LUMPED LC SURFACE MOUNT top hat

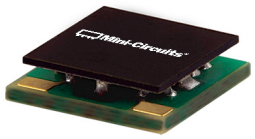
Low Pass Filter

ULP-50+

50Ω DC to 50 MHz

KEY FEATURES

- Low Insertion Loss, 1.5 dB Typ.
- High Rejection, 47 dB Typ.
- Sharp Insertion Loss Roll-off
- Good Return Loss, 20.8 dB Typ.
- Ultra Miniature Surface Mount Package

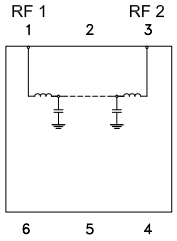


Generic photo used for illustration purposes only

APPLICATIONS

- Wireless Communications
- Receivers / Transformers
- Lab Use

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

The ULP-50+ is a low pass filter in a top hat package (size of 0.25" x 0.25") fabricated using SMT technology. Covering DC to 50 MHz band width, these units offer good matching within the passband and high rejection. This model uses a miniature high Q capacitors and chip inductors for high reliability. In addition it has repeatable performance across production lots and consistent performance across temperature.

ELECTRICAL SPECIFICATIONS[1,2,3] AT +25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Units
Passband	Insertion Loss	DC-F1	DC - 50	—	1.5	2.0	dB
	Freq. Cut-Off	Fc	59	—	3.0	—	dB
	Return Loss	DC-F1	DC - 50	—	20.8	—	dB
Stopband	Rejection	F2-F3	78 - 91	20	27	—	dB
		F3-F4	91 - 700	40	47	—	
		F4-F5	700 - 3000	—	20	—	

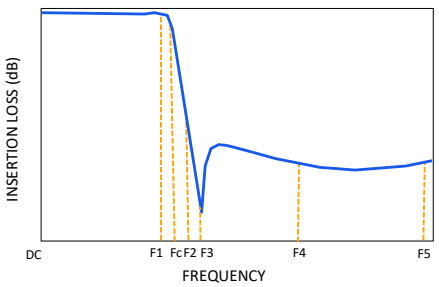
1. Tested in Evaluation Board P/N TB-ULP-50+
2. This filter is bi-directional RF1 and RF2 ports may be interchanged, see S-Parameters for actual performance.
3. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.

ABSOLUTE MAXIMUM RATINGS[4]

Parameter	Ratings
Operating Temperature	-40°C to + 85°C
Storage Temperature	-55°C to +100°C
Input Power[5]	0.1 W max.

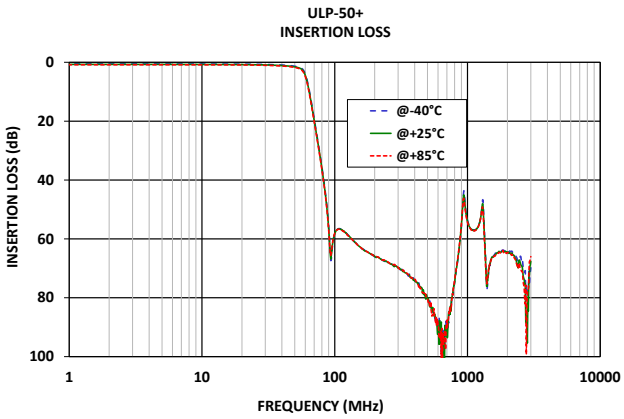
4. Permanent damage may occur if any of these limits are exceeded.
5. Power rating applies only to signals within the passband.

