



LTCC SURFACE MOUNT

Thru-Line

TPHKI-3002+

50Ω DC to 30 GHz

THE BIG DEAL

- LTCC Thru-line with Integrated Interposer Board
- Return Loss, Typ. ≥ 8 dB up to 30 GHz
- Small Size, 4.95 mm x 3.65 mm
- Shielded Construction
- Protected by US Patents 11,638,370 and 11,744,057



Generic photo used for illustration purposes only

APPLICATIONS

- Test & Measurement Equipment
- Aerospace and Defense Signal Conditioning
- EW, Radar, and ECM Defense Systems
- 5G MIMO and Back Haul Radio
- Satellite Communications

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

Mini-Circuits' TPHKI-3002+ is a miniature low-temperature co-fired ceramic (LTCC) 50-Ohm transmission line with a low insertion loss of 1.3 dB typical up to 30 GHz. This can be used as a placeholder in system boards in the absence of LTCC Filters of the same case style, NM3237.

KEY FEATURES

Features	Advantages
Footprint Compatible "Thru-Line" for Mini-Circuits Filters (BFHKI Series), in Case Style NM3237 with same Pad Connections as BFHKI	Enables system designers the flexibility to plan to add LTCC filters to the PCB layout at a later stage in the design process, after system test results are available.
Surface Mountable due to Integrated Interposer Board	Enables installation with automated manufacturing equipment making this suitable for high-volume processes.
Small Size (4.95 x 3.65 mm)	Allows for high layout density of circuit boards, while minimizing effects of parasitics.
Wide Operating and Storage Temperature, -55 to +125°C	Enables use in high reliability and extreme environment condition such as aerospace & defense applications.
Cost Effective	LTCC is a scalable technology that is cost effective due to ease of production in high-volume.





ELECTRICAL SPECIFICATIONS^{1,2,3} AT +25°C

Parameter		F#	Frequency (GHz)	Min.	Typ.	Max.	Units
Passband	Insertion Loss	DC - F1	0.1 - 10	-	0.3	0.6	dB
		F1 - F2	10 - 20	-	0.8	1.2	
		F2 - F3	20 - 30	-	1.3	2.0	
	Return Loss	DC - F1	0.1 - 10	-	15	-	dB
		F1 - F2	10 - 20	-	9	-	
		F2 - F3	20 - 30	-	8	-	

1. Tested on Evaluation Board P/N TB-TPHKI-3002C+. Measured 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. This component should not be used as a DC-block. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.

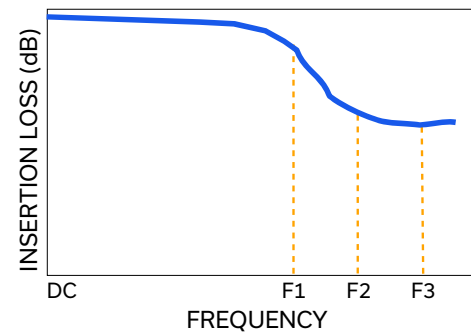
ABSOLUTE MAXIMUM RATINGS⁴

Parameter	Ratings
Operating Temperature	-55°C to +125°C
Storage Temperature	-55°C to +125°C
RF Power Input ⁵	1 W

