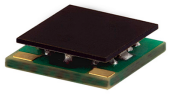
Surface Mount top hat®

Low Pass Filter

ULP-70+

50Ω DC to 70 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-70+ is a lowpass filter in a top hat package (size of 0.25" x 0.25") fabricated using SMT technology. Covering DC to 70 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-70 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-70+ to be used in compact designs.

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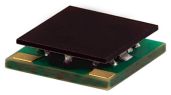


CASE STYLE: QA2224

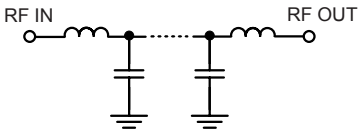
Features

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

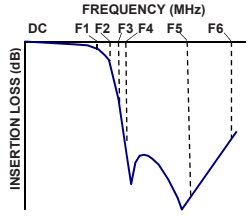
Applications

- 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-70	—	1.5	2.0	dB
	Freq. Cut-Off	F2	77	—	3.0	—	dB
	VSWR	DC-F1	DC-70	—	1.1	—	:1
Stop Band	Rejection Loss	F3-F4	100-115	20	27	—	dB
		F4-F5	115-700	40	47	—	dB
		F5-F6	700-3000	—	20	—	dB
	VSWR	F3-F5	100-700	—	20	—	:1

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

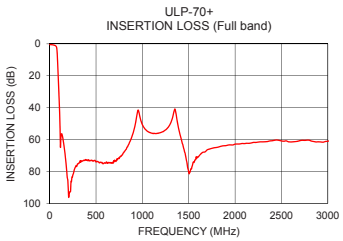
Permanent damage may occur if any of these limits are exceeded.

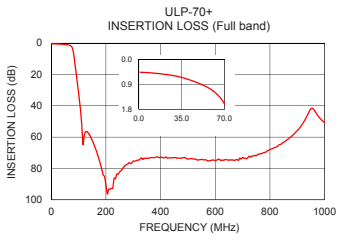
Typical Performance Data at 25°C

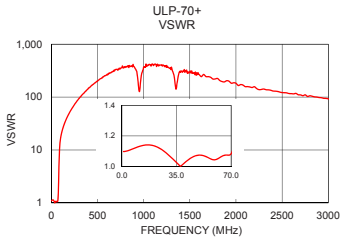
Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)	Frequency (MHz)	Group Delay (nsec)
1.0	0.46	1.10	1	9.09
10.0	0.48	1.13	2	8.95
50.0	0.87	1.07	4	8.88
70.0	1.60	1.08	10	8.89
77.0	3.05	1.86	12	8.92
85.0	10.73	6.81	14	8.96
92.0	20.52	12.40	18	9.07
99.0	30.43	16.14	20	9.15
100.0	31.88	16.58	28	9.53
115.0	62.35	22.26	34	9.93
150.0	62.18	34.15	40	10.43
250.0	82.23	71.48	44	10.87
500.0	74.09	202.04	50	11.72
700.0	72.96	333.48	52	12.09
750.0	71.93	349.05	58	13.49
1000.0	50.72	369.47	60	14.08
1500.0	80.48	300.57	62	14.76
2000.0	62.90	182.55	64	15.56
2500.0	60.91	121.34	68	17.73
3000.0	61.09	92.42	70	19.28

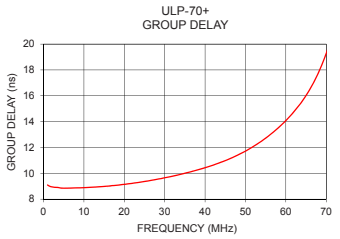
+RoHS Compliant

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









Notes

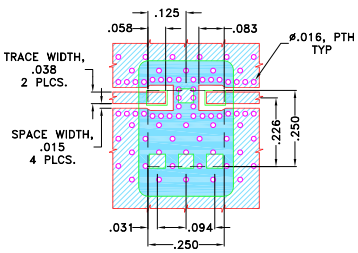
A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's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