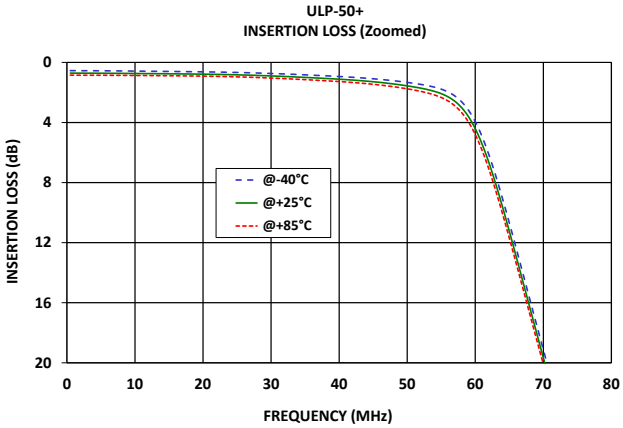
TYPICAL FREQUENCY RESPONSE AT +25°C

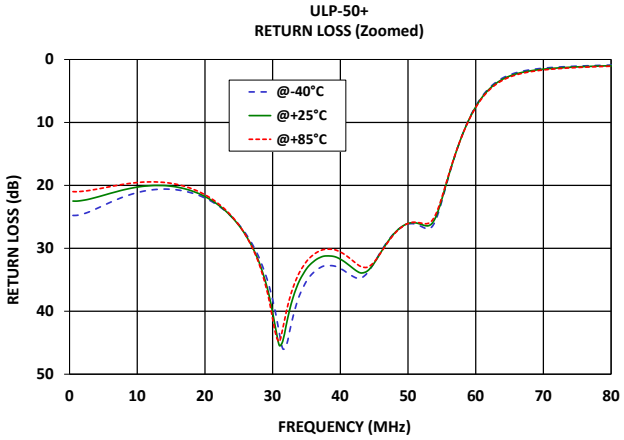


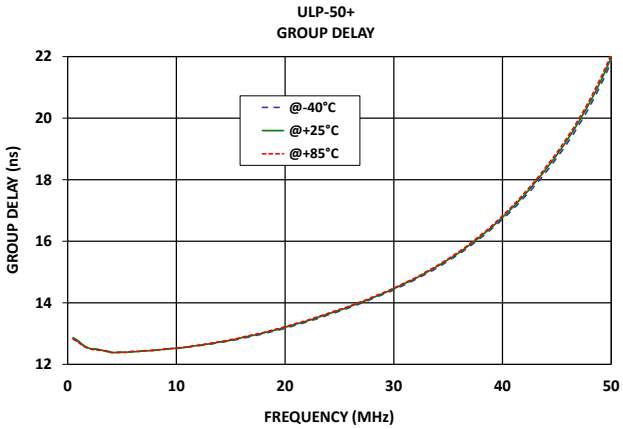
REV. A
ECO-025420
ULP-50+
EDU2382
URJ
250519

TYPICAL PERFORMANCE GRAPHS









FUNCTIONAL DIAGRAM

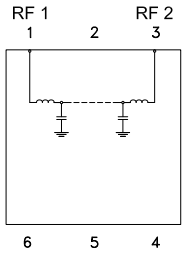
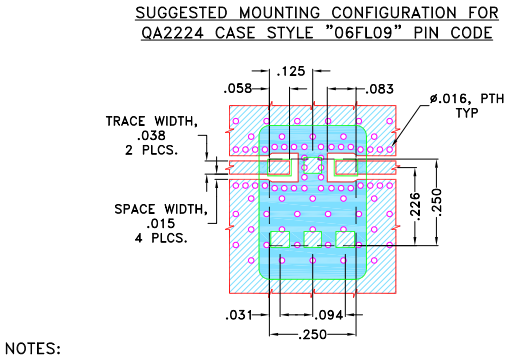


Figure 1. ULP-50+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
RF1 (Note 2)	1	Connects to RF Input Port
RF2 (Note 2)	3	Connects to RF Output Port
GROUND	2,4,5,6	Connects to Ground on PCB, (See drawing PL-484)
NC	—	No connection, not used internally. See drawing PL-484 for connection to PCB

SUGGESTED PCB LAYOUT (PL-484)



NOTES:

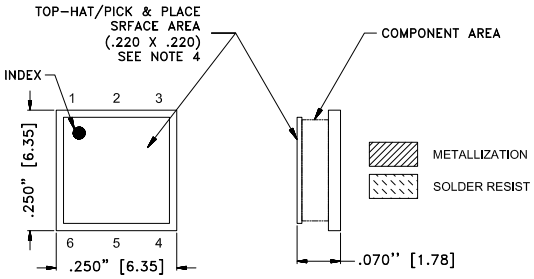
1. TRACE WIDTH IS SHOWN FOR ROGERS (RO4350B) WITH DIELECTRIC THICKNESS .020"±.0015". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

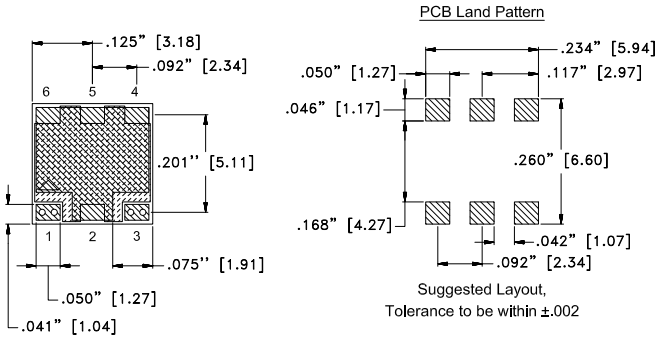
DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK

Figure 2. Suggested PCB Layout PL-484

CASE STYLE DRAWING





Weight: .25 gram

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

PRODUCT MARKING*: ULP-50

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

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD. CLICK HERE

Performance Data and Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads
Case Style	QA2224 Lead Finish: Gold over Nickel Plate
RoHS Status	Compliant
Tape and Reel	TR-F34
Suggested Layout for PCB Design	PL-484
Evaluation Board	TB-ULP-50+
	Gerber File
Environmental Rating	ENV03T2

