



LTCC SURFACE MOUNT

Band Pass Filter

BFHKI-2162+

50Ω 19.4 to 23.8 GHz

THE BIG DEAL

- LTCC Band Pass Filter with Integrated Interposer Board
- Ultra-High Stopband Rejection, Typ. 49 dB
- Small Size, 4.95x3.65 mm
- Rugged Ceramic Construction
- Protected by US Patents 11,638,370 and 11,744,057

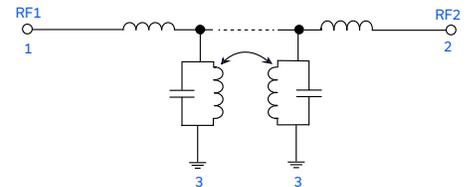


Generic photo used for illustration purposes only

APPLICATIONS

- Test & Measurement Equipment
- Satellite Communications
- Aerospace and Defense Signal Conditioning

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

BFHKI-2162+ is a miniature low temperature co-fired ceramic (LTCC) ultra-high stopband rejection band pass filter with a 19.4 to 23.8 GHz passband supporting a variety of applications. This model achieves a stopband rejection of 72 dB up to 10.3 GHz and 49 dB up to 40 GHz. Housed in a small 4.95 by 3.65 mm ceramic form factor, the filter is ideal for dense signal chain PCB layouts where it complements MMIC size and performance. The BFHKI family with integrated interposer board enables installation onto PCB layouts with automated manufacturing equipment. This model provides 2.8 dB typical insertion loss over a wide band due to its rugged monolithic construction. The LTCC fabrication process assures minimal RF performance variation while delivering a product that is well suited for environmental extremes of high humidity and temperature. This model handles up to 1 W RF input power and has a wide operating temperature range of -55°C to +125°C.

ELECTRICAL SPECIFICATIONS^{1,2,3} AT +25°C, Z₀ = 50Ω

Parameter	F#	Frequency (GHz)	Min.	Typ.	Max.	Units
Passband	Center Frequency ⁴	-	-	21.6	-	GHz
	Insertion Loss	F5-F6	19.4-23.8	2.8	4.5	dB
	Return Loss	F5-F6	19.4-23.8	-	8.5	dB
Stopband, Lower	Insertion Loss	DC-F1	0.1-5.5	64	74	-
		F1-F2	5.5-10.3	64	72	-
		F2-F3	10.3-12.7	52	62	-
		F3-F4	12.7-15	41	51	-
Stopband, Upper	Insertion Loss	F7-F8	29.1-30.9	40	49	-
		F8-F9	30.9-34	46	56	-
		F9-F10	34-36.3	54	64	-
		F10-F11	36.3-40	49	59	-

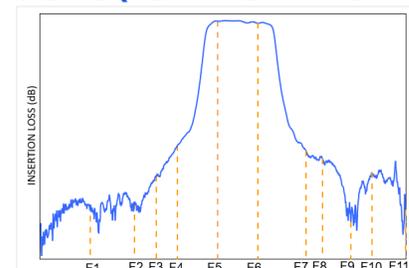
1. Tested on Evaluation Board P/N TB-BFHKI-2162C+ with the connector and feedline effects de-embedded using the 2X Thru IEEE P370 method.
2. Bi-directional, RF1 and RF2 ports can be interchanged.
3. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.
4. Typical variation ±3%.

ABSOLUTE MAXIMUM RATINGS⁵

Operating Temperature	-55 °C to +125 °C
Storage Temperature	-55 °C to +125 °C
Input Power ⁶	1 W

5. Permanent damage may occur if any of these limits are exceeded.
6. Power rating applies only to signals within the passband. Power rating above +25°C operating temperature decreases linearly to 0.5 W at +125°C.

