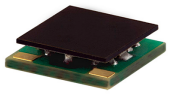
Surface Mount top hat®

Low Pass Filter

ULP-40+

50Ω DC to 40 MHz



CASE STYLE: QA2224

The Big Deal

- Low Insertion loss, 1.5dB Typ.
- High rejection, > 40dB
- Sharp insertion loss roll-off
- Good VSWR
- Ultra miniature surface mount package

Product Overview

The ULP-40+ is a lowpass filter in a top hat package (size of 0.25" x 0.25") fabricated using SMT technology. Covering DC to 40 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.

Key Features

Feature	Advantages
Low passband insertion loss	Passband insertion loss 1.5dB typical ensures low signal loss throughout the passband
Excellent stopband rejection	Rejection of 40 dB ensures unwanted spurious are eliminated
Excellent return loss at DC-40 MHz	This makes signal transmission with very less reflections and well-matched with the adjacent component used in the system
Small size, 0.25" x 0.25"	The Ultra miniature surface mount package enables the ULP-40+ to be used in compact designs.

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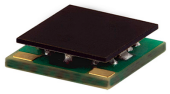
50Ω DC to 40 MHz



CASE STYLE: QA2224

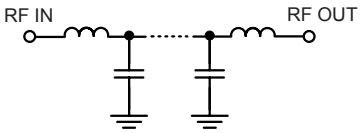
Features

- High rejection
- Sharp insertion loss roll-off
- Good VSWR, 1.1:1 typ at passband
- Ultra miniature surface mount package

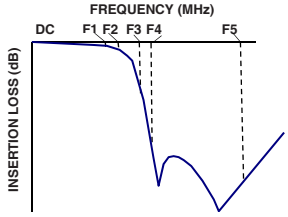
Applications

- Wireless communications
- Receivers / Transformers
- Lab use

Functional Schematic



Typical Frequency Response



Electrical Specifications at 25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Insertion Loss	DC-F1	DC-40	—	1.5	2.0	dB
	Freq. Cut-Off	F2	56	—	3.0	—	dB
	VSWR	DC-F1	DC-40	—	1.1	—	:1
Stop Band	Rejection Loss	F3-F4	70-80	20	27	—	dB
		F4-F5	80-600	40	47	—	dB
		F5-F6	600-3000	—	20	—	dB
	VSWR	F3-F5	70-600	—	20	—	:1

Maximum Ratings	
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	0.1W max.

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

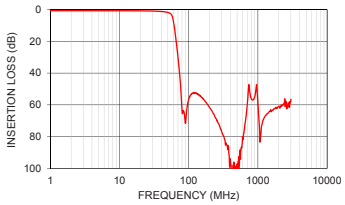
Typical Performance Data at 25°C

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)	Frequency (MHz)	Group Delay (nsec)
1	0.67	1.15	1	11.46
10	0.69	1.17	4	11.16
40	1.15	1.04	6	11.21
56	2.96	1.27	8	11.28
58	4.34	1.89	10	11.36
65	17.82	8.44	12	11.45
67	22.59	10.30	14	11.58
70	29.93	12.61	16	11.74
71	32.46	13.27	18	11.92
75	43.64	15.67	20	12.12
80	63.66	18.35	22	12.36
95	61.25	25.64	24	12.63
100	56.52	28.01	26	12.91
250	68.82	109.58	28	13.24
300	77.17	141.83	30	13.60
600	80.23	285.61	32	14.03
1000	59.18	207.63	34	14.52
2000	60.96	92.54	36	15.11
2500	60.17	76.17	38	15.79
3000	56.50	70.84	40	16.62

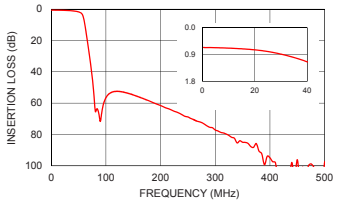
+RoHS Compliant

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

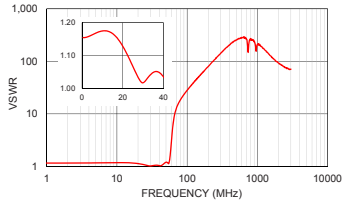
ULP-40+
INSERTION LOSS (Full band)



