LTCC SURFACE MOUNT

High Pass Filter

HFCW-6010+

50Ω 6.4 to 20 GHz

THE BIG DEAL

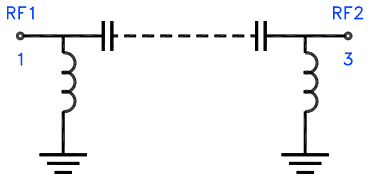
- Insertion Loss, Typ. 0.9 dB
- Good Rejection, Typ. 44 dB
- 0603 Surface Mount Footprint
- Power Handling: 2.5 Watts

Generic photo used for illustration purposes only

APPLICATIONS

- Test & Measurements
- Military Applications
- Telecommunications and Broadband Wireless Systems

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

Mini-Circuits' HFCW-6010+ is a miniature low temperature co-fired ceramic (LTCC) high pass filter with a 6.4 to 20 GHz passband supporting a variety of applications. This model provides 0.9 dB typical insertion loss over a wide band due to its rugged monolithic construction. Housed in an 0603 ceramic form factor which is ideal for dense signal chain PCB layouts where it complements MMIC size and performance. The LTCC fabrication process assures minimal RF performance variation while delivering a product that is well suited for environmental extremes of high humidity and temperature.

KEY FEATURES

Features	Advantages
Wide Passband, 13.6 GHz	This filter has a very wide passband from 6.4 to 20 GHz.
LTCC Construction	Provides repeatable performance in a rugged, ceramic package well suited for tough environments such as high humidity and temperature extremes.
Small Size, 0603	Saves space in dense circuit board layouts and minimizes the effects of parasitics.
Rugged Power Handling, 2.5 Watts	Handles up to 2.5 Watts in a small 0603 package.

REV. A
ECO-026396
HFCW-6010+
EDU3855
URJ
250731

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50Ω 6.4 to 20 GHz

ELECTRICAL SPECIFICATIONS[1,2,3] AT +25°C

Parameter		F#	Frequency (GHz)	Min.	Typ.	Max.	Units
Passband	Insertion Loss	F3-F4	6.4 - 7.7	—	2.0	—	dB
		F4-F5	7.7 - 14	—	0.9	1.4	
		F5-F6	14 - 20	—	2.0	—	
	Return Loss	F3-F6	6.4 - 20	—	9	—	dB
Stopband	Rejection	DC-F1	DC - 3.5	39	44	—	dB
		F1-F2	3.5 - 4.9	20	34	—	
	Freq. Cut-Off[4]	Fc	6.01		2.8	—	dB

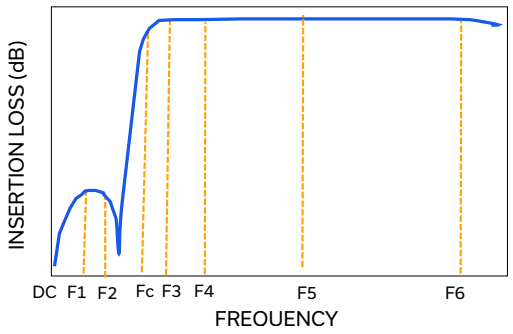
1. Tested in Evaluation Board P/N TB-HFCW-6010+.
2. Bi-directional, RF1 and RF2 can be interchanged.
3. This component should not be used as a DC-block. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.
4. Typical variation ± 5%.

ABSOLUTE MAXIMUM RATINGS[5]

Parameter	Ratings
Operating Temperature	-55°C to +125°C
Storage Temperature	-55°C to +125°C
Input Power[6]	2.5 W @ +25°C

5. Permanent damage may occur if any of these limits are exceeded.
6. Power rating applies only to signals within the passband. Power rating above +25°C operating temperature decreases linearly to 0.7 W at +125°C.

