

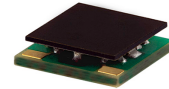
# Surface Mount <sup>top hat®</sup> Low Pass Filter

## ULP-137+

50Ω DC to 137 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-137+ is a lowpass filter in a top hat package (size of 0.25" x 0.25") fabricated using SMT technology. Covering DC to 137 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-137 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-137+ to be used in compact designs.

#### Notes

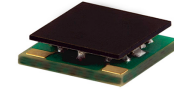
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# Surface Mount <sup>top hat®</sup> Low Pass Filter

## ULP-137+

50Ω DC to 137 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

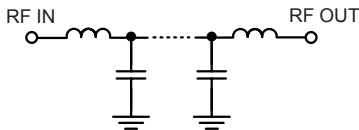
Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit	
Pass Band	Insertion Loss	DC-F1	DC-137	—	1.5	2.0	dB
	Freq. Cut-Off	F2	150	—	3.0	—	dB
	VSWR	DC-F1	DC-137	—	1.2	—	:1
Stop Band	Rejection Loss	F3-F4	190-215	20	27	—	dB
		F4-F5	215-1000	40	47	—	dB
	VSWR	F5-F6	1000-3000	—	20	—	dB
		F3-F5	190-1000	—	20	—	:1

### Maximum Ratings

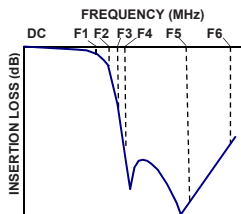
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	0.8W max.

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

### Functional Schematic



### Typical Frequency Response

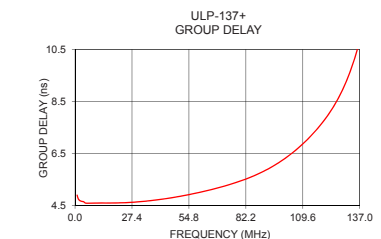
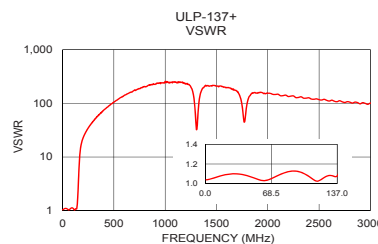
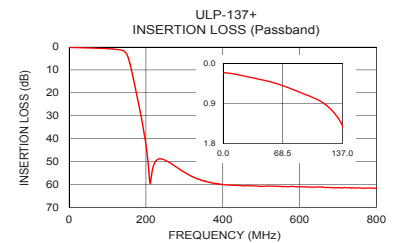
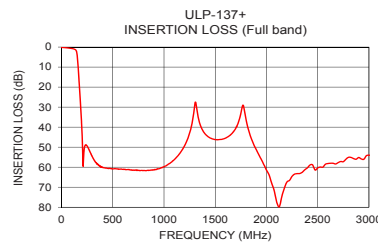


### Typical Performance Data at 25°C

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)	Frequency (MHz)	Group Delay (nsec)
1	0.21	1.04	1	4.90
10	0.23	1.06	5	4.60
75	0.55	1.08	10	4.60
137	1.39	1.08	20	4.60
150	3.10	2.16	30	4.64
160	8.33	6.00	40	4.73
170	15.99	11.96	50	4.85
175	19.99	14.51	60	5.01
176	20.80	14.97	70	5.21
180	24.04	16.62	80	5.46
188	30.73	19.35	90	5.79
190	32.49	19.97	100	6.26
200	42.64	22.71	105	6.55
215	55.47	26.42	110	6.90
250	49.48	34.69	115	7.31
300	54.73	46.72	120	7.79
500	60.86	104.94	125	8.39
1000	59.80	257.07	130	9.18
2000	61.52	154.70	135	10.28
3000	54.05	101.04	137	10.83

### +RoHS Compliant

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



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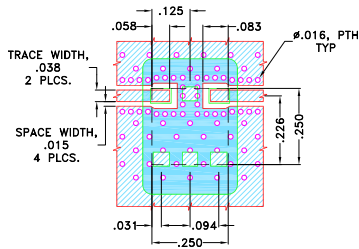
REV.A  
M161927  
ULP-137+  
EDU2386  
URJ  
170512  
Page 2 of 3

