

**KEY FEATURES**

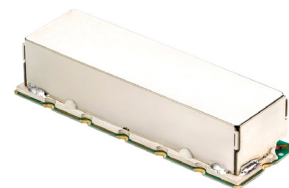
- Excellent Rejection of 80 dB Typ.
- Fast Roll-off Transition at Stopband
- Good Insertion Loss of 2 dB Typ.

APPLICATIONS

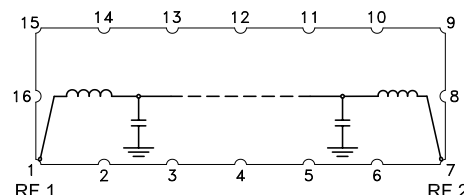
- Test and Measurements
- Harmonic Rejection
- Receivers/Transmitters

PRODUCT OVERVIEW

Mini-Circuits' LPHI-90+ is a Lumped LC filter in a metal shielded package, that offers a good insertion loss and high rejection. This low pass filter covers from DC to 90 MHz and the stopband up to 1.8 GHz. This filter has high Q capacitors and inductors to achieve a low insertion loss. It has repeatable performance across production lots.



Generic photo used for illustration purposes only

FUNCTIONAL DIAGRAM**ELECTRICAL SPECIFICATIONS^{1,2} AT +25°C**

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Units
Passband	Insertion Loss	DC-F1	DC - 90	—	2	2.7	dB
	Return Loss	DC-F1	DC - 90	12	20	—	dB
Stopband	Rejection	F2-F3	100 - 110	20	28	—	dB
		F3-F4	110 - 600	70	80	—	
		F4-F5	600 - 1800	58	72	—	

1. Tested in Evaluation Board P/N TB-LPHI-90+

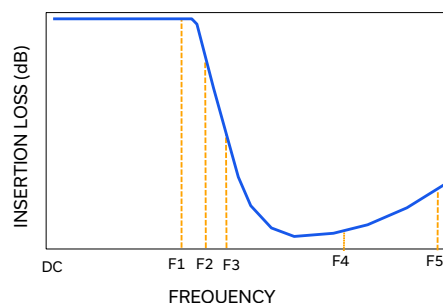
2. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.

ABSOLUTE MAXIMUM RATINGS³

Parameter	Ratings
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +100°C
Input Power ⁴	2 W at +25°C

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

4. Power rating applies only to signals within the passband. Power rating above +25°C, de-rate linearly to 0.5 W at +85°C.

TYPICAL FREQUENCY RESPONSE



LUMPED LC SURFACE MOUNT

Low Pass Filter

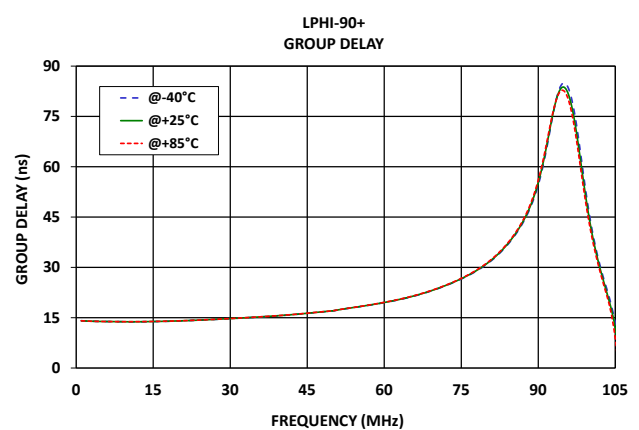
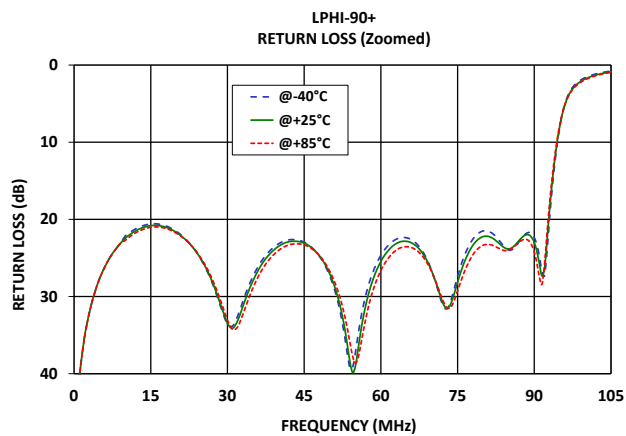
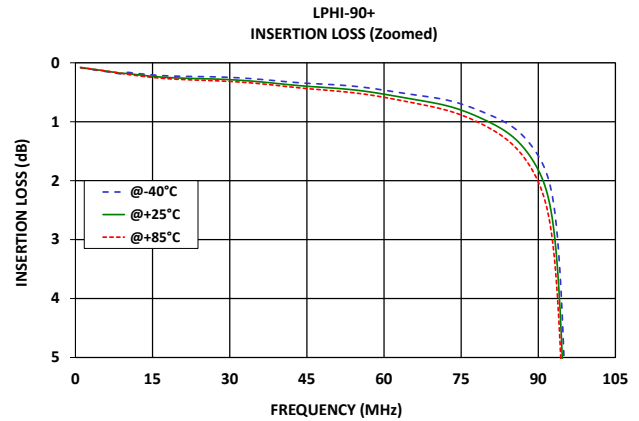
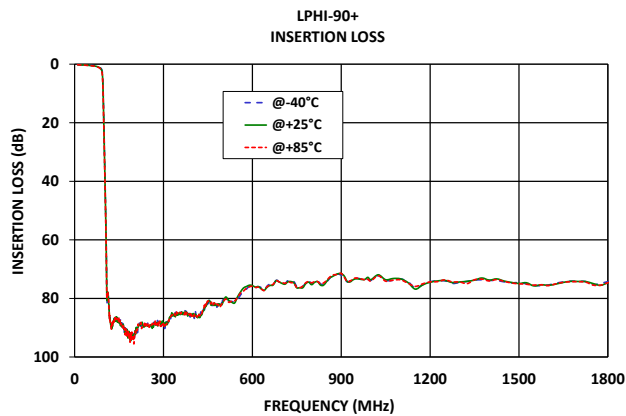
LPHI-90+

