

Ceramic

Low Pass Filter

LFCW-113+

50Ω

DC to 11 GHz



Generic photo used for illustration purposes only

CASE STYLE: JC0603C-1

The Big Deal

- Good rejection, 39 dB typical
- Rugged, ceramic construction
- Tiny size, 0.063" x 0.032" x 0.024" (0603)
- Good power handling, 2.5 W

Product Overview

Mini-Circuits' LFCW-113+ is an LTCC low pass filter with a passband from DC to 11 GHz, supporting a variety of applications. This model provides 1.5 dB typical passband insertion loss and provides a very good stopband rejection due to strategically constructed layout with minimal interaction between components. It handles up to 2.5 W RF input power and provides a wide operating temperature range from -55 to +125°C. Housed in a tiny 0603 ceramic form factor with wraparound terminations, the filter is ideal for dense PCB layouts and with minimal performance variation due to parasitics.

Key Features

Feature	Advantages
Ultra-wide stopband	The LTCC lowpass filter provides a very good stopband rejection until 26.5 GHz suitable for high end applications.
LTCC Construction	Provides repeatable performance in a rugged, ceramic package well suited for tough environments such as high humidity and temperature extremes.
Tiny size (0.063" x 0.032" x 0.024")	Saves space in dense circuit board layouts and minimizes the effects of parasitics.
Good power handling, 2.5 W	Supports a wide range of system power requirements.
Wrap-around terminations	Provides excellent solderability and easy visual inspection

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



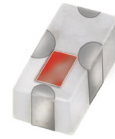
www.minicircuits.com P.O. Box 350166, Brooklyn, NY 11235-0003 (718) 934-4500 sales@minicircuits.com

Low Pass Filter

50Ω

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LFCW-113+



Generic photo used for illustration purposes only
CASE STYLE: JC0603C-1

Features

- Low loss, 1.5 dB typical
- Good rejection 39 dB typical
- Extremely small size 0603 (0.063" X 0.032" X 0.024")
- Temperature stable
- LTCC construction

Applications

- X-Band Radar
- Public Safety Communications

+RoHS Compliant

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

Electrical Specifications^{1,2} at 25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Insertion Loss	DC-F1	DC - 11000	—	1.5	2.4	dB
	Freq. Cut-Off	F2*	11900	—	3.0	—	dB
	Return Loss	DC-F1	DC - 11000	—	12	—	dB
Stop Band	Rejection Loss	F3-F4	14800 - 16000	20	39	—	dB
		F4-F5	16000 - 19000	28	36	—	dB
		F5-F6	19000 - 23500	23	32	—	dB
		F6-F7	23500 - 26500	—	20	—	dB

1 DC de-coupling capacitors are required in Applications where DC voltage and/or current is present at either input or output ports. Please contact Mini-Circuits for alternatives if DC pass from IN-OUT is required.

2 Measured on Mini-Circuits Characterization Test Board TB-LFCW-113+

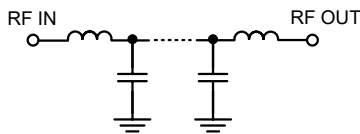
* Typically, a ±5% frequency deviation from the stated value may occur on a unit-to-unit basis.

Maximum Ratings

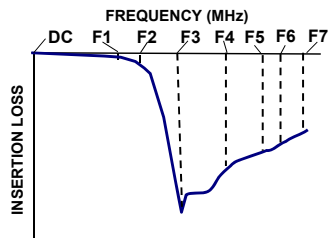
Operating Temperature	-55°C to 125°C
Storage Temperature	-55°C to 125°C
RF Power Input*	2.5 W @25°C

*Passband rating, derate linearly to 0.7 W at 125°C ambient
Permanent damage may occur if any of these limits are exceeded.