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

5. 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

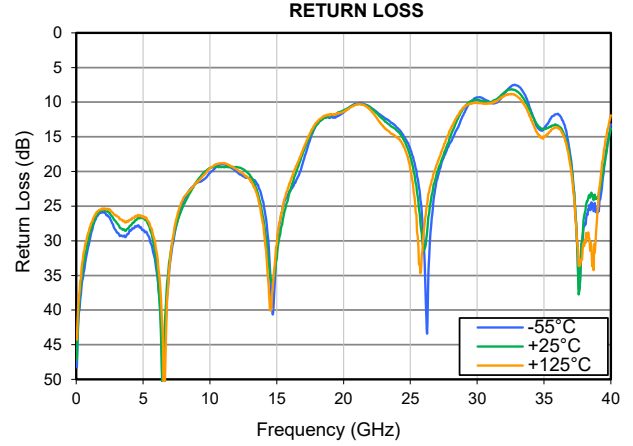
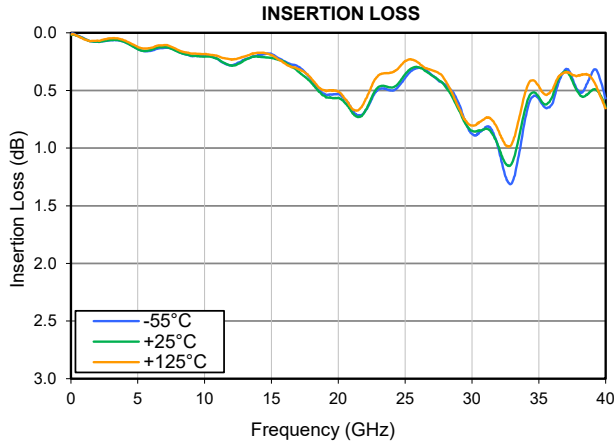
Thru-Line

TPHKI-3002+

Mini-Circuits

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TYPICAL PERFORMANCE GRAPHS





FUNCTIONAL DIAGRAM

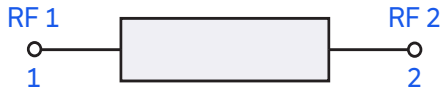


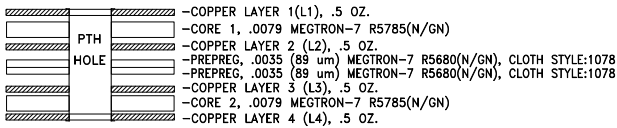
Figure 1. TPHKI-3002+ Functional Diagram

PAD DESCRIPTION

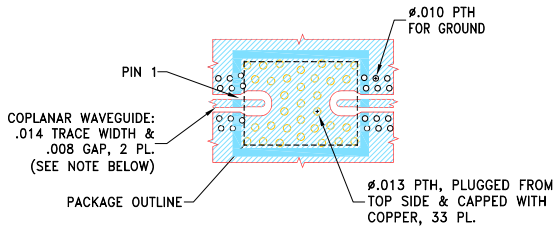
Function	Pad Number	Description
RF1 ²	1	Connects to RF Input Port
RF2 ²	2	Connects to RF Output Port
GROUND	3	Connects to Ground on PCB, (See drawing PL-767)

SUGGESTED PCB LAYOUT (PL-767)

STACK-UP DIAGRAM



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

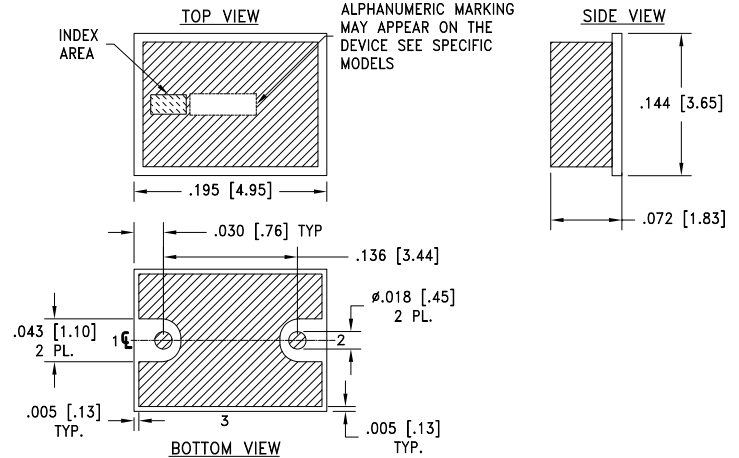


- NOTES:
- PCB IS MULTILAYER PCB, SEE STACK-UP DIAGRAM.
 - TRACE WIDTH & GAP ARE SHOWN FOR .0079 MEGTRON-7 R5785(N/GN), COPPER: 1/2 OZ. EACH LAYER. FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.
 - LAYERS L2, L3 & L4 OF PCB ARE CONTINUOUS GROUND PLANES.

