

Surface Mount ^{top hat®} Low Pass Filter

ULP-176+

50Ω DC to 176 MHz

The Big Deal

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



CASE STYLE: QA2224

Product Overview

The ULP-176+ is a lowpass filter in a top hat package (size of 0.25" x 0.25") fabricated using SMT technology. Covering DC to 176 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-176 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-176+ to be used in compact designs.

Notes

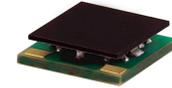
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B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
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ULP-176+

50Ω DC to 176 MHz



CASE STYLE: QA2224

Features

- High rejection
- Sharp insertion loss roll-off
- Good VSWR, 1.2:1 typ at passband
- Ultra miniature surface mount package

Applications

- Wireless communications
- Receivers / Transformers
- Lab use

Electrical Specifications at 25°C

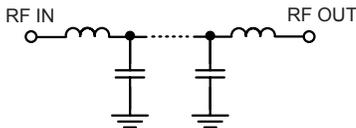
Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit	
Pass Band	Insertion Loss	DC-F1	DC-176	—	1.5	2.0	dB
	Freq. Cut-Off	F2	191	—	3.0	—	dB
	VSWR	DC-F1	DC-176	—	1.2	—	:1
Stop Band	Rejection Loss	F3-F4	245-285	20	27	—	dB
		F4-F5	285-1000	40	47	—	dB
	VSWR	F5-F6	1000-3000	—	20	—	dB
		F3-F5	245-1000	—	20	—	:1

Maximum Ratings

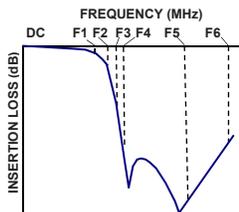
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	0.8W max.

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

Functional Schematic



Typical Frequency Response

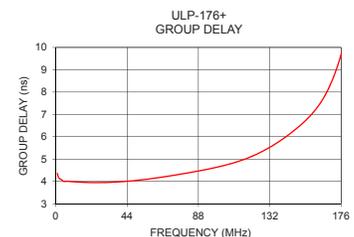
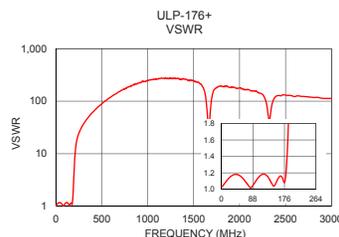
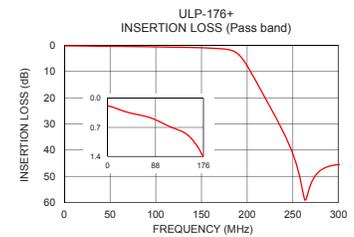
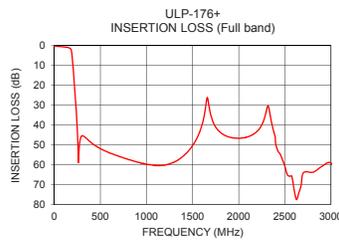


Typical Performance Data at 25°C

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)	Frequency (MHz)	Group Delay (nsec)
1	0.18	1.03	1	4.35
50	0.38	1.17	5	4.00
176	1.45	1.08	10	3.99
185	2.20	1.56	20	3.95
191	3.63	2.50	40	3.98
200	7.80	5.61	50	4.05
210	13.94	10.70	80	4.36
220	20.30	15.31	90	4.49
235	29.98	20.49	100	4.64
245	37.20	23.23	110	4.83
250	41.50	24.55	120	5.09
285	46.78	33.12	130	5.44
300	45.55	36.55	140	5.89
500	51.87	89.41	150	6.45
750	56.51	171.43	155	6.79
1000	59.68	244.40	160	7.19
2000	46.72	176.95	165	7.71
2500	57.80	129.83	170	8.43
2800	64.12	117.68	175	9.42
3000	60.93	112.33	176	9.66

+RoHS Compliant

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



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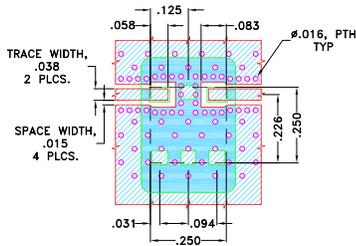
REV.A
M161927
ULP-176+
EDU2389
URJ
170512
Page 2 of 3