## 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

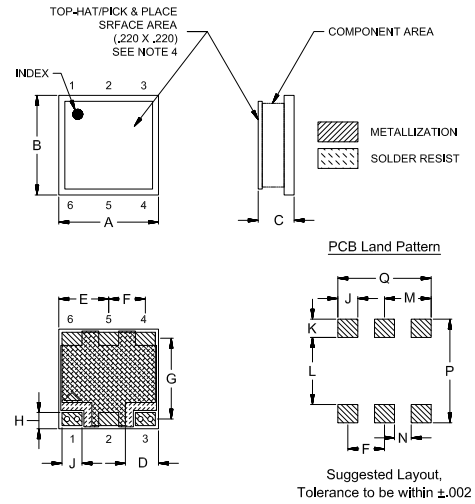


**NOTES:**

- 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 )

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

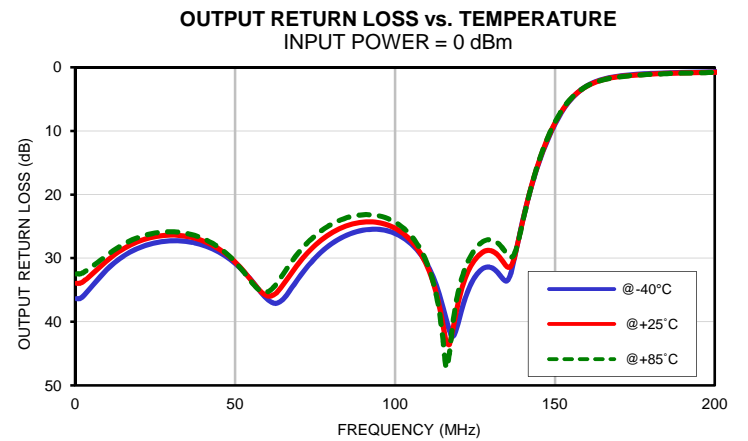
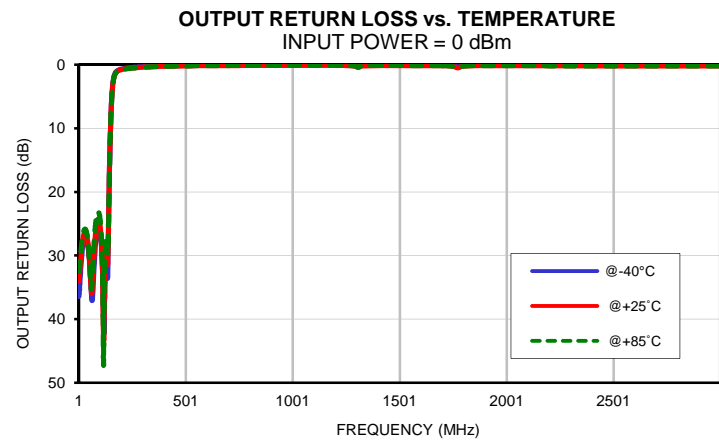
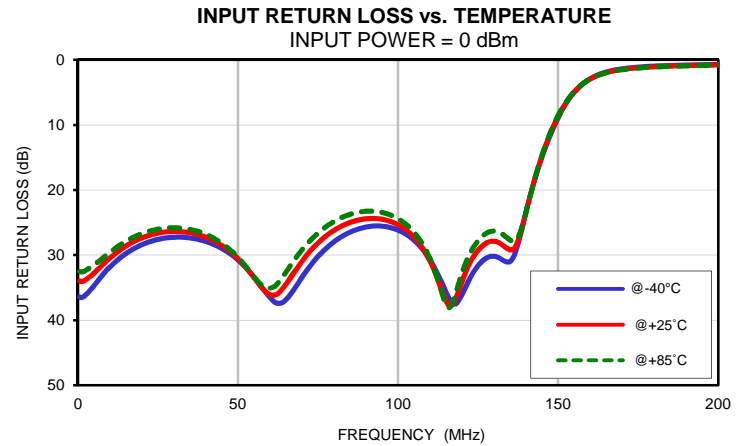
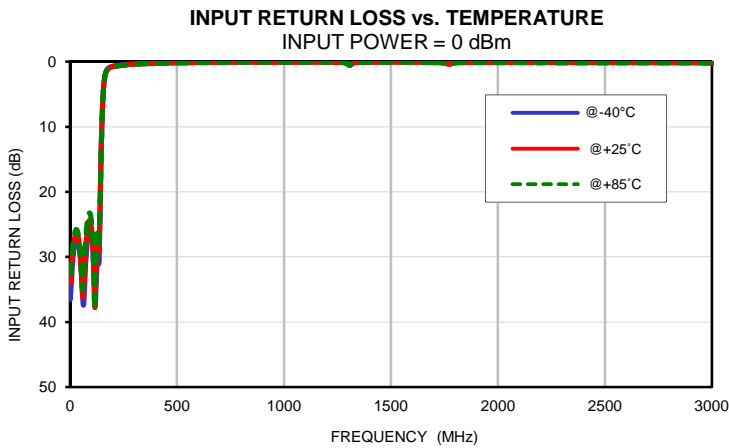
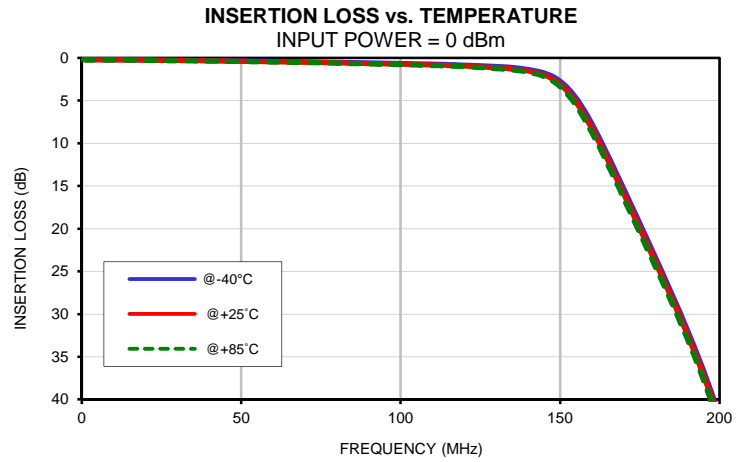
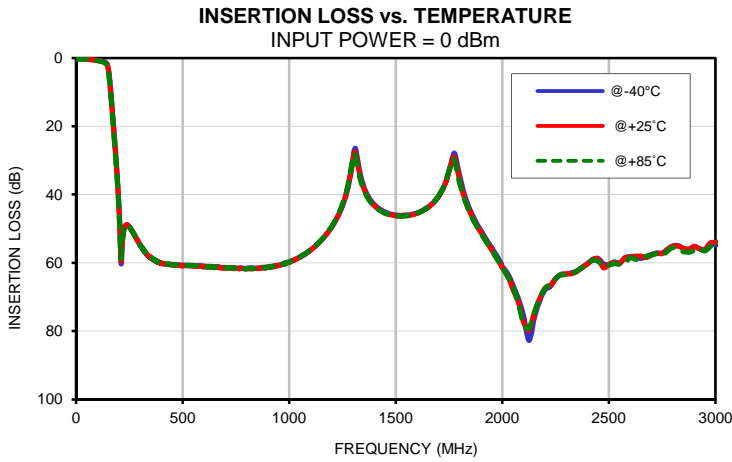
FREQ.  (MHz)	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
	(dB)			(dB)			(dB)		
	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C	@-40°C	@+25°C	@+85°C
1	0.17	0.21	0.25	36.53	34.07	32.58	36.37	33.94	32.46
2	0.17	0.22	0.25	36.29	33.91	32.45	36.18	33.83	32.38
5	0.18	0.22	0.25	34.70	32.76	31.53	34.58	32.67	31.46
10	0.19	0.23	0.26	31.81	30.43	29.55	31.77	30.39	29.52
15	0.21	0.25	0.28	29.75	28.60	27.87	29.74	28.58	27.87
20	0.23	0.27	0.30	28.38	27.34	26.69	28.39	27.34	26.71
25	0.25	0.29	0.32	27.58	26.62	26.01	27.58	26.61	26.03
50	0.35	0.40	0.42	30.74	30.57	30.36	30.81	30.58	30.57
75	0.48	0.55	0.59	30.21	28.13	26.60	29.99	27.99	26.47
100	0.65	0.74	0.80	26.15	25.34	24.40	26.09	25.26	24.31
125	0.92	1.05	1.14	31.60	29.24	27.79	32.96	30.22	28.62
137	1.20	1.39	1.51	29.08	28.38	27.63	30.90	30.44	29.61
