Surface Mount

Bandpass Filter

BPF-E16+

50Ω 2 to 30 MHz

CASE STYLE: HR1176

The Big Deal

- Low isertion loss (1 dB typical)
- Good VSWR (1.4:1 typical)
- High rejection
- Fast roll-off

Product Overview

The BPF-E16+ is a 50Ω band pass filter in a shielded package (size of 1.20" x 1.20" x 0.370") fabricated using SMT technology. These units offer good matching within the pass band and high rejection. This unit has miniature high Q capacitors and wire welded inductors for high reliability. In addition it has repeatable performance across production lots and consistent performance across temperature.

Key Features

Feature	Advantages
Sharp shape factor	Sharp shape factor helps in adjacent channel rejection and increased selectivity.
Good VSWR, 1.4:1 typical in passband	The BPF-E16+ has very good return loss which provides good matching when used with other devices.
More than 40dB rejection up to 500MHz	This enables the filter to attenuate spurious signals and reject harmonics for broad band of frequency.
Shielded case	Reduced interference with and from the surrounding components.

Notes
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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

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Bandpass Filter

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CASE STYLE: HR1176

Features

- Excellent VSWR, 1.4:1 typical in passband
- High rejection
- Sharp insertion loss roll off
- Shielded case
- Aqueous washable

Applications

- Harmonic rejection
- Transmitters / receivers
- Lab use

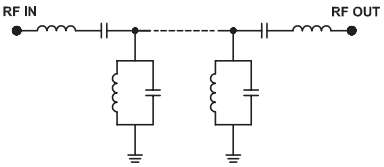
Electrical Specifications at 25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Center Frequency	—	—	—	16	—	MHz
	Insertion Loss	F1-F2	2-30	—	1.5	3.0	dB
	VSWR	F1-F2	2-30	—	1.4	1.9	:1
Stop Band, Lower	Insertion Loss	DC-F3	DC-1.4	20	40	—	dB
	VSWR	DC-F3	DC-1.4	—	21	—	:1
Stop Band, Upper	Insertion Loss	F4-F5	35-500	20	32	—	dB
	VSWR	F4-F5	35-500	—	22	—	:1

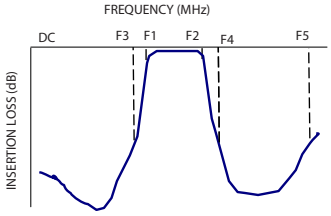
Maximum Ratings	
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	0.5W max.

Permanent damage may occur if any of these limits are exceeded.

Functional Schematic



Typical Frequency Response

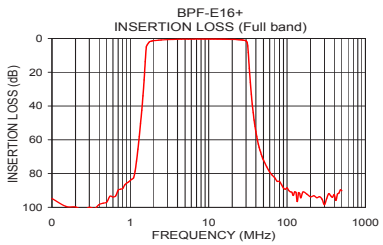


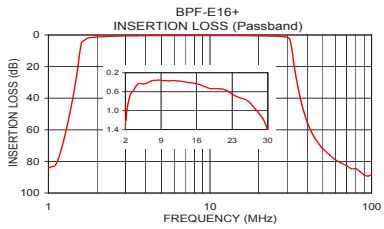
Typical Performance Data at 25°C

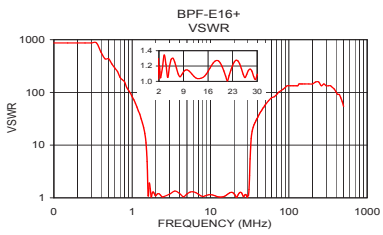
Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)	Frequency (MHz)	Group Delay (nsec)
0.10	89.63	868.59	2	1325.56
1.20	72.57	44.55	4	269.01
1.40	41.88	21.46	6	146.43
1.50	23.78	11.03	8	108.69
1.55	12.95	4.88	10	91.88
1.60	4.84	1.10	11	87.19
1.70	2.58	1.49	12	84.03
2.00	1.25	1.09	13	81.77
3.00	0.70	1.18	14	80.25
16.00	0.49	1.13	15	79.26
25.00	0.81	1.23	16	78.69
30.00	1.47	1.09	17	78.29
31.00	2.29	1.44	18	78.21
31.50	4.11	2.65	20	80.84
32.00	7.86	5.47	22	84.77
33.00	17.29	13.29	24	89.39
35.00	32.63	21.73	25	94.14
40.00	54.55	33.42	26	100.52
200.00	91.51	144.77	28	116.42
500.00	93.56	54.29	30	156.93