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

Figure 2. Suggested PCB Layout PL-767

CASE STYLE DRAWING



METALLIZATION

Weight: .135 grams.
Dimensions are in inches [mm]. Tolerances: 2 Pl.±.01; 3 Pl. ±.005

PRODUCT MARKING*: F446

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



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

Performance Data & Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads
Case Style	NM3237 Lead Finish: Gold over Nickel Plating.
RoHS Status	Compliant
Tape and Reel	F77
Suggested Layout for PCB Design	PL-767
Evaluation Board	TB-TPHKI-3002C+ Gerber File
Environmental Rating	ENV06T12

NOTES

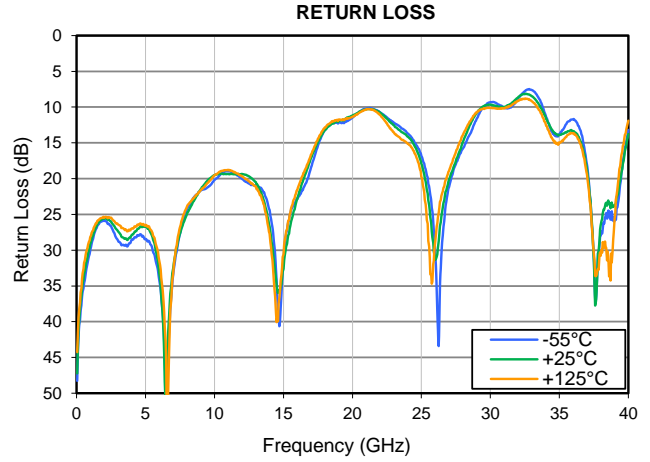
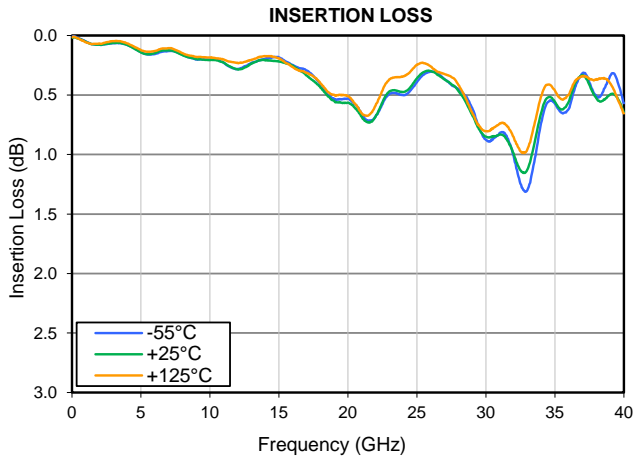
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- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document 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

