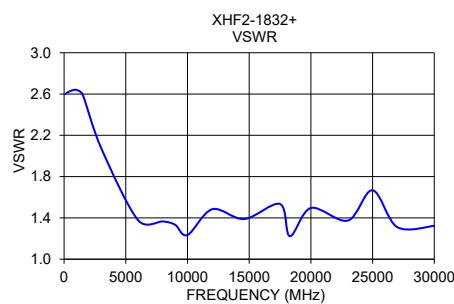
Parameter	Ratings
Operating Temperature	-55°C to +105°C
Storage Temperature	-65°C to +150°C
RF Power Input, Passband (F3-F5) <sup>2</sup>	0.32W at 25°C
RF Power Input, Stopband (DC-F3) <sup>3</sup>	0.09W at 25°C

<sup>2</sup> Passband rating derates linearly to 0.16W at 105°C ambient<sup>3</sup> Stopband rating derates linearly to 0.04W at 105°C ambient<sup>4</sup> Permanent damage may occur if any of these limits are exceeded.**Specification Definition****ESD rating**

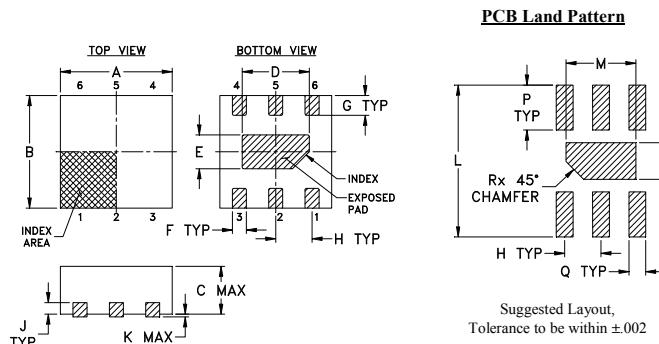
Human body model (HBM): Class 1A (250 to &lt;500 V) in accordance with ANSI/ESD 5.1-2001

**Typical Performance Data at 25°C**

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)
100	6.83	2.60
500	7.16	2.63
1000	8.12	2.64
1500	9.54	2.60
3000	15.60	2.08
6000	21.60	1.38
8000	29.02	1.37
9000	32.39	1.33
10000	21.01	1.23
12000	14.40	1.48
14600	15.12	1.39
17500	2.90	1.53
18300	1.93	1.22
20000	1.24	1.50
23000	0.91	1.37
25000	0.92	1.67
27000	0.70	1.31
30000	0.78	1.32



## Outline Drawing



PCB Land Pattern

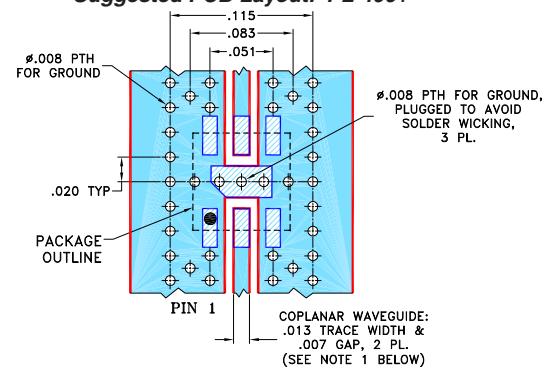
Demo Board MCL P/N:

TB-883-1832+ (without connectors)

TB-883-1832C+ (with connectors)

B20-118-F1+ Connector sold separately

Suggested PCB Layout: PL-499+



## NOTES:

1. COPLANAR WAVEGUIDE IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .0066" ± .0007"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH 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

## Outline Dimensions ( inch mm )

A	B	C	D	E	F	G	H	J
0.079	0.079	0.039	0.047	0.024	0.010	0.014	0.026	0.008
2.00	2.00	1.00	1.20	0.60	0.25	0.35	0.65	0.20
K	L	M	N	P	Q	R	wt	
0.002	0.106	0.049	0.026	0.031	0.012	0.012	grams	
0.05	2.70	1.25	0.65	0.80	0.30	0.30		0.006