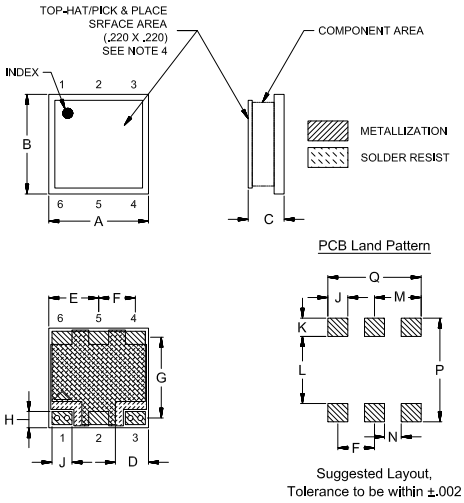
NOTES:

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



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	

Low Pass Filter ULP-70+

Typical Performance Data

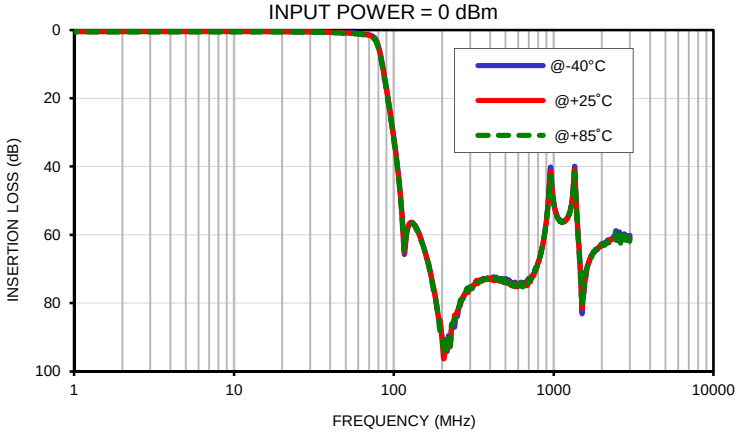
FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(MHz)	(dB)			(dB)			(dB)		
	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C
1	0.36	0.46	0.54	28.98	26.63	25.17	28.85	26.54	25.09
2	0.36	0.46	0.54	28.82	26.56	25.12	28.70	26.46	25.04
5	0.37	0.47	0.55	27.69	25.85	24.61	27.56	25.74	24.52
10	0.39	0.48	0.56	25.64	24.45	23.58	25.41	24.23	23.36
15	0.41	0.50	0.58	24.47	23.67	23.02	24.16	23.33	22.70
20	0.44	0.53	0.60	24.47	23.88	23.37	23.98	23.36	22.86
25	0.47	0.56	0.63	25.75	25.38	24.97	24.98	24.54	24.13
50	0.76	0.87	0.96	30.25	28.90	27.98	32.18	30.49	29.44
60	0.97	1.11	1.21	33.02	33.24	33.05	39.20	39.48	39.96
70	1.40	1.60	1.74	28.78	28.01	27.34	30.20	29.35	28.72
75	2.06	2.34	2.55	14.79	14.72	14.54	14.88	14.84	14.68
76	2.34	2.65	2.88	12.48	12.43	12.30	12.53	12.51	12.39
77	2.71	3.05	3.31	10.44	10.42	10.33	10.47	10.46	10.38
78	3.20	3.57	3.86	8.66	8.67	8.61	8.68	8.69	8.64
80	4.58	5.02	5.36	5.87	5.93	5.93	5.87	5.94	5.94
85	10.19	10.73	11.15	2.44	2.57	2.64	2.44	2.57	2.64
90	17.13	17.69	18.12	1.46	1.58	1.66	1.47	1.58	1.65
92	19.96	20.52	20.95	1.30	1.40	1.47	1.30	1.41	1.47
93	21.37	21.93	22.36	1.23	1.34	1.40	1.23	1.34	1.40
95	24.19	24.75	25.18	1.13	1.23	1.29	1.13	1.23	1.29
98	28.44	29.00	29.44	1.02	1.11	1.17	1.03	1.12	1.17
100	31.31	31.88	32.33	0.96	1.05	1.10	0.97	1.06	1.11
105	38.91	39.50	39.99	0.86	0.93	0.98	0.87	0.94	0.98
110	47.92	48.61	49.20	0.78	0.85	0.89	0.79	0.86	0.90
115	62.10	62.35	62.72	0.72	0.78	0.82	0.73	0.79	0.83
120	60.20	59.84	59.58	0.66	0.72	0.76	0.68	0.74	0.77