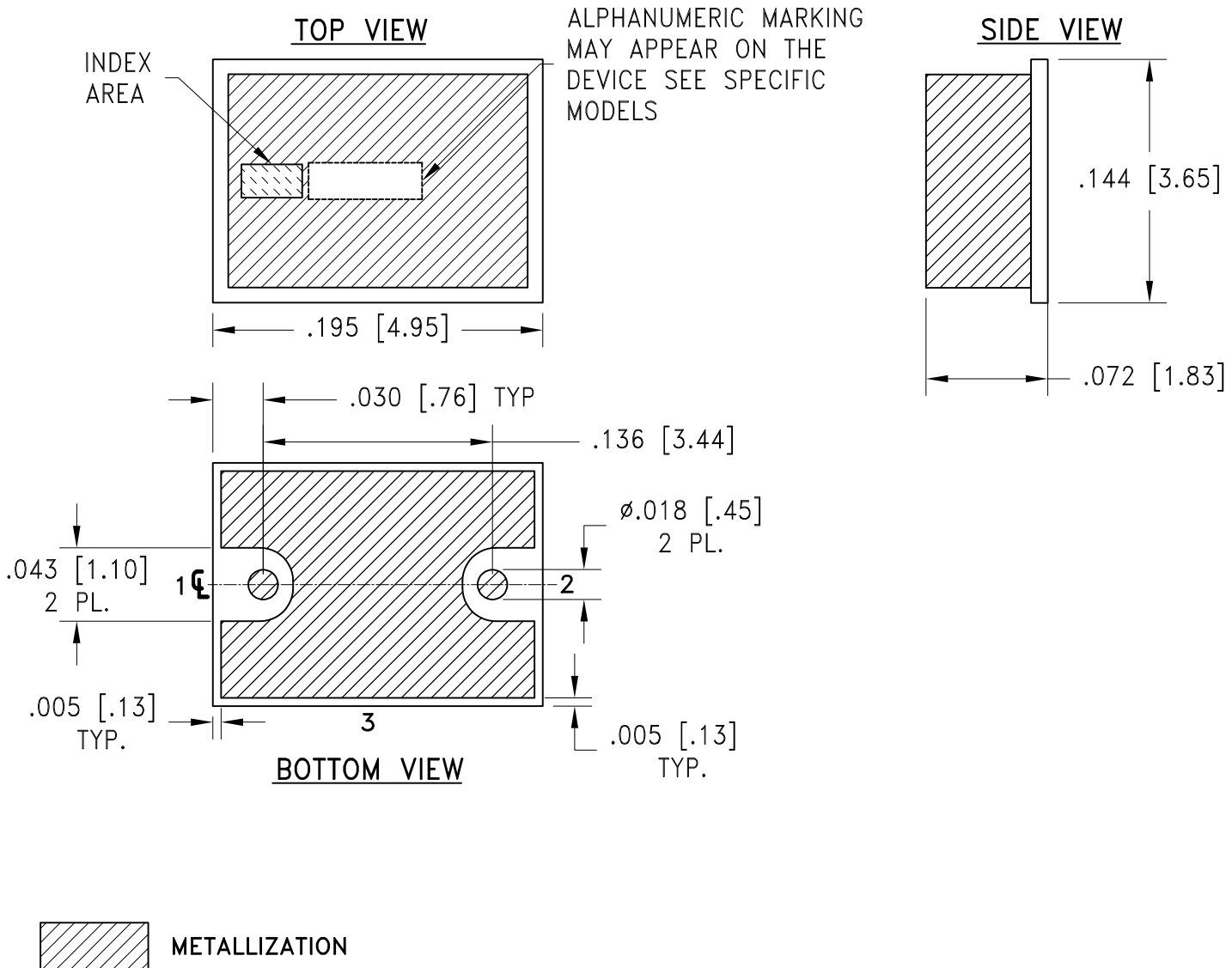


Typical Performance Data

FREQUENCY (GHz)	INSERTION LOSS (dB)			RETURN LOSS (dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
0.1	0.00	0.01	0.01	44.27	43.37	41.32
1.0	0.05	0.05	0.06	29.94	29.15	28.16
2.0	0.08	0.08	0.07	25.93	25.63	25.48
3.0	0.06	0.06	0.05	28.64	27.33	26.41
4.0	0.08	0.08	0.07	28.51	27.84	26.95
5.0	0.14	0.14	0.12	28.43	26.68	26.46
6.0	0.16	0.15	0.13	34.23	33.19	31.42
7.0	0.13	0.12	0.11	33.54	32.53	33.24
8.0	0.16	0.16	0.15	24.34	24.99	23.94
9.0	0.20	0.20	0.18	21.66	21.48	21.62
10.0	0.20	0.21	0.19	20.19	19.50	19.55
11.0	0.23	0.23	0.20	18.98	19.36	18.82
12.0	0.28	0.28	0.23	20.04	19.36	19.71
13.0	0.23	0.24	0.21	20.94	20.49	21.11
14.0	0.20	0.21	0.18	24.41	26.68	27.71
15.0	0.19	0.22	0.19	31.53	32.60	30.59
16.0	0.25	0.25	0.26	22.87	22.86	21.61
17.0	0.29	0.34	0.32	18.44	17.13	16.65
18.0	0.41	0.44	0.40	13.16	13.21	12.81