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

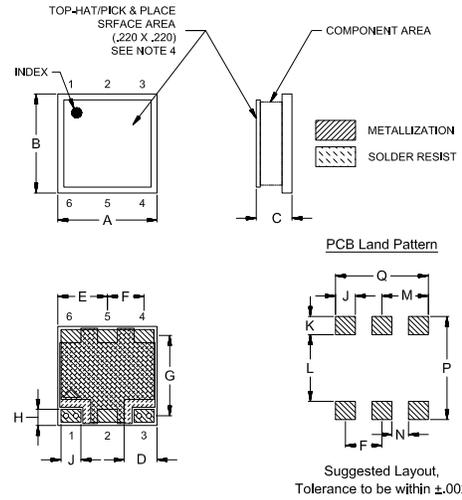


NOTES:

- TRACE WIDTH IS SHOWN FOR ROGERS (R04350B) WITH DIELECTRIC THICKNESS .020 \pm .0015". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
- 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
6.35	6.35	1.91	2.54	1.91	3.18	2.34	5.11	1.04	1.27
L	M	N	P	Q					
-	-	-	-	-					Wt.
.168	.117	.042	.260	.234					grams
4.27	2.97	1.07	6.60	5.94					0.25

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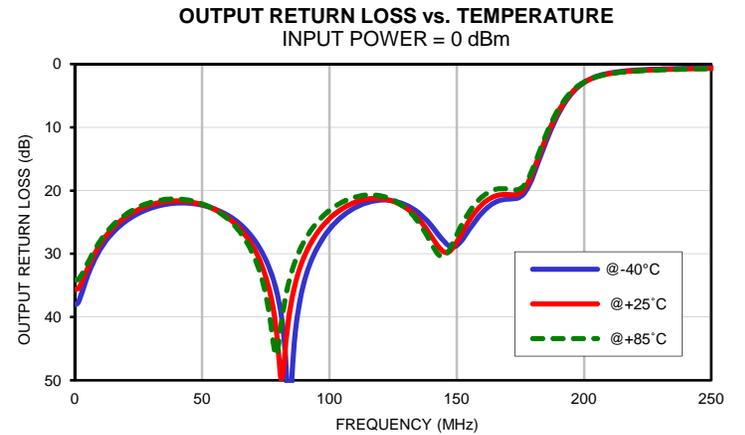
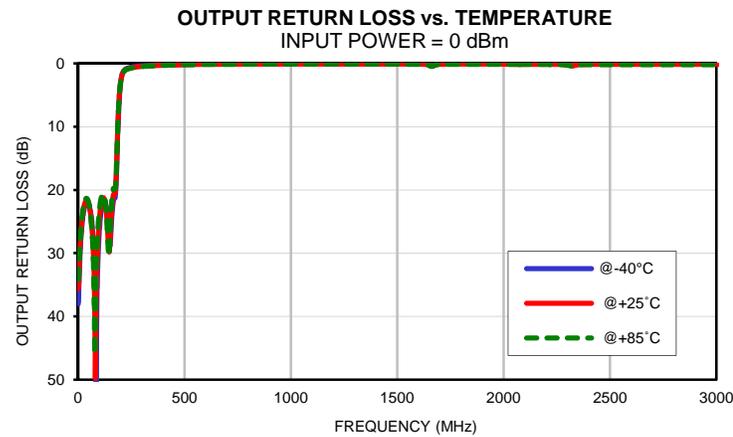
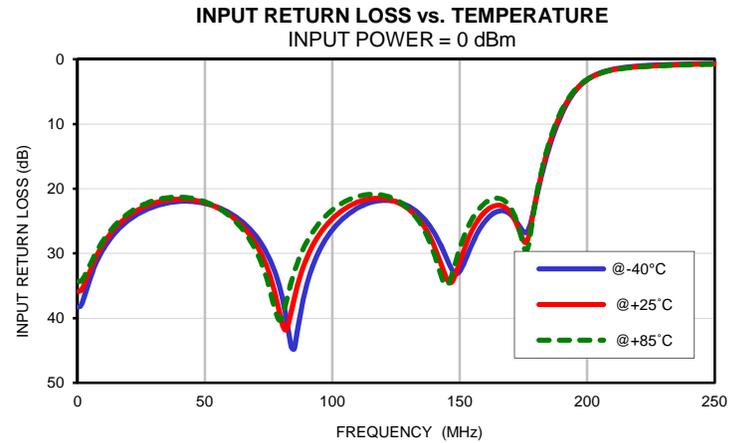
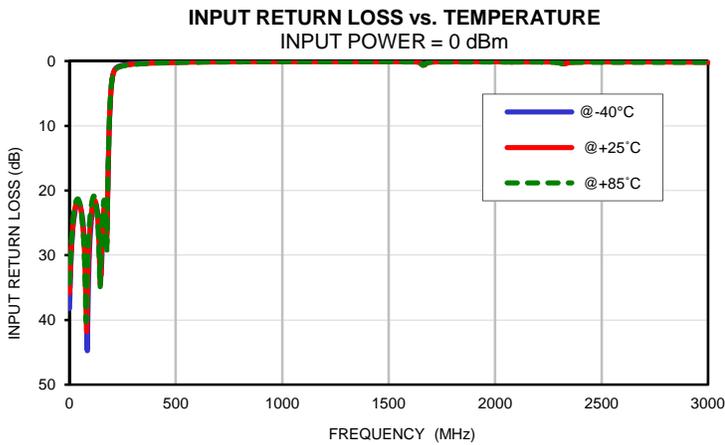
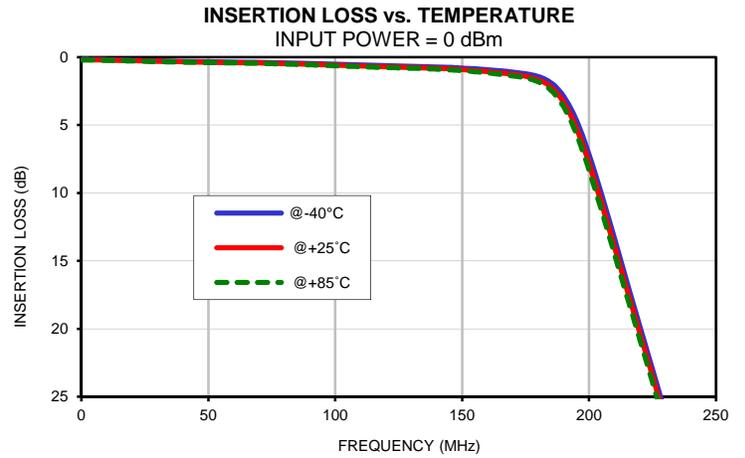
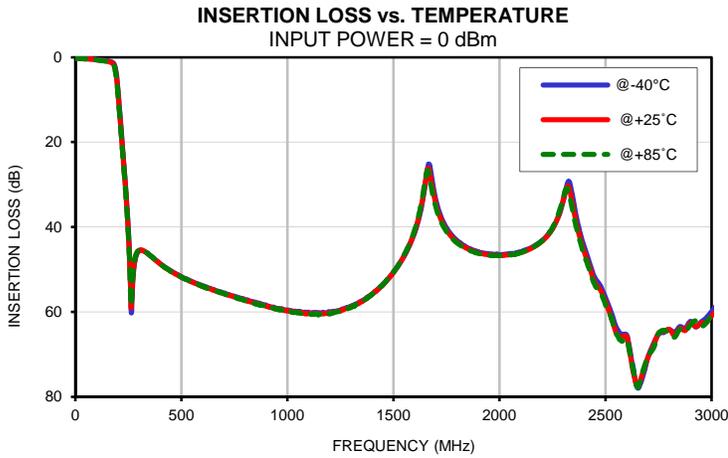
Typical Performance Data