125	56.75	56.80	56.88	0.62	0.68	0.71	0.63	0.69	0.72
150	62.04	62.18	62.21	0.46	0.51	0.53	0.47	0.52	0.55
160	66.58	66.47	66.74	0.41	0.46	0.49	0.42	0.47	0.50
165	68.50	68.68	69.10	0.39	0.44	0.47	0.40	0.45	0.48
170	71.42	71.59	71.76	0.37	0.42	0.45	0.39	0.43	0.46
175	74.19	74.22	75.06	0.36	0.41	0.43	0.37	0.41	0.44
200	90.05	90.45	90.01	0.29	0.34	0.36	0.30	0.34	0.36
250	83.90	82.23	82.38	0.20	0.24	0.26	0.21	0.25	0.27
300	75.34	75.32	75.66	0.15	0.19	0.20	0.15	0.19	0.21
350	73.60	73.46	73.38	0.11	0.15	0.16	0.11	0.15	0.16
400	72.71	72.81	72.46	0.08	0.12	0.13	0.09	0.12	0.13
450	72.95	73.09	73.10	0.06	0.10	0.11	0.07	0.10	0.11
500	73.44	74.09	73.87	0.04	0.09	0.10	0.05	0.09	0.10
550	74.10	74.21	74.52	0.03	0.08	0.09	0.04	0.08	0.09
600	74.39	74.88	74.59	0.02	0.07	0.08	0.03	0.07	0.08
650	74.23	74.77	74.32	0.01	0.06	0.07	0.02	0.06	0.07
700	72.82	72.96	73.84	0.01	0.05	0.06	0.01	0.06	0.07
750	71.54	71.93	71.59	0.00	0.05	0.06	0.01	0.05	0.06
800	68.26	68.15	68.04	0.00	0.05	0.06	0.00	0.05	0.06
850	63.37	63.29	63.12	0.01	0.04	0.06	0.00	0.04	0.06
900	56.13	55.85	55.62	0.01	0.05	0.06	0.00	0.05	0.06
950	41.19	41.86	42.81	0.07	0.13	0.14	0.04	0.09	0.11
1000	50.20	50.72	51.17	0.01	0.05	0.07	0.01	0.05	0.06
1250	53.81	53.96	54.05	0.03	0.04	0.07	0.02	0.04	0.07
1500	79.31	80.48	80.53	0.02	0.06	0.08	0.02	0.06	0.08
1750	65.47	65.52	65.83	0.01	0.08	0.10	0.01	0.06	0.09
2000	62.90	62.90	62.41	0.01	0.10	0.13	0.00	0.08	0.11
2200	62.33	61.81	62.03	0.02	0.11	0.15	0.01	0.09	0.13
2250	61.46	61.59	61.80	0.03	0.13	0.16	0.02	0.10	0.13
2500	60.82	60.91	61.20	0.05	0.14	0.17	0.04	0.12	0.15
2750	59.71	60.56	60.26	0.07	0.16	0.19	0.06	0.14	0.17
2800	60.69	60.46	61.53	0.07	0.16	0.19	0.07	0.15	0.18
2900	60.92	61.43	61.25	0.08	0.18	0.20	0.07	0.15	0.18
3000	60.18	61.09	61.24	0.09	0.19	0.21	0.08	0.17	0.19