Mini-Circuits

50Ω

DC to 90 MHz

TYPICAL PERFORMANCE GRAPHS





Mini-Circuits

LUMPED LC SURFACE MOUNT

Low Pass Filter

LPHI-90+

50 Ω

DC to 90 MHz

FUNCTIONAL DIAGRAM

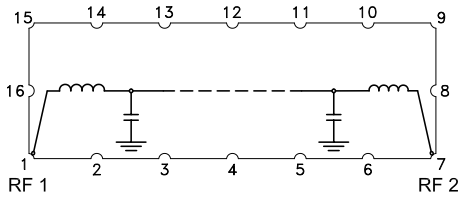


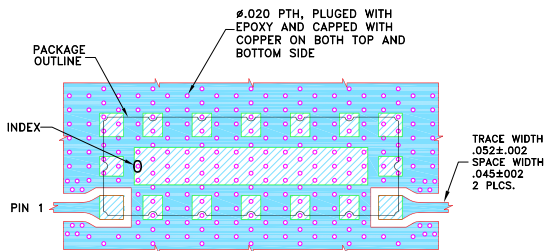
Figure 1. LPHI-90+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
RF1 ²	1	Connects to RF Input Port
RF2 ²	7	Connects to RF Output Port
GROUND	2-6 & 8-16	Connects to Ground on PCB, (See drawing PL-814)
NC	—	No connection, not used internally. See drawing PL-814 for connection to PCB

SUGGESTED PCB LAYOUT (PL-814)

SUGGESTED MOUNTING CONFIGURATION
FOR CASE STYLE BAN2915-1

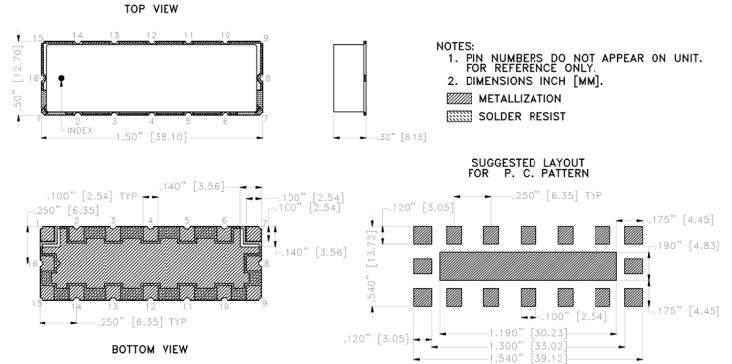


NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (R04350B) WITH DIELECTRIC THICKNESS .023±.002; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
 2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)
■ DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

Figure 2. Suggested PCB Layout PL-814

CASE STYLE DRAWING



Weight: 6.5 gram

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

PRODUCT MARKING*: LPHI-90

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



Mini-Circuits

LUMPED LC SURFACE MOUNT

Low Pass Filter

LPHI-90+

50 Ω

DC to 90 MHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD.

[CLICK HERE](#)

Performance Data and Graphs	Data
	Graphs
	S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads
Case Style	BAN2915-1 Lead Finish: Gold over Nickel
RoHS Status	Compliant
Tape and Reel	TR-F019
Suggested Layout for PCB Design	PL-814
Evaluation Board	TB-LPHI-90+
	Gerber File
Environmental Rating	ENV02T1