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

Low Pass Filter ULP-50+

Typical Performance Data

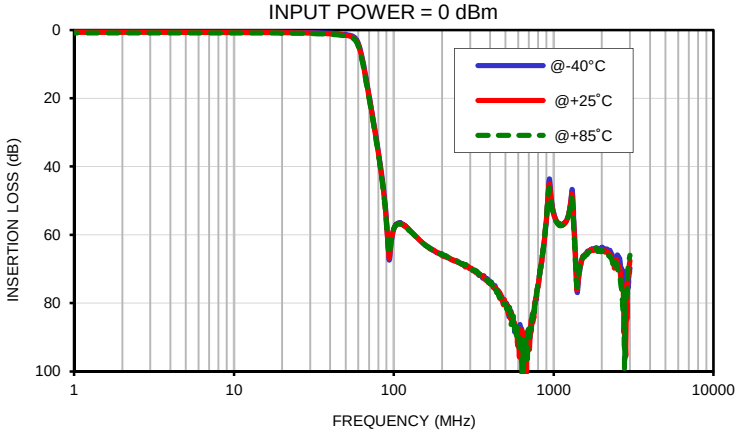
FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(MHz)	(dB)			(dB)			(dB)		
	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C
1	0.55	0.71	0.85	24.77	22.50	21.01	24.67	22.43	20.94
2	0.55	0.72	0.85	24.54	22.37	20.93	24.43	22.29	20.85
5	0.56	0.72	0.86	23.19	21.58	20.41	23.08	21.48	20.32
10	0.58	0.74	0.87	21.15	20.28	19.55	21.08	20.20	19.49
15	0.60	0.76	0.89	20.62	20.13	19.67	20.56	20.06	19.62
20	0.63	0.78	0.92	22.01	21.78	21.49	21.93	21.69	21.43
25	0.67	0.83	0.96	26.22	26.34	26.27	26.11	26.22	26.18
50	1.33	1.56	1.76	26.15	26.06	26.06	27.60	27.45	27.48
55	1.78	2.08	2.34	22.48	22.18	21.88	24.83	24.39	23.99
59	3.18	3.61	3.97	9.49	9.56	9.62	9.67	9.75	9.82
60	3.95	4.42	4.81	7.42	7.53	7.63	7.53	7.66	7.76
62	6.14	6.67	7.11	4.53	4.71	4.85	4.59	4.77	4.91
64	9.07	9.62	10.07	2.93	3.13	3.29	2.96	3.16	3.32
65	10.68	11.24	11.70	2.45	2.64	2.80	2.46	2.66	2.82
68	15.76	16.30	16.74	1.65	1.82	1.96	1.65	1.82	1.96
70	19.13	19.66	20.10	1.38	1.54	1.67	1.38	1.54	1.66
71	20.80	21.33	21.76	1.29	1.44	1.56	1.29	1.44	1.55
72	22.46	22.98	23.41	1.22	1.36	1.47	1.21	1.35	1.47
75	27.35	27.86	28.28	1.05	1.18	1.28	1.04	1.17	1.27
78	32.20	32.71	33.13	0.95	1.05	1.14	0.94	1.04	1.13
80	35.47	35.98	36.41	0.89	0.99	1.07	0.88	0.98	1.06
90	55.75	56.48	56.95	0.70	0.77	0.83	0.68	0.76	0.81
91	58.96	59.58	60.21	0.69	0.76	0.81	0.67	0.74	0.80
92	62.91	63.25	63.34	0.67	0.74	0.79	0.66	0.73	0.78
93	66.47	66.09	65.70	0.66	0.73	0.78	0.65	0.72	0.76
95	64.94	64.19	63.47	0.63	0.70	0.75	0.62	0.69	0.73
98	59.93	59.70	59.49	0.60	0.66	0.71	0.58	0.65	0.69
100	58.31	58.25	58.10	0.58	0.64	0.68	0.57	0.63	0.67
125	58.51	58.69	58.78	0.41	0.45	0.48	0.39	0.44	0.46
150	62.13	62.22	62.27	0.30	0.34	0.37	0.29	0.33	0.35
175	64.55	64.32	64.33	0.24	0.28	0.29	0.23	0.27	0.28
200	66.07	65.92	65.53	0.19	0.23	0.25	0.18	0.22	0.24
225	66.94	67.04	67.01	0.16	0.19	0.21	0.15	0.18	0.20
250	67.89	67.99	67.76	0.13	0.17	0.18	0.12	0.16	0.17
300	69.88	69.93	69.67	0.10	0.13	0.14	0.09	0.12	0.13
350	71.98	71.83	71.67	0.07	0.11	0.12	0.06	0.10	0.11
400	74.34	74.15	73.72	0.06	0.09	0.10	0.05	0.08	0.09
450	76.48	76.65	77.10	0.04	0.08	0.08	0.03	0.07	0.08
500	80.36	80.39	80.25	0.03	0.07	0.08	0.02	0.06	0.07
550	84.97	83.72	85.80	0.02	0.06	0.07	0.02	0.06	0.06
600	90.08	92.04	89.38	0.02	0.06	0.07	0.01	0.05	0.06
650	90.94	91.92	97.69	0.01	0.05	0.06	0.00	0.05	0.06
700	90.18	90.03	87.64	0.00	0.05	0.06	0.00	0.04	0.06
750	82.93	84.51	83.09	0.00	0.05	0.06	0.00	0.05	0.06
800	74.60	74.88	73.69	0.00	0.05	0.06	0.01	0.04	0.06
850	66.10	65.89	65.83	0.01	0.05	0.06	0.01	0.04	0.06
900	55.77	55.32	54.90	0.00	0.06	0.08	0.01	0.05	0.07
950	45.30	46.77	47.97	0.03	0.08	0.09	0.01	0.06	0.08
1000	53.57	54.03	54.37	0.01	0.05	0.07	0.02	0.05	0.07
1250	53.37	53.40	53.45	0.01	0.06	0.08	0.02	0.05	0.08
1500	67.26	67.35	67.47	0.01	0.07	0.10	0.02	0.06	0.09
1750	64.23	64.45	64.67	0.00	0.09	0.12	0.01	0.08	0.11
2000	63.68	64.47	64.66	0.01	0.11	0.14	0.00	0.10	0.13
2200	64.73	65.46	66.04	0.02	0.12	0.16	0.02	0.12	0.15
2250	64.57	65.77	66.44	0.03	0.12	0.16	0.02	0.12	0.15
2500	65.93	68.18	69.84	0.05	0.14	0.18	0.05	0.14	0.18
2750	79.74	88.57	76.45	0.06	0.16	0.19	0.07	0.17	0.20
2800	76.36	88.07	82.89	0.06	0.16	0.19	0.07	0.17	0.20
2900	70.50	72.18	72.32	0.07	0.17	0.20	0.08	0.19	0.22
3000	69.80	67.62	66.03	0.07	0.17	0.21	0.08	0.19	0.22

