

# Ceramic Low Pass Filter

## LFCW-6500+

50Ω DC to 6.5 GHz



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

### The Big Deal

- Very good rejection, 43 dB typical
- Rugged, ceramic construction
- Tiny size, 0.063" x 0.032" x 0.024" (0603)
- Good power handling, 2.5W

### Product Overview

Mini-Circuits' LFCW-6500+ is an LTCC low pass filter with a passband from DC to 6.5 GHz, supporting a variety of applications. This model provides 1.6 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 2.5W 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, 2.5W	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](http://www.minicircuits.com/MCLStore/terms.jsp)



# Low Pass Filter

## LFCW-6500+

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

### Features

- Low loss, 1.6 dB typical
- Good rejection 43 dB typical
- Extremely small size 0603 (0.063" X 0.032" X 0.024")
- Temperature stable
- LTCC construction

### Applications

- Military radios
- Point-Point communication
- 5G Sub 6 GHz
- WiFi
- ISM band

### Electrical Specifications<sup>1,2</sup> at 25°C

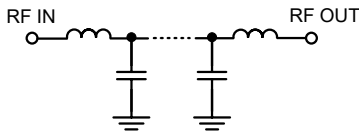
Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit	
Pass Band	Insertion Loss	DC-F1	DC - 6500	—	1.6	2.5	dB
	Freq. Cut-Off	F2*	7500	—	3.0	—	dB
	Return Loss	DC-F1	DC - 6500	—	10	—	dB
Stop Band	Rejection Loss	F3-F4	9000 - 9500	20	43	—	dB
		F4-F5	9500 - 15000	30	40	—	dB
		F5-F6	15000 - 18500	25	37	—	dB
		F6-F7	18500 - 26500	—	23	—	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-6500+

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

### Functional Schematic



### Maximum Ratings

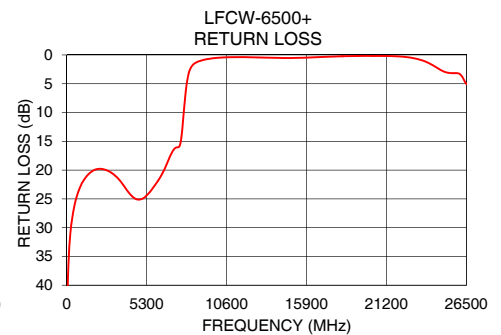
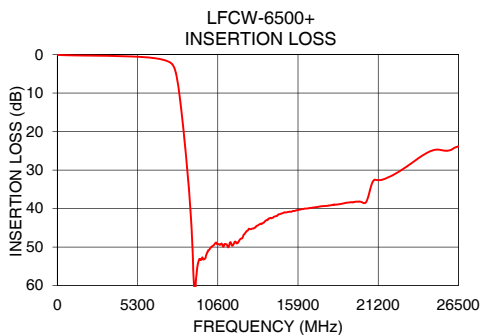
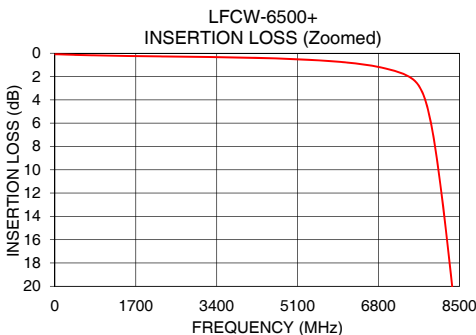
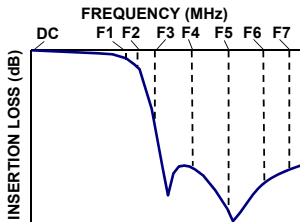
Operating Temperature	-55°C to 125°C
Storage Temperature	-55°C to 125°C
RF Power Input*	2.5W @25°C

\*Passband rating, derate linearly to 0.8W at 125°C ambient  
Permanent damage may occur if any of these limits are exceeded.