NOTES

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



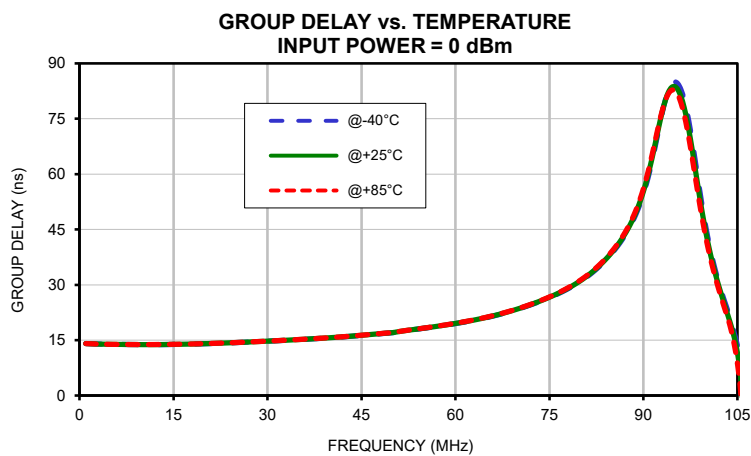
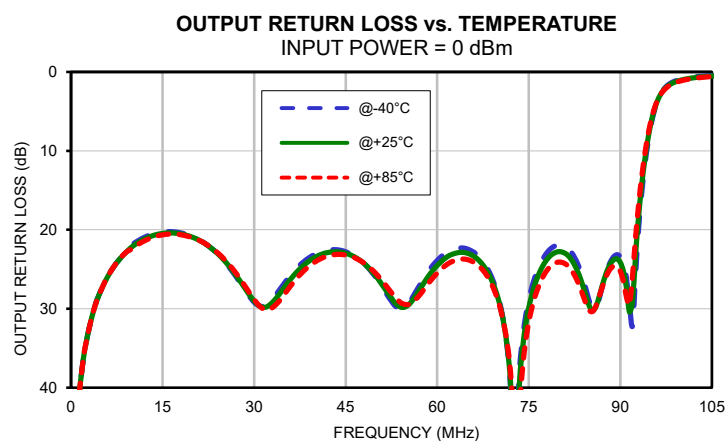
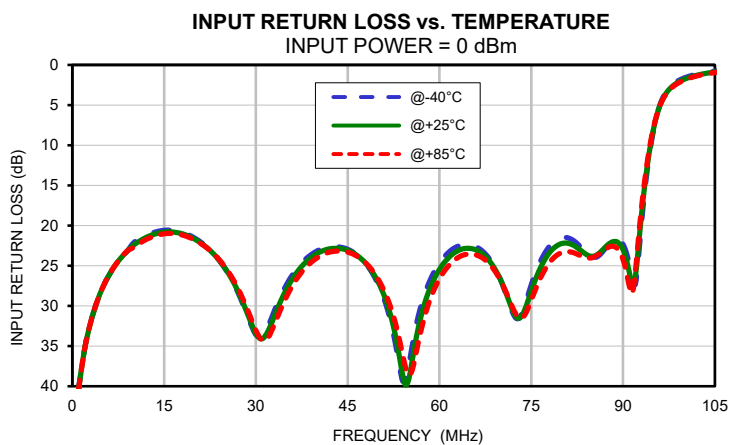
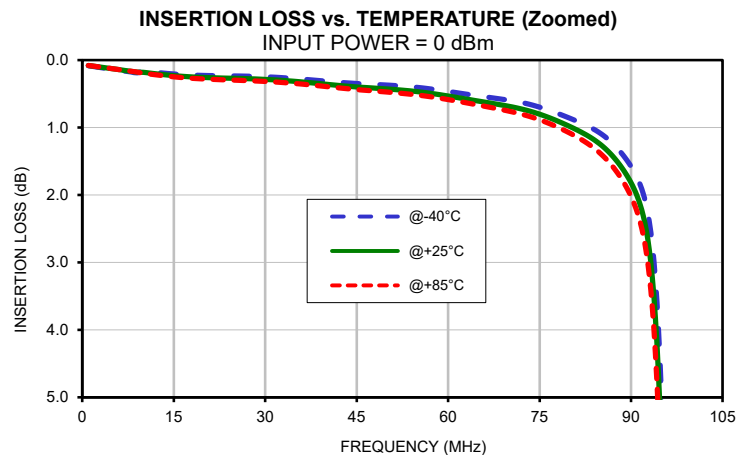
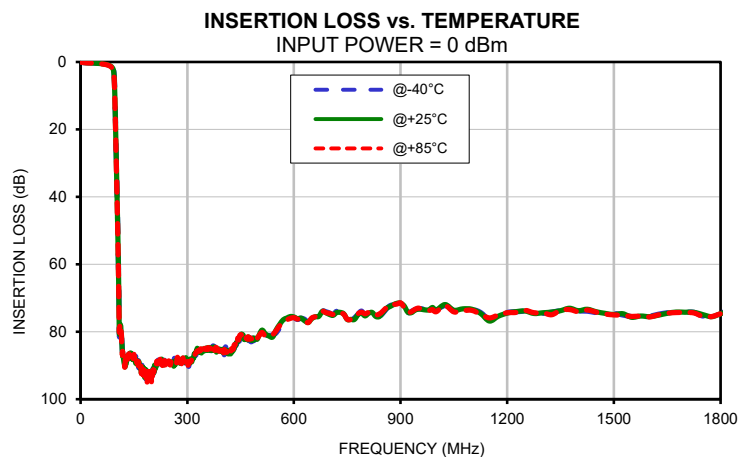
Typical Performance Data