Typical Performance Data

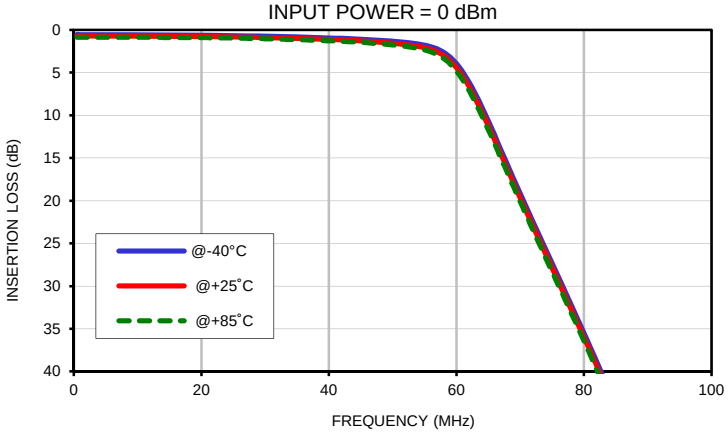
FREQ. (MHz)	GROUP DELAY (nsec)		
	@-40°C	@+25°C	@+85°C
1.0	12.73	12.75	12.71
2.0	12.52	12.52	12.51
3.0	12.48	12.47	12.46
4.0	12.40	12.39	12.39
5.0	12.39	12.39	12.39
6.0	12.42	12.41	12.42
7.0	12.44	12.44	12.44
8.0	12.46	12.46	12.46
9.0	12.49	12.49	12.49
10.0	12.52	12.52	12.53
11.0	12.56	12.56	12.57
12.0	12.60	12.61	12.62
13.0	12.65	12.66	12.68
14.0	12.71	12.73	12.74
15.0	12.77	12.78	12.81
16.0	12.84	12.86	12.88
17.0	12.91	12.94	12.96
18.0	12.99	13.02	13.03
19.0	13.08	13.10	13.13
20.0	13.17	13.21	13.22
21.0	13.28	13.31	13.33
22.0	13.38	13.41	13.43
23.0	13.49	13.52	13.55
24.0	13.61	13.64	13.66
25.0	13.73	13.76	13.78
26.0	13.85	13.89	13.90
27.0	13.99	14.02	14.04
28.0	14.13	14.15	14.18
29.0	14.27	14.30	14.32
30.0	14.42	14.46	14.48
31.0	14.58	14.63	14.65
32.0	14.76	14.79	14.81
33.0	14.95	14.98	15.02
34.0	15.14	15.18	15.21
35.0	15.36	15.40	15.43
36.0	15.58	15.63	15.67
37.0	15.84	15.89	15.92
38.0	16.11	16.16	16.21
39.0	16.40	16.45	16.50
40.0	16.72	16.78	16.83
40.5	16.88	16.94	17.00
41.0	17.06	17.12	17.18
41.5	17.23	17.31	17.36
42.0	17.43	17.50	17.56
42.5	17.61	17.70	17.76
43.0	17.82	17.91	17.97
43.5	18.02	18.12	18.18
44.0	18.25	18.35	18.42
44.5	18.48	18.57	18.65
45.0	18.71	18.81	18.88
45.5	18.95	19.05	19.14
46.0	19.21	19.32	19.40
46.5	19.47	19.59	19.67
47.0	19.77	19.88	19.97
47.5	20.05	20.18	20.27
48.0	20.37	20.49	20.58
48.5	20.70	20.83	20.93
49.0	21.05	21.18	21.29
49.5	21.43	21.56	21.67
50.0	21.84	21.98	22.09