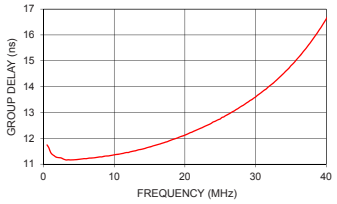
ULP-40+
INSERTION LOSS (Passband)



ULP-40+
VSWR



ULP-40+
GROUP DELAY



Notes

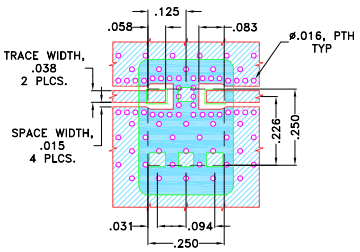
A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's 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/MCLStore/terms.jsp

Pad Connections

INPUT	1
OUTPUT	3
GROUND	2,4,5,6

Demo Board MCL P/N: TB-894+
Suggested PCB Layout (PL-484)

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



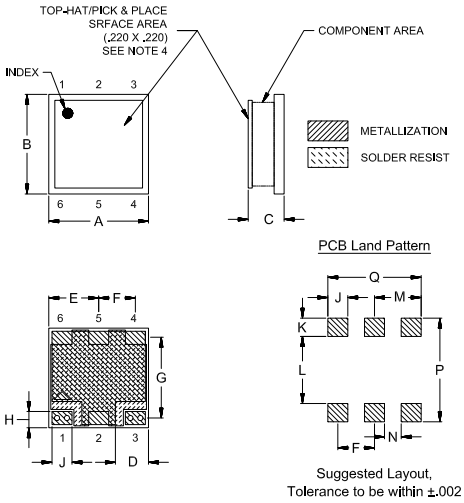
NOTES:

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

Outline Drawing



Suggested Layout,
Tolerance to be within ±.002

Outline Dimensions (inch / mm)

A	B	C		D	E	F	G	H	J	K
-	-	**Min**	**Max**	-	-	-	-	-	-	-
.250	**.250**	**.075**	**.100**	**.075**	**.125**	**.092**	**.201**	**.041**	**.050**	**.046**
6.35	6.35	1.91	2.54	1.91	3.18	2.34	5.11	1.04	1.27	1.17

L	M	N	P	Q	Wt.
-	-	-	-	-	grams
.168	**.117**	**.042**	**.260**	**.234**	0.25
4.27	2.97	1.07	6.60	5.94	