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
1	0.08	0.08	0.08	40.45	40.55	40.56	43.14	43.29	43.37
5	0.14	0.13	0.13	27.64	27.66	27.65	27.50	27.52	27.52
10	0.16	0.18	0.20	22.16	22.44	22.73	21.90	22.15	22.40
15	0.21	0.23	0.25	20.59	20.81	21.03	20.29	20.46	20.64
20	0.23	0.26	0.28	21.55	21.69	21.79	20.88	20.97	21.02
25	0.24	0.27	0.30	25.40	25.35	25.21	23.87	23.79	23.63
30	0.25	0.29	0.32	33.58	33.48	33.06	29.17	29.02	28.82
35	0.27	0.32	0.35	27.36	27.93	28.86	26.72	27.24	28.13
40	0.31	0.36	0.39	23.16	23.48	24.02	23.09	23.48	24.06
45	0.35	0.40	0.44	22.95	23.08	23.31	22.79	22.98	23.20
50	0.37	0.43	0.47	27.33	27.06	26.71	26.09	25.91	25.58
55	0.41	0.47	0.52	37.34	39.08	38.63	29.57	29.66	29.47
60	0.46	0.53	0.59	24.65	25.44	26.61	23.88	24.52	25.48
65	0.53	0.61	0.67	22.39	22.85	23.55	22.45	22.98	23.79
70	0.60	0.69	0.76	26.77	26.80	26.87	28.49	28.76	29.08
75	0.70	0.80	0.88	27.36	28.13	29.25	28.85	29.86	31.70
80	0.86	0.99	1.08	21.50	22.23	23.35	21.90	22.76	24.09
85	1.09	1.25	1.39	23.98	23.83	23.99	29.26	29.80	30.29
90	1.58	1.82	2.02	22.36	23.01	24.23	23.42	24.14	25.26
95	5.03	5.80	6.52	8.00	7.86	7.68	6.84	6.54	6.23
100	26.53	27.37	28.22	1.62	1.78	1.89	0.91	1.02	1.11
105	51.86	52.65	53.52	0.78	0.88	0.95	0.45	0.52	0.58
110	79.86	79.33	78.42	0.47	0.54	0.59	0.28	0.34	0.38
115	81.33	81.54	81.13	0.32	0.37	0.41	0.20	0.24	0.28
120	87.29	87.42	87.97	0.24	0.28	0.31	0.15	0.18	0.22
125	89.91	90.43	90.06	0.18	0.22	0.25	0.11	0.15	0.18
130	88.34	88.26	87.48	0.15	0.18	0.21	0.10	0.13	0.15
135	86.64	87.44	87.03	0.13	0.16	0.18	0.08	0.12	0.14
140	87.05	86.28	87.16	0.12	0.15	0.17	0.08	0.11	0.13
145	86.38	86.68	87.37	0.11	0.13	0.15	0.07	0.09	0.12
150	87.22	88.28	86.71	0.10	0.12	0.14	0.06	0.08	0.11
200	92.87	92.35	95.54	0.08	0.09	0.10	0.05	0.07	0.08
250	88.93	89.52	89.35	0.09	0.10	0.11	0.06	0.08	0.09
300	88.92	88.59	88.57	0.09	0.11	0.12	0.07	0.09	0.11
350	84.55	85.11	85.24	0.09	0.11	0.12	0.07	0.10	0.11
400	85.36	85.17	85.62	0.10	0.12	0.13	0.08	0.11	0.13
450	81.75	81.22	80.89	0.10	0.13	0.14	0.09	0.12	0.14
500	80.60	81.49	81.47	0.09	0.12	0.13	0.09	0.12	0.14
550	80.33	79.45	79.68	0.10	0.13	0.15	0.10	0.14	0.16
600	75.83	75.62	75.82	0.11	0.13	0.15	0.11	0.15	0.17
650	75.78	76.15	75.94	0.09	0.13	0.14	0.10	0.14	0.16
700	74.44	74.88	74.52	0.10	0.14	0.16	0.11	0.16	0.18
750	75.98	76.36	76.30	0.11	0.14	0.17	0.13	0.17	0.20
780	74.85	74.97	74.67	0.10	0.14	0.16	0.12	0.16	0.19
800	75.12	75.30	74.66	0.09	0.13	0.16	0.11	0.16	0.19
850	74.53	74.31	73.90	0.10	0.14	0.17	0.13	0.17	0.20
900	72.08	71.53	71.43	0.09	0.13	0.16	0.13	0.18	0.21
950	73.19	73.29	72.99	0.09	0.14	0.17	0.13	0.18	0.21
1000	73.86	73.61	74.06	0.10	0.14	0.17	0.13	0.19	0.22
1050	73.83	73.62	74.11	0.15	0.20	0.22	0.13	0.18	0.22
1100	73.35	73.32	73.65	0.09	0.14	0.18	0.13	0.19	0.23
1150	76.40	76.83	75.90	0.09	0.15	0.18	0.14	0.20	0.24
1200	74.28	74.47	74.35	0.08	0.14	0.17	0.13	0.20	0.24
1250	73.99	73.85	73.67	0.09	0.15	0.19	0.14	0.21	0.26
1300	74.56	74.37	74.38	0.10	0.16	0.20	0.15	0.23	0.27
1400	73.85	73.76	74.04	0.11	0.18	0.23	0.16	0.24	0.28
1500	74.57	74.90	75.00	0.32	0.44	0.52	0.16	0.25	0.30
1600	75.41	75.52	75.61	0.15	0.23	0.27	0.19	0.28	0.32
1700	74.21	74.22	74.29	0.15	0.23	0.18	0.20	0.29	0.34
1800	74.28	74.67	74.65	0.16	0.24	0.28	0.22	0.31	0.35