TYPICAL FREQUENCY RESPONSE AT +25°C





LTCC SURFACE MOUNT

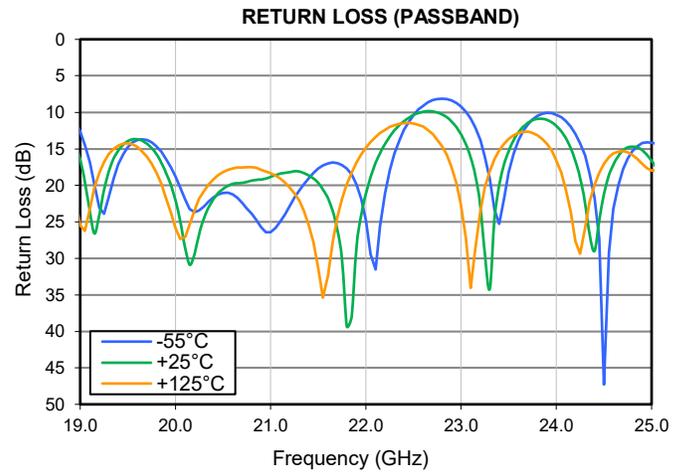
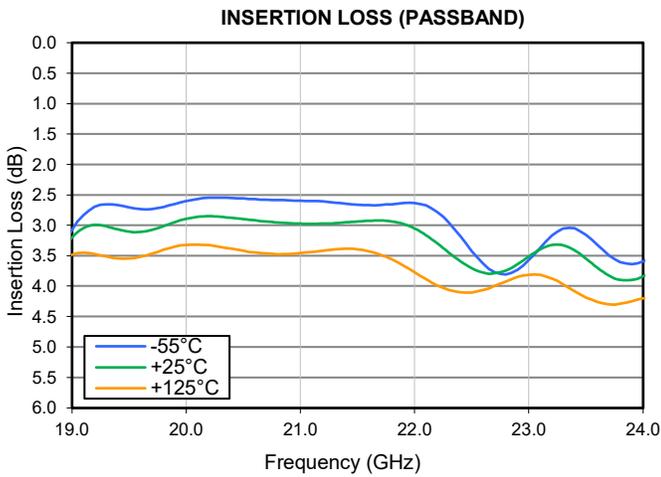
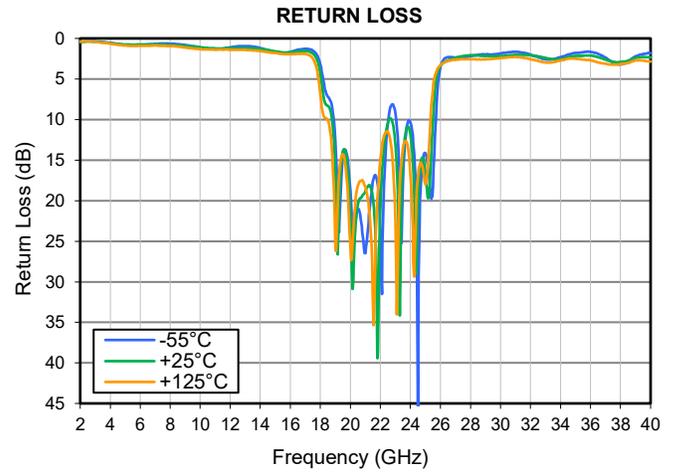
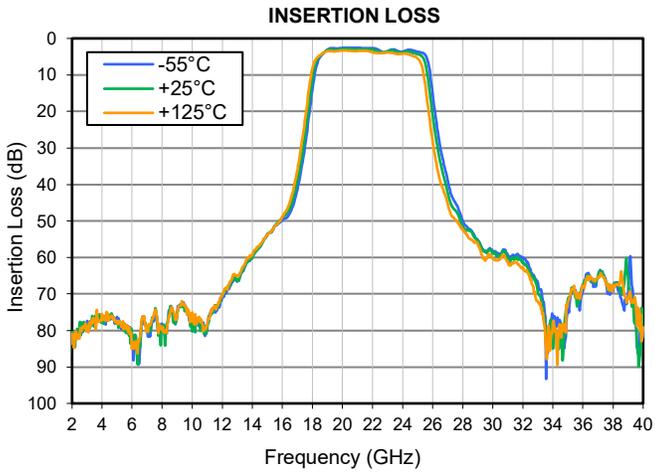
Band Pass Filter