150	2.71	3.10	3.37	8.89	8.69	8.57	8.93	8.74	8.62
160	7.69	8.33	8.79	2.89	2.92	2.92	2.89	2.93	2.92
170	15.32	15.99	16.51	1.36	1.46	1.49	1.35	1.45	1.49
175	19.35	19.99	20.51	1.10	1.20	1.24	1.09	1.19	1.23
180	23.41	24.04	24.55	0.95	1.05	1.09	0.94	1.04	1.08
185	27.55	28.17	28.69	0.86	0.95	0.98	0.84	0.94	0.97
186	28.40	29.01	29.53	0.84	0.93	0.97	0.83	0.92	0.96
187	29.25	29.87	30.39	0.82	0.91	0.95	0.81	0.90	0.94
188	30.11	30.73	31.25	0.81	0.90	0.94	0.80	0.89	0.93
190	31.87	32.49	33.02	0.79	0.87	0.91	0.77	0.86	0.90
200	41.92	42.64	43.23	0.68	0.77	0.80	0.67	0.76	0.79
205	48.82	49.69	50.41	0.65	0.72	0.76	0.63	0.71	0.75
210	59.01	58.99	58.77	0.61	0.69	0.72	0.60	0.68	0.71
215	56.41	55.47	54.91	0.58	0.66	0.69	0.57	0.65	0.68
220	52.06	51.70	51.53	0.56	0.63	0.66	0.54	0.62	0.65
225	50.16	50.00	49.91	0.53	0.60	0.64	0.52	0.59	0.63
250	49.48	49.48	49.47	0.43	0.50	0.53	0.42	0.49	0.52
300	54.70	54.73	54.70	0.31	0.37	0.40	0.30	0.36	0.39
350	58.52	58.42	58.41	0.24	0.29	0.31	0.23	0.29	0.30
375	59.33	59.48	59.41	0.21	0.26	0.28	0.20	0.26	0.27
400	60.01	60.08	60.03	0.19	0.23	0.25	0.18	0.23	0.24
450	60.57	60.62	60.45	0.15	0.19	0.21	0.14	0.20	0.20
500	60.72	60.86	60.81	0.12	0.17	0.18	0.12	0.17	0.17
550	60.83	60.88	60.82	0.10	0.14	0.15	0.09	0.15	0.15