Typical Performance Data

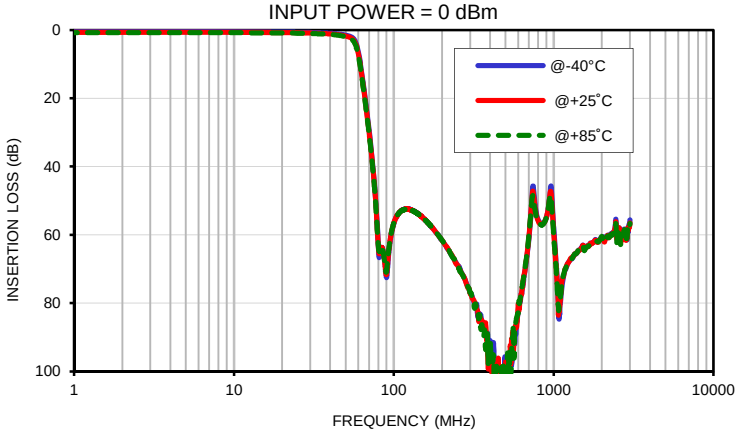
FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(MHz)	(dB)			(dB)			(dB)		
	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C
1	0.51	0.67	0.79	25.23	22.89	21.49	25.22	22.88	21.48
5	0.51	0.67	0.79	24.40	22.45	21.22	24.39	22.44	21.21
10	0.53	0.69	0.81	23.24	21.90	20.97	23.21	21.86	20.95
20	0.59	0.75	0.86	25.12	24.37	23.77	24.97	24.22	23.65
25	0.64	0.80	0.93	30.40	29.83	29.23	29.86	29.26	28.76
40	0.95	1.15	1.30	37.15	35.26	34.13	40.41	37.42	36.01
50	1.51	1.78	1.99	20.77	20.94	21.08	20.59	20.68	20.77
55	2.19	2.60	2.91	24.65	23.34	22.43	21.47	20.48	19.86
56	2.51	2.96	3.31	19.08	18.45	17.97	17.51	16.89	16.48
57	3.00	3.52	3.91	14.05	13.83	13.65	13.30	13.03	12.84
58	3.76	4.34	4.78	10.27	10.25	10.23	9.84	9.78	9.75
59	4.86	5.51	5.98	7.47	7.57	7.65	7.20	7.27	7.33
60	6.35	7.04	7.54	5.47	5.65	5.79	5.28	5.44	5.56
62	10.23	10.94	11.46	3.16	3.40	3.58	3.05	3.28	3.44
65	17.12	17.82	18.32	1.85	2.07	2.23	1.79	2.00	2.15
66	19.51	20.19	20.69	1.65	1.85	2.00	1.60	1.80	1.94
67	21.91	22.59	23.08	1.50	1.69	1.83	1.46	1.64	1.77
68	24.33	25.01	25.49	1.39	1.57	1.70	1.35	1.52	1.64
70	29.25	29.93	30.42	1.22	1.38	1.50	1.19	1.35	1.45
72	34.38	35.08	35.57	1.11	1.25	1.35	1.08	1.22	1.32
80	63.51	63.66	63.37	0.84	0.95	1.02	0.83	0.93	1.00
85	64.17	64.15	64.29	0.75	0.83	0.89	0.74	0.82	0.88
90	72.51	71.10	70.75	0.67	0.75	0.80	0.66	0.74	0.79
100	56.67	56.52	56.54	0.56	0.62	0.66	0.55	0.62	0.65
120	52.43	52.50	52.53	0.41	0.46	0.49	0.41	0.46	0.49
125	52.51	52.56	52.62	0.39	0.43	0.46	0.39	0.43	0.46
150	54.75	54.80	54.81	0.29	0.33	0.35	0.29	0.33	0.35
200	61.62	61.54	61.52	0.18	0.22	0.23	0.18	0.22	0.23
250	68.80	68.82	69.34	0.12	0.16	0.17	0.12	0.16	0.17
300	76.96	77.17	76.98	0.09	0.12	0.13	0.09	0.13	0.13
350	83.48	84.98	87.64	0.07	0.10	0.11	0.06	0.10	0.11
400	90.96	94.91	90.93	0.05	0.09	0.09	0.05	0.09	0.09
500	101.15	97.76	106.30	0.03	0.07	0.07	0.03	0.07	0.07
600	82.78	80.23	83.00	0.02	0.06	0.07	0.01	0.06	0.06
650	72.44	72.10	72.20	0.02	0.06	0.07	0.01	0.06	0.06
750	47.02	48.78	50.00	0.05	0.09	0.09	0.03	0.08	0.08
800	55.70	55.98	56.22	0.01	0.06	0.08	0.01	0.06	0.07
850	56.87	56.92	57.10	0.01	0.07	0.08	0.00	0.07	0.07
900	54.94	54.82	54.86	0.02	0.07	0.08	0.00	0.07	0.07
950	47.47	47.85	48.60	0.04	0.10	0.11	0.03	0.10	0.10
1000	57.95	59.18	60.08	0.02	0.08	0.09	0.01	0.08	0.08
1200	69.50	69.23	69.30	0.03	0.10	0.11	0.01	0.09	0.09
1250	67.73	67.80	67.70	0.03	0.10	0.12	0.01	0.09	0.10
1300	67.04	66.55	66.97	0.03	0.11	0.12	0.01	0.10	0.10
1400	65.17	65.25	65.23	0.04	0.12	0.14	0.01	0.10	0.11
1500	63.60	63.87	63.75	0.05	0.13	0.15	0.02	0.11	0.12
1600	63.42	63.43	63.72	0.06	0.15	0.16	0.03	0.12	0.14
1700	62.42	62.48	62.98	0.07	0.15	0.18	0.04	0.13	0.15
1750	62.41	62.32	62.45	0.08	0.16	0.19	0.04	0.14	0.15
1800	61.74	61.74	61.97	0.08	0.17	0.19	0.04	0.14	0.16
1850	61.72	62.08	61.95	0.08	0.17	0.20	0.04	0.15	0.17
1900	61.98	62.19	62.07	0.09	0.18	0.20	0.05	0.16	0.17
1950	61.30	61.48	61.46	0.09	0.18	0.21	0.05	0.16	0.18
2000	61.34	60.96	60.47	0.09	0.19	0.21	0.06	0.17	0.19
2200	60.45	60.82	60.80	0.11	0.21	0.24	0.07	0.19	0.20
2400	58.56	58.64	58.69	0.12	0.22	0.25	0.09	0.20	0.23
2500	59.97	60.17	60.34	0.13	0.23	0.26	0.10	0.22	0.24
2600	61.29	61.15	61.32	0.14	0.24	0.27	0.11	0.23	0.25
2800	58.47	59.05	59.54	0.14	0.24	0.27	0.12	0.24	0.26
3000	55.63	56.50	56.71	0.14	0.25	0.27	0.13	0.25	0.27