Typical Performance Curves

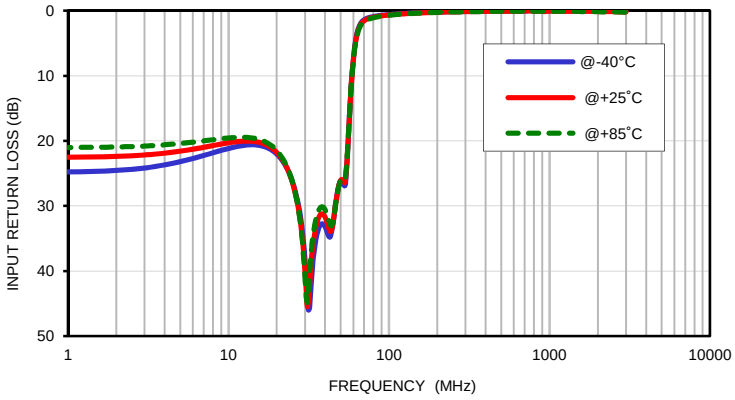
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



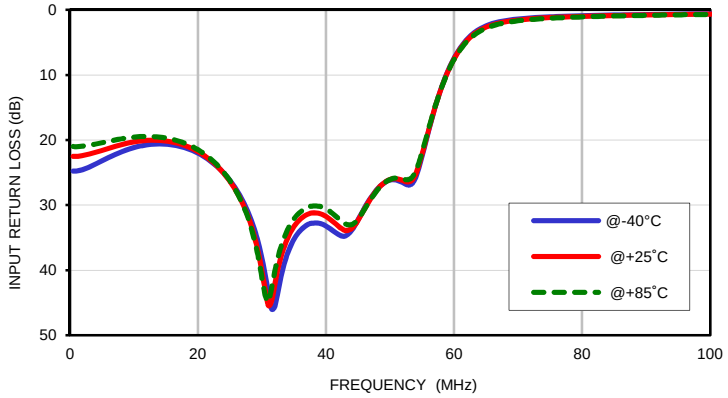
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



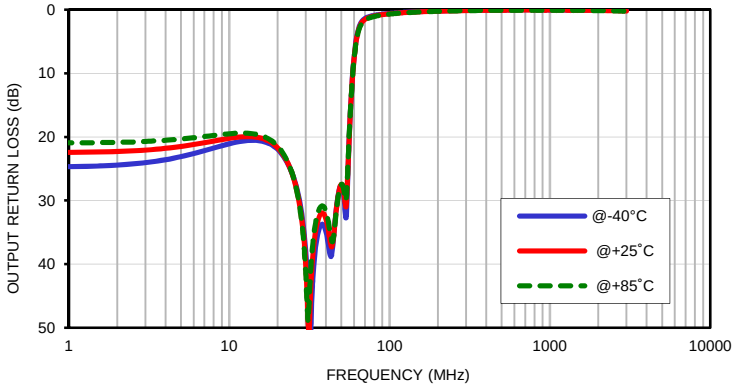
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



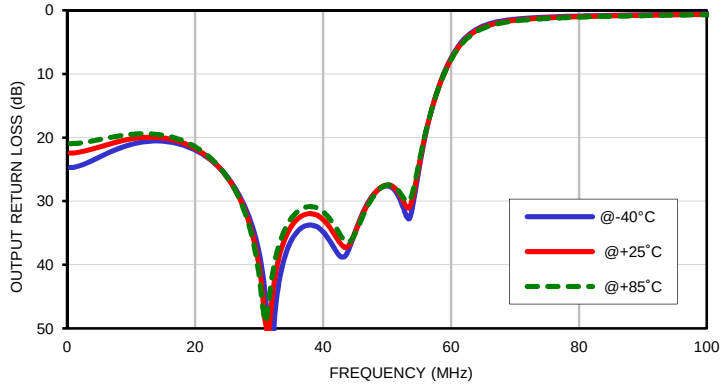
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