Typical Performance Data

FREQ.	GROUP DELAY		
(MHz)	(nsec)		
	@-40°C	@+25°C	@+85°C
1	14.09	14.08	14.08
5	13.88	13.88	13.88
10	13.77	13.79	13.81
15	13.84	13.87	13.88
20	14.04	14.05	14.07
25	14.35	14.36	14.37
27	14.49	14.50	14.51
29	14.65	14.66	14.67
30	14.72	14.74	14.75
33	14.97	14.99	15.00
35	15.15	15.17	15.18
37	15.33	15.36	15.38
40	15.65	15.67	15.69
43	16.01	16.04	16.06
45	16.30	16.32	16.35
47	16.60	16.62	16.64
50	17.03	17.06	17.07
53	17.79	17.82	17.84
55	18.24	18.27	18.29
57	18.71	18.74	18.78
60	19.49	19.54	19.58
63	20.41	20.46	20.52
64	20.75	20.81	20.87
65	21.13	21.19	21.25
68	22.42	22.48	22.54
70	23.43	23.50	23.56
72	24.57	24.64	24.71
74	25.84	25.93	26.01
76	27.28	27.39	27.50
78	28.96	29.10	29.24
80	9.50	31.16	31.33
81	32.18	32.37	32.56
82	33.52	33.73	33.93
83	35.02	35.24	35.46
84	36.71	36.95	37.19
85	38.61	38.87	39.14
86	40.77	41.07	41.38
87	43.26	43.62	44.00
88	46.24	46.68	47.16
89	49.91	50.47	51.06
90	54.61	55.31	56.05

Typical Performance Curves



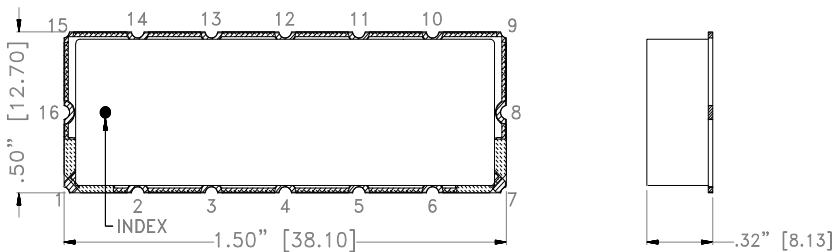
Case Style

BAN

Outline Dimension

BAN2915-1

TOP VIEW



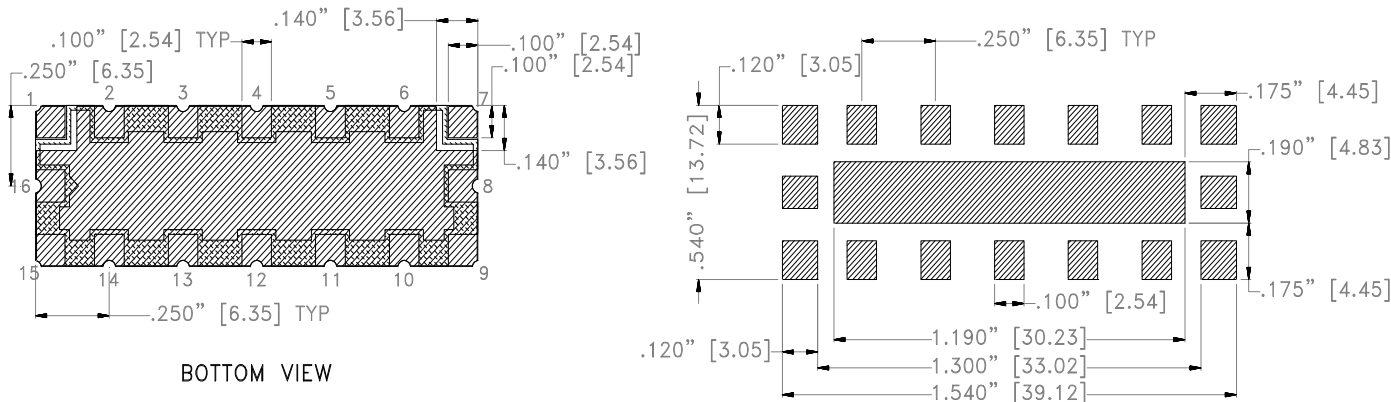
NOTES:

1. PIN NUMBERS DO NOT APPEAR ON UNIT.
FOR REFERENCE ONLY.
2. DIMENSIONS INCH [MM].

 METALLIZATION

 SOLDER RESIST

SUGGESTED LAYOUT
FOR P. C. PATTERN



Dimensions are in inches [mm]. Tolerances: 2 Pl $\pm$.03; 3 Pl $\pm$.015

Notes:

1. Case material: Nickel-Silver alloy.
2. Base: Printed wiring laminate.
3. Unit Weight: 6.5g
4. Termination finish:
For RoHS Case Styles: 2-5 μ inch (.05-.13 microns) Gold over 120-240 μ inch (3.05-6.10 microns) Nickel plate.
All models, (+) suffix.