Functional Schematic

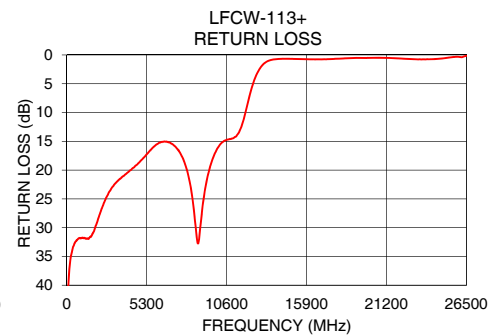
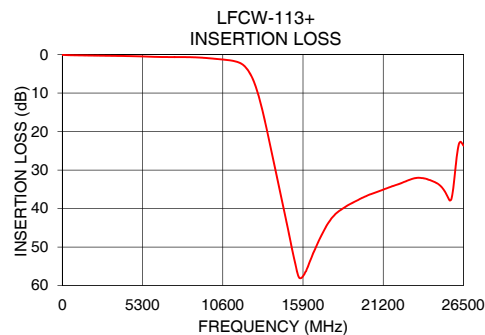
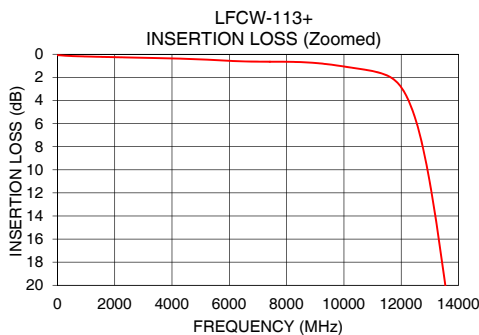


Typical Frequency Response



Typical Performance Data at 25°C

Frequency (MHz)	Insertion Loss (dB)	Return Loss (dB)
10	0.08	46.35
100	0.09	40.80
500	0.15	32.87
1000	0.19	31.83
2000	0.25	29.19
3000	0.30	23.03
6000	0.57	15.49
10000	1.06	16.20
11000	1.45	14.49
11900	2.54	9.47
12100	3.25	7.32
13600	21.13	0.84
14100	30.35	0.69
14800	43.29	0.67
16000	56.97	0.74
19000	38.84	0.53
20000	36.88	0.51
21000	35.38	0.50
23500	32.01	0.78
26500	23.65	0.14



Notes

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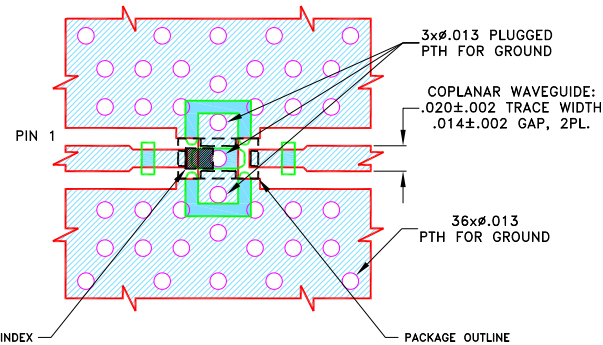


Pad Connections

INPUT	1
OUTPUT	3
GROUND	2, 4

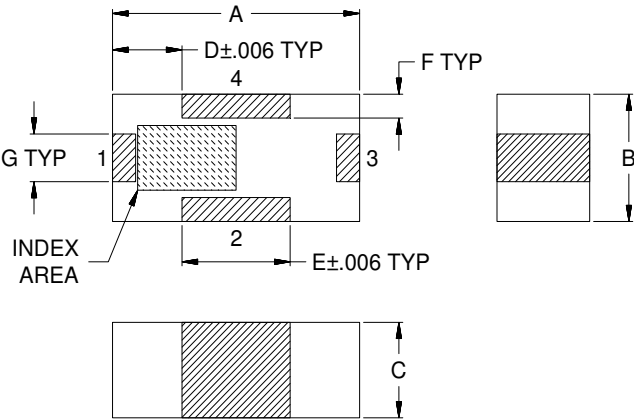
Product Marking: P

Demo Board MCL P/N: TB-LFCW-113+
Suggested PCB Layout (PL-650)