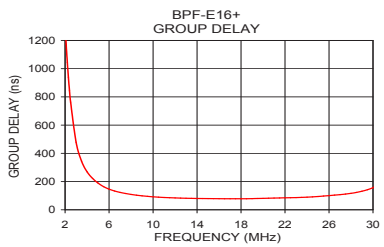
+RoHS Compliant

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









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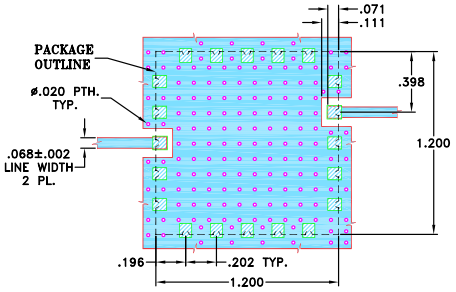
Pad Connections

INPUT	18
OUTPUT	9
GROUND	1-8, 10-17, 19-,20

Demo Board MCL P/N: TB-573+
Suggested PCB Layout (PL-329)

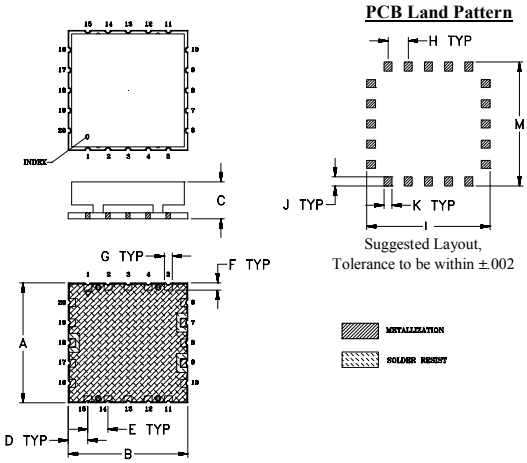


NOTES:
1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030"±.003". COPPER: 1/2 OZ. EACH SIDE.
   FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

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

DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK

Outline Drawing



Outline Dimensions (inch / mm)

A	B	C	D	E	F	G
1.200	1.200	.370	.196	.202	.071	.079
30.48	30.48	9.40	4.98	5.13	1.80	2.01

H	J	K	L	M	wt
.202	.091	.079	1.240	1.240	grams
5.13	2.31	2.01	31.50	31.50	8.5

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Surface Mount Band Pass Filter BPF-E16+