TYPICAL FREQUENCY RESPONSE AT +25°C



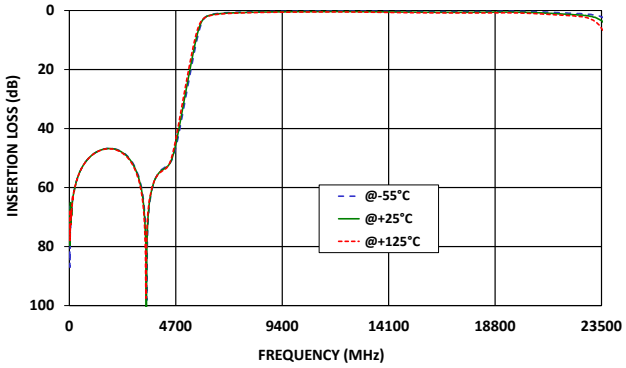
High Pass Filter

HFCW-6010+

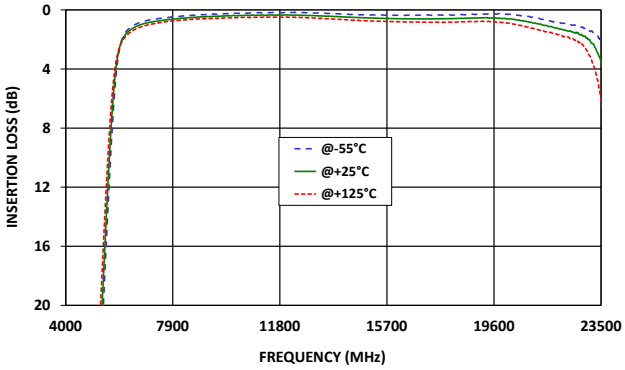
50Ω 6.4 to 20 GHz

TYPICAL PERFORMANCE GRAPHS

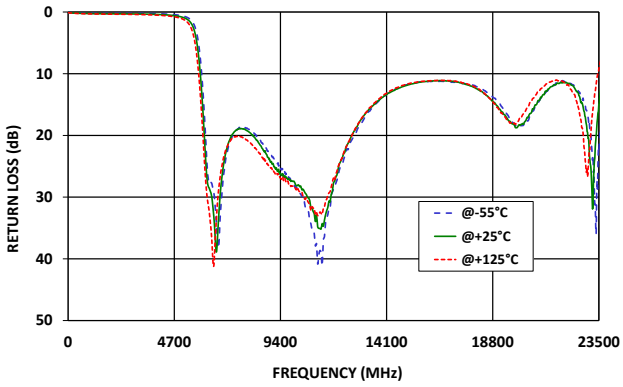
HFCW-6010+
INSERTION LOSS



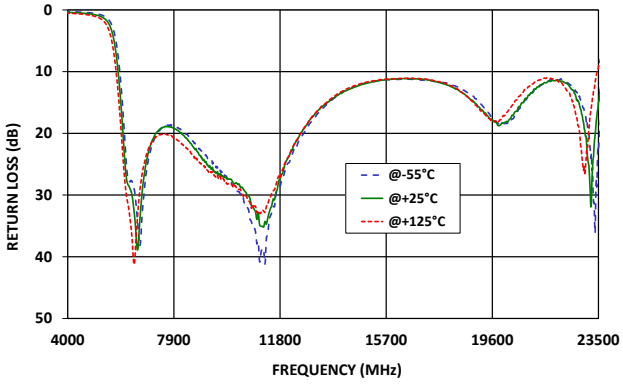
HFCW-6010+
INSERTION LOSS (Zoomed)



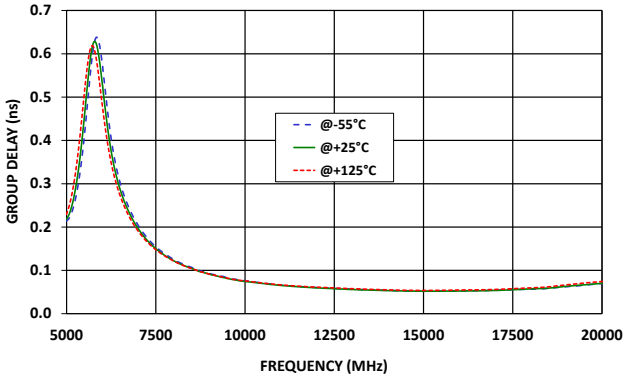
HFCW-6010+
RETURN LOSS



HFCW-6010+
RETURN LOSS (Zoomed)