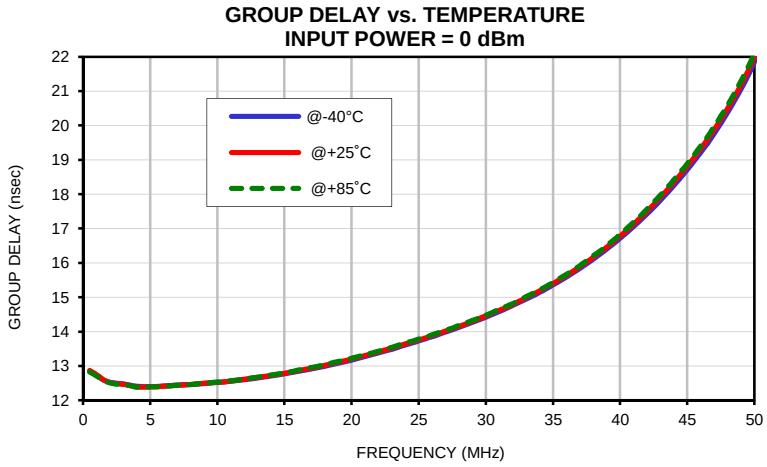
OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm

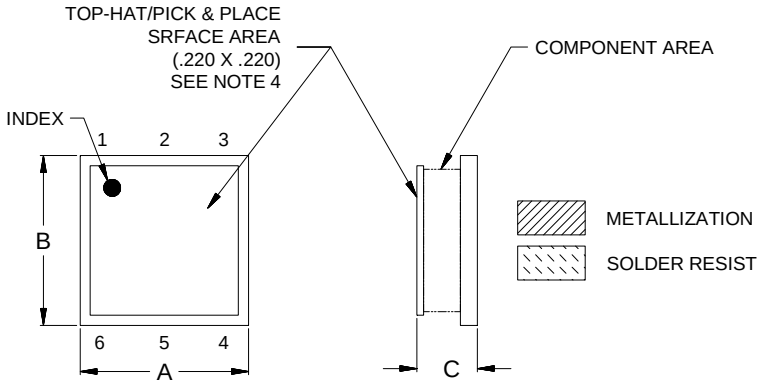


Typical Performance Curves

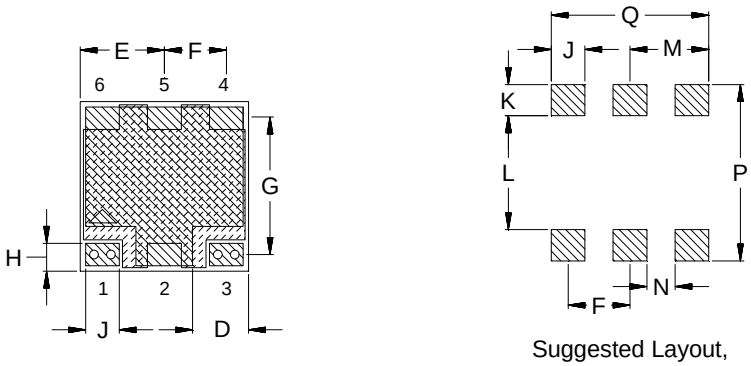


Case Style QA

Outline Dimensions QA2224



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE#	A	B	C	D	E	F	G	H	J	K	L	M
QA2224	.250 (6.35)	.250 (6.35)	.070 (1.78)	.075 (1.91)	.125 (3.18)	.092 (2.34)	.201 (5.11)	.041 (1.04)	.050 (1.27)	.046 (1.17)	.168 (4.27)	.117 (2.97)

CASE#	N	P	Q	WT. GRAM
QA2224	.042 (1.07)	.260 (6.60)	.234 (5.94)	0.25

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

Notes:

1. Case material: Ceramic base.
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.
4. Top-Hat total thickness: .013 inches MAX

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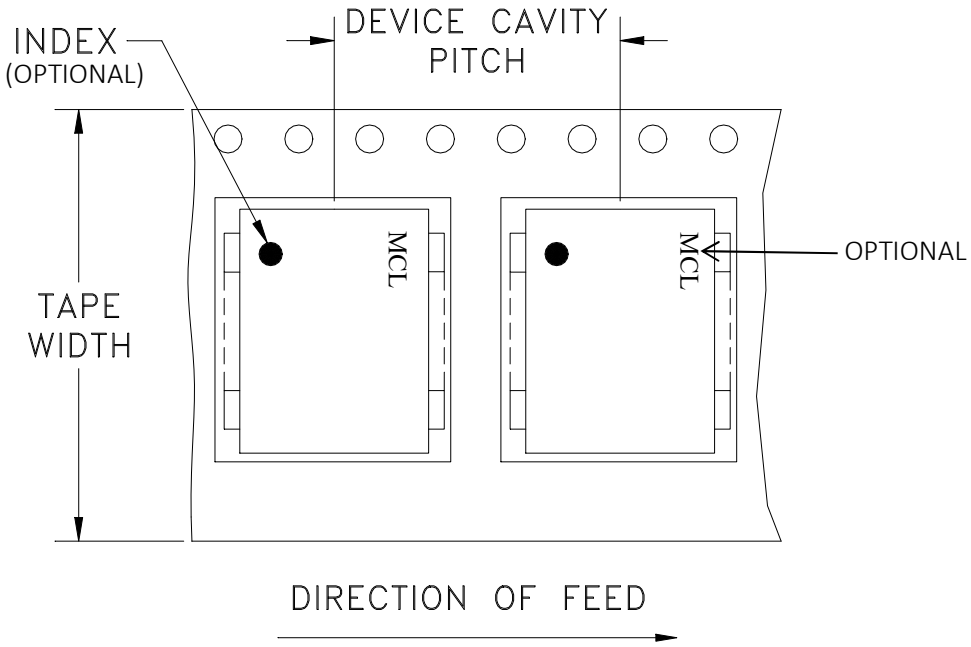
Tape & Reel Packaging TR-F34