FREQ. (MHz)	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
	(dB)			(dB)			(dB)		
	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C
1	0.15	0.18	0.21	38.18	35.79	34.30	37.88	35.56	34.12
2	0.15	0.19	0.22	37.40	35.32	33.96	37.18	35.12	33.78
5	0.16	0.20	0.22	33.79	32.54	31.68	33.61	32.37	31.53
10	0.18	0.22	0.24	29.40	28.58	28.05	29.32	28.51	27.99
50	0.34	0.38	0.40	22.26	22.16	22.01	22.29	22.21	22.08
100	0.52	0.59	0.64	26.36	24.63	23.28	26.13	24.46	23.15
150	0.80	0.92	0.99	32.77	31.33	29.17	28.68	28.14	27.01
176	1.24	1.45	1.58	26.75	28.29	29.62	20.66	20.01	19.38
180	1.42	1.66	1.82	21.59	21.39	21.41	17.71	16.97	16.43
185	1.88	2.20	2.43	13.77	13.25	12.91	12.35	11.73	11.27
191	3.16	3.63	3.99	7.64	7.34	7.10	7.07	6.73	6.45
200	7.17	7.80	8.30	3.13	3.13	3.09	2.90	2.88	2.82
210	13.33	13.94	14.46	1.53	1.63	1.66	1.41	1.50	1.52
220	19.76	20.30	20.78	1.03	1.14	1.18	0.95	1.05	1.09
222	21.05	21.57	22.04	0.98	1.08	1.12	0.90	1.00	1.04
225	22.97	23.48	23.94	0.91	1.01	1.06	0.84	0.94	0.98
228	24.90	25.40	25.85	0.85	0.95	1.00	0.79	0.89	0.93
230	26.20	26.69	27.14	0.82	0.92	0.96	0.76	0.86	0.90
235	29.50	29.98	30.42	0.76	0.85	0.89	0.70	0.79	0.84
238	31.55	32.03	32.48	0.72	0.81	0.86	0.67	0.76	0.81
240	32.95	33.44	33.89	0.70	0.79	0.83	0.66	0.74	0.79
242	34.40	34.89	35.36	0.69	0.77	0.82	0.64	0.73	0.77
244	35.90	36.41	36.89	0.67	0.75	0.80	0.62	0.71	0.75
245	36.69	37.20	37.68	0.66	0.75	0.79	0.62	0.70	0.74
250	40.92	41.50	42.03	0.62	0.71	0.75	0.58	0.66	0.71
255	46.16	46.87	47.50	0.59	0.67	0.71	0.55	0.63	0.67
260	53.61	54.46	55.09	0.56	0.64	0.68	0.52	0.61	0.65
270	53.46	52.67	52.05	0.51	0.59	0.63	0.48	0.56	0.59
280	48.11	47.82	47.60	0.47	0.55	0.58	0.44	0.51	0.55
285	46.94	46.78	46.62	0.45	0.52	0.56	0.42	0.50	0.53
290	46.24	46.12	46.01	0.44	0.51	0.54	0.40	0.48	0.51
295	45.83	45.75	45.65	0.42	0.49	0.52	0.39	0.46	0.50
300	45.60	45.55	45.43	0.40	0.48	0.51	0.38	0.45	0.48
325	45.71	45.71	45.63	0.34	0.41	0.44	0.32	0.39	0.41
350	46.61	46.64	46.57	0.30	0.36	0.38	0.28	0.34	0.36
400	48.63	48.72	48.70	0.23	0.28	0.30	0.21	0.27	0.29
450	50.32	50.46	50.45	0.18	0.23	0.25	0.17	0.22	0.24
500	51.71	51.87	51.80	0.14	0.19	0.21	0.13	0.18	0.20
550	52.90	52.98	52.96	0.11	0.17	0.18	0.11	0.16	0.17
600	53.85	53.99	54.01	0.09	0.14	0.16	0.08	0.14	0.15
750	56.31	56.51	56.49	0.04	0.10	0.11	0.04	0.10	0.11
1000	59.55	59.68	59.82	0.00	0.07	0.08	0.01	0.07	0.09
1100	60.11	60.28	60.55	0.01	0.07	0.08	0.00	0.07	0.09
1150	60.24	60.47	60.52	0.01	0.06	0.08	0.00	0.07	0.09
1200	60.10	60.32	60.49	0.02	0.06	0.08	0.01	0.07	0.09
1250	59.59	59.82	59.81	0.02	0.06	0.08	0.00	0.07	0.09
1300	58.72	58.85	58.95	0.02	0.07	0.08	0.01	0.07	0.09
1400	55.78	55.83	55.82	0.02	0.07	0.08	0.01	0.08	0.10
1500	50.73	50.66	50.57	0.02	0.07	0.09	0.01	0.08	0.10
1750	40.26	40.71	41.08	0.00	0.10	0.12	0.01	0.10	0.13
2000	46.50	46.72	46.74	0.00	0.10	0.12	0.00	0.11	0.14
2250	40.33	40.33	40.08	0.03	0.13	0.16	0.02	0.13	0.16
2300	33.88	33.63	33.12	0.10	0.23	0.28	0.09	0.22	0.27
2400	44.85	45.97	46.73	0.04	0.14	0.16	0.03	0.14	0.17
2500	56.80	57.80	58.43	0.03	0.13	0.16	0.02	0.13	0.16
2600	65.51	65.89	66.46	0.04	0.14	0.17	0.02	0.13	0.16
2700	70.62	70.67	70.36	0.04	0.14	0.17	0.02	0.13	0.16
2800	64.22	64.12	65.04	0.05	0.15	0.17	0.02	0.13	0.16
2900	62.24	62.60	63.03	0.05	0.15	0.17	0.02	0.13	0.16
3000	59.90	60.93	60.85	0.05	0.15	0.18	0.01	0.13	0.15