19.0	0.53	0.55	0.50	12.18	11.96	11.75
20.0	0.53	0.56	0.51	11.48	11.18	11.36
21.0	0.66	0.68	0.65	10.21	10.31	10.32
22.0	0.68	0.68	0.59	10.72	10.77	11.09
23.0	0.49	0.47	0.37	12.16	12.54	13.52
24.0	0.50	0.47	0.34	13.69	14.12	15.12
25.0	0.39	0.36	0.25	16.85	17.87	19.72
26.0	0.30	0.30	0.26	30.67	31.35	28.79
27.0	0.37	0.37	0.32	21.19	20.18	18.93
28.0	0.45	0.47	0.41	15.81	14.88	13.88
29.0	0.61	0.67	0.65	11.64	10.79	10.68
30.0	0.88	0.85	0.80	9.30	9.67	10.10

Typical Performance Data





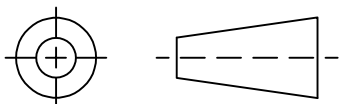
Weight: .135 grams.

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.

THIRD ANGLE PROJECTION

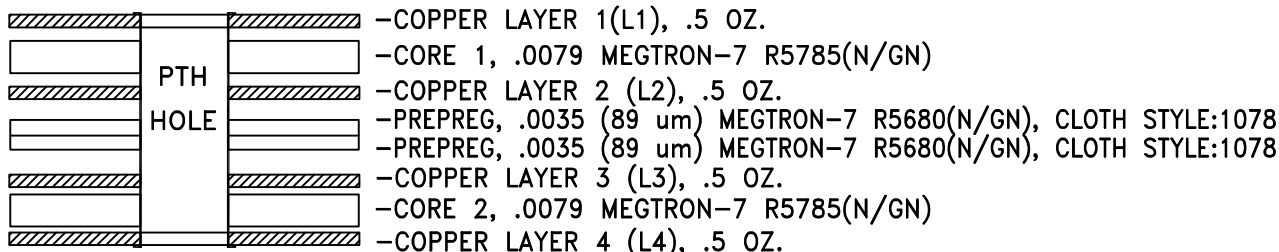


REVISIONS

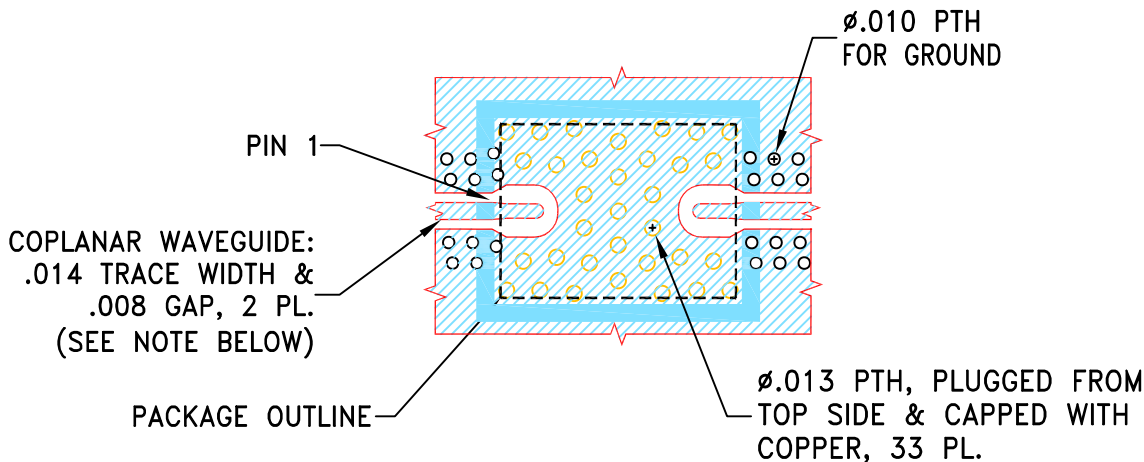
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-019771	NEW RELEASE	11/06/23	ITG	IL

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.