Typical Performance Data

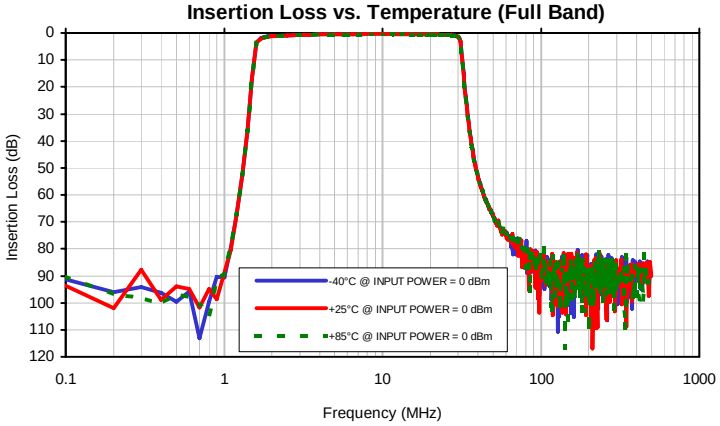
FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(MHz)	(dB)			(dB)			(dB)		
	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C
0.1	91.24	93.70	90.14	0.03	0.04	0.03	0.03	0.04	0.03
0.2	96.02	102.00	96.95	0.02	0.03	0.03	0.03	0.02	0.02
0.3	94.26	87.86	98.30	0.01	0.01	0.01	0.01	0.02	0.01
0.4	96.30	99.00	100.33	0.01	0.02	0.02	0.02	0.02	0.02
0.5	99.65	93.80	97.07	0.03	0.03	0.02	0.01	0.03	0.01
0.6	95.70	94.82	97.75	0.03	0.03	0.04	0.02	0.02	0.03
0.7	113.23	101.70	101.08	0.04	0.04	0.06	0.02	0.04	0.02
0.8	99.58	94.80	104.71	0.07	0.06	0.07	0.04	0.06	0.05
0.9	90.46	98.68	91.43	0.07	0.08	0.10	0.07	0.06	0.07
1.0	90.65	88.69	89.00	0.10	0.13	0.13	0.08	0.11	0.10
1.1	79.47	80.37	78.73	0.14	0.17	0.18	0.12	0.16	0.17
1.2	67.41	67.43	67.16	0.22	0.25	0.28	0.19	0.22	0.24
1.3	52.59	52.51	52.73	0.37	0.39	0.43	0.30	0.34	0.37
1.4	36.35	36.23	36.47	0.66	0.72	0.78	0.52	0.58	0.62
1.5	16.95	16.84	17.21	2.15	2.35	2.47	1.41	1.54	1.61
1.6	3.47	3.64	3.91	12.64	12.74	13.04	9.00	9.06	8.98
1.7	1.95	2.07	2.22	22.70	23.44	23.14	19.02	19.25	18.94
1.8	1.53	1.61	1.71	19.25	19.37	19.37	19.66	19.87	19.87
1.9	1.27	1.34	1.42	21.05	21.26	21.17	24.07	24.44	24.39
2.0	1.09	1.16	1.23	23.81	23.99	24.09	25.87	25.80	25.96
3.0	0.69	0.73	0.75	21.31	21.01	21.02	21.13	20.81	20.77
4.0	0.52	0.56	0.57	18.73	18.83	18.87	19.07	19.26	19.36
5.0	0.44	0.48	0.48	18.30	18.05	17.92	18.70	18.37	18.22
6.0	0.47	0.51	0.51	15.08	14.96	14.89	15.07	14.95	14.85
7.0	0.38	0.41	0.42	18.35	18.29	18.14	18.39	18.34	18.23
8.0	0.33	0.35	0.35	28.05	27.80	27.24	29.43	29.55	29.17
9.0	0.32	0.34	0.34	28.12	28.02	28.21	29.40	29.28	29.72
10.0	0.32	0.35	0.34	23.61	23.73	24.02	23.78	23.85	24.12
15.0	0.35	0.38	0.37	31.26	31.05	30.66	30.98	31.31	31.29
20.0	0.48	0.49	0.51	26.22	26.39	26.38	26.28	26.28	26.15
21.0	0.50	0.52	0.54	27.29	27.29	27.47	27.19	27.42	27.75
22.0	0.54	0.56	0.58	23.66	23.36	23.23	23.69	23.65	23.70
23.0	0.60	0.61	0.64	21.64	21.34	21.17	21.80	21.63	21.53
24.0	0.64	0.65	0.67	23.03	22.93	22.71	23.29	23.22	22.97
25.0	0.67	0.69	0.72	32.56	33.58	33.28	34.19	34.65	33.72
26.0	0.75	0.77	0.80	26.01	25.47	25.49	25.95	25.60	25.73
27.0	0.88	0.90	0.94	19.75	19.58	19.46	19.80	19.70	19.65
28.0	1.00	1.02	1.06	20.54	20.70	20.54	20.84	21.09	20.94
29.0	1.14	1.16	1.22	29.19	29.77	29.90	42.06	40.90	40.02
30.0	1.46	1.51	1.59	28.99	32.54	35.44	23.59	23.60	23.45
31.0	3.02	3.39	3.61	9.71	8.43	8.15	9.02	7.87	7.58
32.0	10.34	11.16	11.47	2.01	1.81	1.83	1.92	1.76	1.78
33.0	19.37	20.15	20.45	0.84	0.81	0.84	0.81	0.81	0.85
34.0	27.06	27.71	27.96	0.55	0.55	0.57	0.54	0.56	0.60
35.0	33.45	34.01	34.21	0.45	0.44	0.46	0.42	0.45	0.48
36.0	38.78	39.30	39.51	0.38	0.38	0.39	0.36	0.39	0.41
37.0	43.24	43.71	43.88	0.33	0.33	0.35	0.33	0.36	0.37
38.0	46.96	47.50	47.53	0.31	0.31	0.32	0.29	0.32	0.34
39.0	50.20	50.69	50.71	0.27	0.28	0.29	0.26	0.29	0.30
40.0	53.01	53.14	53.25	0.26	0.27	0.28	0.25	0.28	0.29
50.0	68.13	67.48	67.57	0.20	0.20	0.22	0.19	0.22	0.22
100.0	85.31	87.28	86.53	0.16	0.17	0.18	0.09	0.13	0.15
200.0	93.46	87.59	98.26	0.15	0.17	0.18	0.07	0.13	0.16
300.0	87.15	87.33	88.16	0.15	0.18	0.20	0.07	0.15	0.17
400.0	91.43	88.43	96.35	0.17	0.21	0.23	0.09	0.19	0.24
500.0	90.16	89.63	91.84	0.18	0.23	0.26	0.22	0.38	0.47