- NOTES:
- 1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (R04835 Lo Pro) WITH DIELECTRIC THICKNESS .0107±.0010. COPPER: 1/2 Oz. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP 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	Wt.
.063	.032	.024	.018	.028	.006	.012	grams
1.60	0.80	0.60	0.45	0.70	0.15	0.30	.005

Note: Please refer to case style drawing for details

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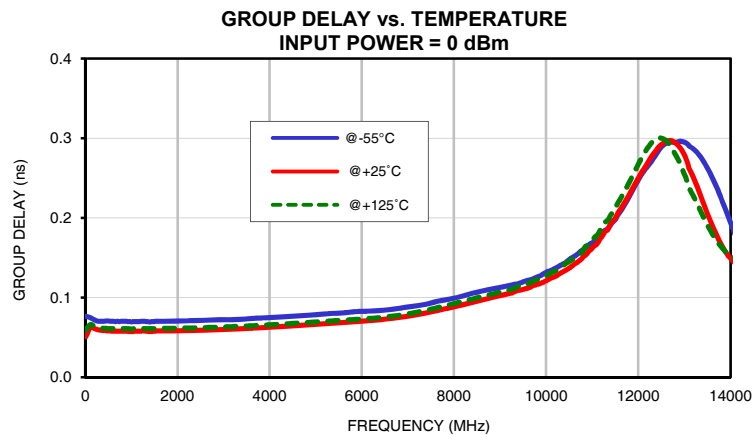
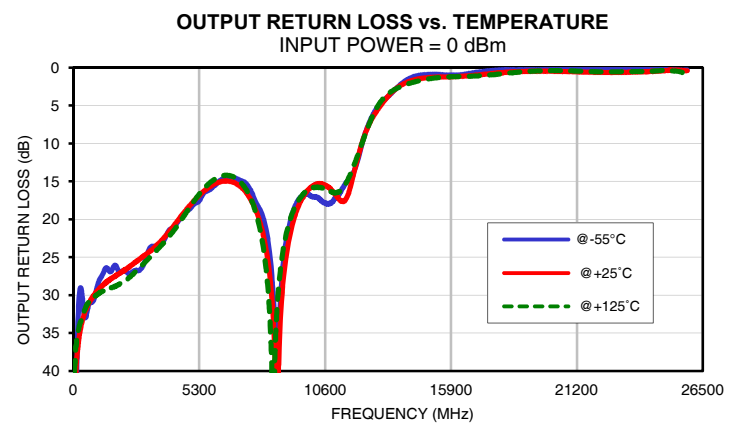
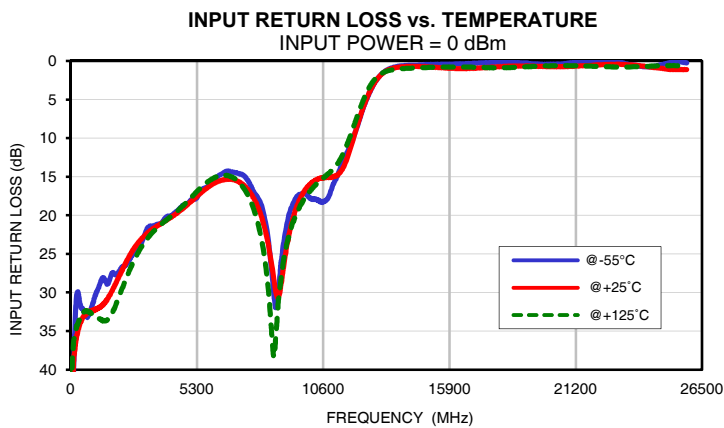
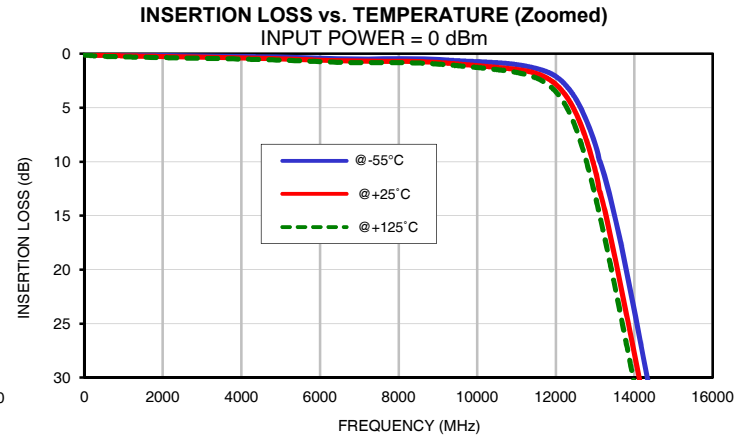
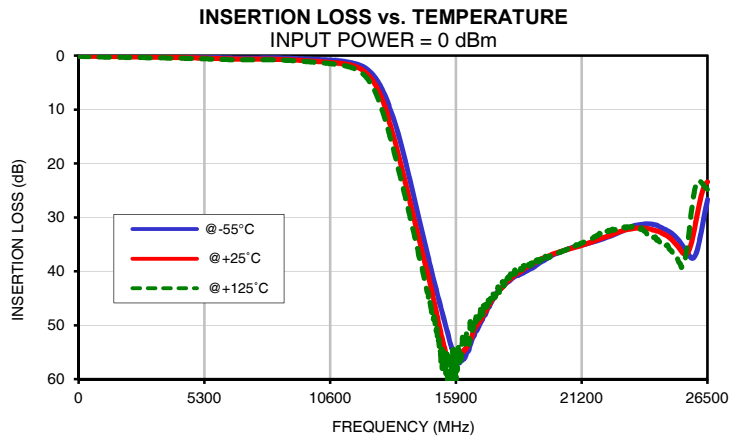
Typical Performance Data

FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(MHz)	(dB)			(dB)			(dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
10	0.07	0.08	0.10	54.03	43.98	40.44	52.62	43.68	38.95
100	0.07	0.09	0.14	43.73	41.32	37.35	53.29	40.78	36.77
200	0.08	0.10	0.17	33.36	37.02	35.10	33.01	36.76	34.65
250	0.09	0.11	0.19	30.62	35.88	34.49	29.94	35.35	34.06
300	0.09	0.12	0.20	29.93	35.21	34.10	29.01	34.53	33.55
400	0.09	0.14	0.22	31.42	33.98	33.39	30.96	33.03	32.67
500	0.10	0.15	0.23	32.07	33.35	32.85	32.96	32.08	31.83
600	0.10	0.16	0.25	32.76	32.88	32.39	31.90	31.41	31.18
700	0.11	0.16	0.26	33.16	32.62	32.40	30.97	30.78	30.72
800	0.11	0.17	0.26	32.71	32.47	32.54	30.89	30.29	30.40
1000	0.12	0.19	0.28	30.75	32.26	32.96	28.91	29.47	29.89
2000	0.16	0.25	0.35	27.52	28.21	30.83	27.00	27.02	28.40
3000	0.20	0.31	0.41	23.42	22.95	24.00	25.63	24.71	25.72
4000	0.25	0.37	0.49	20.25	20.69	20.66	21.58	21.73	22.38
6000	0.41	0.59	0.72	15.56	15.90	15.16	15.40	15.24	14.59
7000	0.48	0.68	0.81	14.51	15.55	15.51	14.79	15.57	14.96
8000	0.46	0.69	0.81	18.60	20.06	22.82	19.88	22.12	23.73
10000	0.73	1.10	1.27	17.60	16.10	17.05	16.89	15.75	15.91
10500	0.82	1.26	1.46	18.20	15.20	15.43	17.65	15.32	15.90
11000	1.00	1.45	1.73	16.13	15.02	14.09	17.25	16.56	16.47
11100	1.06	1.50	1.80	15.47	14.88	13.72	16.98	17.01	16.44
11200	1.11	1.56	1.88	14.87	14.73	13.31	16.69	17.39	16.35
11300	1.19	1.63	1.98	14.07	14.47	12.82	16.07	17.57	16.07
11380	1.25	1.69	2.07	13.45	14.13	12.37	15.68	17.63	15.72
11400	1.27	1.71	2.09	13.30	14.07	12.24	15.59	17.62	15.65
11500	1.35	1.81	2.23	12.56	13.44	11.57	15.12	17.18	15.11
11900	1.87	2.53	3.14	9.65	9.73	8.30	12.98	12.82	12.16
12100	2.36	3.17	3.93	7.83	7.70	6.56	10.70	10.47	10.45