## Product Marking



# MMIC Reflectionless High Pass Filter

XHF2-1832+

## Typical Performance Data

FREQ. (MHz)	INSERTION LOSS (dB)			INPUT RETURN LOSS (dB)			OUTPUT RETURN LOSS (dB)		
	@-55°C	@25°C	@+105°C	@-55°C	@+25°C	@+105°C	@-55°C	@+25°C	@+105°C
	6.82	6.83	6.83	7.03	7.05	7.05	7.01	7.04	7.05
500	7.13	7.16	7.18	6.92	6.97	6.99	6.92	6.96	6.98
1000	8.05	8.11	8.16	6.92	6.96	7.01	6.91	6.93	6.97
1500	9.42	9.52	9.59	7.06	7.12	7.18	7.04	7.06	7.11
2000	11.16	11.27	11.38	7.45	7.55	7.63	7.40	7.44	7.52
2500	13.15	13.30	13.44	8.16	8.30	8.44	8.04	8.12	8.25
3000	15.38	15.59	15.79	9.14	9.35	9.53	8.95	9.11	9.30
3500	17.77	18.07	18.33	10.47	10.68	10.93	10.17	10.42	10.67
4000	20.02	20.36	20.66	11.94	12.16	12.40	11.61	11.95	12.20
4500	21.45	21.73	21.98	13.31	13.60	13.79	13.07	13.55	13.74
5000	21.78	21.95	22.10	14.24	14.74	15.00	14.30	14.99	15.24
5500	21.58	21.68	21.79	14.79	15.53	16.07	15.20	16.04	16.58
6000	21.49	21.59	21.70	15.06	16.00	16.72	15.73	16.60	17.45
6500	21.84	21.99	22.13	15.19	16.17	16.92	16.07	16.77	17.69
7000	22.85	23.06	23.27	15.32	16.23	16.90	16.34	16.80	17.56
7500	24.81	25.11	25.42	15.44	16.22	16.85	16.43	16.76	17.33
8000	28.58	29.01	29.39	15.52	16.21	16.94	16.49	16.86	17.41
8500	37.66	37.39	36.64	15.78	16.39	17.36	16.60	17.20	17.99
9000	33.89	32.38	31.15	16.32	16.90	18.06	16.90	17.91	19.00
9500	25.57	25.14	24.75	17.30	18.07	19.05	17.67	19.19	20.62
10000	21.15	21.00	20.87	18.41	19.59	20.33	18.57	20.72	22.17
10500	18.24	18.23	18.23	18.82	20.34	21.09	19.02	21.02	22.19
11000	16.23	16.32	16.42	18.00	19.12	20.08	18.27	19.03	19.63
11500	14.87	15.07	15.25	16.45	16.88	17.67	16.59	16.42	16.68
12000	14.10	14.39	14.64	14.79	14.74	15.19	14.75	14.21	14.20
12500	13.87	14.25	14.62	13.42	13.23	13.27	13.37	12.69	12.54
13000	14.25	14.72	15.19	12.53	12.43	12.17	12.42	11.79	11.55
13500	15.42	15.91	16.35	12.10	12.22	11.84	12.11	11.64	11.44
14000	17.32	17.33	17.16	12.39	12.89	12.60	12.47	12.39	12.37
14500	17.08	15.89	14.93	14.22	15.19	15.41	14.18	14.85	15.13
15000	12.66	11.72	11.03	19.64	21.92	23.65	19.22	21.77	21.72
15500	8.71	8.31	8.04	28.37	27.92	21.88	38.76	23.32	19.25
16000	6.24	6.14	6.13	16.82	16.50	14.98	17.89	15.44	14.13
16500	4.72	4.75	4.85	13.14	13.18	12.70	13.59	12.68	12.20
17000	3.63	3.72	3.86	12.23	12.47	12.56	12.45	12.31	12.31
17500	2.79	2.89	3.06	12.96	13.52	14.15	12.90	13.56	14.11
18000	2.11	2.24	2.43	15.26	16.59	17.88	14.83	16.89	18.24
18500	1.59	1.76	1.99	21.01	23.37	23.90	19.42	23.95	26.36
19000	1.25	1.46	1.73	29.34	22.74	18.96	27.77	24.55	20.33
19500	1.08	1.31	1.62	18.33	16.81	14.86	20.40	17.79	15.74
20000	1.02	1.24	1.55	13.93	14.03	13.09	15.42	14.98	14.03
20500	1.00	1.18	1.48	12.37	13.42	13.14	13.61	14.39	14.35
21000	0.95	1.11	1.38	12.28	14.06	14.56	13.53	15.39	16.68
21500	0.85	1.01	1.28	14.06	16.43	17.68	15.28	18.65	22.65
22000	0.72	0.93	1.23	18.11	20.14	18.90	20.20	27.11	25.87
22500	0.65	0.90	1.25	23.31	19.92	15.70	34.26	23.80	17.18
23000	0.64	0.91	1.32	18.87	16.05	12.80	21.65	17.15	13.48
23500	0.68	0.95	1.36	14.83	13.46	11.34	16.24	13.98	11.63
24000	0.71	0.97	1.34	13.00	12.31	11.08	14.03	12.55	11.14
24500	0.72	0.96	1.28	12.00	11.83	11.58	12.86	11.92	11.41
25000	0.72	0.92	1.19	11.84	12.16	12.80	12.51	12.03	12.48
25500	0.69	0.87	1.10	12.09	12.89	14.74	12.58	12.66	14.02
26000	0.62	0.79	1.03	12.76	14.27	17.19	13.15	13.90	16.01
26500	0.58	0.75	1.01	13.94	16.06	19.00	13.68	15.21	17.33
27000	0.51	0.70	0.98	15.63	18.83	20.19	15.06	17.44	19.02
27500	0.46	0.66	0.97	17.60	21.47	21.26	16.65	19.74	20.55
28000	0.43	0.65	0.97	19.13	22.44	21.63	18.64	21.75	22.93
28500	0.41	0.64	0.97	19.28	21.69	21.90	19.92	23.19	26.93
29000	0.44	0.66	1.01	17.97	20.21	20.91	19.64	24.29	33.55
29500	0.46	0.70	1.07	17.55	19.46	18.80	21.00	31.17	29.69
30000	0.49	0.78	1.20	17.53	17.14	15.12	23.54	25.87	18.67