Typical Performance Data

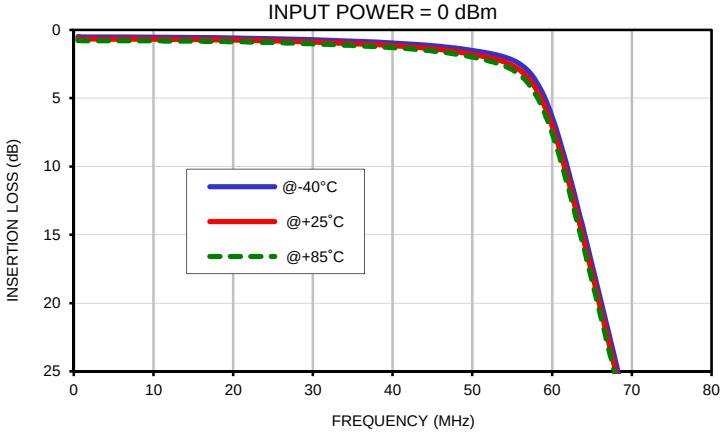
FREQ. (MHz)	GROUP DELAY (nsec)		
	@-40°C	@+25°C	@+85°C
1.0	11.35	11.46	11.45
2.0	11.22	11.26	11.24
3.0	11.17	11.18	11.17
4.0	11.17	11.16	11.15
5.0	11.19	11.19	11.18
6.0	11.22	11.21	11.22
7.0	11.25	11.24	11.25
8.0	11.28	11.28	11.27
9.0	11.32	11.32	11.32
10.0	11.36	11.36	11.36
11.0	11.39	11.41	11.40
12.0	11.45	11.45	11.46
13.0	11.51	11.52	11.52
14.0	11.57	11.58	11.59
15.0	11.64	11.66	11.67
16.0	11.74	11.74	11.75
17.0	11.81	11.83	11.84
18.0	11.90	11.92	11.93
19.0	12.00	12.02	12.04
20.0	12.10	12.12	12.14
20.5	12.16	12.18	12.20
21.0	12.20	12.24	12.26
21.5	12.28	12.30	12.32
22.0	12.34	12.36	12.38
22.5	12.39	12.42	12.44
23.0	12.46	12.49	12.51
23.5	12.52	12.54	12.57
24.0	12.60	12.63	12.65
24.5	12.66	12.69	12.71
25.0	12.73	12.75	12.77
25.5	12.81	12.83	12.86
26.0	12.88	12.91	12.93
26.5	12.95	12.99	13.01
27.0	13.03	13.06	13.08
27.5	13.12	13.15	13.18
28.0	13.21	13.24	13.26
28.5	13.29	13.32	13.34
29.0	13.38	13.42	13.42
29.5	13.47	13.50	13.52
30.0	13.57	13.60	13.62
30.5	13.67	13.71	13.72
31.0	13.79	13.81	13.83
31.5	13.89	13.91	13.93
32.0	13.99	14.03	14.04
32.5	14.10	14.13	14.16
33.0	14.22	14.26	14.28
33.5	14.35	14.39	14.41
34.0	14.48	14.52	14.54
34.5	14.62	14.65	14.68
35.0	14.75	14.81	14.83
35.5	14.91	14.94	14.97
36.0	15.06	15.11	15.14
36.5	15.21	15.26	15.29
37.0	15.37	15.44	15.48
37.5	15.56	15.61	15.64
38.0	15.74	15.79	15.83
38.5	15.93	15.99	16.02
39.0	16.13	16.19	16.24
39.5	16.33	16.40	16.45
40.0	16.54	16.62	16.68