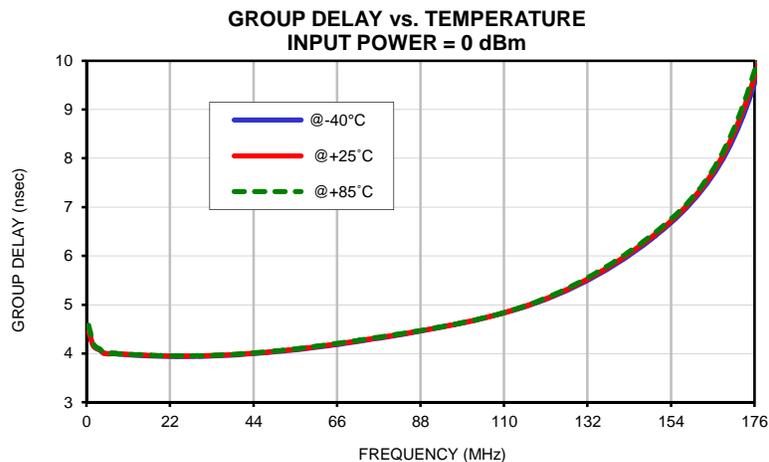
Typical Performance Data

FREQ. (MHz)	GROUP DELAY		
	(nsec)		
	@-40°C	@+25°C	@+85°C
1	4.34	4.35	4.44
2	4.14	4.14	4.17
4	4.04	4.05	4.05
6	3.99	3.99	3.99
8	3.99	4.00	4.00
10	3.98	3.99	3.99
12	3.97	3.98	3.98
14	3.96	3.97	3.98
16	3.95	3.96	3.96
18	3.95	3.96	3.96
20	3.94	3.95	3.96
22	3.94	3.95	3.95
24	3.94	3.94	3.95
26	3.94	3.95	3.95
28	3.94	3.95	3.95
30	3.94	3.95	3.95
32	3.95	3.95	3.96
34	3.95	3.96	3.96
36	3.96	3.97	3.97
38	3.97	3.97	3.98
40	3.97	3.98	3.99
42	3.99	3.99	4.00
44	4.00	4.01	4.01
46	4.01	4.02	4.02
48	4.02	4.03	4.04
50	4.04	4.05	4.05
52	4.05	4.06	4.07
54	4.07	4.08	4.09
56	4.09	4.09	4.10
58	4.10	4.11	4.12
60	4.12	4.13	4.14
62	4.14	4.15	4.17
64	4.16	4.17	4.18
66	4.18	4.19	4.21
68	4.21	4.22	4.23
70	4.23	4.24	4.25
72	4.25	4.27	4.28
75	4.29	4.30	4.31
80	4.35	4.36	4.37
85	4.42	4.43	4.43
90	4.49	4.49	4.50
95	4.56	4.57	4.57
110	4.83	4.83	4.84
115	4.95	4.95	4.96
120	5.08	5.09	5.10
125	5.24	5.25	5.27
130	5.42	5.44	5.46
135	5.62	5.65	5.69
140	5.86	5.89	5.93
145	6.13	6.16	6.20
150	6.42	6.45	6.49
155	6.75	6.79	6.82
160	7.15	7.19	7.23
165	7.65	7.71	7.76
168	8.03	8.11	8.17
170	8.34	8.43	8.50
172	8.68	8.79	8.88
174	9.08	9.20	9.31
175	9.30	9.42	9.54
176	9.53	9.66	9.79