Typical Performance Data

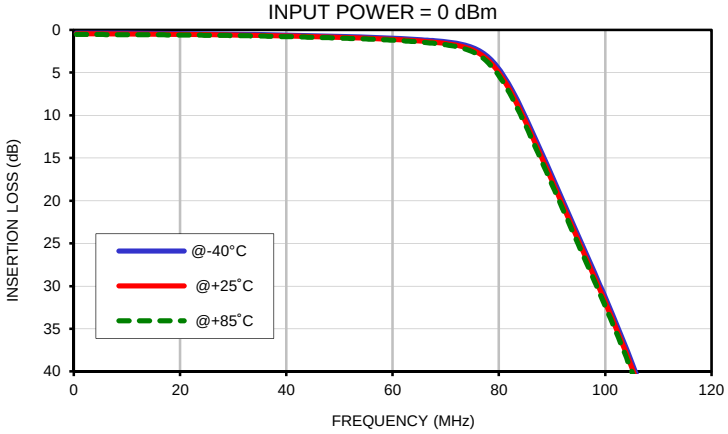
FREQ. (MHz)	GROUP DELAY (nsec)		
	@-40°C	@+25°C	@+85°C
1.0	9.25	9.09	9.01
2.0	9.00	8.95	8.91
3.0	8.94	8.92	8.89
4.0	8.88	8.88	8.87
5.0	8.84	8.85	8.85
6.0	8.85	8.85	8.85
7.0	8.86	8.86	8.86
8.0	8.87	8.87	8.87
9.0	8.88	8.88	8.87
10.0	8.89	8.89	8.89
11.0	8.90	8.91	8.91
12.0	8.92	8.92	8.92
13.0	8.94	8.94	8.94
14.0	8.96	8.96	8.97
15.0	8.98	8.99	8.99
16.0	9.00	9.01	9.02
17.0	9.03	9.05	9.05
18.0	9.06	9.07	9.09
19.0	9.09	9.11	9.12
20.0	9.12	9.15	9.15
21.0	9.17	9.19	9.20
22.0	9.21	9.23	9.24
23.0	9.25	9.27	9.28
24.0	9.29	9.32	9.33
25.0	9.35	9.37	9.39
26.0	9.39	9.41	9.44
27.0	9.44	9.48	9.49
28.0	9.50	9.53	9.55
29.0	9.56	9.58	9.61
30.0	9.62	9.66	9.67
31.0	9.68	9.72	9.74
32.0	9.75	9.78	9.81
35.0	9.97	10.00	10.03
38.0	10.22	10.25	10.28
40.0	10.40	10.43	10.46
42.0	10.60	10.63	10.66
43.0	10.71	10.75	10.78
45.0	10.95	10.98	11.02
48.0	11.36	11.40	11.43
50.0	11.68	11.72	11.76
51.0	11.84	11.90	11.94
52.0	12.03	12.09	12.13
53.0	12.22	12.29	12.33
54.0	12.43	12.49	12.55
55.0	12.65	12.72	12.77
56.0	12.89	12.97	13.02
57.0	13.14	13.21	13.27
58.0	13.41	13.49	13.55
59.0	13.68	13.77	13.84
60.0	13.99	14.08	14.15
61.0	14.31	14.41	14.49
62.0	14.66	14.76	14.85
63.0	15.04	15.14	15.23
64.0	15.45	15.56	15.66
65.0	15.90	16.02	16.13
66.0	16.40	16.53	16.64
67.0	16.97	17.10	17.21
68.0	17.60	17.73	17.86
69.0	18.31	18.46	18.59
70.0	19.11	19.28	19.42

Typical Performance Curves

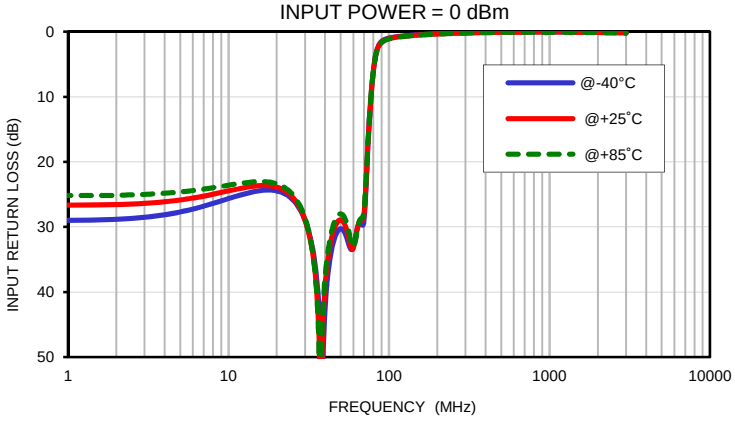
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