ISO 9001 ISO 14001 AS 9100 CERTIFIED

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 • Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

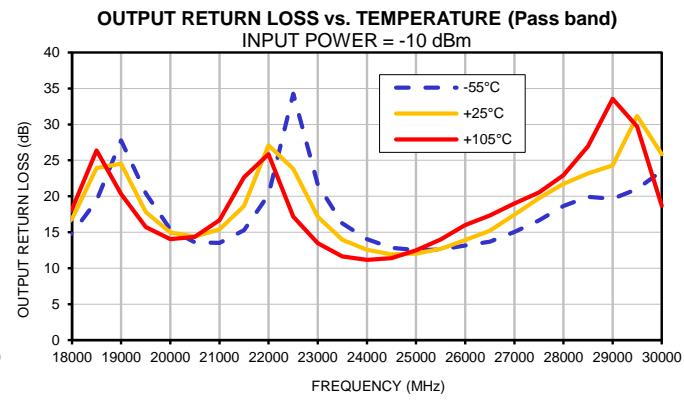
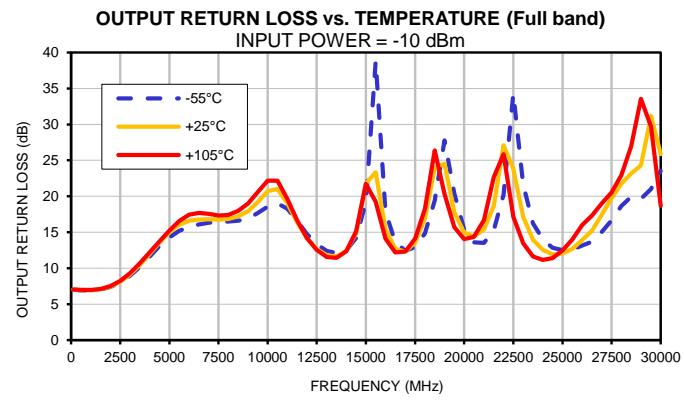
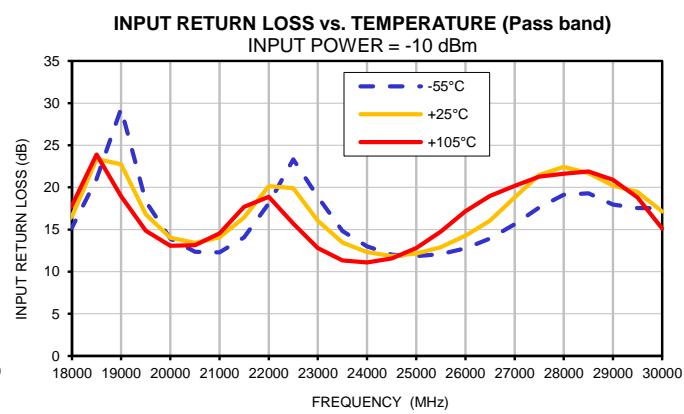
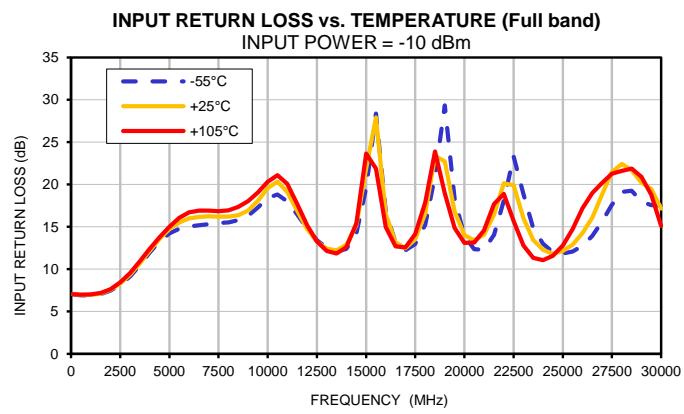
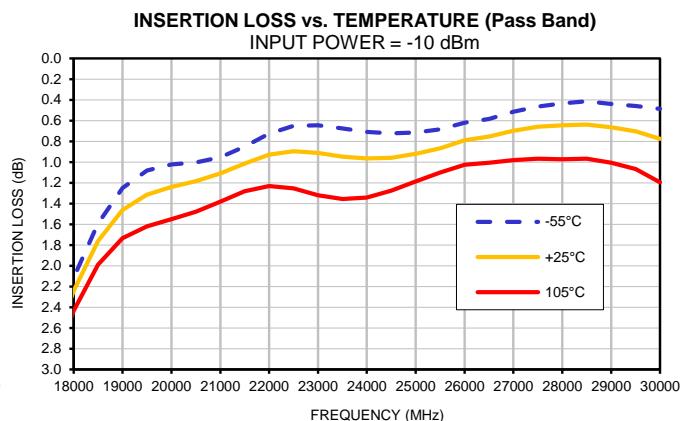
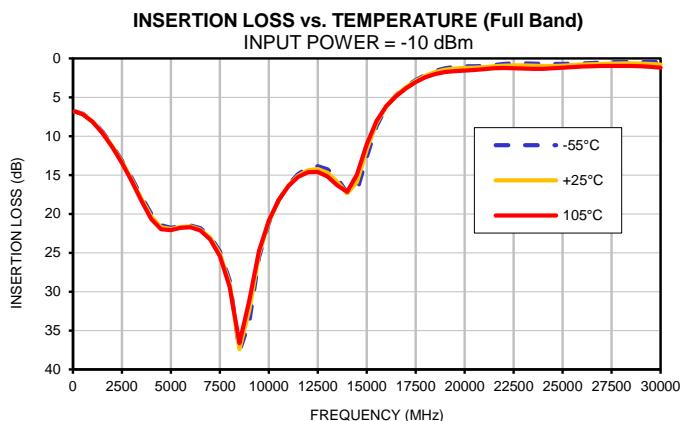
IF/RF MICROWAVE COMPONENTS



# MMIC Reflectionless High Pass Filter

XHF2-1832+

## Typical Performance Curves



 **Mini-Circuits®**

ISO 9001 ISO 14001 AS 9100 CERTIFIED

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 • Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site  
 The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

IF/RF MICROWAVE COMPONENTS

  
[minicircuits.com](http://minicircuits.com)