### Typical Performance Data at 25°C

Frequency (MHz)	Insertion Loss (dB)	Return Loss (dB)
10	0.09	42.89
100	0.09	37.66
500	0.15	26.38
1000	0.20	22.30
2000	0.26	19.84
3000	0.31	20.52
6000	0.74	22.08
6500	0.97	19.76
7500	2.17	15.72
7700	3.19	11.83
8200	14.69	2.36
8340	19.80	1.79
8600	30.42	1.28
9000	57.67	0.90
9500	53.32	0.65
10000	50.81	0.49
15000	40.98	0.53
18500	38.91	0.21
20000	38.21	0.17
26500	23.87	5.08

### Typical Frequency Response



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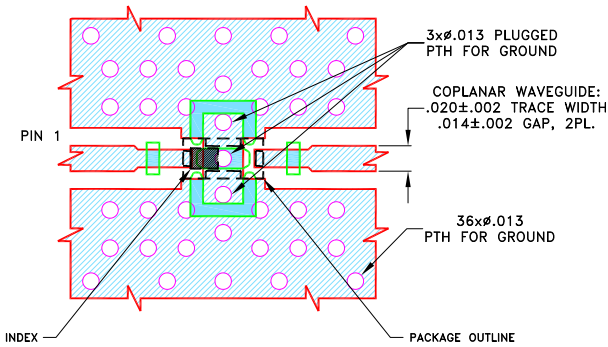


## Pad Connections

INPUT	1
OUTPUT	3
GROUND	2, 4

Product Marking: T

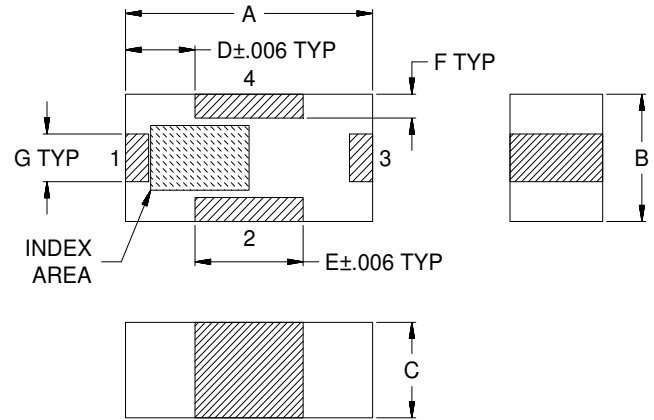
Demo Board MCL P/N: TB-LFCW-6500+  
Suggested PCB Layout (PL-650)