Typical Performance Data

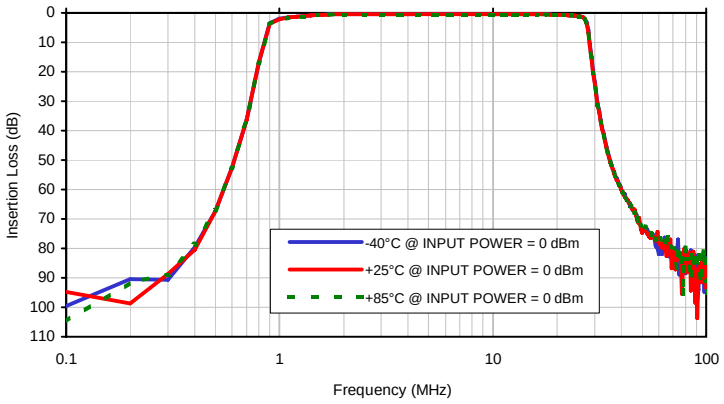
FREQ. (MHz)	GROUP DELAY (nsec)		
	@-40°C	@+25°C	@+85°C
2.0	1242.09	1238.89	1241.22
3.0	466.35	466.01	466.36
3.5	336.61	336.51	336.67
4.0	264.66	264.45	264.84
4.5	219.93	219.69	220.06
5.0	186.21	186.31	186.34
5.5	161.37	161.17	161.12
6.0	143.61	143.61	143.68
6.5	130.93	131.19	131.29
7.0	121.92	122.00	122.04
7.5	114.55	114.71	114.86
8.0	108.12	108.61	108.53
8.5	103.14	103.38	103.34
9.0	98.66	98.71	98.95
9.5	94.95	95.00	95.02
10.0	91.27	91.70	91.81
10.5	88.93	89.00	89.21
11.0	86.73	87.06	87.05
11.5	85.12	85.38	85.49
12.0	84.17	84.19	84.09
12.5	82.64	82.79	82.71
13.0	81.89	81.97	81.93
13.5	81.11	81.32	81.35
14.0	80.03	80.48	80.46
14.5	79.84	80.01	80.06
15.0	79.45	79.60	79.92
15.5	79.06	79.12	79.20
16.0	78.90	79.00	79.08
16.5	78.73	78.91	78.95
17.0	78.79	78.94	78.95
17.5	78.80	79.04	79.12
18.0	78.96	79.18	79.30
18.5	79.52	79.81	79.80
19.0	79.85	80.03	80.30
19.5	80.55	80.85	81.07
20.0	81.09	81.44	81.75
20.5	82.22	82.56	82.65
21.0	83.26	83.55	83.60
21.5	84.05	84.51	84.62
22.0	85.05	85.39	85.50
22.5	86.19	86.46	86.72
23.0	87.78	87.97	88.14
23.5	89.16	89.60	89.76
24.0	91.23	91.86	91.99
24.5	93.60	94.20	94.39
25.0	96.40	96.98	97.10
25.5	99.13	100.02	100.27
26.0	102.20	103.05	103.21
26.5	105.32	106.12	106.54
27.0	108.98	109.81	110.29
27.5	113.71	114.85	115.40
28.0	119.88	121.38	121.84
28.5	127.88	129.61	130.26
29.0	137.36	139.53	140.36
29.5	150.01	153.09	154.00
30.0	168.85	173.53	174.99

Typical Performance Curves

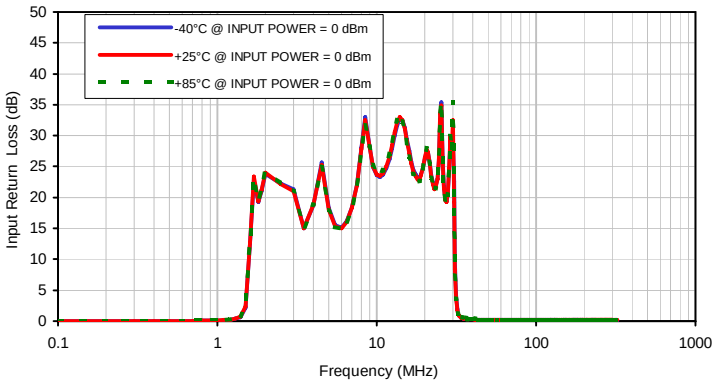
Insertion Loss vs. Temperature (Full Band)