BFHKI-2162+

Mini-Circuits

50Ω 19.4 to 23.8 GHz

TYPICAL PERFORMANCE GRAPHS





FUNCTIONAL DIAGRAM

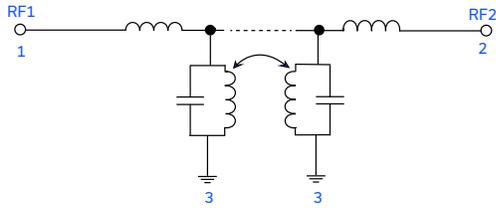
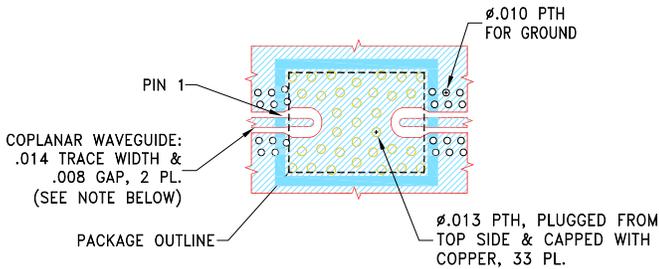


Figure 1. BFHKI-2162+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
RF1 ²	1	Connects to RF Input Port
RF2 ²	2	Connects to RF Output Port
GROUND	3	Connects to Ground on PCB, (See drawing PL-767)

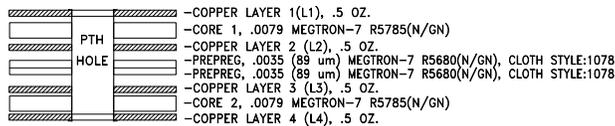
SUGGESTED PCB LAYOUT (PL-767)



- NOTES:
- PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
 - TRACE WIDTH & GAP ARE SHOWN FOR .0079 MEGTRON-7 R5785(N/GN), COPPER: 1/2 OZ. EACH LAYER. FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.
 - LAYERS L2, L3 & L4 OF PCB ARE CONTINUOUS GROUND PLANES.

- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).
- DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

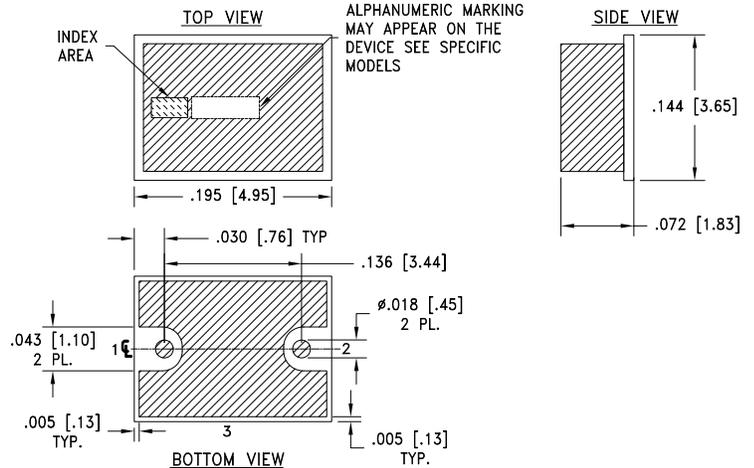
STACK-UP DIAGRAM



- TOTAL FINISHED THICKNESS 0.026 ± 10%.
- PTH PRESENT FROM COPPER LAYER 1 TO COPPER LAYER 4.

Figure 2. Suggested PCB Layout

CASE STYLE DRAWING



METALLIZATION

Weight: .135 grams.

Dimensions are in inches [mm]. Tolerances: 2 Pl. ±.01; 3 Pl. ±.005

PRODUCT MARKING*: F560

*Marking may contain other features or characters for internal lot control.



LTCC SURFACE MOUNT

Band Pass Filter

BFHKI-2162+

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50Ω 19.4 to 23.8 GHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD

[CLICK HERE](#)

Performance Data & Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads
Case Style	NM3237 Finish: Gold over Nickel Plating
RoHS/REACH Status	Compliant
Tape and Reel	TR-F77
Suggested Layout for PCB Design	PL-767
Evaluation Board	TB-BFHKI-2162C+ Gerber File
Environmental Rating	ENV06T12

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-Circuits' 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/terms/viewterm.html