Typical Performance Curves

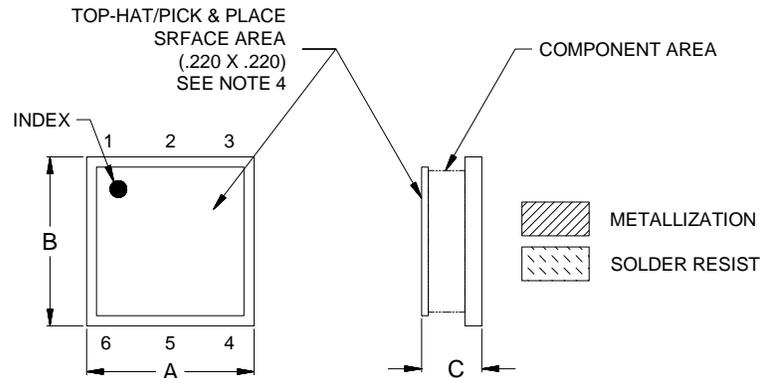


Typical Performance Curves

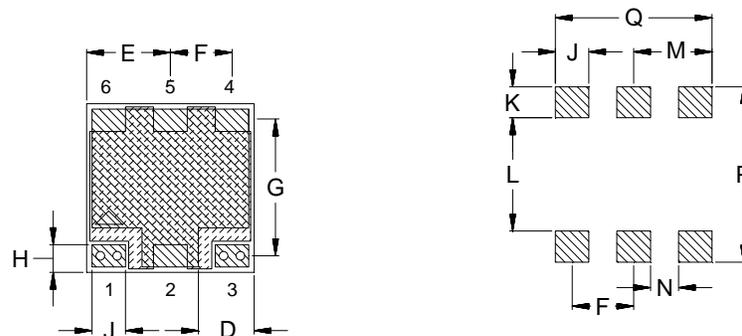


Outline Dimensions

QA2224



PCB Land Pattern



Suggested Layout,
Tolerance to be within $\pm .002$

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. $\pm .03$; 3Pl. $\pm .015$

Notes:

- Case material: Ceramic base.
- Base: Printed wiring laminate.
- 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.
- Top-Hat total thickness: .013 inches MAX



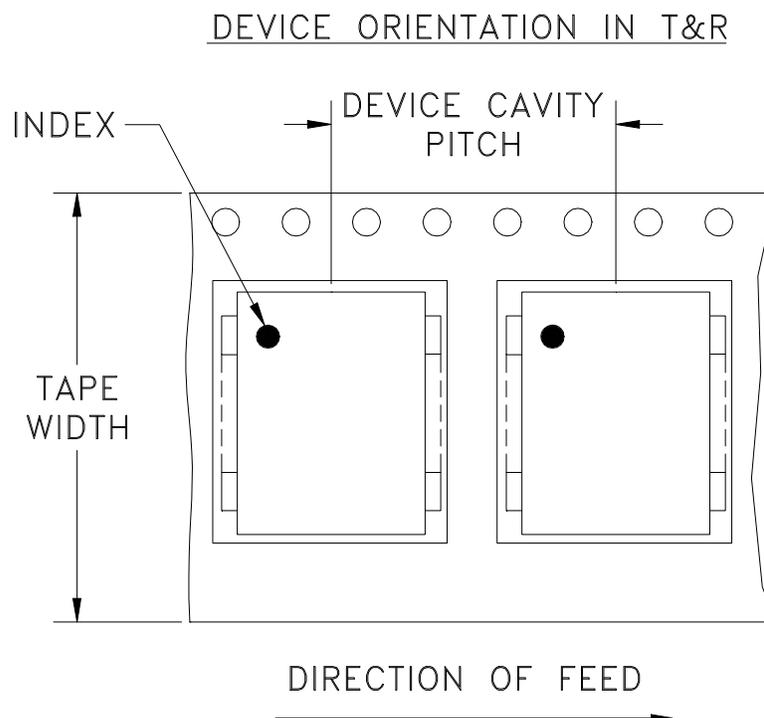
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The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