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
16	12	7	Small quantity standard (see note)	20
				50
				100
				200
		13	Standard	500
				1000

Note: Availability of small reel quantity varies by model.
Refer to pricing and availability on individual model dashboard.

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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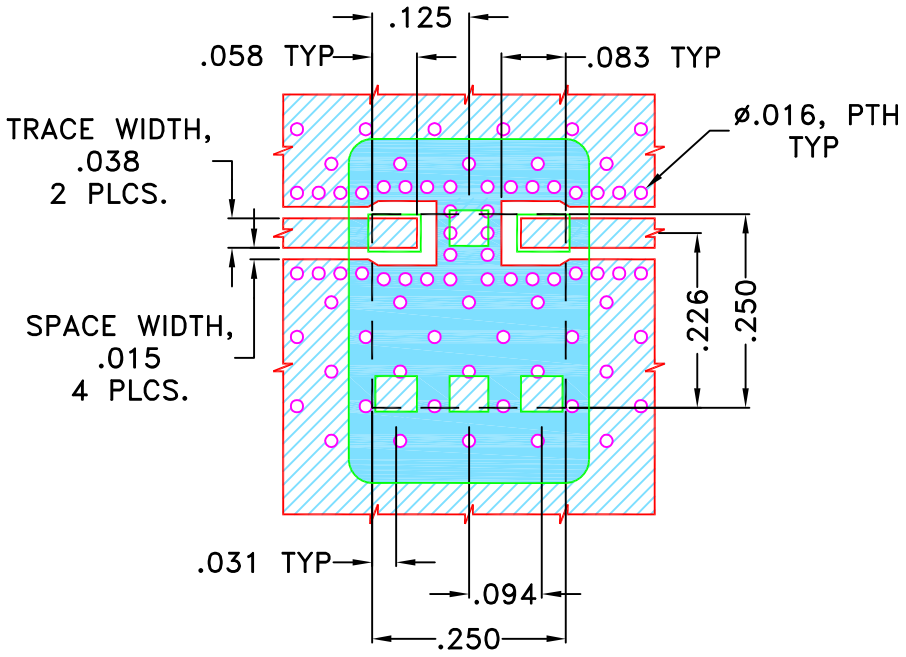
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M156213	NEW RELEASE	MAY 16	TM	MD
A	M161508	COPPER LAND PATTERN UPDATED	APR 17	EJ	MD

SUGGESTED MOUNTING CONFIGURATION FOR QA2224 CASE STYLE "06FL09" PIN CODE



NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS (RO4350B) WITH DIELECTRIC THICKNESS .020"±.0015". 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	TM	02 MAY 16
TOLERANCES ON:	CHECKED	MD	02 MAY 16
2 PL DECIMALS ±	APPROVED	MD	02 MAY 16
3 PL DECIMALS ± .005"			
ANGLES ±			
FRACTIONS ±			