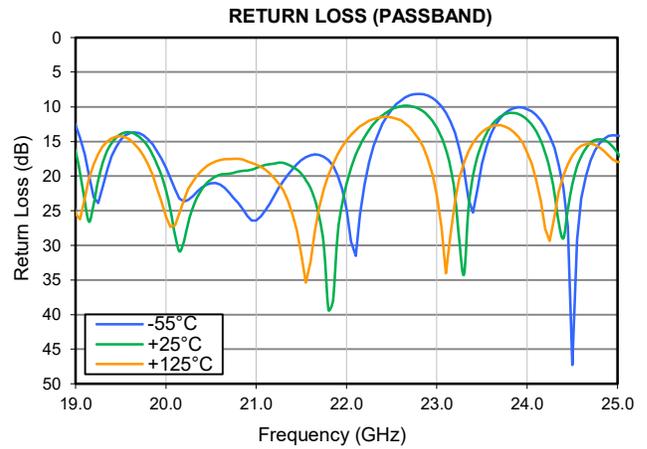
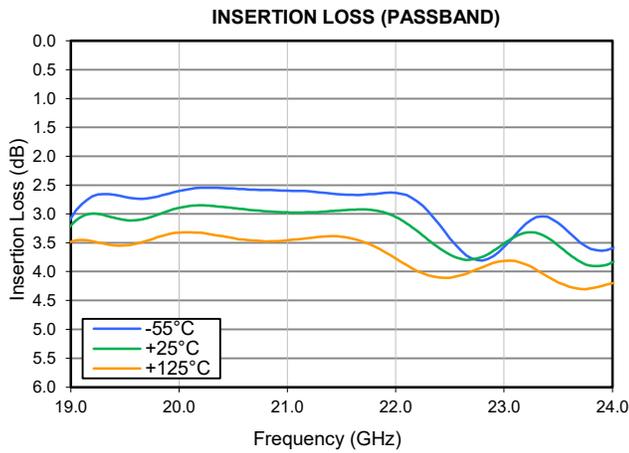
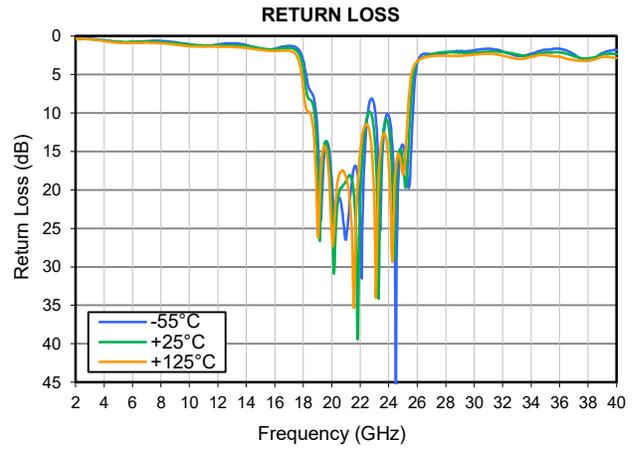
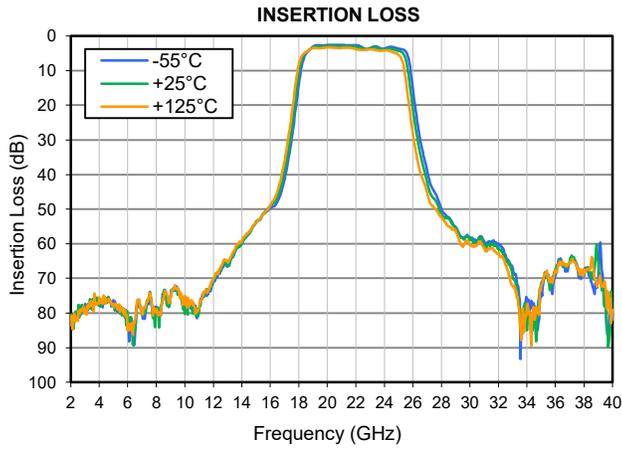