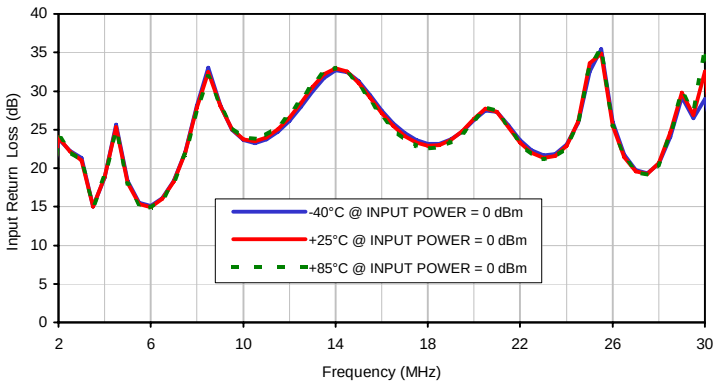
Insertion Loss vs. Temperature (Pass band)



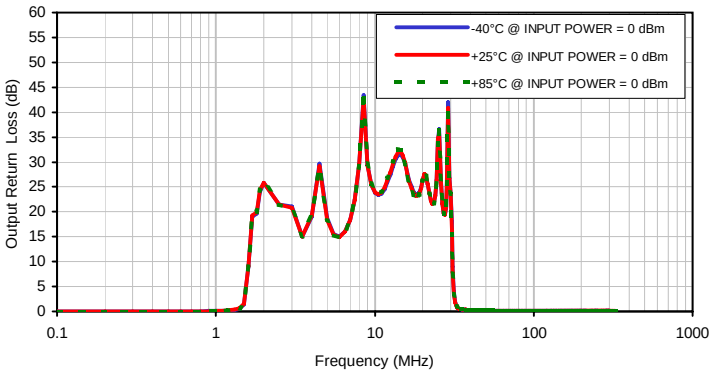
Input Return Loss vs. Temperature



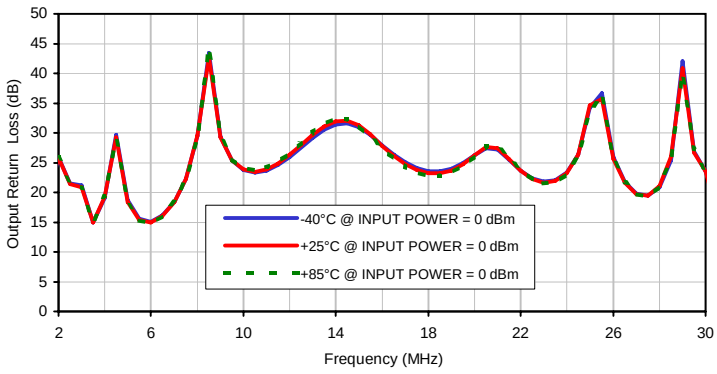
Input Return Loss vs. Temperature



Output Return Loss vs. Temperature

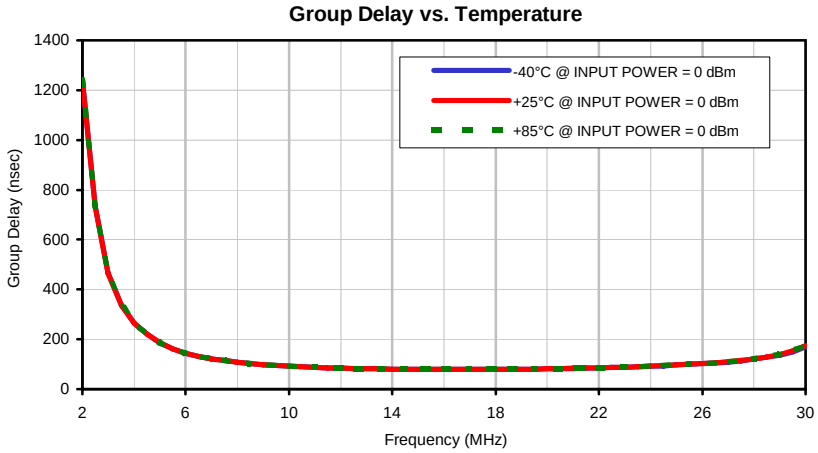


Output Return Loss vs. Temperature



Surface Mount Band Pass Filter BPF-E16+

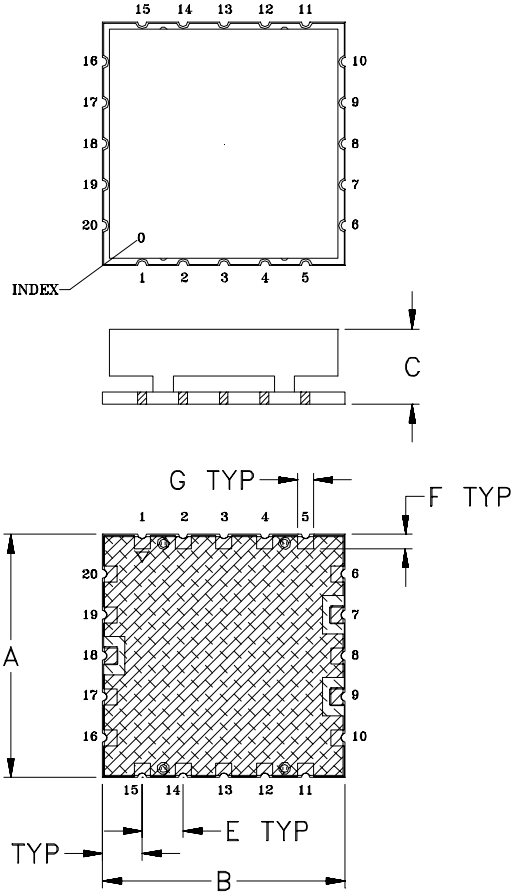
Typical Performance Curves



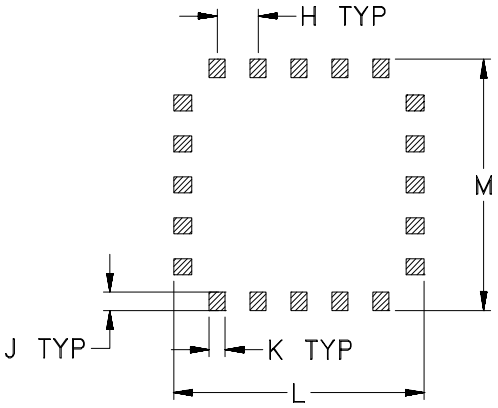
Case Style HR

Outline Dimensions

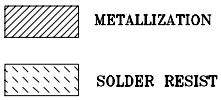
HR1176



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002