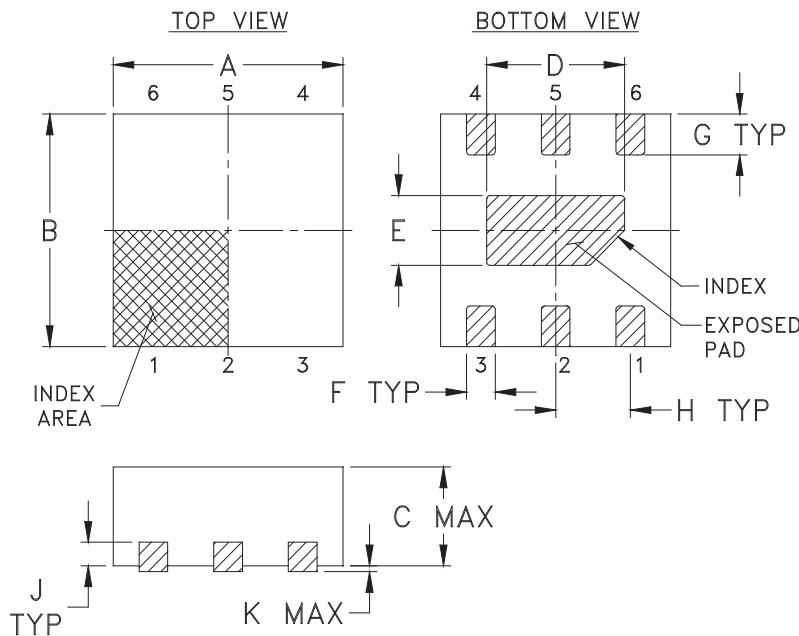
REV. OR  
XHF2-1832+  
1/11/2017  
Page 1 of 1

# Case Style

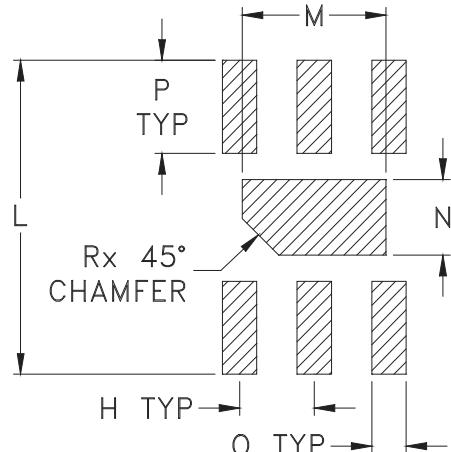
MC

MC1630-1

## Outline Dimensions



### PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

CASE #.	A	B	C	D	E	F	G	H	J	K	L	M	N	P
MC1630-1	.079 (2.00)	.079 (2.00)	.039 (1.00)	.047 (1.20)	.024 (.60)	.010 (.25)	.014 (.35)	.026 (.65)	.008 (.20)	.002 (.05)	.106 (2.70)	.049 (1.25)	.026 (.65)	.031 (.80)

CASE #.	Q	R	WT, GRAM
MC1630-1	.012 (.30)	.012 (.30)	.006

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 over Nickel plated or Matte-Tin plated (See Data sheet).  
All models, (+) suffix.

3. Lead #1 identifier shall be located in the cross-hatched area shown.

Identifier may be either a molded or marked feature.