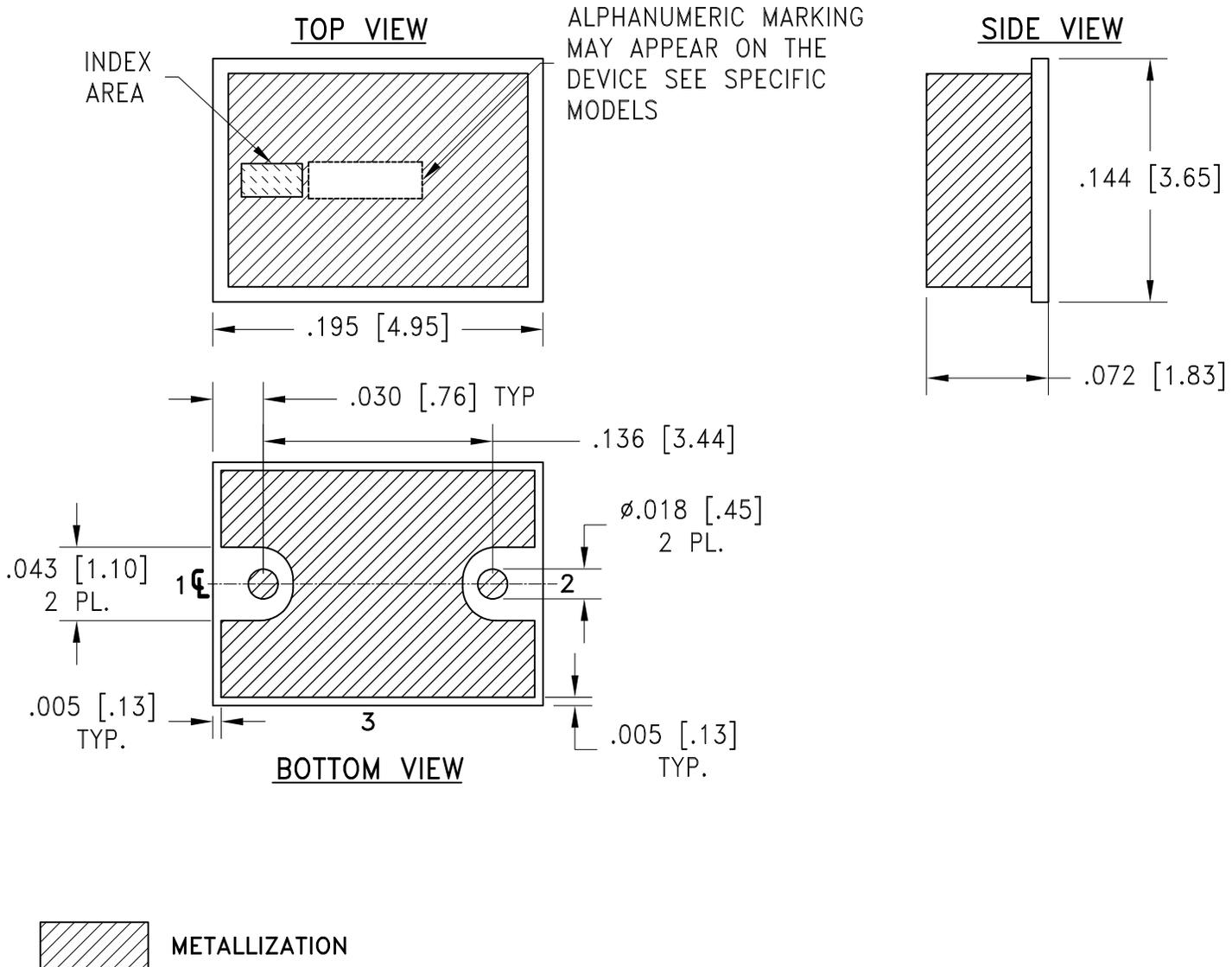
LTCC Bandpass Filter
Typical Performance Data