CASE#	A	B	C	D	E	F	G	H	J	K	L	M	WT. GRAM
HR1176	1.200 (30.48)	1.200 (30.48)	.370 (9.40)	.196 (4.98)	.202 (5.13)	.071 (1.80)	.079 (2.01)	.202 (5.13)	.091 (2.31)	.079 (2.01)	1.240 (31.50)	1.240 (31.50)	8.5

Dimensions are in inches (mm). Tolerances: 2Pl. ± .03; 3Pl. ± .015

Notes:

1. Case material: Nickel-Silver alloy.
2. Base: Printed wiring laminate.
3. Termination finish:
   For RoHS Case Styles: 3-5 µ inch Gold over 120-240 µ inch Nickel plate.
   For RoHS-5 Case Styles: Tin-Lead plate.

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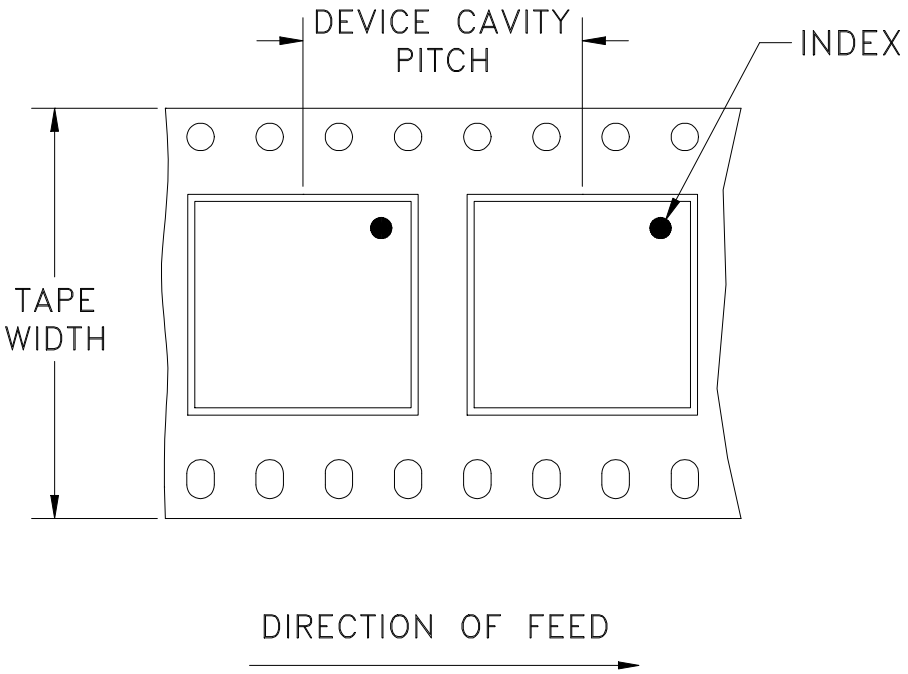
Tape & Reel Packaging TR-F80