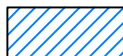


NOTES:

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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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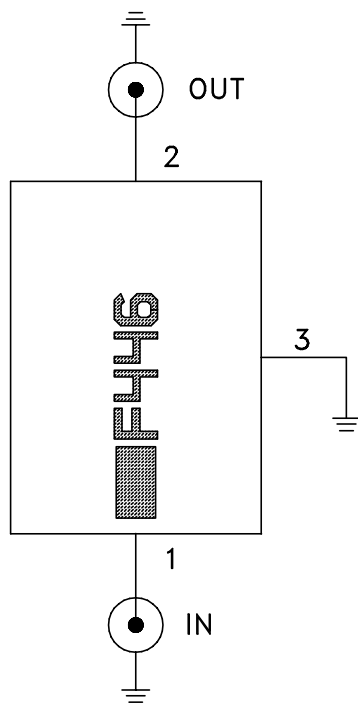
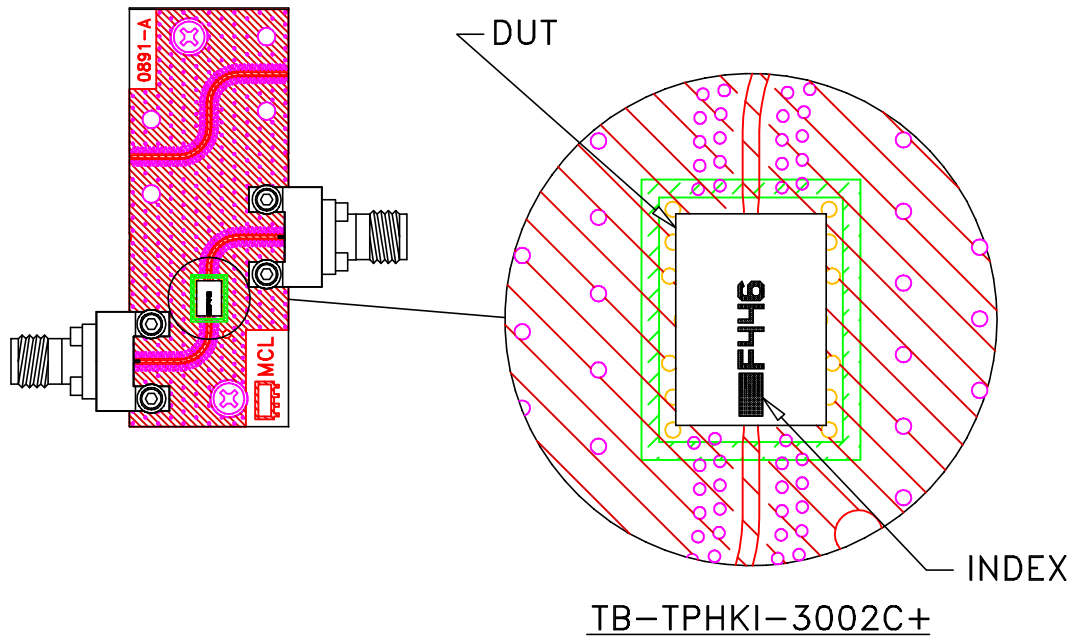
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PL,NM3237, TB-BFHKI-XXXXC+

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SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-767	OR
FILE:	98PL767	SCALE: 6:1	SHEET: 1 OF 1

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.

 **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 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"	--