### NOTES:

- COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (R04835 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.
  - 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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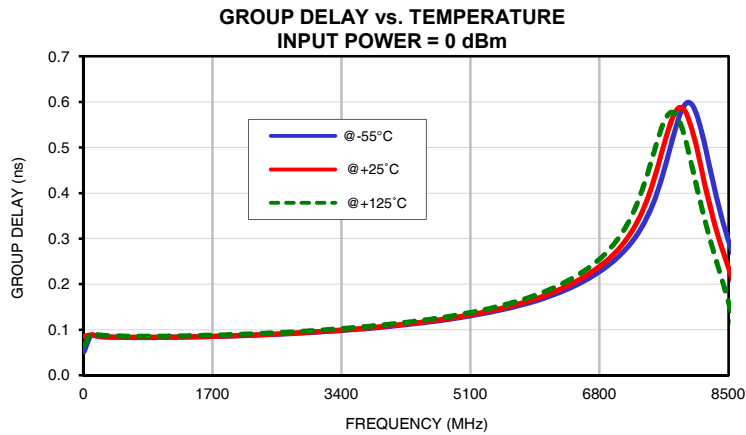
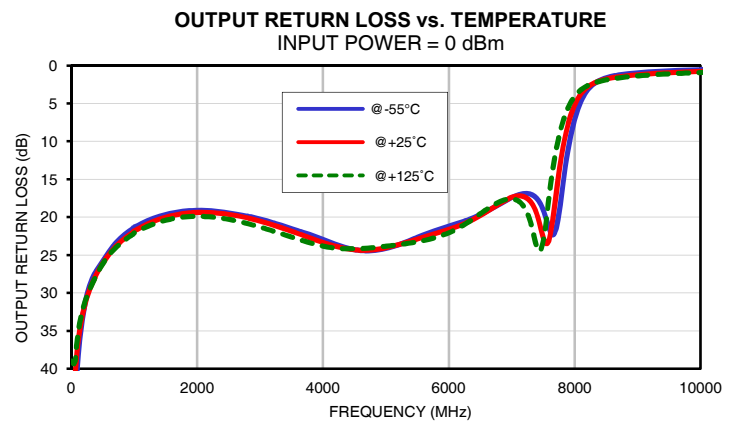
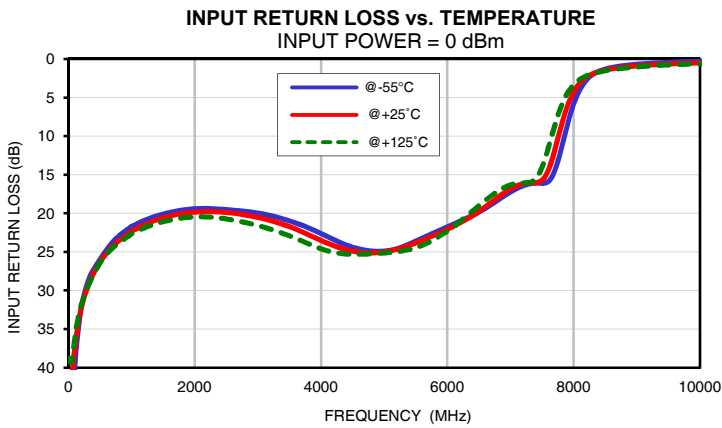
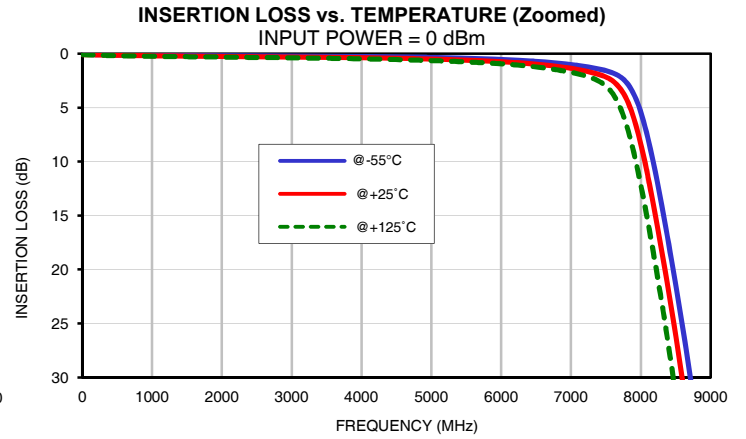
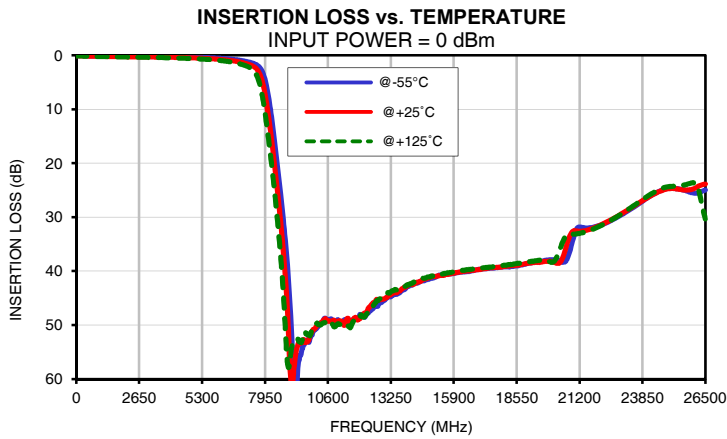
*Typical Performance Data*