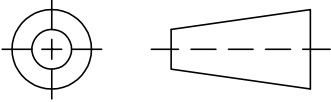


ALL NEW
minicircuits.com

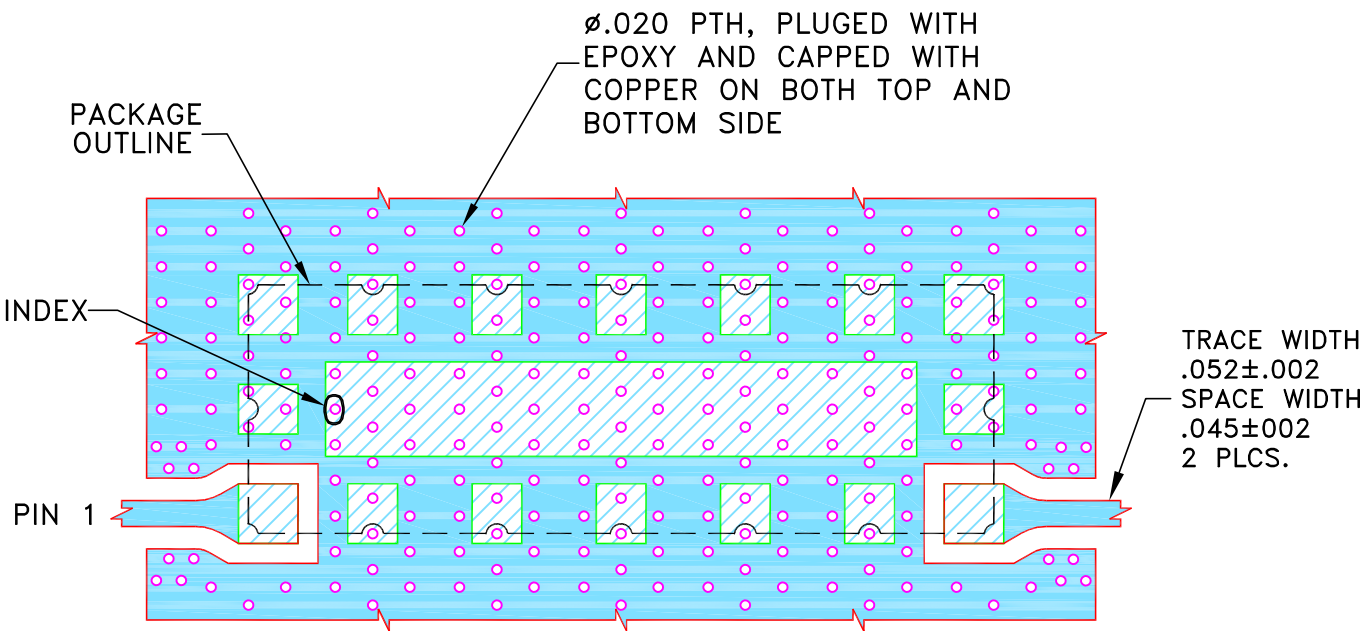
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site

The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

RF/IF MICROWAVE COMPONENTS

THIRD ANGLE PROJECTION		REVISIONS				
		REV	ECN No.	DESCRIPTION	DATE	DR
		OR	NP0-005031	NEW RELEASE	FEB 25	LK

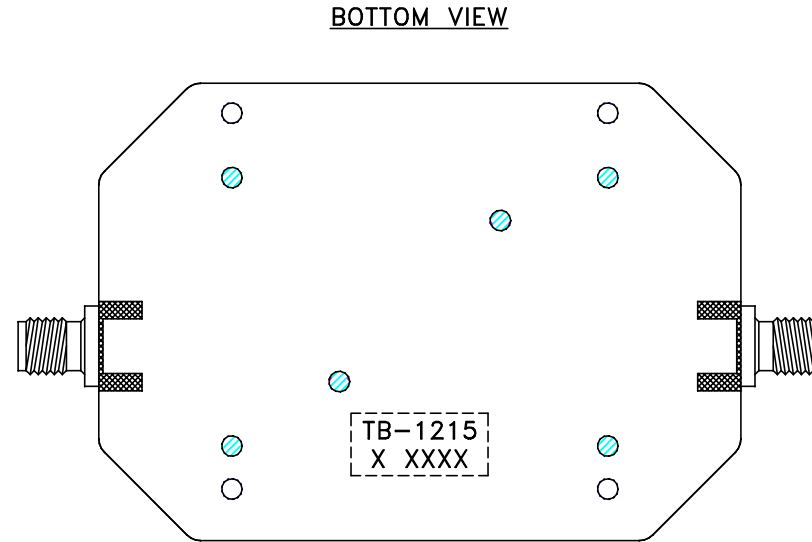
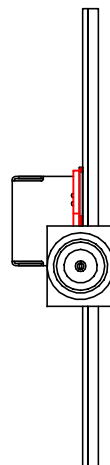
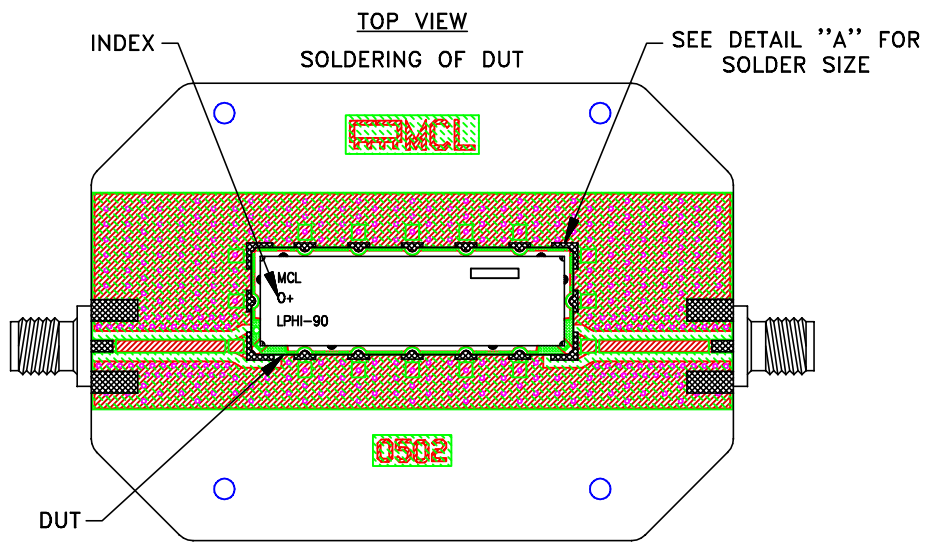
SUGGESTED MOUNTING CONFIGURATION
FOR CASE STYLE BAN2915-1