13000	8.30	10.70	13.08	1.85	1.87	1.71	4.52	4.74	4.23
13600	16.61	20.49	23.23	0.77	0.88	1.09	2.71	2.72	2.76
14000	23.74	27.74	30.55	0.58	0.72	0.97	1.67	1.97	2.22
14200	27.54	31.38	34.34	0.53	0.69	0.93	1.33	1.72	2.02
14800	38.65	42.07	45.41	0.47	0.73	0.85	0.93	1.35	1.55
14900	40.47	43.89	47.84	0.45	0.73	0.84	0.90	1.32	1.50
15000	42.21	46.02	49.04	0.45	0.74	0.83	0.88	1.28	1.45
15100	44.00	48.11	50.60	0.45	0.78	0.83	0.86	1.25	1.40
15200	45.60	50.15	53.93	0.43	0.80	0.81	0.88	1.24	1.35
15300	47.26	52.02	54.40	0.42	0.81	0.81	0.90	1.24	1.32
15500	50.61	55.78	56.44	0.42	0.85	0.79	0.91	1.20	1.27
15600	52.29	56.70	58.50	0.41	0.87	0.78	0.96	1.20	1.24
16000	56.67	56.14	54.04	0.39	0.94	0.77	0.97	1.17	1.19
16200	56.37	54.89	53.05	0.37	0.96	0.77	0.96	1.16	1.16
16400	54.81	53.74	51.34	0.34	0.96	0.77	0.90	1.11	1.15
16600	52.28	51.62	50.95	0.33	0.96	0.78	0.79	1.07	1.13
16800	50.84	49.89	48.89	0.30	0.95	0.79	0.68	1.02	1.11
17000	49.09	48.56	47.76	0.26	0.92	0.81	0.58	0.96	1.08
17200	47.30	47.03	46.63	0.25	0.89	0.81	0.52	0.90	1.04
17400	45.66	45.45	45.44	0.21	0.84	0.84	0.43	0.83	0.97
17600	44.13	44.24	43.90	0.20	0.80	0.85	0.37	0.77	0.94
17800	43.11	43.22	42.60	0.16	0.77	0.87	0.34	0.72	0.87
18000	42.31	42.17	42.14	0.17	0.72	0.87	0.28	0.63	0.81
18200	41.60	41.38	40.48	0.15	0.70	0.87	0.29	0.63	0.75
18400	40.87	40.55	40.09	0.16	0.66	0.84	0.25	0.57	0.68
19000	39.61	38.97	39.04	0.24	0.66	0.77	0.26	0.48	0.53
20000	36.89	36.75	36.98	0.41	0.72	0.63	0.24	0.48	0.37
21000	35.37	35.46	35.11	0.21	0.70	0.59	0.12	0.52	0.43
22000	34.11	33.94	33.15	0.03	0.51	0.68	0.03	0.59	0.54
22500	33.31	33.14	32.19	0.00	0.44	0.73	0.03	0.62	0.53
23500	31.46	32.01	31.86	0.45	0.50	0.75	0.03	0.59	0.50
26500	26.69	23.44	24.84	0.00	1.02	0.65	1.27	0.65	0.53