Typical Performance Curves

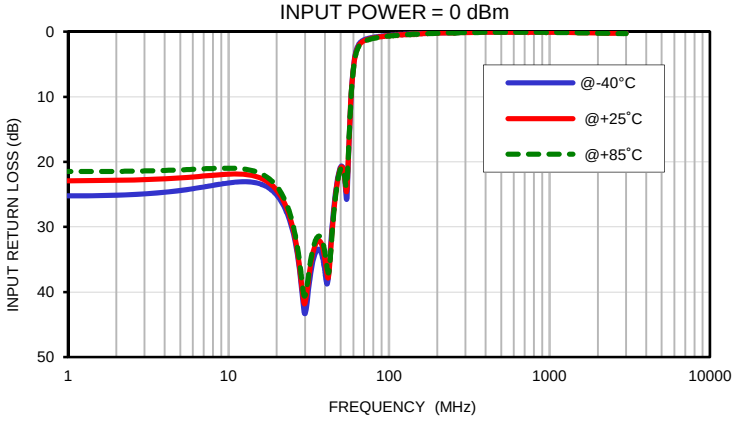
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



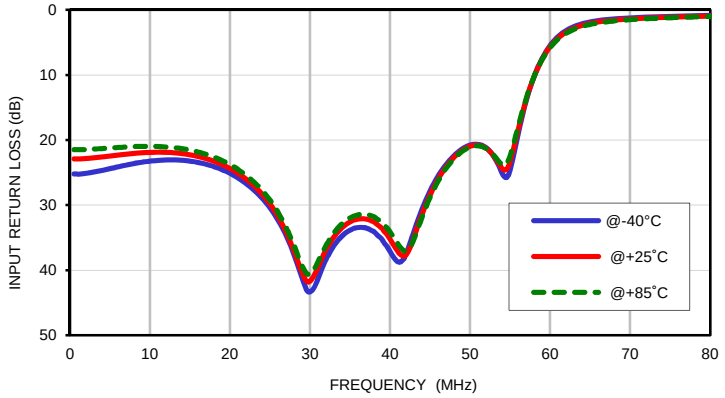
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



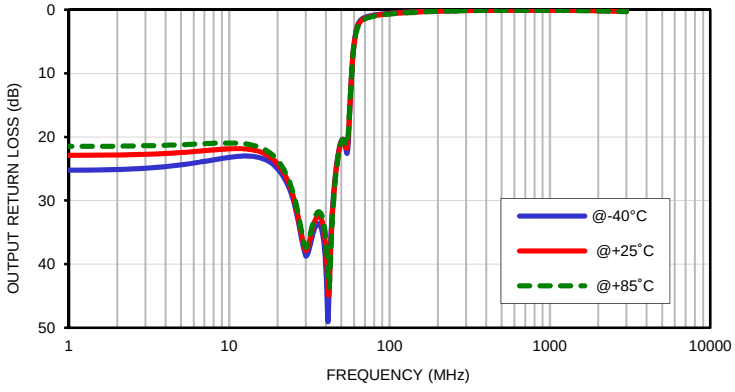
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



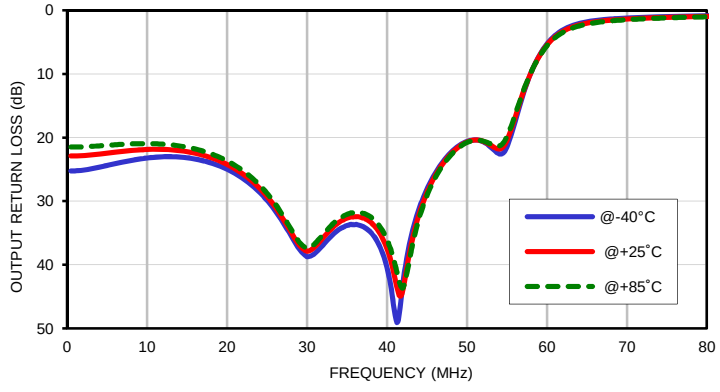
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