P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site

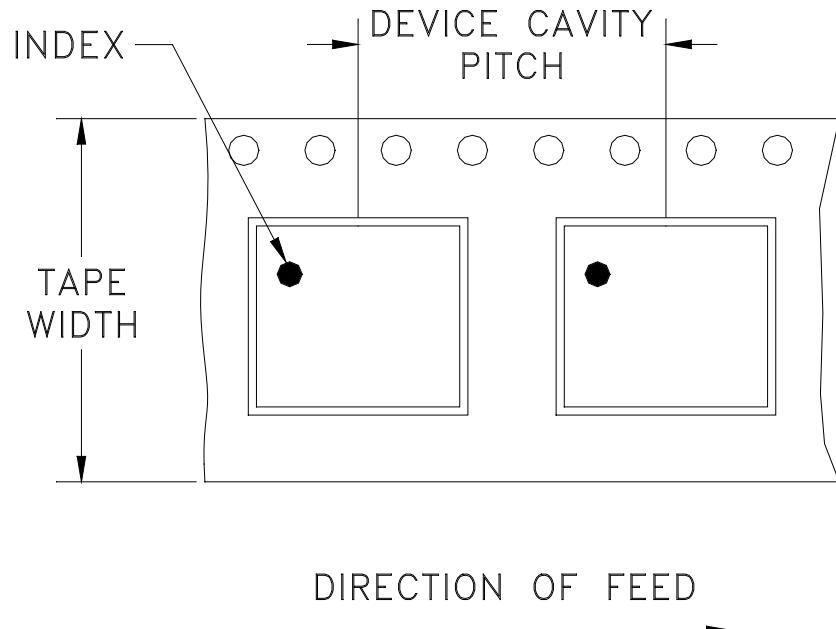


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

RF/I/F MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F66

## DEVICE ORIENTATION IN T&R



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



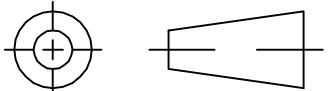
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010