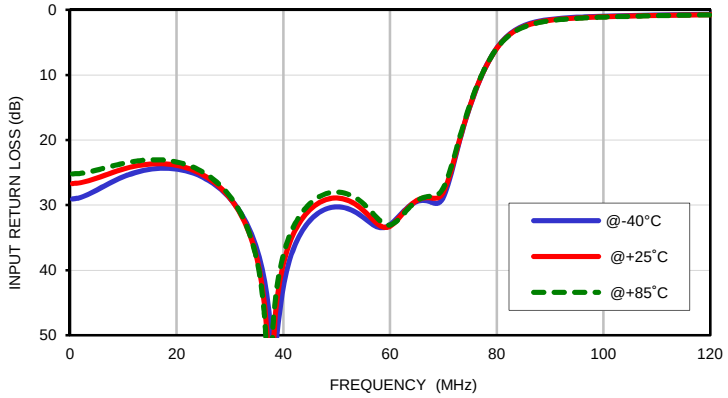
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



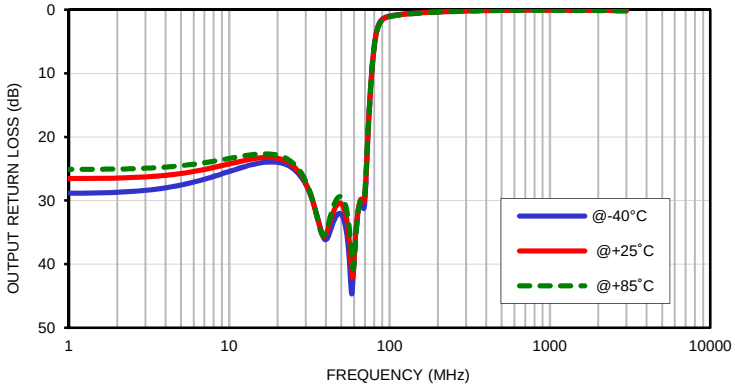
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



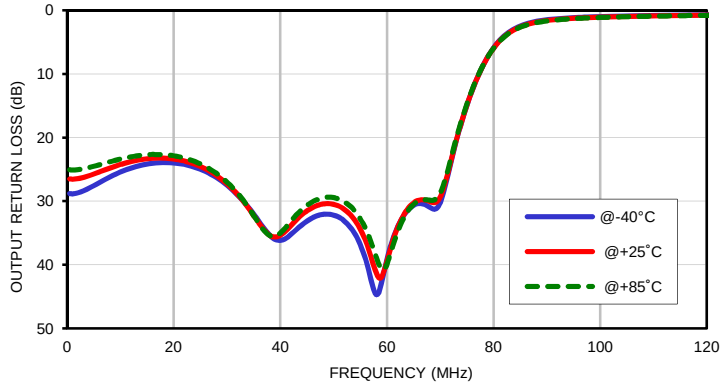
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



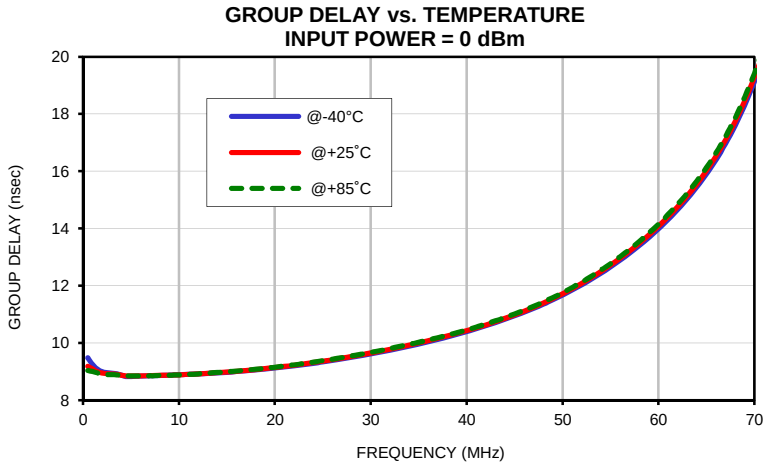
OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm

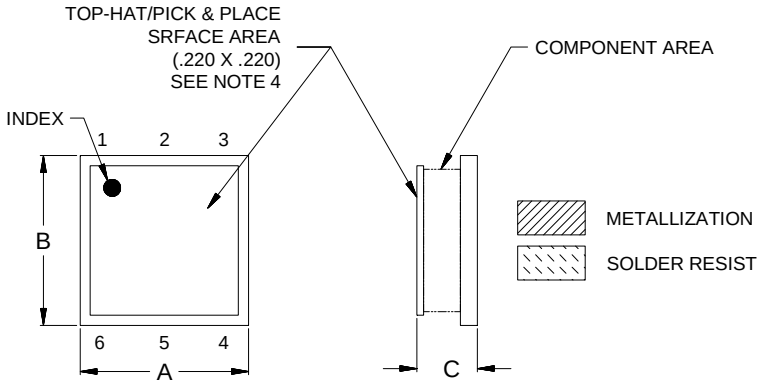


Typical Performance Curves

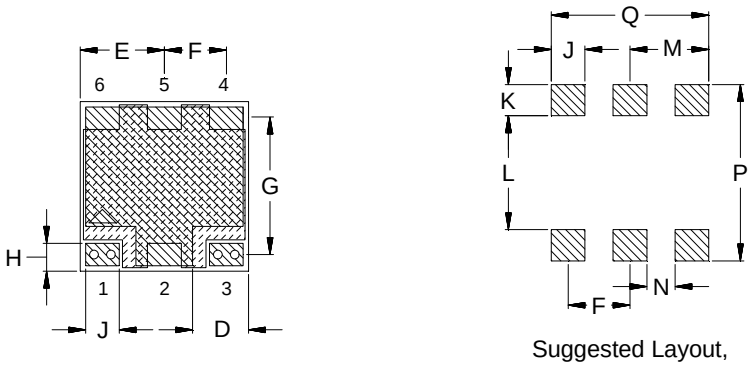


Case Style QA

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)

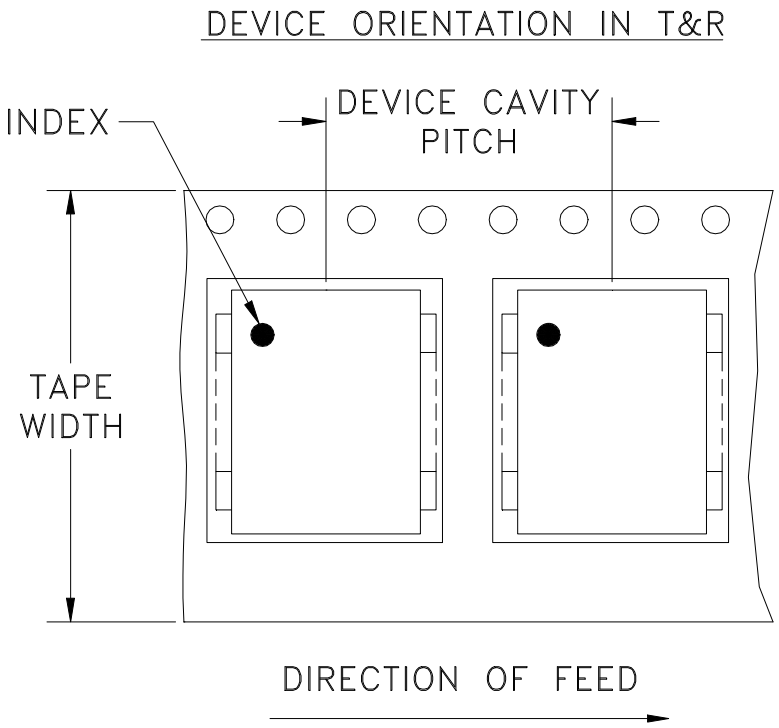
CASE#	N	P	Q	WT. GRAM
QA2224	.042 (1.07)	.260 (6.60)	.234 (5.94)	0.25