Typical Performance Data

FREQ.	GROUP DELAY		
(MHz)	(nsec)		
	@-55°C	@+25°C	@+125°C
10	0.08	0.05	0.06
100	0.07	0.06	0.07
200	0.07	0.06	0.06
400	0.07	0.06	0.06
600	0.07	0.06	0.06
800	0.07	0.06	0.06
1000	0.07	0.06	0.06
1200	0.07	0.06	0.06
1400	0.07	0.06	0.06
1600	0.07	0.06	0.06
1800	0.07	0.06	0.06
2000	0.07	0.06	0.06
2200	0.07	0.06	0.06
2400	0.07	0.06	0.06
2600	0.07	0.06	0.06
2800	0.07	0.06	0.06
3000	0.07	0.06	0.06
3200	0.07	0.06	0.06
3400	0.07	0.06	0.06
3600	0.07	0.06	0.06
3800	0.07	0.06	0.07
4000	0.07	0.06	0.07
4200	0.08	0.06	0.07
4400	0.08	0.06	0.07
4600	0.08	0.06	0.07
4800	0.08	0.07	0.07
5000	0.08	0.07	0.07
5200	0.08	0.07	0.07
5400	0.08	0.07	0.07
5600	0.08	0.07	0.07
5800	0.08	0.07	0.07
6000	0.08	0.07	0.07
6200	0.08	0.07	0.07
7000	0.09	0.08	0.08
7200	0.09	0.08	0.08
7500	0.09	0.08	0.09
8000	0.10	0.09	0.09
9000	0.11	0.10	0.11
10500	0.15	0.14	0.15
10700	0.16	0.15	0.15
11000	0.17	0.16	0.17

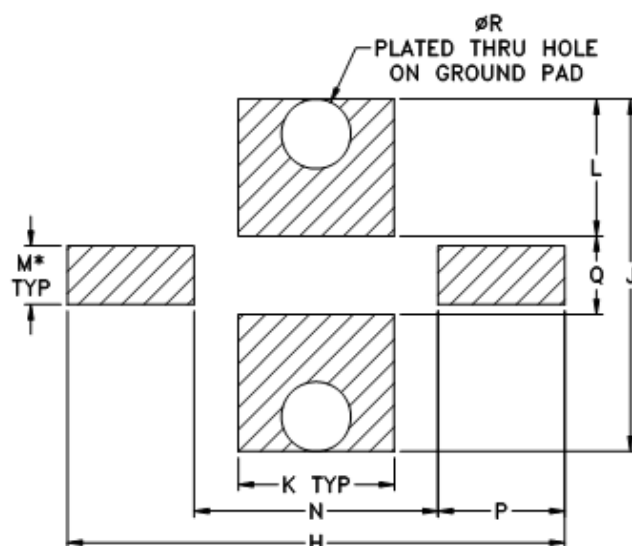
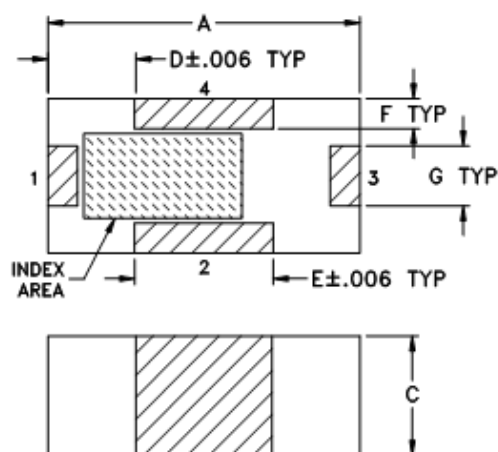
Typical Performance Curves



Outline Dimensions

JC0603C-1

PCB Land Pattern



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

CASE #	A	B	C	D	E	F	G	H	J	K	L
JC0603C-1	.063 (1.60)	.031 (0.80)	.024 (0.60)	.018 (0.45)	.028 (0.70)	.006 (0.15)	.012 (0.30)	.100 (2.54)	.071 (1.80)	.032 (0.80)	.028 (0.70)

CASE #	M*	N	P	Q	R	WT. GRAMS
JC0603C-1	.012 (0.30)	.049 (1.24)	.026 (0.65)	.016 (0.40)	.014 (0.35)	.005

Dimensions are in inches (mm). Tolerances: 3 Pl. $\pm .004$

Notes:

1. Open style, ceramic base.
2. Termination finish:
For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.
- 3.* - Line width should be designed to match 50 OHMS characteristic impedance, depending on PCB material & thickness.