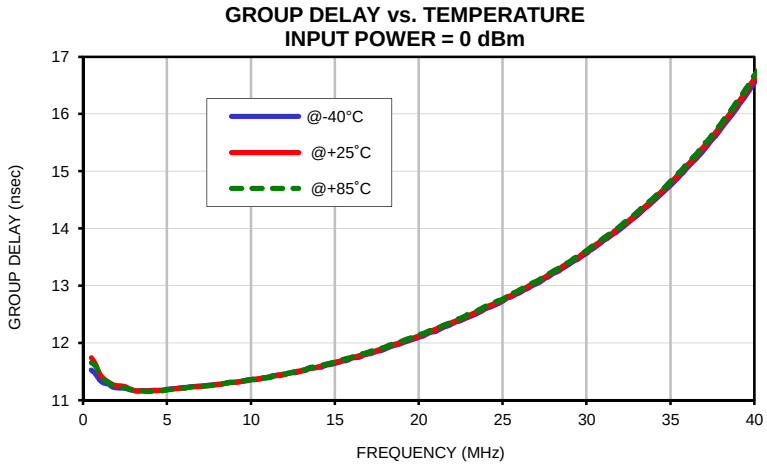
OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm

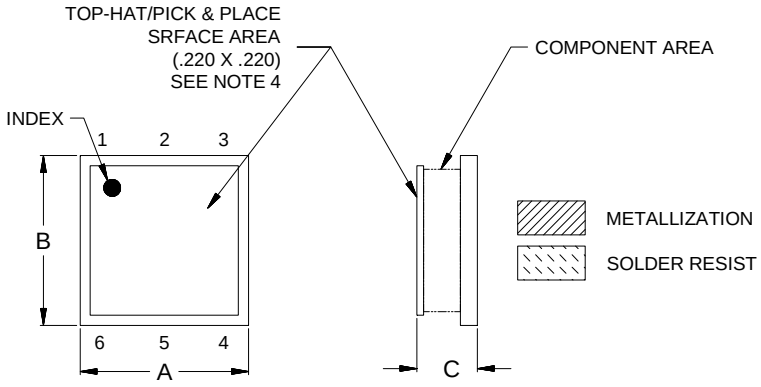


Typical Performance Curves

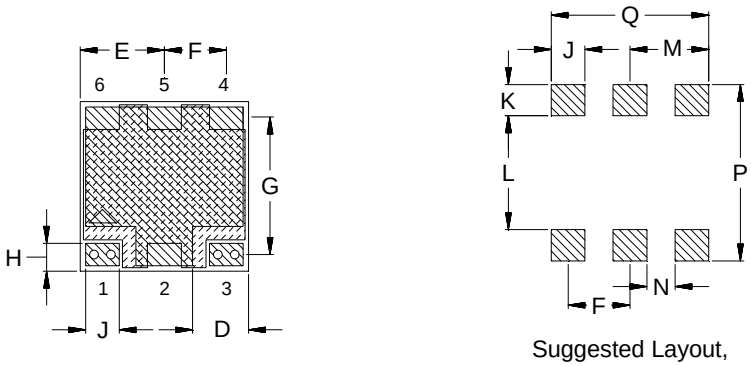


Case Style QA

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)

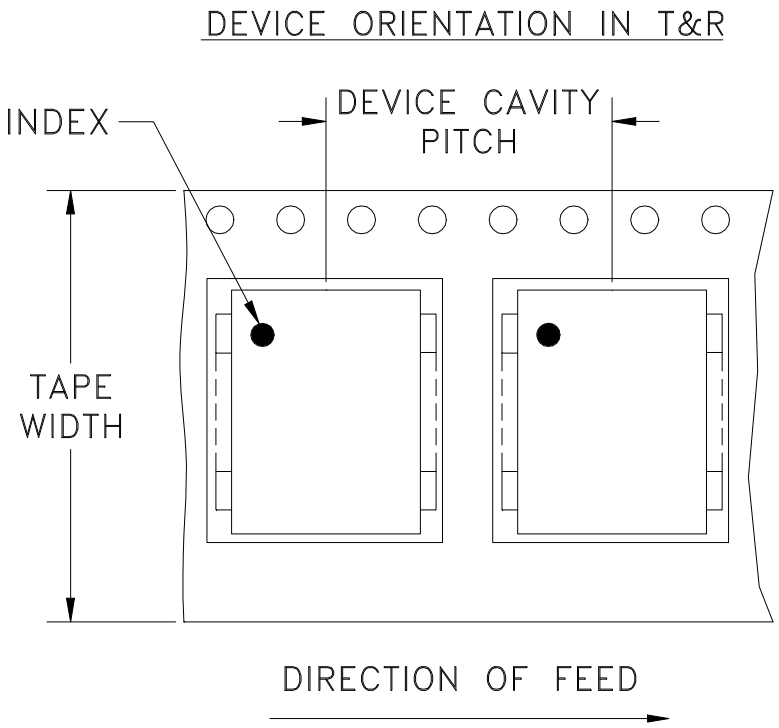
CASE#	N	P	Q	WT. GRAM
QA2224	.042 (1.07)	.260 (6.60)	.234 (5.94)	0.25