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

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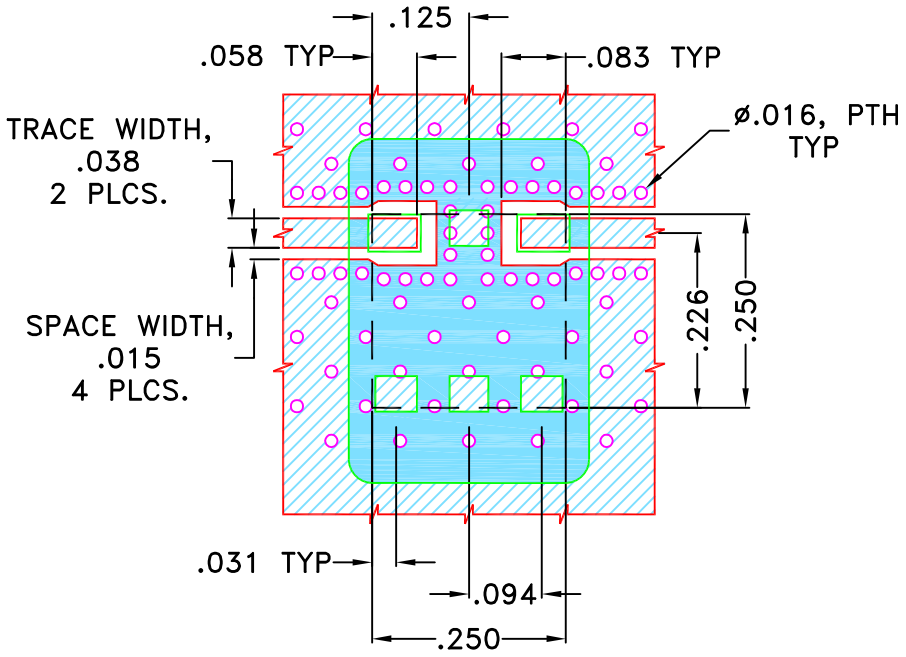
THIRD ANGLE PROJECTION