FREQ.  (MHz)	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
	(dB)			(dB)			(dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
10	0.07	0.09	0.10	41.29	42.89	38.79	42.06	42.76	38.96
100	0.07	0.09	0.11	40.09	37.66	36.43	39.47	37.26	35.98
200	0.08	0.11	0.13	32.57	32.38	31.99	32.26	32.12	31.69
250	0.09	0.12	0.14	30.51	30.87	30.75	30.23	30.62	30.46
300	0.09	0.12	0.15	29.06	29.65	29.71	28.81	29.40	29.43
350	0.10	0.13	0.16	28.04	28.65	28.78	27.82	28.41	28.50
400	0.10	0.14	0.17	27.28	27.79	27.93	27.09	27.55	27.65
500	0.11	0.15	0.19	26.01	26.38	26.47	25.84	26.11	26.16
550	0.11	0.15	0.19	25.37	25.75	25.84	25.19	25.47	25.52
600	0.11	0.16	0.20	24.79	25.22	25.32	24.57	24.92	24.97
650	0.12	0.16	0.20	24.26	24.76	24.90	24.01	24.41	24.51
700	0.12	0.17	0.21	23.77	24.31	24.50	23.49	23.94	24.08
750	0.12	0.17	0.22	23.34	23.93	24.16	23.06	23.53	23.71
800	0.13	0.18	0.22	22.95	23.56	23.84	22.65	23.14	23.36
850	0.13	0.18	0.23	22.60	23.23	23.53	22.28	22.79	23.03
1000	0.14	0.20	0.24	21.69	22.30	22.65	21.32	21.81	22.09
1200	0.15	0.21	0.26	20.93	21.50	21.90	20.51	20.95	21.27
1500	0.17	0.23	0.28	20.11	20.58	21.09	19.66	20.01	20.41
2000	0.19	0.26	0.32	19.43	19.84	20.47	19.11	19.37	19.89
2500	0.20	0.29	0.35	19.53	19.90	20.73	19.44	19.63	20.29
3000	0.22	0.31	0.38	19.97	20.52	21.59	20.24	20.52	21.30
3500	0.24	0.34	0.42	20.98	21.73	22.93	21.51	21.85	22.62
4000	0.26	0.38	0.48	22.62	23.51	24.60	22.92	23.34	23.82
5000	0.35	0.50	0.64	24.90	25.01	25.15	24.13	24.04	23.83
5100	0.36	0.52	0.66	24.81	24.87	25.09	23.93	23.86	23.74
5200	0.38	0.54	0.68	24.60	24.66	25.00	23.65	23.63	23.63
6000	0.54	0.74	0.94	21.78	22.08	22.32	21.20	21.63	22.08
6100	0.57	0.78	0.99	21.40	21.67	21.70	20.92	21.32	21.67
6200	0.60	0.82	1.04	21.03	21.25	21.05	20.65	21.00	21.21
6300	0.63	0.87	1.10	20.66	20.79	20.38	20.37	20.65	20.70
6400	0.67	0.92	1.16	20.28	20.31	19.71	20.04	20.23	20.14
6500	0.71	0.97	1.23	19.86	19.76	19.03	19.67	19.78	19.56
6600	0.76	1.03	1.31	19.36	19.15	18.35	19.24	19.30	18.98
6800	0.87	1.18	1.50	18.30	17.92	17.14	18.33	18.26	18.00
7000	1.01	1.36	1.73	17.24	16.84	16.33	17.42	17.39	17.58
7200	1.19	1.60	2.05	16.43	16.16	16.07	16.88	17.30	18.71
7300	1.29	1.74	2.26	16.19	16.05	16.00	16.97	17.97	20.73
7500	1.57	2.17	3.00	16.11	15.72	14.03	19.04	22.65	23.12
7700	2.12	3.19	4.92	14.52	11.83	8.66	21.63	17.21	11.36
8200	10.73	14.69	19.21	2.72	2.36	2.20	3.28	2.87	2.68
8340	15.48	19.80	24.71	1.81	1.79	1.81	2.21	2.19	2.22
8600	25.39	30.42	36.69	1.11	1.28	1.39	1.41	1.61	1.75
8800	34.13	40.63	50.23	0.86	1.06	1.19	1.13	1.38	1.53
9000	45.74	57.67	56.74	0.69	0.90	1.03	0.96	1.21	1.37
9300	60.92	54.15	52.57	0.52	0.73	0.86	0.78	1.04	1.19
9500	54.71	53.32	52.89	0.44	0.65	0.77	0.70	0.94	1.10
9800	53.20	52.73	51.85	0.34	0.55	0.67	0.60	0.83	0.99
10000	50.91	50.81	50.19	0.29	0.49	0.62	0.55	0.77	0.92
12000	48.29	48.42	48.13	0.18	0.38	0.54	0.24	0.43	0.57
13500	44.32	44.00	43.54	0.25	0.48	0.64	0.11	0.31	0.44
15000	41.27	40.98	40.93	0.29	0.53	0.68	0.04	0.25	0.37
16000	40.30	40.29	40.07	0.20	0.45	0.59	0.00	0.24	0.35
17000	39.65	39.67	39.47	0.09	0.34	0.46	0.03	0.23	0.33
18500	39.05	38.91	38.63	0.04	0.21	0.35	0.05	0.22	0.38
20000	37.88	38.21	38.38	0.08	0.17	0.30	0.03	0.41	0.93
21000	33.07	32.51	33.15	0.09	0.17	0.32	2.26	1.22	0.77
22000	31.62	31.64	31.77	0.04	0.25	0.44	0.00	0.29	0.43
23000	29.46	29.31	29.32	0.20	0.56	0.80	0.08	0.24	0.38
25000	24.65	24.71	24.31	2.28	2.88	3.62	0.16	0.19	0.34
26500	24.95	23.87	30.34	2.91	5.08	5.49	0.11	0.31	0.44