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

Tape & Reel Packaging TR-F34



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

Mini-Circuits®
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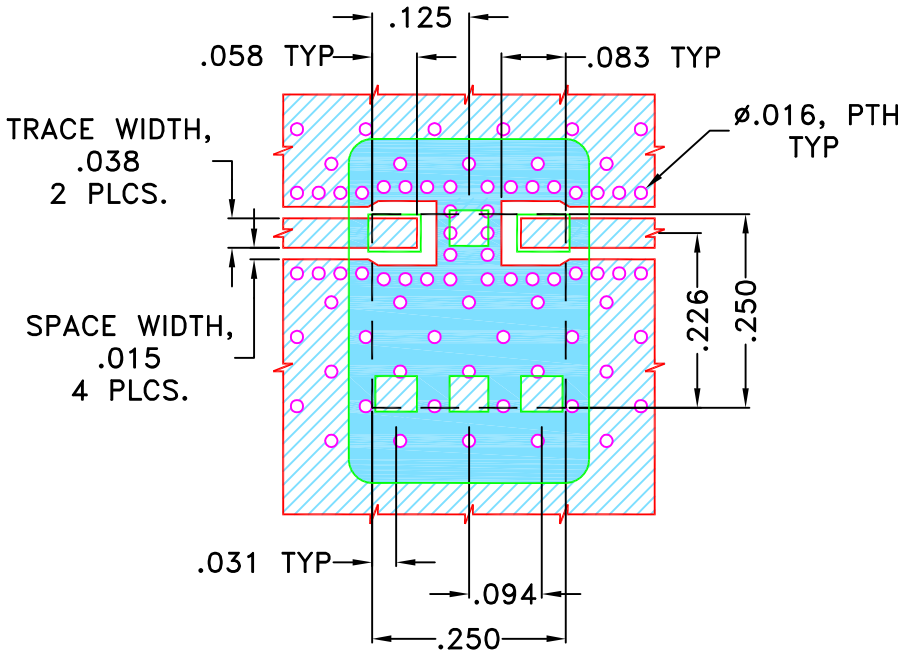
THIRD ANGLE PROJECTION