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

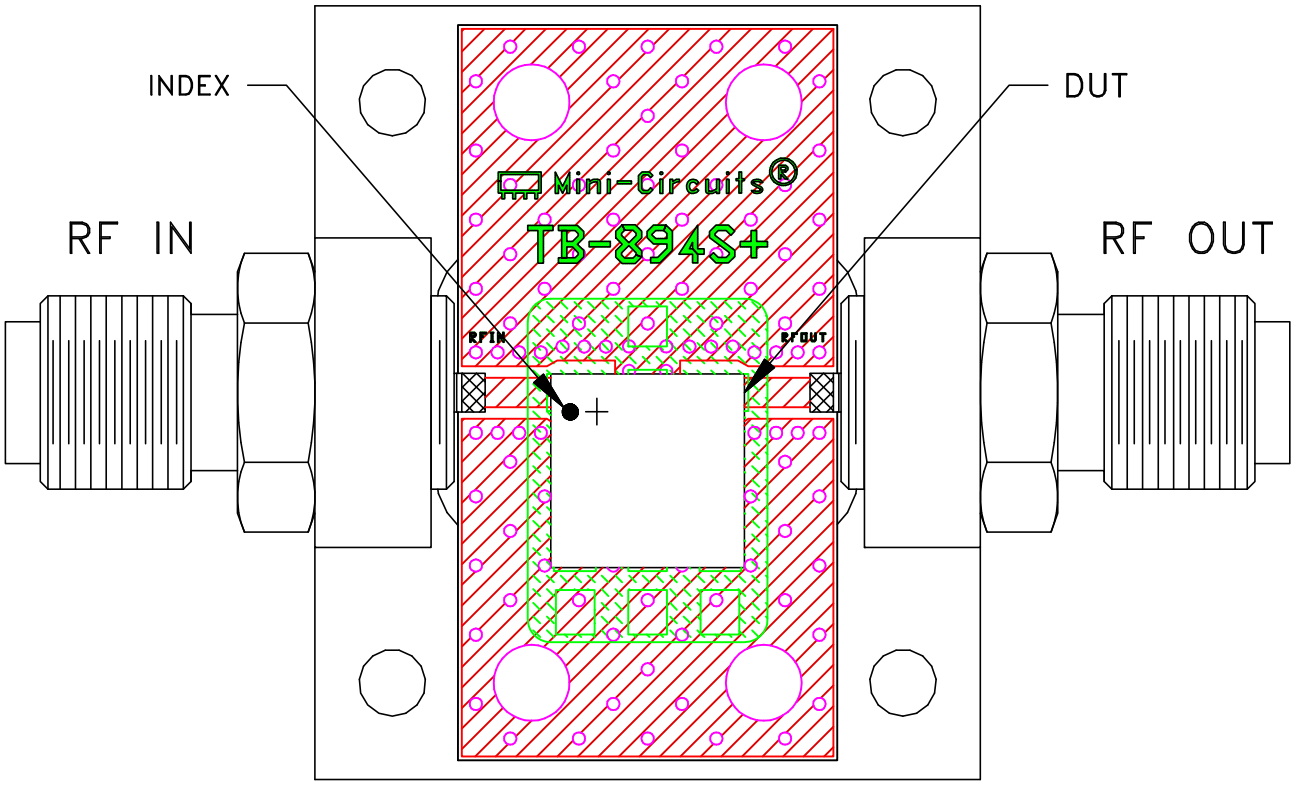
Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

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

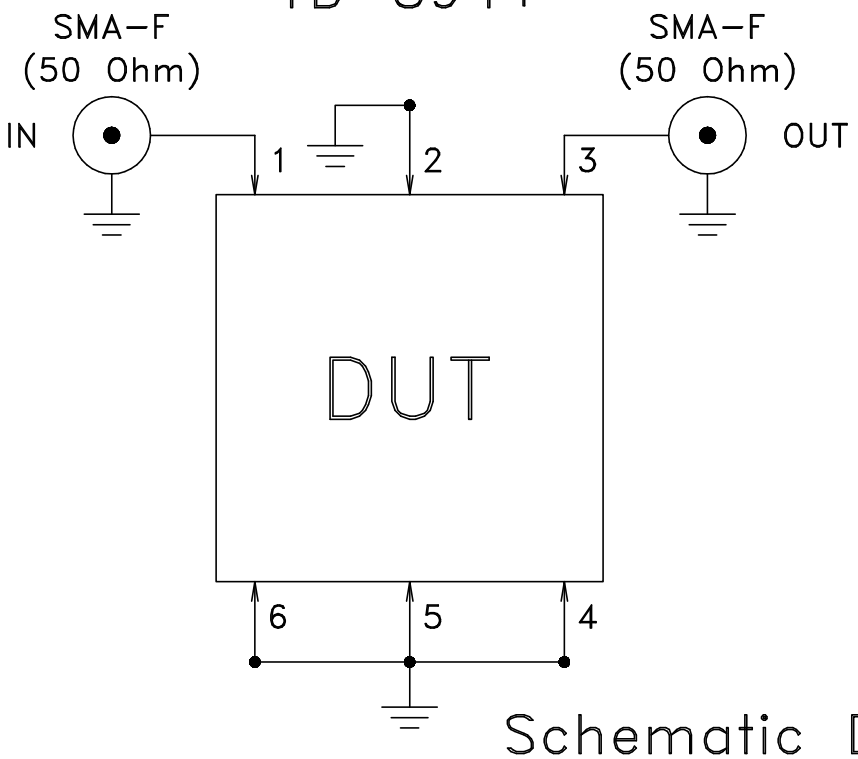
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-484	A

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 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