600	60.99	61.11	61.00	0.08	0.12	0.14	0.07	0.13	0.13
650	61.20	61.18	61.34	0.07	0.11	0.12	0.06	0.12	0.12
700	61.41	61.43	61.34	0.05	0.10	0.11	0.05	0.11	0.11
750	61.54	61.61	61.68	0.04	0.09	0.10	0.04	0.11	0.10
800	61.61	61.69	61.57	0.03	0.08	0.09	0.03	0.10	0.09
850	61.56	61.68	61.65	0.03	0.08	0.09	0.02	0.10	0.09
900	61.27	61.29	61.42	0.02	0.08	0.09	0.02	0.10	0.09
950	60.78	60.82	60.71	0.01	0.07	0.08	0.01	0.10	0.09
1000	59.82	59.80	59.83	0.01	0.07	0.08	0.01	0.10	0.09
1200	49.48	49.43	49.20	0.00	0.07	0.08	0.00	0.10	0.09
1400	42.99	43.33	43.49	0.00	0.08	0.09	0.00	0.11	0.10
1500	46.01	46.22	46.23	0.00	0.08	0.09	0.00	0.11	0.10
1600	45.33	45.51	45.46	0.00	0.09	0.10	0.01	0.12	0.11
1700	40.59	40.64	40.43	0.01	0.10	0.12	0.02	0.14	0.14
1750	33.33	33.15	32.79	0.08	0.19	0.22	0.10	0.24	0.25
2000	61.09	61.52	61.31	0.01	0.11	0.13	0.02	0.14	0.15
2200	67.92	67.39	67.59	0.03	0.13	0.15	0.03	0.15	0.16
2400	60.19	60.33	60.25	0.04	0.14	0.16	0.04	0.16	0.17
2500	60.48	60.39	60.68	0.05	0.15	0.17	0.05	0.17	0.18
2600	58.23	58.19	58.49	0.06	0.16	0.18	0.05	0.18	0.19
2750	57.11	57.29	57.79	0.07	0.17	0.19	0.06	0.18	0.19
2800	55.06	55.10	55.47	0.07	0.16	0.18	0.07	0.19	0.20
2900	55.22	55.17	56.37	0.08	0.18	0.20	0.06	0.19	0.19
3000	54.74	54.05	53.87	0.08	0.17	0.19	0.07	0.19	0.20