*Typical Performance Data*

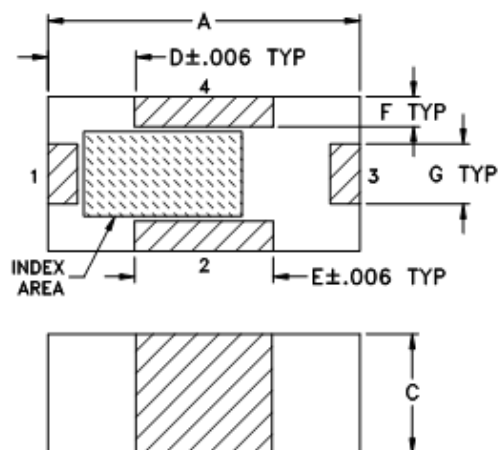
FREQ.  (MHz)	GROUP DELAY		
	(nsec)		
	@-55°C	@+25°C	@+125°C
10	0.05	0.09	0.07
50	0.07	0.09	0.08
100	0.09	0.09	0.09
150	0.09	0.09	0.09
200	0.09	0.09	0.09
250	0.08	0.08	0.09
300	0.08	0.08	0.09
350	0.08	0.08	0.09
400	0.08	0.08	0.09
450	0.08	0.08	0.09
500	0.08	0.08	0.09
550	0.08	0.08	0.09
1000	0.08	0.08	0.09
1150	0.08	0.08	0.09
1300	0.08	0.08	0.09
1450	0.08	0.08	0.09
1600	0.08	0.08	0.09
1750	0.09	0.09	0.09
1900	0.09	0.09	0.09
2050	0.09	0.09	0.09
2200	0.09	0.09	0.09
2350	0.09	0.09	0.09
2500	0.09	0.09	0.09
2650	0.09	0.09	0.09
2800	0.09	0.09	0.10
2950	0.09	0.09	0.10
3100	0.09	0.10	0.10
3250	0.10	0.10	0.10
3400	0.10	0.10	0.10
3550	0.10	0.10	0.10
3600	0.10	0.10	0.11
3700	0.10	0.10	0.11
3800	0.10	0.10	0.11
4000	0.11	0.11	0.11
5000	0.13	0.13	0.13
5100	0.13	0.13	0.14
5500	0.14	0.15	0.15
6000	0.16	0.17	0.18
6100	0.17	0.18	0.19
6300	0.18	0.19	0.20
6500	0.20	0.21	0.22