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



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

RF/IF MICROWAVE COMPONENTS

Tape & Reel Packaging TR-F74

DEVICE ORIENTATION IN T&R

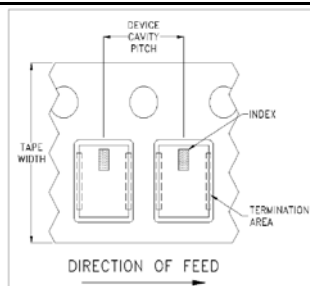


ILLUSTRATION 1

Applicable Case Styles

GE0805C-1
GE0805C-1AP
JV1210C-1
GU2939

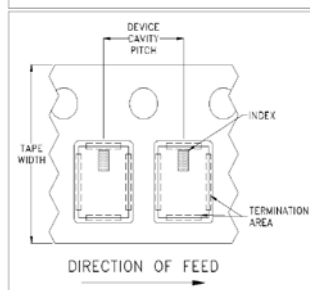


ILLUSTRATION 2

Applicable Case Styles

JV1210C
JV1210C-2
JV1210C-3
JV1210C-4
JV1210C-5
JV1210C-6
JV1210C-11

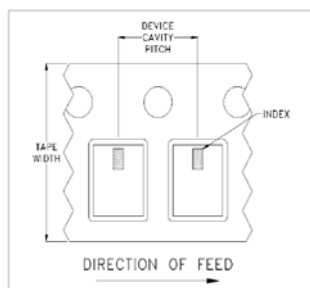


ILLUSTRATION 3

Applicable Case Styles

JC0603C-8
JV1210C-7
JV1210C-8
JV1210C-9
JV1210C-10
JV1210C-13
GE0805C-13

Tape Width, mm	Device Cavity Pitch, mm	Real Size, inches	Devices per Reel	
8	4	7	Small quantity standards (see note)	20
				50
				100
				200
				500
				1000
			Standard	2000
				4000

Note: Small reel availability 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

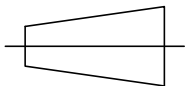


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P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661



REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M175765	NEW RELEASE	AUG 19	DDR	VC
A	M175661	DESIGN CHANGED	NOV 19	DDR	VC

3x ϕ .013 PLUGGED PTH FOR GROUND

COPLANAR WAVEGUIDE:
 $.020 \pm .002$ TRACE WIDTH
 $.014 \pm .002$ GAP, 2PL.

36x ϕ .013 PTH FOR GROUND

PACKAGE OUTLINE

PIN 1

DEX

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (RO4835 Lo Pro) WITH DIELECTRIC THICKNESS $.0107 \pm .0010$. COPPER: 1/2 Oz. EACH SIDE.
FOR OTHER MATERIALS TRACE WIDTH AND GAP 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	DDR	05 AUG 19
TOLERANCES ON:	CHECKED	RV	05 AUG 19
2 PL DECIMALS ±	APPROVED	RKS	05 AUG 19
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