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 ±			

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

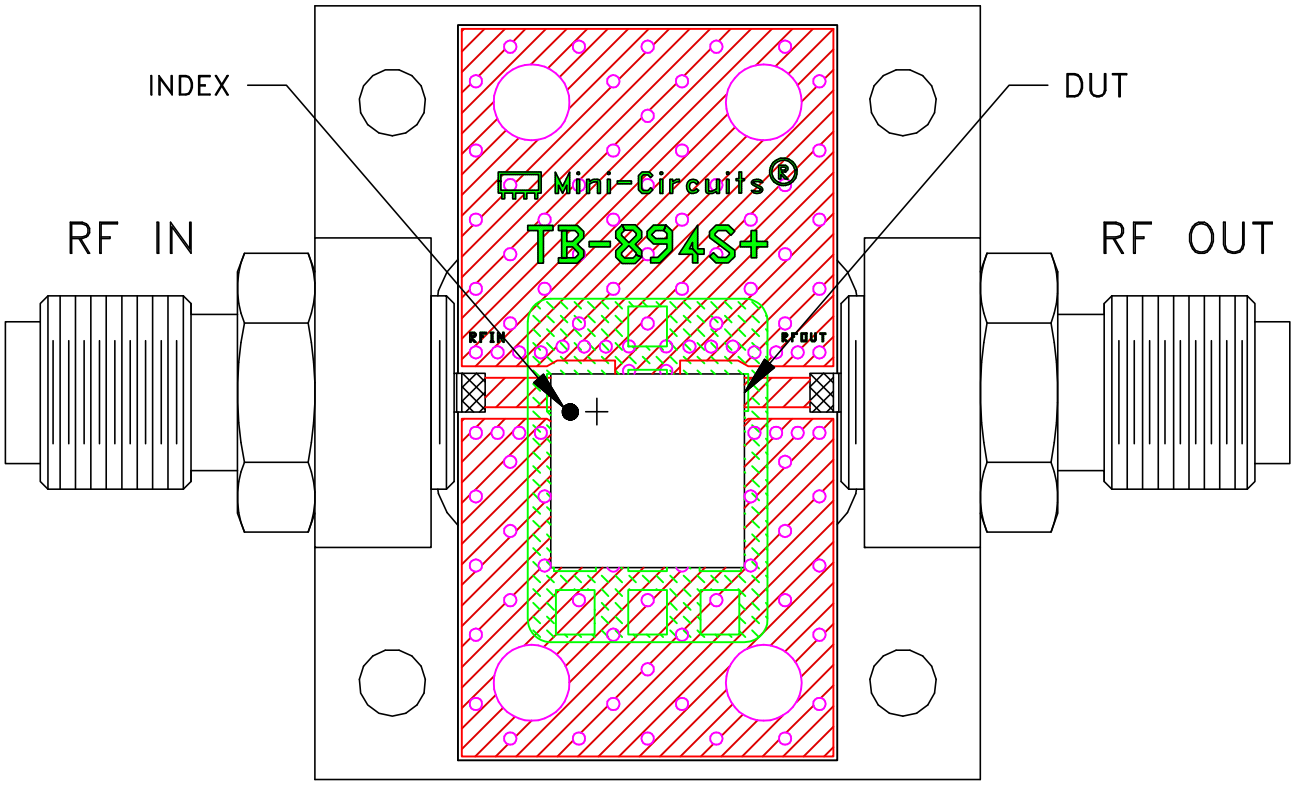
Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

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

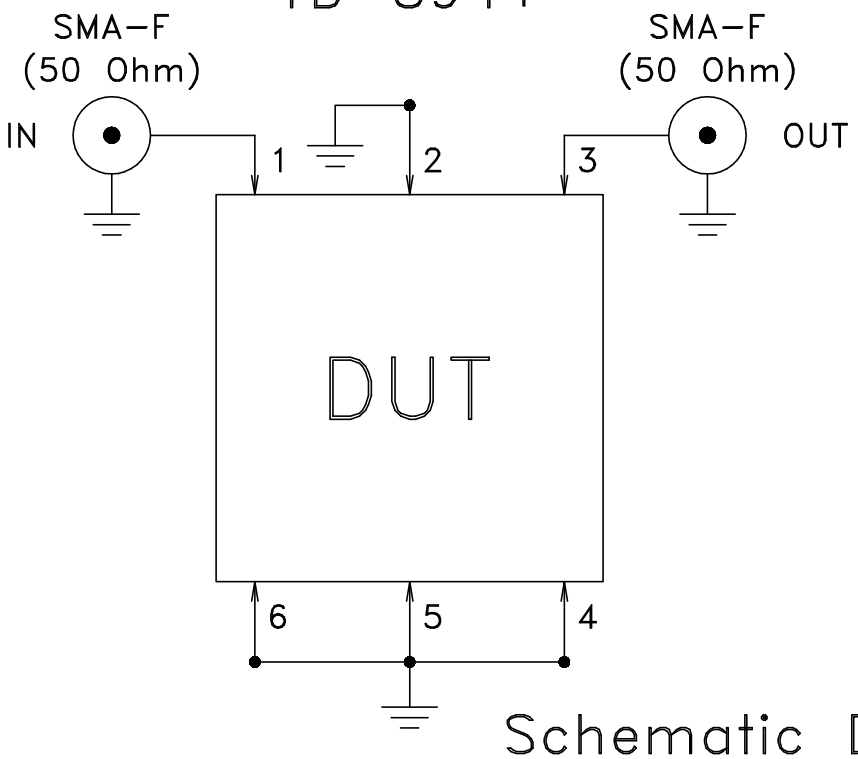
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-484	A

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.

Mini-Circuits®

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Environmental Specifications ENV02T3

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	0° to 70° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Life (HTOL)	1000 hours at max operating temperature	MIL-STD-202, Method 108, Condition D
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, 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