RF/IF MICROWAVE COMPONENTS

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



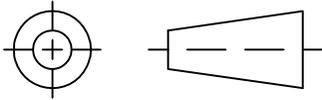
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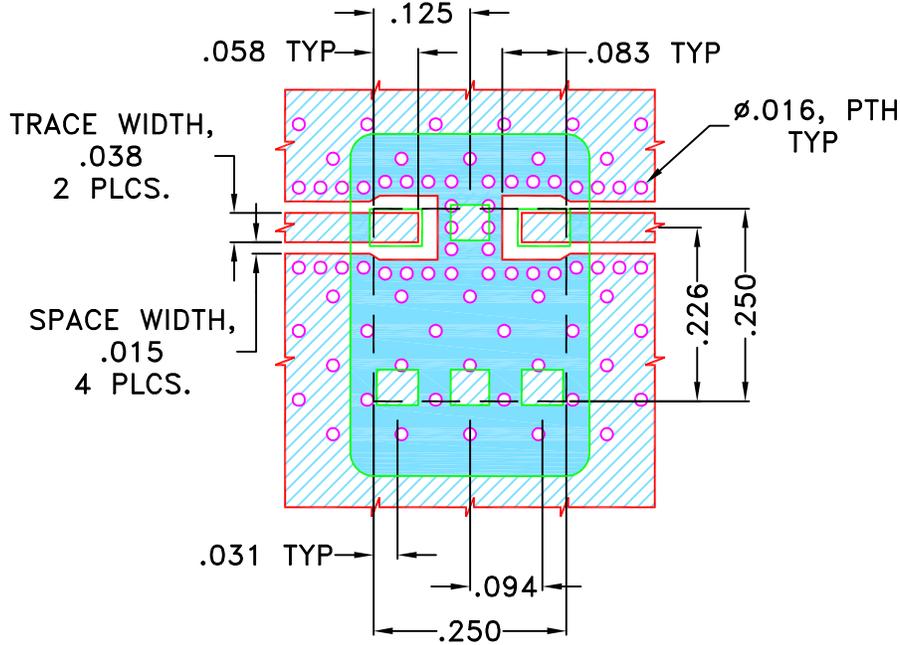
THIRD ANGLE PROJECTION



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 (R04350B) 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 TOLERANCES ON: 2 PL DECIMALS ± 3 PL DECIMALS ± .005" ANGLES ± FRACTIONS ±	DRAWN	TM 02 MAY 16
	CHECKED	MD 02 MAY 16
	APPROVED	MD 02 MAY 16