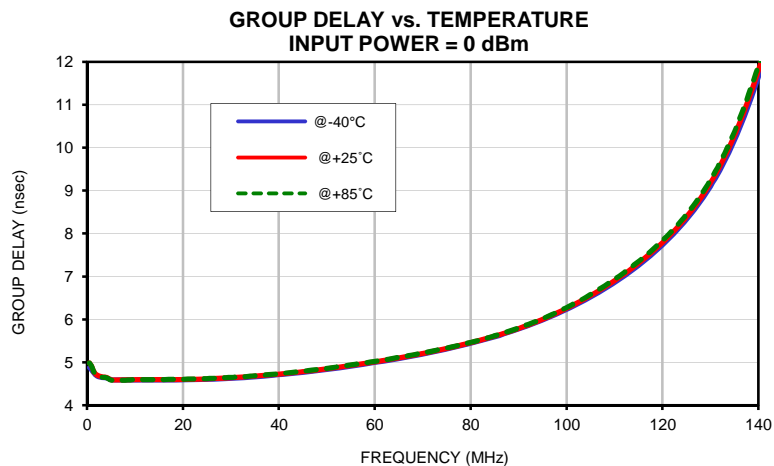
Typical Performance Data

FREQ.  (MHz)	GROUP DELAY		
	(nsec)		
	@-40°C	@+25°C	@+85°C
1.0	4.82	4.90	4.90
2.0	4.69	4.71	4.70
3.0	4.65	4.67	4.66
4.0	4.64	4.65	4.64
5.0	4.60	4.60	4.59
6.0	4.59	4.59	4.58
7.0	4.59	4.59	4.58
8.0	4.59	4.59	4.59
9.0	4.59	4.60	4.59
10.0	4.59	4.60	4.60
11.0	4.59	4.60	4.60
12.0	4.59	4.60	4.60
13.0	4.59	4.60	4.60
14.0	4.59	4.60	4.60
15.0	4.59	4.60	4.60
16.0	4.59	4.60	4.60
17.0	4.59	4.60	4.60
18.0	4.59	4.60	4.60
19.0	4.59	4.60	4.60
20.0	4.59	4.60	4.61
21.0	4.59	4.60	4.61
22.0	4.60	4.61	4.61
23.0	4.60	4.61	4.62
24.0	4.60	4.61	4.62
25.0	4.60	4.62	4.62
26.0	4.61	4.62	4.63
27.0	4.61	4.62	4.63
28.0	4.62	4.63	4.64
29.0	4.62	4.64	4.64
30.0	4.63	4.64	4.65
31.0	4.63	4.65	4.65
32.0	4.64	4.66	4.67
33.0	4.65	4.66	4.67
34.0	4.65	4.67	4.68
35.0	4.67	4.68	4.69
36.0	4.67	4.69	4.70
37.0	4.68	4.70	4.70
38.0	4.69	4.71	4.72
39.0	4.70	4.72	4.72
40.0	4.71	4.73	4.74
42.0	4.73	4.75	4.76
43.0	4.74	4.76	4.77
45.0	4.77	4.78	4.79
50.0	4.83	4.85	4.86
55.0	4.91	4.92	4.94
60.0	5.00	5.01	5.02
65.0	5.09	5.11	5.12
68.0	5.15	5.17	5.18
70.0	5.19	5.21	5.22
75.0	5.31	5.33	5.33
80.0	5.45	5.46	5.47
85.0	5.60	5.61	5.62
90.0	5.78	5.79	5.80
95.0	5.99	6.00	6.02
100.0	6.23	6.26	6.28
105.0	6.52	6.55	6.58
120.0	7.74	7.79	7.84
125.0	8.32	8.39	8.44
130.0	9.09	9.18	9.24
137.0	10.70	10.83	10.93