INTERNET <http://www.minicircuits.com>

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

Mini-Circuits ISO 9001 & ISO 14001 Certified

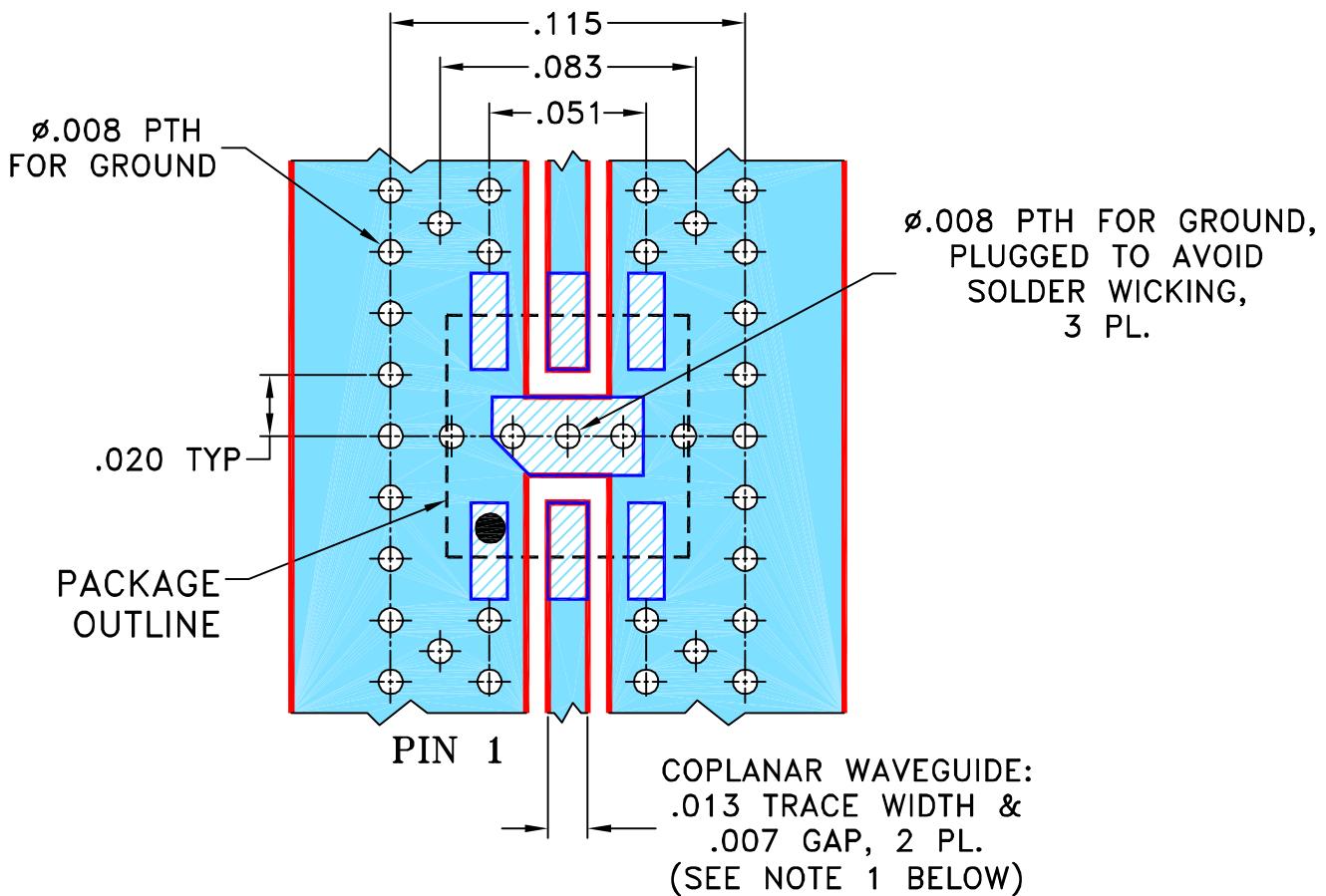
## THIRD ANGLE PROJECTION



## REVISI0NS

REV OR	ECN No. M160396	DESCRIPTION NEW RELEASE	DATE 02/23/17	DR GF	AUTH RS

SUGGESTED MOUNTING CONFIGURATION FOR  
MC1630-1 CASE STYLE, "06FL03" PIN CODE

NOTES:

1. COPLANAR WAVEGUIDE IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS  $.0066" \pm .0007"$ ; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH 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 GF 02/20/17

TOLERANCES ON:

CHECKED ITG 02/22/17

2 PL DECIMALS  $\pm$ 

APPROVED RS 02/23/17

3 PL DECIMALS  $\pm .005$ ANGLES  $\pm$ FRACTIONS  $\pm$ 

Mini-Circuits®