BFHKI-2162+

FREQUENCY (GHz)	INSERTION LOSS (dB)			RETURN LOSS (dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
0.50	87.17	91.62	96.26	0.38	0.37	0.40
1.00	86.47	86.34	85.13	0.53	0.52	0.48
2.00	82.38	80.43	81.71	0.40	0.43	0.38
3.00	77.41	79.13	78.77	0.35	0.41	0.42
4.00	76.39	76.26	75.38	0.55	0.59	0.65
5.00	76.20	77.62	77.28	0.80	0.75	0.86
6.00	0.93	1.08	1.24	13.08	13.08	12.94
7.00	80.14	80.16	79.96	0.68	0.72	0.87
8.00	78.05	80.48	79.80	0.65	0.80	0.94
9.00	75.52	75.11	75.72	0.81	0.93	1.13
10.00	78.04	80.31	75.09	1.11	1.10	1.32
11.00	78.90	79.21	78.78	1.32	1.22	1.40
12.00	70.44	70.49	70.05	1.10	1.21	1.40
13.00	2.27	2.48	2.78	4.59	4.50	4.25
14.00	59.93	60.02	59.32	1.18	1.30	1.57
15.00	53.69	53.93	53.79	1.73	1.60	1.81
16.00	49.80	49.06	48.84	1.67	1.70	1.96
17.00	41.26	39.04	35.85	1.28	1.55	1.92
18.00	2.84	3.02	3.26	3.75	3.73	3.61
19.00	3.07	3.20	3.48	12.65	16.51	25.47
19.25	2.66	3.00	3.49	23.87	20.61	16.82
19.50	2.70	3.10	3.54	14.77	13.93	14.26
19.75	1.76	1.87	1.97	6.21	6.35	6.50
20.00	2.60	2.89	3.32	18.78	22.05	25.89
20.25	2.55	2.85	3.34	23.41	26.56	21.81
20.50	2.56	2.90	3.42	21.03	20.48	18.17
20.75	2.58	2.94	3.47	23.15	19.54	17.50
21.00	0.69	0.90	1.13	23.02	20.16	16.81
21.25	2.62	2.97	3.41	21.65	18.07	21.07
21.50	2.66	2.94	3.39	17.70	19.66	31.32
21.75	2.66	2.93	3.52	17.23	30.26	21.84
22.00	2.63	3.05	3.77	24.77	21.14	14.85
22.25	2.68	3.06	3.57	4.57	4.40	4.03
22.50	3.42	3.71	4.10	10.36	10.36	11.53
22.75	3.80	3.77	3.96	8.18	10.02	13.71
23.00	3.57	3.51	3.81	9.22	13.05	22.66
23.25	3.10	3.32	3.91	16.03	29.65	20.31
23.50	4.96	5.30	5.72	2.30	2.33	2.28
23.75	3.56	3.87	4.30	10.94	11.08	12.80
24.00	3.59	3.84	4.20	10.32	11.86	16.57
24.25	3.29	3.61	4.21	14.22	19.00	29.34
24.50	3.16	3.68	4.53	47.27	21.17	17.02
24.75	3.38	4.02	4.94	16.30	14.78	15.48
25.00	3.64	4.29	5.46	14.13	16.64	17.97
26.00	15.18	20.93	28.15	3.53	3.36	3.28
27.00	4.69	4.83	4.86	3.10	3.35	3.72
28.00	49.94	51.50	52.34	2.19	2.08	2.54
29.00	55.11	55.28	56.01	1.97	2.17	2.57
30.00	58.29	58.86	60.38	1.87	2.17	2.42
31.00	59.35	59.99	61.05	1.65	2.03	2.30
32.00	5.68	5.29	4.40	13.73	18.33	15.66
33.00	67.05	69.43	72.23	2.56	2.41	2.95
34.00	77.38	85.03	77.83	2.32	2.56	2.73
35.00	73.64	71.37	72.12	1.81	2.16	2.48
36.00	69.37	67.28	68.06	1.65	2.11	2.70
37.00	8.05	9.18	10.55	2.25	2.31	2.40
38.00	69.33	67.60	68.24	3.19	2.89	3.15
39.00	71.01	65.04	71.40	2.19	2.38	2.71
40.00	80.17	80.35	79.04	1.85	2.33	2.86

Typical Performance Data





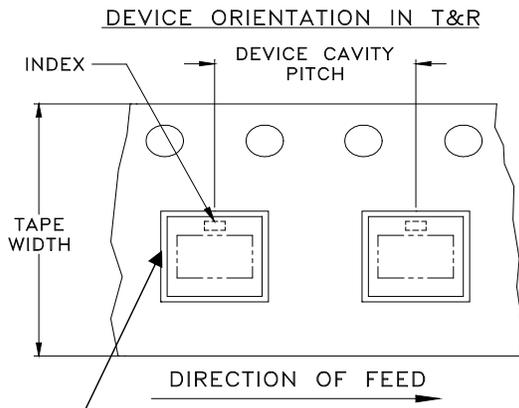
Weight: .135 grams.

Dimensions are in inches (mm). Tolerances: 2 Pl.±.01; 3 Pl. ±.005

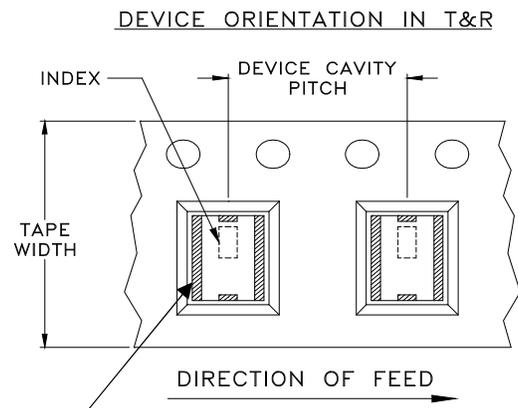
Notes:

1. Case material: LTCC on printed circuit board base.
2. Termination Finish: **as shown below or indicated on Data Sheet.**
For RoHS Case Styles: Gold Plate over Nickel plate. All models, (+) suffix.