## Typical Performance Curves

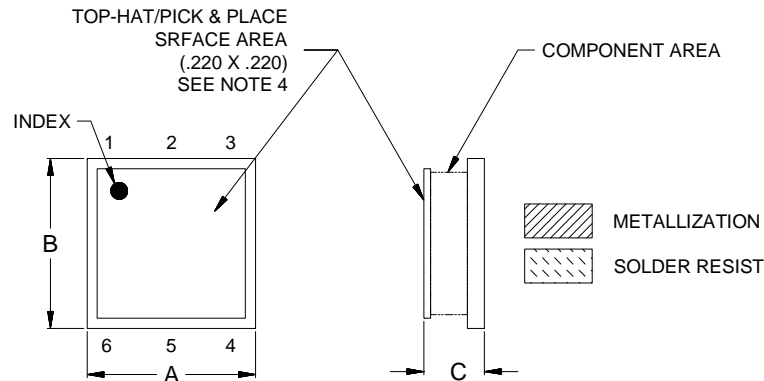


## Typical Performance Curves

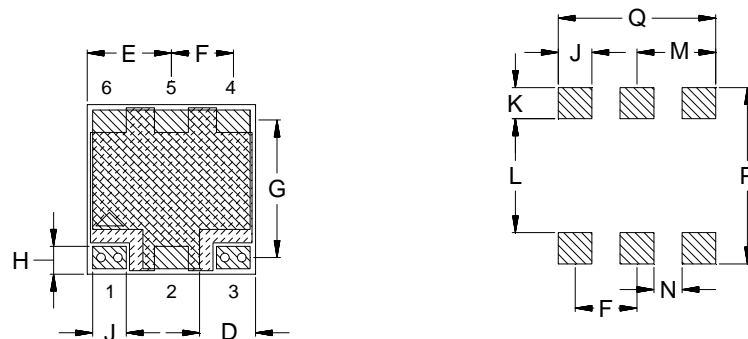


## Outline Dimensions

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  $\mu$  inch Gold over 120-240  $\mu$  inch Nickel plate.  
For RoHS-5 Case Styles: Tin-Lead plate.
- Top-Hat total thickness: .013 inches MAX