THIS DOCUMENT AND ITS CONTENTS ARE THE PROPERTY OF MINI-CIRCUITS.  
EXCEPT FOR USE EXPRESSLY GRANTED, IN WRITING, TO ITS VENDORS, VENDEE  
AND THE UNITED STATES GOVERNMENT, MINI-CIRCUITS RESERVES ALL PROPRIETARY  
DESIGN, USE, MANUFACTURING AND REPRODUCTION RIGHTS THERETO.  
THESE CONTENTS SHALL NOT BE USED, DUPLICATED OR DISCLOSED TO ANY OUTSIDE  
PARTY, IN WHOLE OR IN PART, WITHOUT WRITTEN PERMISSION OF MINI-CIRCUITS.

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



Mini-Circuits®

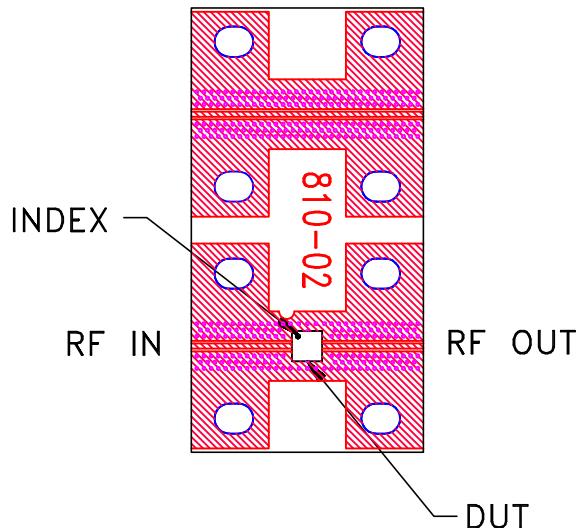
13 Neptune Avenue  
Brooklyn NY 11235

PL, 06FL03, MC1630-1,  
TB-883-XX+

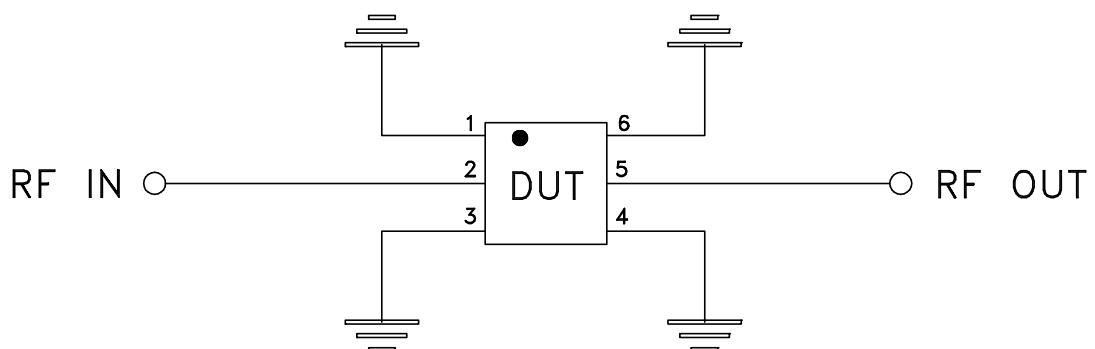
SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-499	REV: OR
FILE: 98PL499	SCALE: 16:1	SHEET: 1 OF 1	