Tape & Reel Packaging TR-F77



Note: The shape of the pocket may differ



Note: The location and shape of the metallization may differ

Applicable Case Styles

GU1604, GU1804, GU2644,
TT1618-2

Applicable Case Styles

MZ4532C, NM1812C,
NM1812C-1, NM1812C-2,
NM1812C-3, NM1812C-5,
NM1812C-6, NM3237

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

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.

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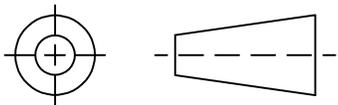
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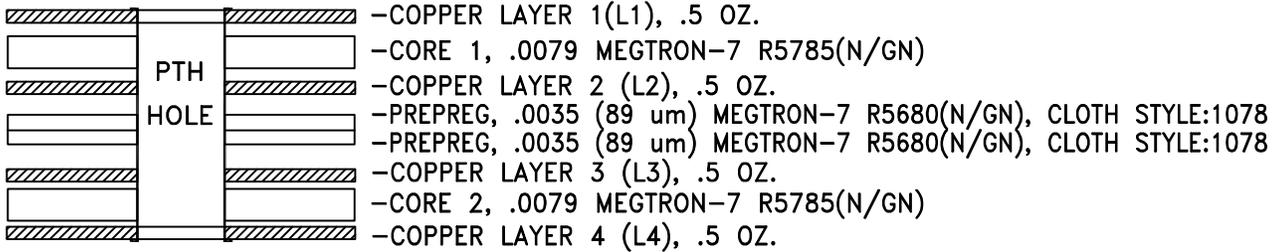


REVISIONS

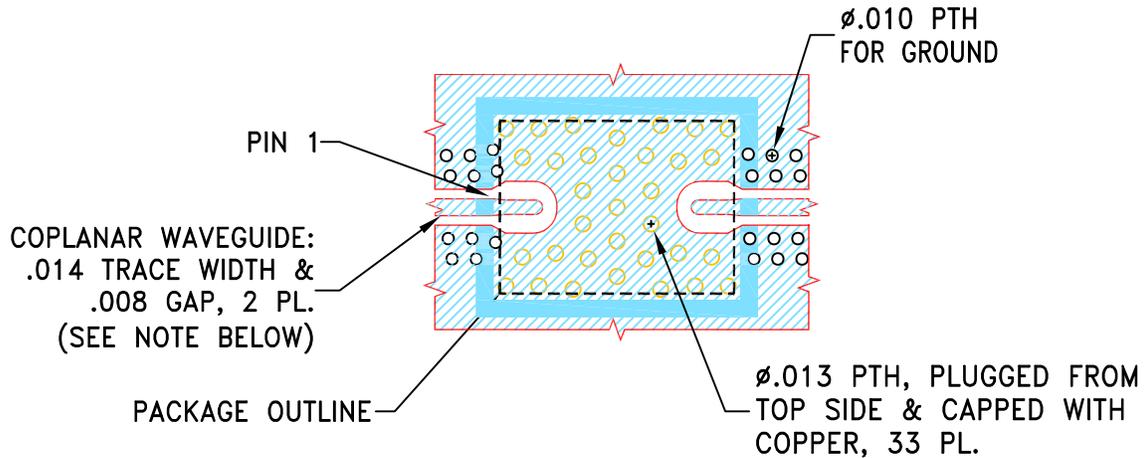
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-019771	NEW RELEASE	11/06/23	ITG	IL

SUGGESTED MOUNTING CONFIGURATION
FOR NM3237 CASE STYLE

STACK-UP DIAGRAM



1. TOTAL FINISHED THICKNESS 0.026 ± 10%.
2. PTH PRESENT FROM COPPER LAYER 1 TO COPPER LAYER 4.



NOTES:

1. PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
2. TRACE WIDTH & GAP ARE SHOWN FOR .0079 MEGTRON-7 R5785(N/GN), COPPER: 1/2 OZ. EACH LAYER. FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.
3. LAYERS L2, L3 & L4 OF PCB ARE CONTINUOUS GROUND PLANES.