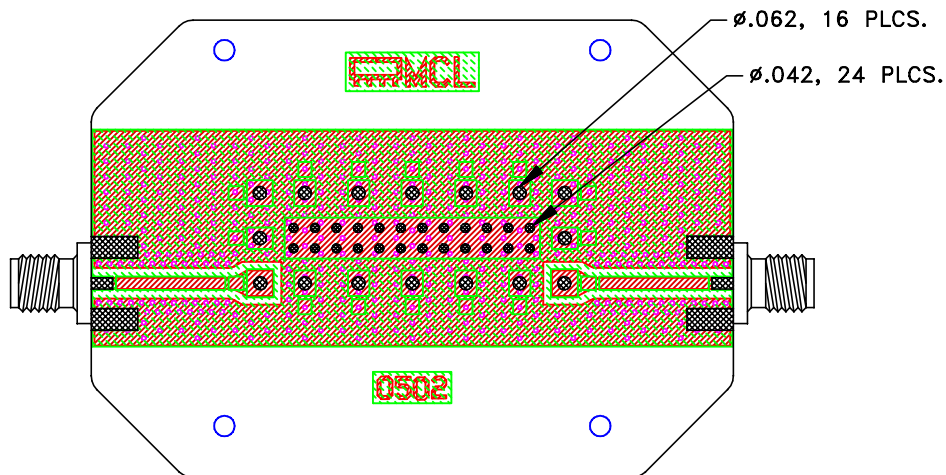
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FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
 - BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
-  DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)
-  DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

UNLESS OTHERWISE SPECIFIED		INITIALS		DATE	 Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235	
DIMENSIONS ARE IN INCHES TOLERANCES ON: 2 PL DECIMALS ± 3 PL DECIMALS ± .005 ANGLES ± FRACTIONS ±	DRAWN	LK	03 FEB 25			
	CHECKED	LK	03 FEB 25			
	APPROVED	KSK	13 FEB 25			
					PL DWG, BAN2915-1, TB-1215	
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ASHEETA1.DWG REV:A DATE:01/12/95					DRAWING NO: 98-PL-814	
					REV: OR	
					FILE: 98-PL-814	SCALE: 2.5:1
					SHEET: 1	OF 1



DETAIL "A"
SOLDER PASTE LOCATION FOR DUT



NOTES:

1. DENOTES SOLDER.
2. DENOTES METALLIZATION.
3. DENOTES SOLDER MASK.

UNLESS OTHERWISE SPECIFIED	INITIALS	DATE
DIMENSIONS ARE IN INCHES		
TOLERANCES ON:		
2 PL DECIMALS ±	DRAWN SPM	11 FEB 25
3 PL DECIMALS ±	CHECKED DDR	12 FEB 25
ANGLES ±	APPROVED KSK	
FRACTIONS ±		

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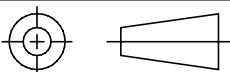
BSHEETA1.DWG REV:A DATE:01/12/94

Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

EVAL BOARD, FOR LPHI-90+

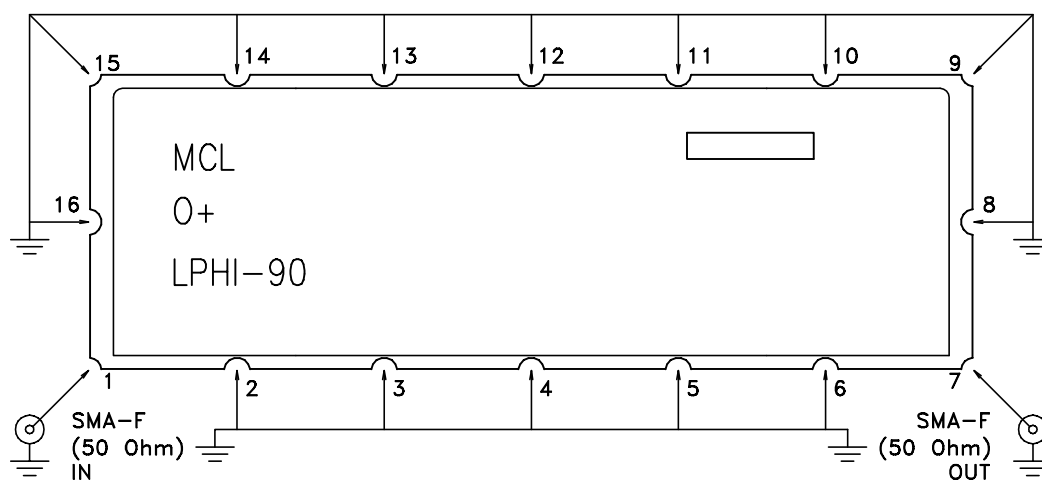
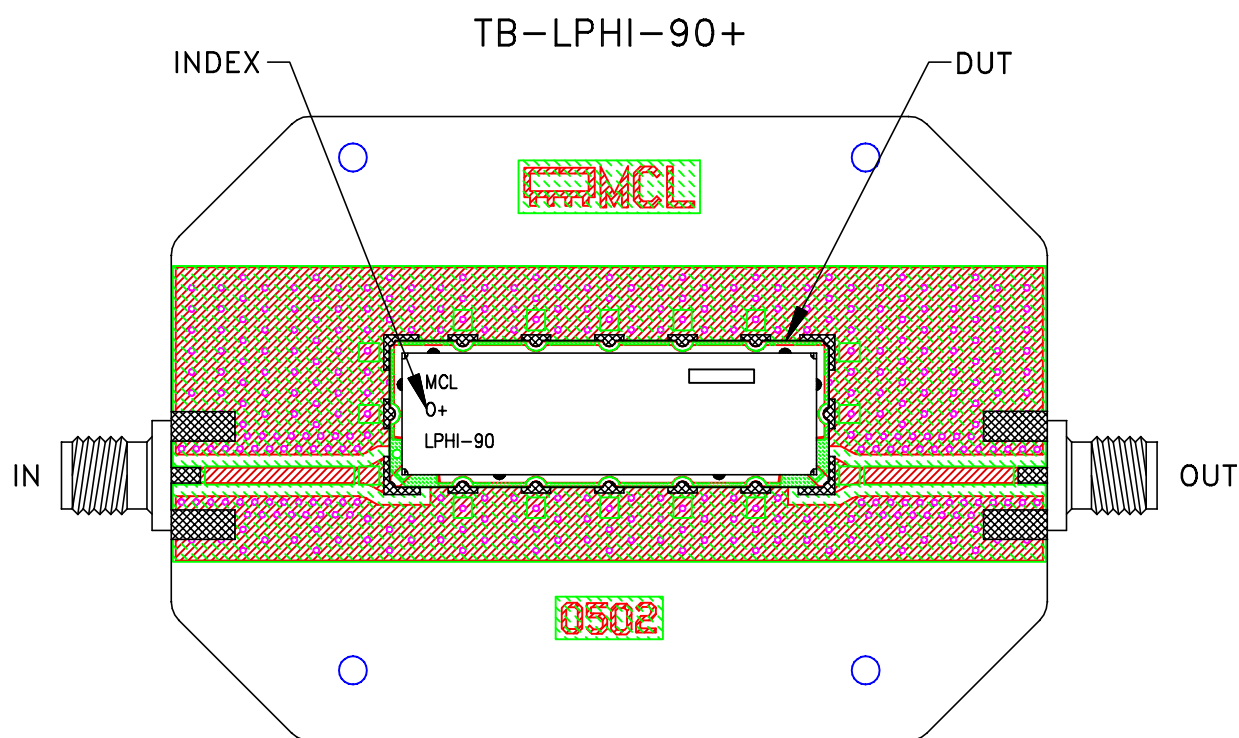
SIZE	CODE IDENT	DRAWING NO:	REV:
B	15542	TB-LPHI-90-20+	OR
FILE: WTB-LPHI-90+	SCALE: 1.5:1	SHEET: 1 OF 2	

THIRD ANGLE PROJECTION



OR NPO-005037	NEW RELEASE	FEB 25	SPM	VC
REV ECN No.	DESCRIPTION	DATE	DR	AUTH
REVISIONS				

Evaluation Board and Circuit



Schematic diagram

Notes:

1. 50 Ohm SMA female connectors.
2. PCB Material: ROGERS (R04350B) OR Equivalent
Dielectric Constant=3.48, Thickness=.023 $\pm$.002 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	-40° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
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 Eutetic Process: 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, 95% Coverage
Vibration (High Frequency)	20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)	MIL-STD-202, Method 204, Condition D
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