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

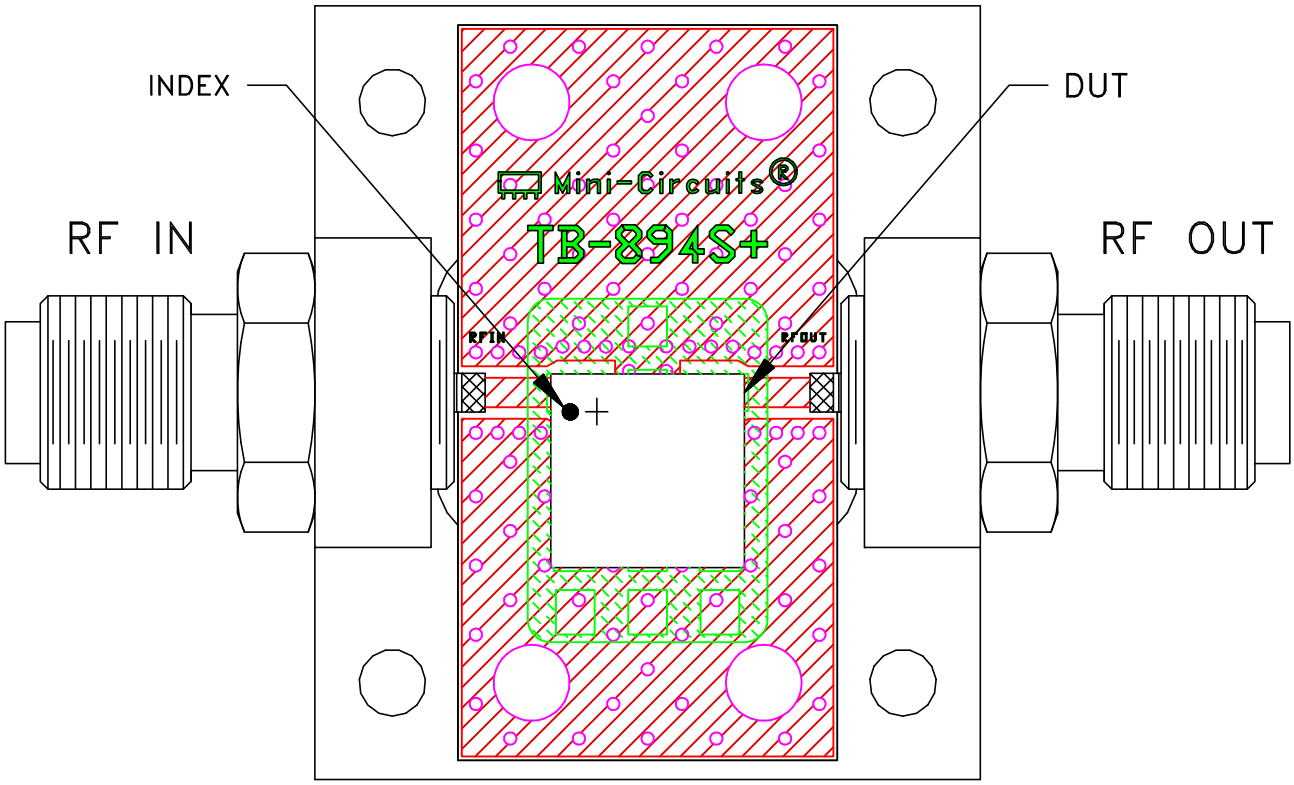
Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

PL, 06FL09, QA2224, ULP, TB-894+, 50 Ohm

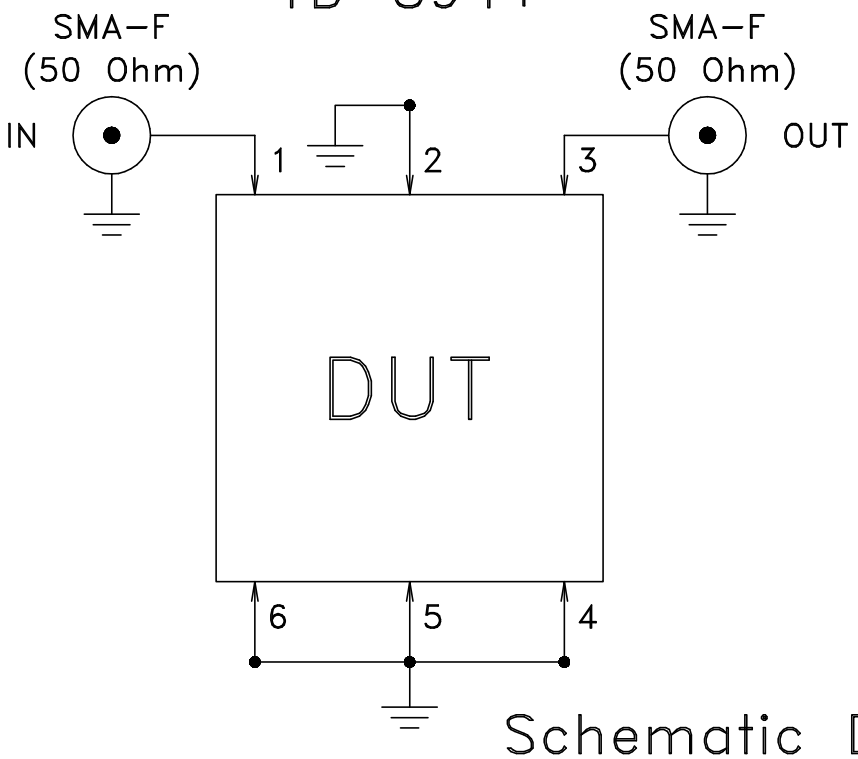
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-484	A

FILE:	SCALE:	SHEET:
98PL484	4:1	1 OF 1

Evaluation Board and Circuit



TB-894+



Schematic Diagram

NOTES:

1. 50 Ohm SMA Female connectors.
2. PCB Material: ROGERS (RO4350B) OR Equivalent
   Dielectric Constant=3.48±.05, Thickness=.020 inch.

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Environmental Specifications ENV03T2

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
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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