## Typical Performance Curves

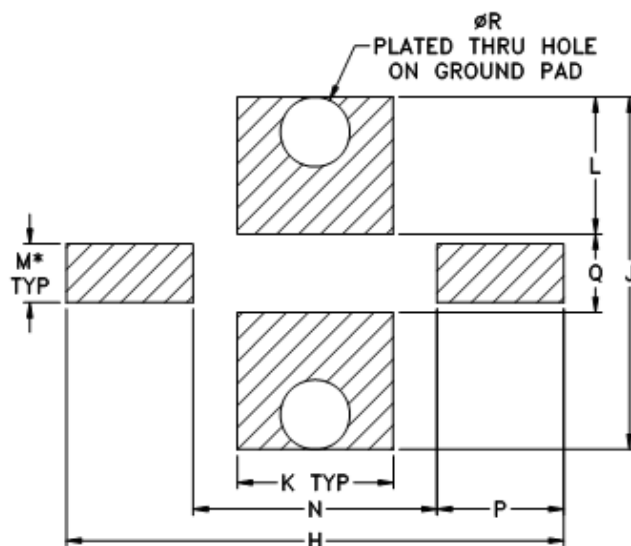


## Outline Dimensions

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](http://www.minicircuits.com)

RF/MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F114

## DEVICE ORIENTATION IN T&R



ILLUSTRATION 1

Applicable Case Styles	
GE0805C	JC0603C
GE0805C-1	JC0603C-4
GE0805C-1AP	JC0603C-6
GE0805C-7	
GE0805C-9	
GE0805C-10	
GE0805C-11	
GE0805C-12	



ILLUSTRATION 2

Applicable Case Styles	
GE0805C-2	JC0603C-1
GE0805C-3	JC0603C-2
GE0805C-4	JC0603C-3
GE0805C-5	JC0603C-5
GE0805C-6	JC0603C-7
GE0805C-8	
GE0805C-15	

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

Note: Please Consult individual model data sheet to determine device per reel availability.

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)



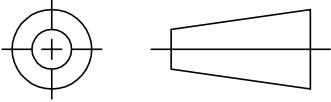
INTERNET <http://www.minicircuits.com>

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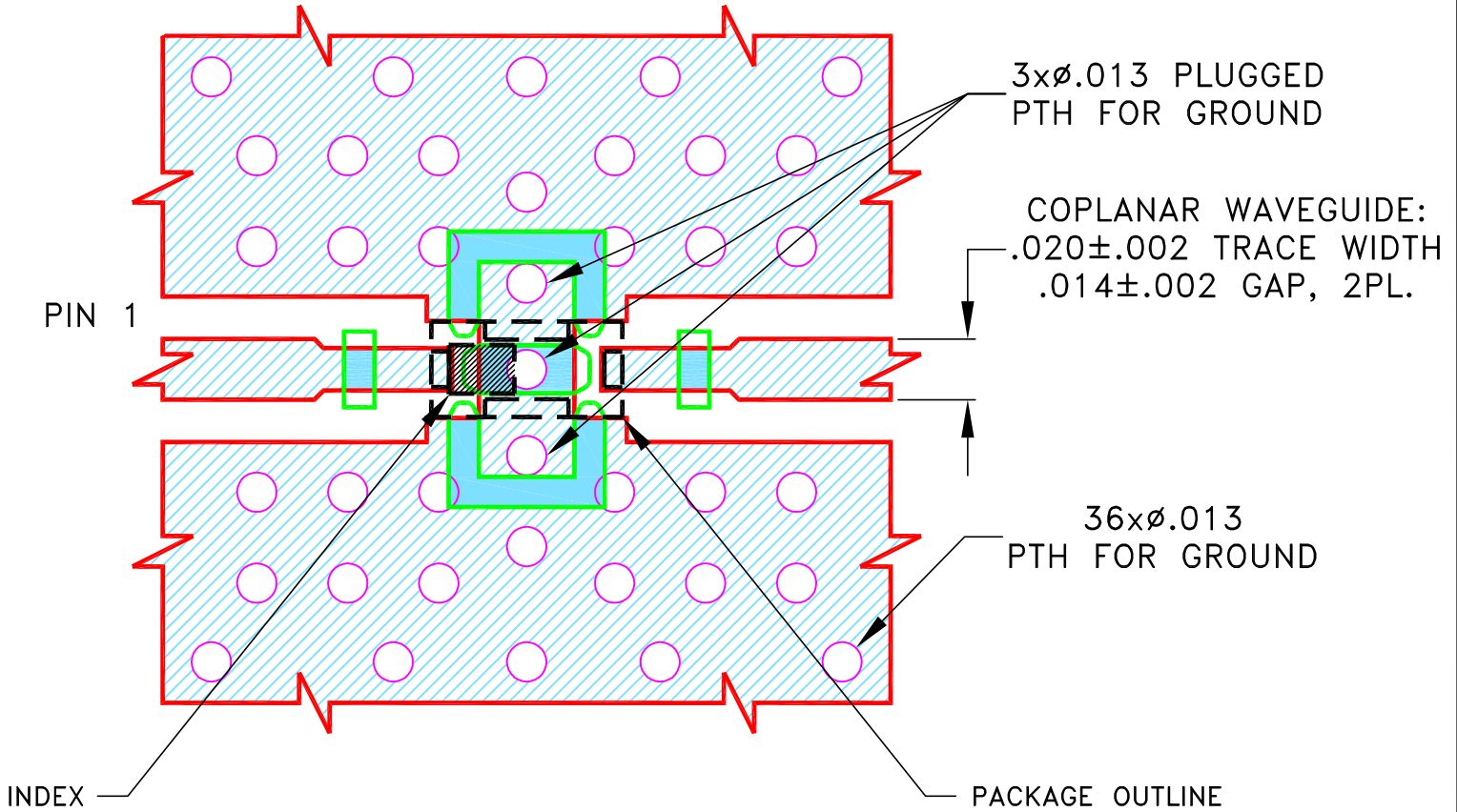
THIRD ANGLE PROJECTION