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

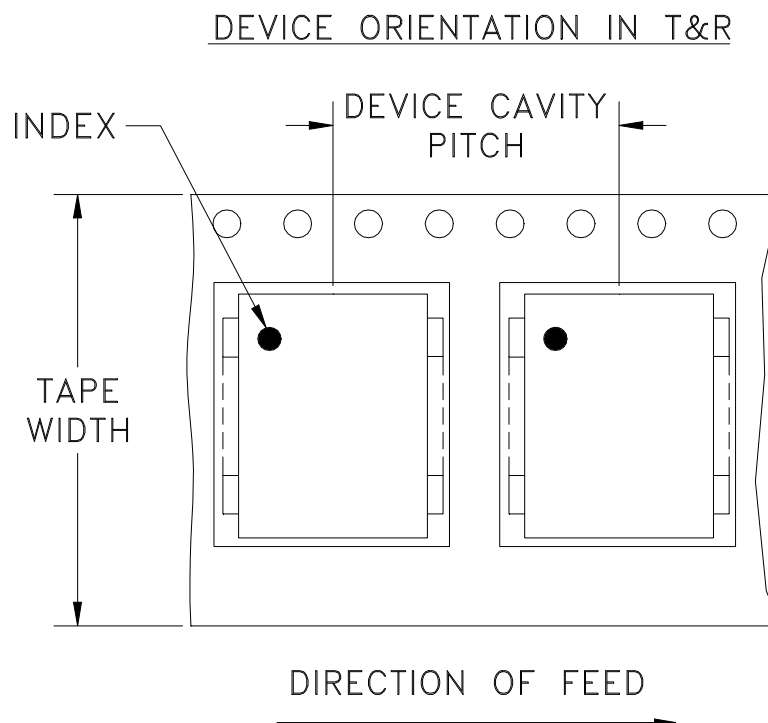


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RF/IF MICROWAVE COMPONENTS



# 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](http://www.minicircuits.com/pages/pdfs/tape.pdf)



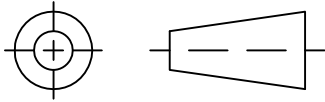
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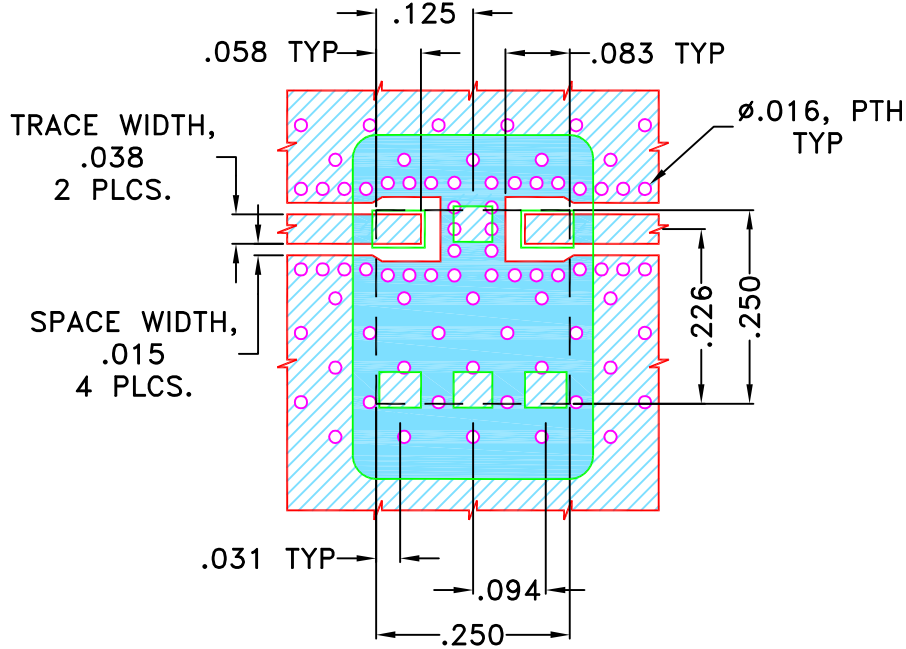
THIRD ANGLE PROJECTION