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel
44	40	13	100

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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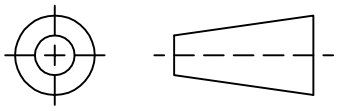
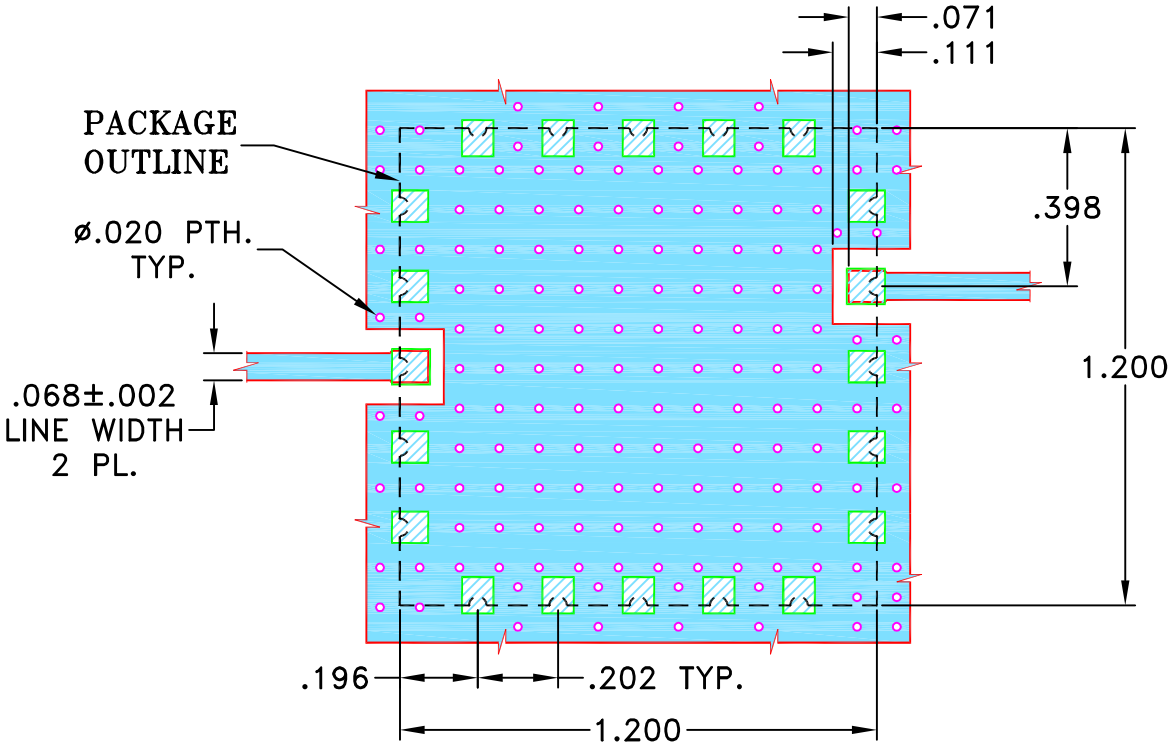
THIRD ANGLE PROJECTION



REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M126151	NEW RELEASE	APR 10	RB	KG

SUGGESTED MOUNTING CONFIGURATION FOR HR1176 CASE STYLE "20FL01" PIN CODE



NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030"±.003". 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 SOLDERMASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	RB	27 APR 10
TOLERANCES ON:	CHECKED	MD	27 APR 10
2 PL DECIMALS ± .005"	APPROVED	KR	27 APR 10
3 PL DECIMALS ±			
ANGLES ±			
FRACTIONS ±			