 Mini-Circuits®

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



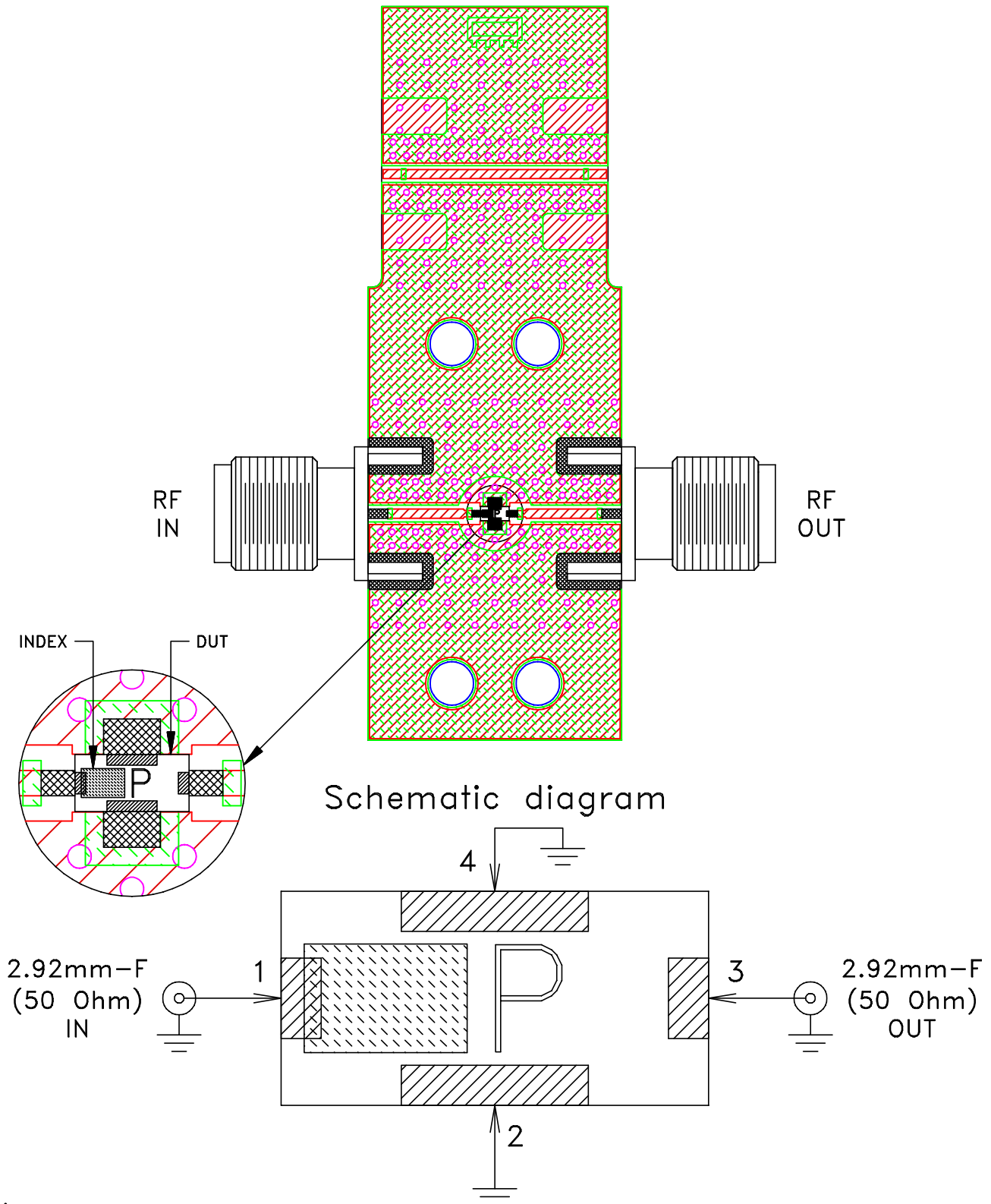
Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

PL, JC0603C-1, TB-1114+

SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-650		REV: A
FILE: 98PL650		SCALE: 16:1	SHEET: 1 OF 1	

Evaluation Board and Circuit

TB-LFCW-113+



Notes:

1. PCB Material: ROGERS (R04835 Lo Pro) OR Equivalent, Dielectric Constant= $3.48 \pm .05$
Dielectric Thickness: $.0107 \pm .0010$
2. 50 Ohm 2.92mm Female Connectors.
3. Connectors on the test board shall not be subjected to temperature greater than 200°C to avoid permanent damage to the connectors.

 **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	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 125° C Ambient Environment	Individual Model Data Sheet
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
Solder Reflow Heat	Sn-Pb Eutectic Process 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020C, 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, 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