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



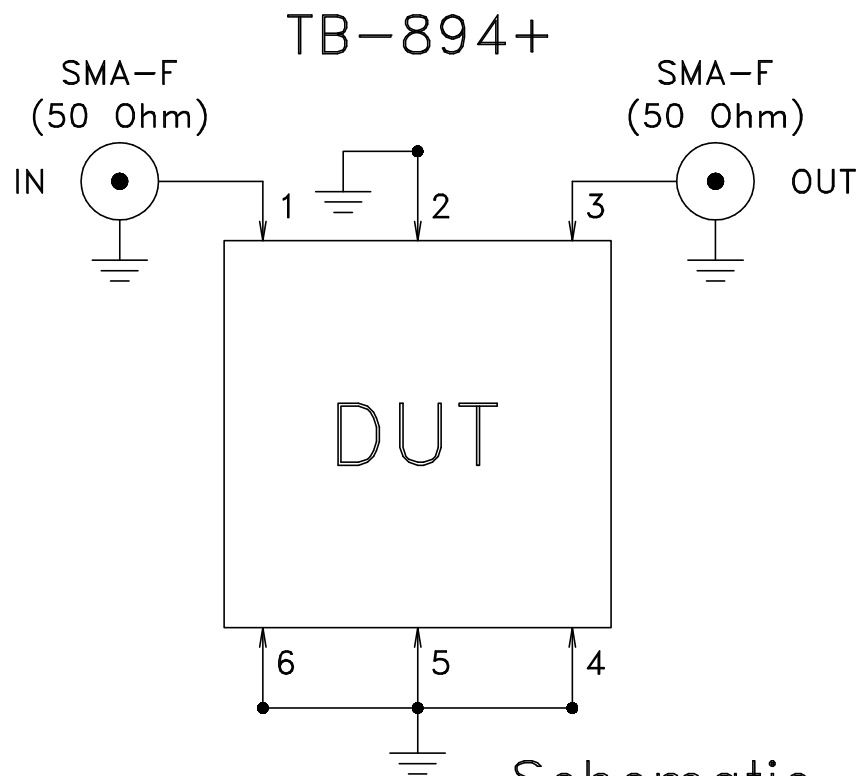
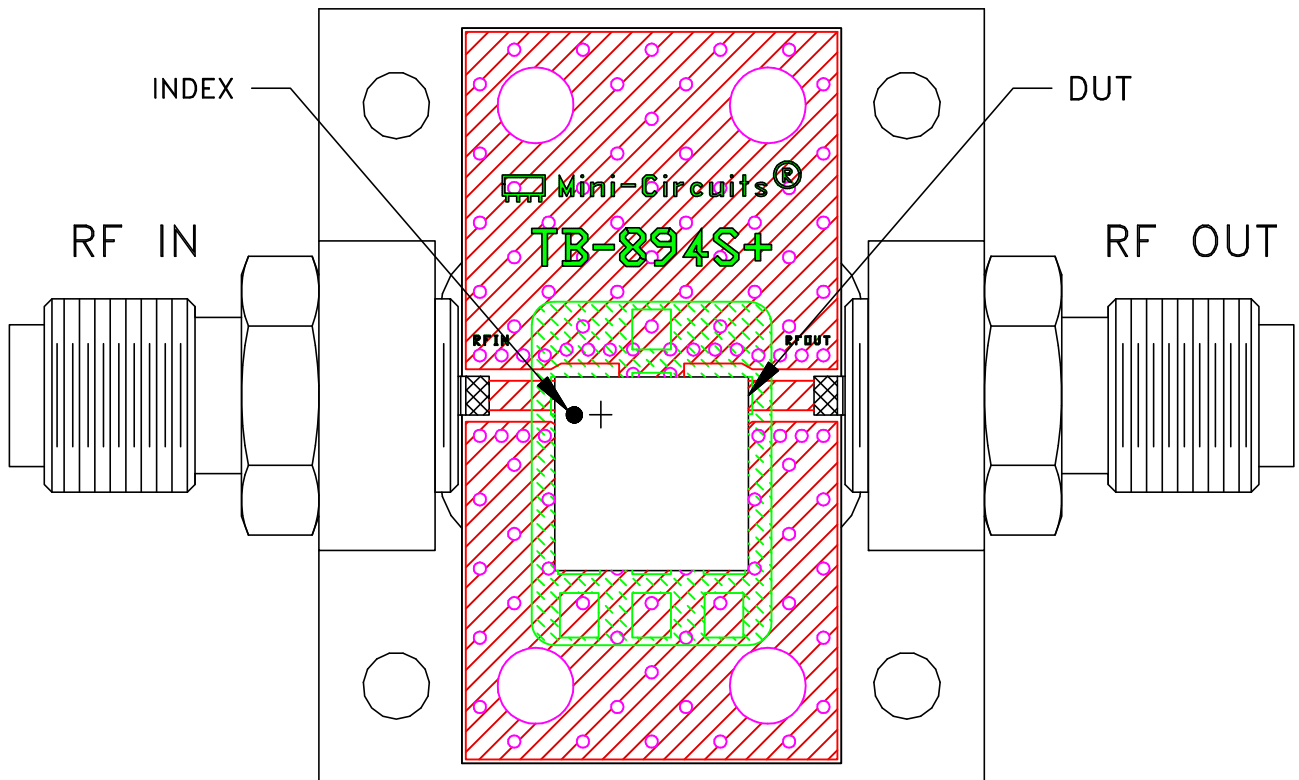
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Brooklyn NY 11235

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



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®**

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