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

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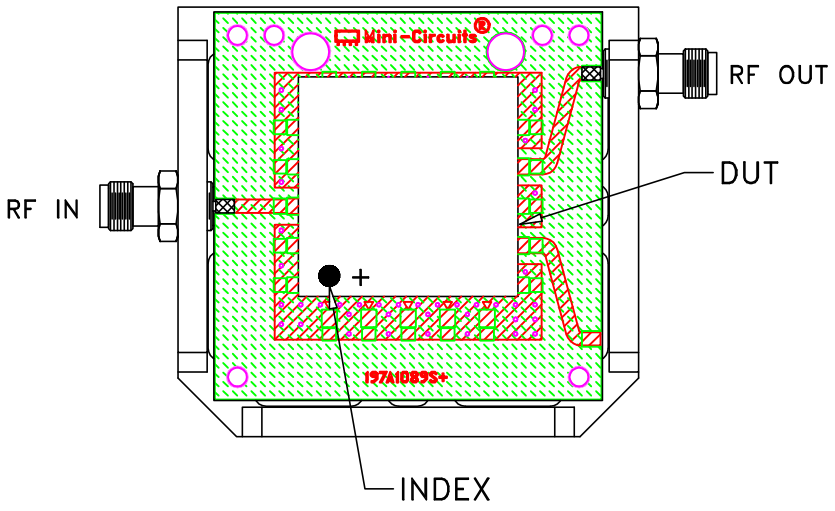
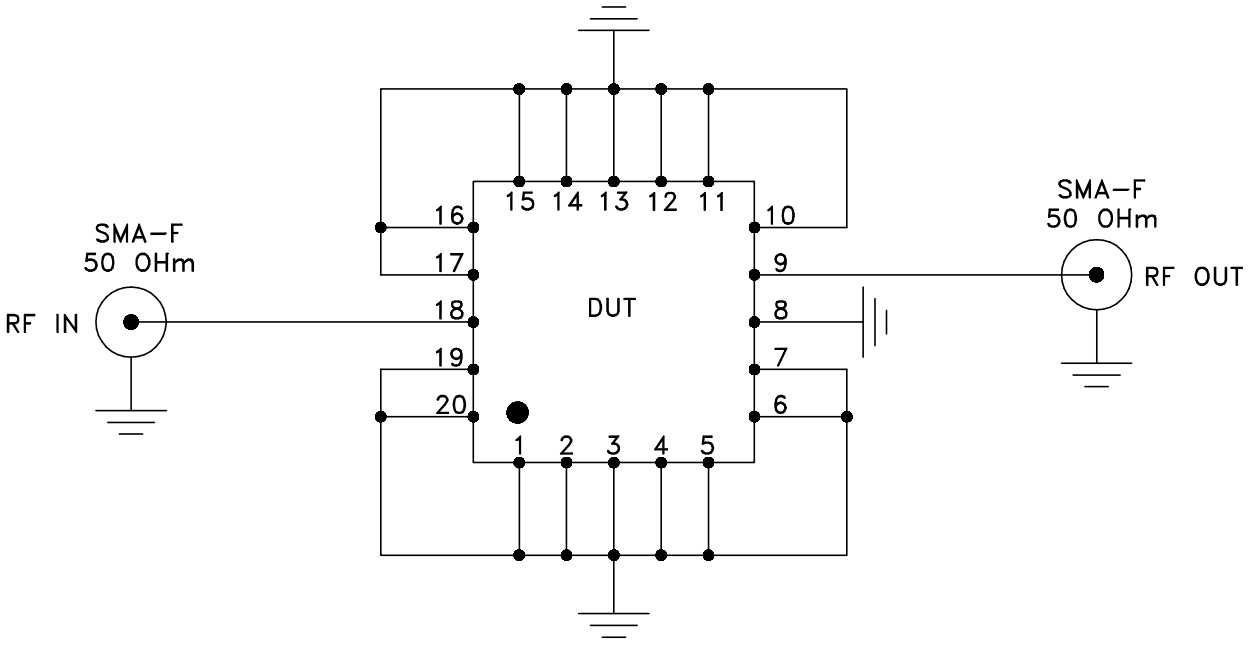
PL, 20FL01, HR1176, BPF-E, TB-573S+, 50Ω

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-329	OR
FILE: 98PL329		SCALE: 2:1	SHEET: 1 OF 1

Evaluation Board and Circuit



TB-573+



Schematic Diagram

Notes:
1. 50 Ohm SMA Female connectors.
2. PCB Material: ROGERS R04350 or equivalent, Dielectric Constant=3.48, Thickness=.030 inch.

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Environmental Specifications ENV03

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 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
HAST	130°C, 85% RH, 96 hours	JESD22-A110
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutectic Process: 225°C peak Pb-Free Process, 245°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Vibration (High Frequency)	20g peak, 20-2000 Hz, 4 times in each of three axes (total 12)	MIL-STD-883, Method 2007.3, Condition A
Mechanical Shock	50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes	MIL-STD-202, Method 213, Condition A
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

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