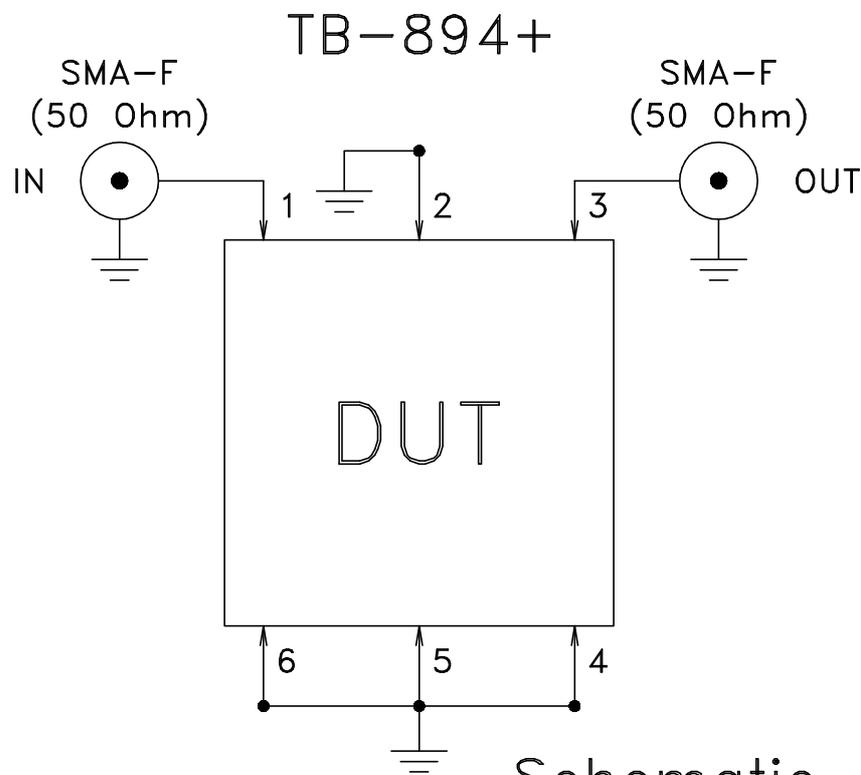
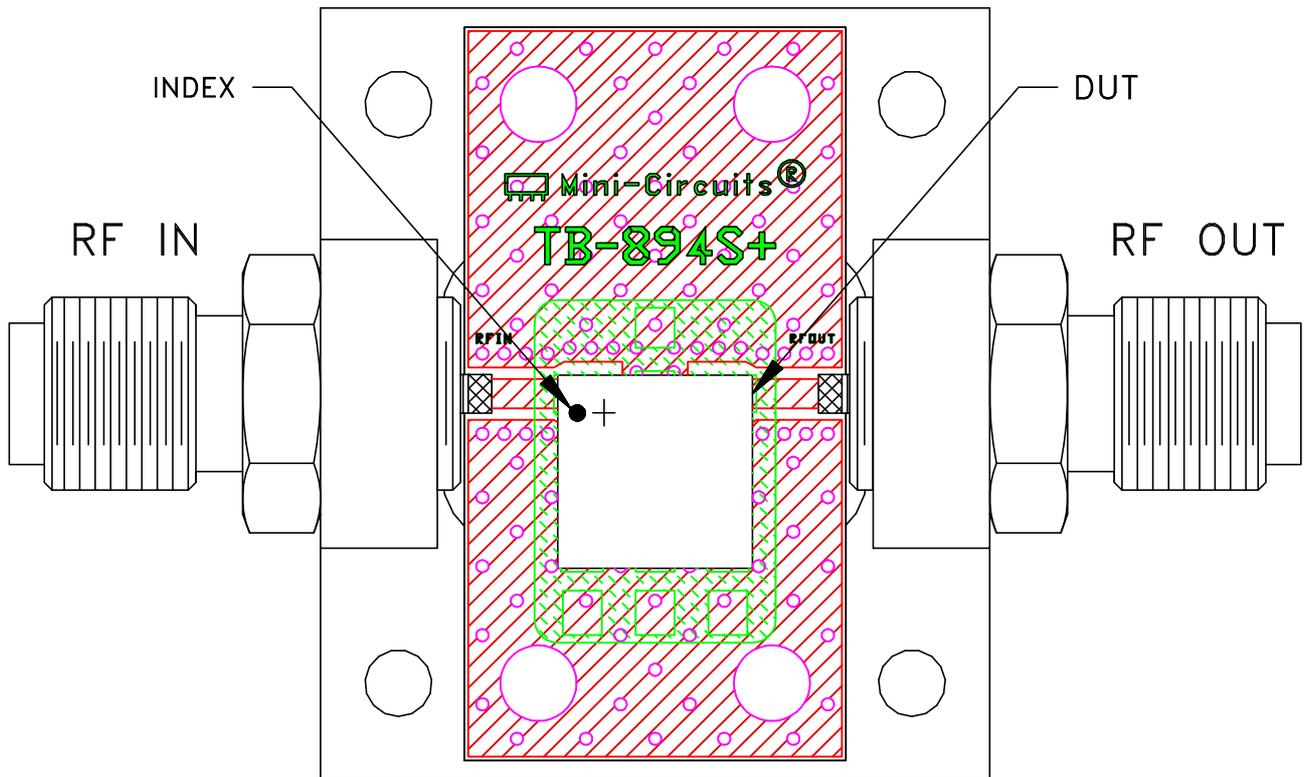
Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

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

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SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-484	REV: A
FILE: 98PL484	SCALE: 4:1	SHEET: 1 OF 1	

Evaluation Board and Circuit



NOTES:

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

Schematic Diagram

 **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
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