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	11/06/23
TOLERANCES ON:	CHECKED GF	11/06/23
2 PL DECIMALS ±	APPROVED IL	11/06/23
3 PL DECIMALS ± .005		
ANGLES ±		
FRACTIONS ±		



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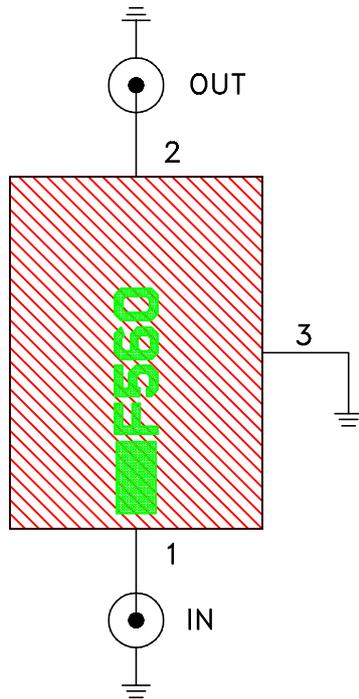
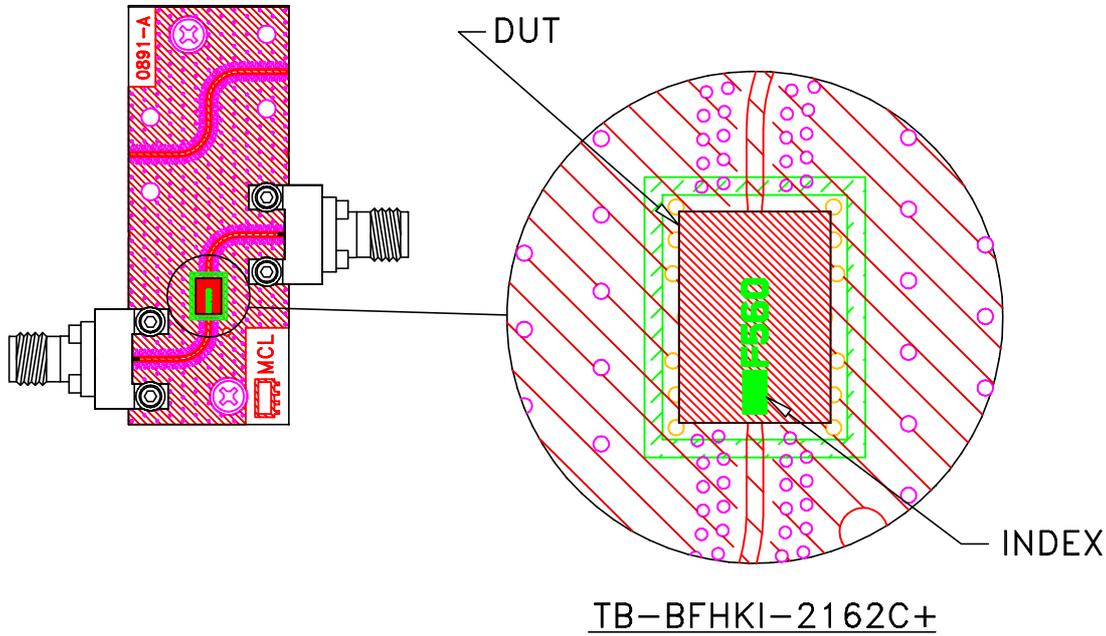
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Brooklyn NY 11235

PL,NM3237, TB-BFHKI-XXXXC+

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Evaluation Board and Circuit



Schematic Diagram

1. 50 Ohm 2.92 mm Female end Launch connectors.
2. PCB Material: MEGTRON-7 R5785(N or GN) or equivalent,
Dielectric Constant=3.37 Thickness=.0079 inch.

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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 125° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Thermal Cycling	-55 to 125°C, 100 cycles, Dwell Time 15 minutes.	MIL-STD-202, Method 107, Condition A-3
Humidity	85°C, 90-95% Relative Humidity, 250hours	
Solderability	10X / 30X Magnification	J-STD-002C Test S, J-STD-002C Test S1
High Temp Storage	125°C, 250 hours	
Bend Test	1mm, deflection for 5 seconds Span of bending: 2.75"	--