# Evaluation Board and Circuit

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



TB-883-1832+



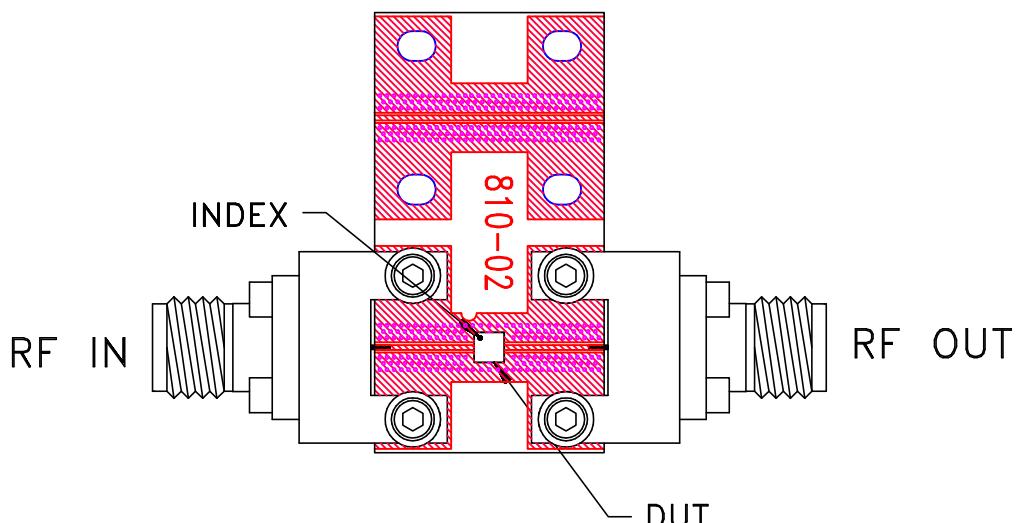
Schematic Diagram

Note:

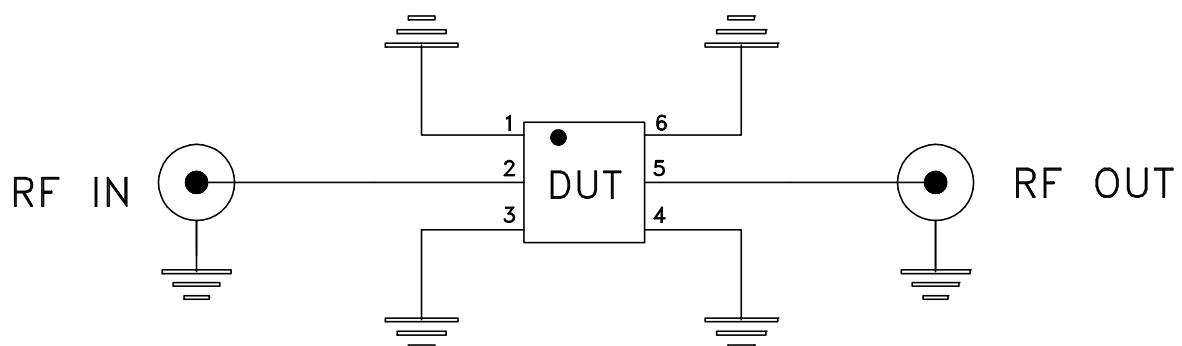
PCB Material: R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.0066 inch.

 **Mini-Circuits®**

# Evaluation Board and Circuit



TB-883-1832C+



Schematic Diagram

Notes:

1. 50 Ohm 2.92mm Female end launch connectors.
2. PCB Material: RO4350 or equivalent,  
Dielectric Constant=3.5, Thickness=.0066 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 + propylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215