REVISIONS

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

**SUGGESTED MOUNTING CONFIGURATION  
FOR JC0603C-1 CASE STYLE**



**NOTES:**

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (R04835 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®** 13 Neptune Avenue  
Brooklyn NY 11235

**PL, JC0603C-1, TB-1114+**

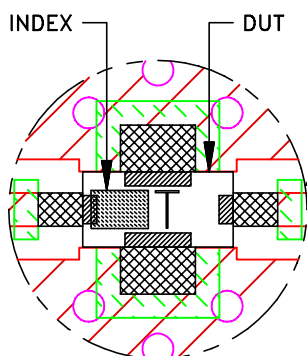
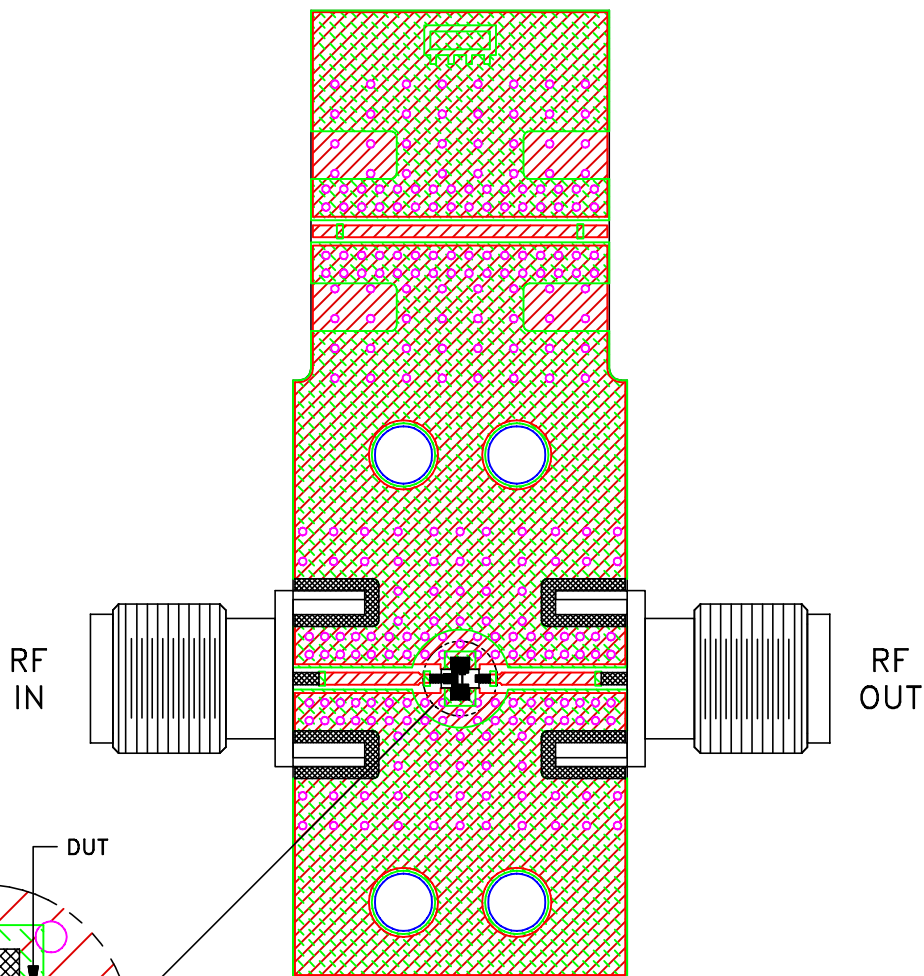
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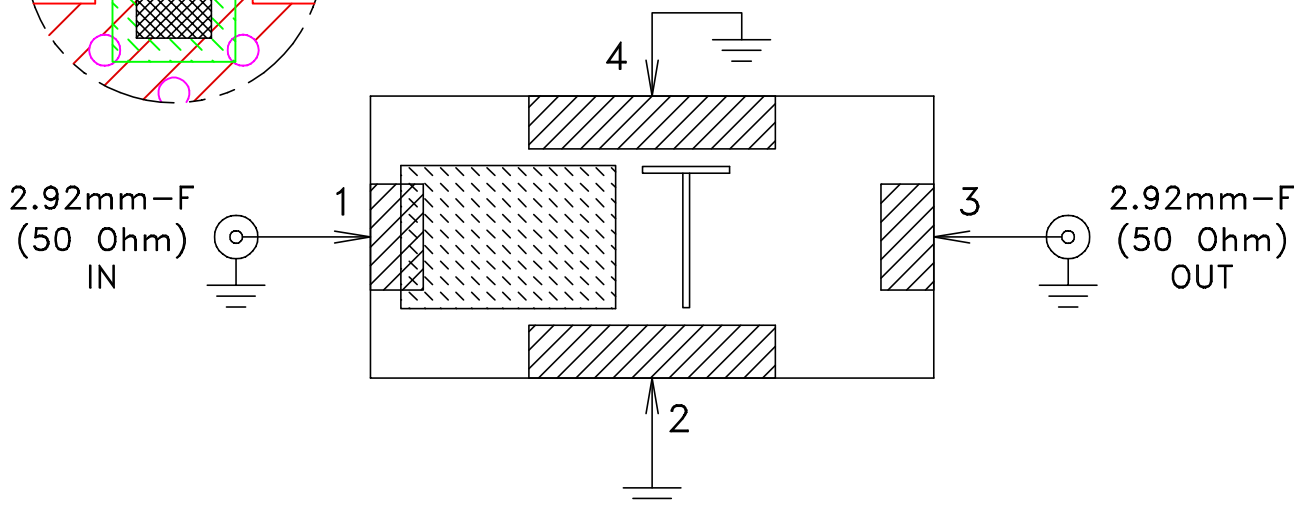
SIZE: A	CODE IDENT: 15542	DRAWING NO: 98-PL-650	REV: A
FILE: 98PL650	SCALE: 16:1	SHEET: 1 OF 1	

# Evaluation Board and Circuit


TB-LFCW-6500+



Schematic diagram



- Notes:
1. PCB Material: ROGERS (RO4835 Lo Pro) OR Equivalent, Dielectric Constant= $3.48 \pm 0.05$   
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.

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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 100°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° 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 Eutetic Process: 225°C peak Pb-Free Process 245° - 250°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, 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