HFCW-6010+
GROUP DELAY



High Pass Filter

HFCW-6010+

50Ω 6.4 to 20 GHz

FUNCTIONAL DIAGRAM

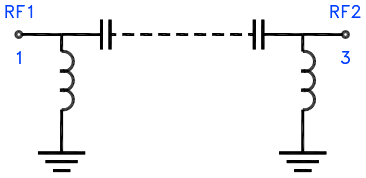
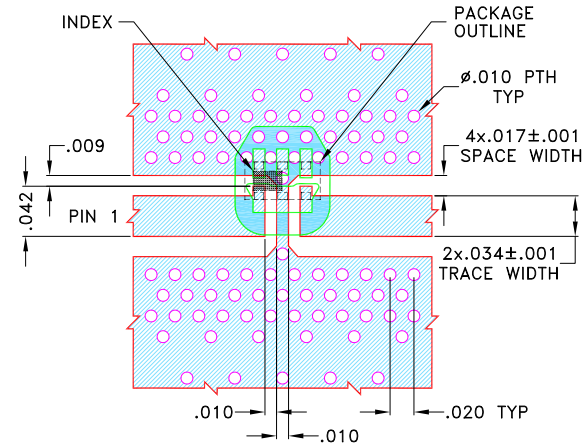


Figure 1. HFCW-6010+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
RF1[2]	1	Connects to RF Input Port
RF2[2]	3	Connects to RF Output Port
GROUND	2,4,5,6	Connects to Ground on PCB, (See drawing PL-703)

SUGGESTED PCB LAYOUT (PL-703)

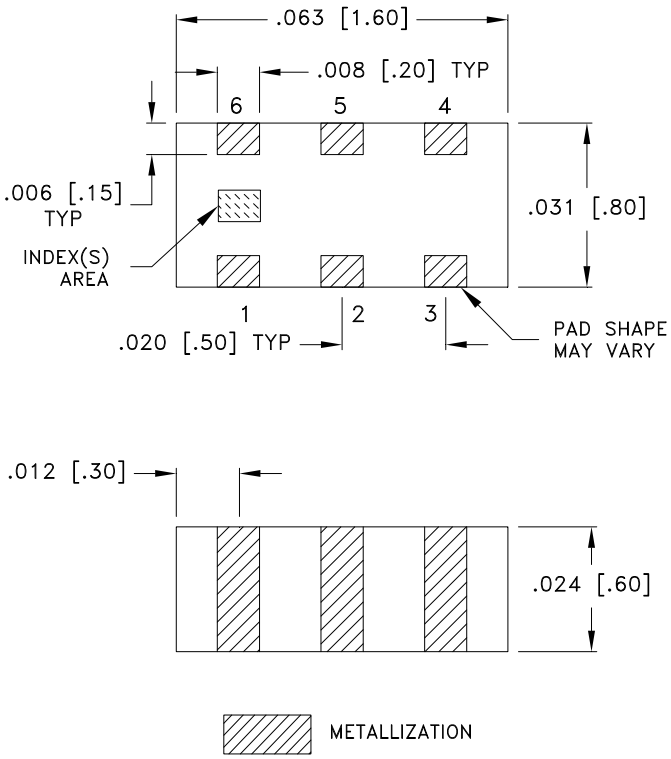


NOTES:
1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (RO4350B) WITH DIELECTRIC THICKNESS .0200±.0015. COPPER: 1/2 Oz. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)
DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

Figure 2. PL-703 Suggested PCB Layout

CASE STYLE DRAWING



Weight: .005 grams.
Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .005

PRODUCT MARKING*: S

*Marking may contain other features or characters for internal lot control.

LTCC SURFACE MOUNT

High Pass Filter

HFCW-6010+

50Ω 6.4 to 20 GHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD. CLICK HERE

Performance Data and Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads
Case Style	JC0603C Lead Finish: Tin over Nickel Plating
RoHs Status	Compliant
Tape and Reel	F114
Suggested Layout for PCB Design	PL-703
Evaluation Board	TB-HFCW-6010+
	Gerber File
Environmental Rating	ENV06

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-Circuits' 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/terms/viewterm.html

Ceramic High Pass Filter HFCW-6010+

Typical Performance Data

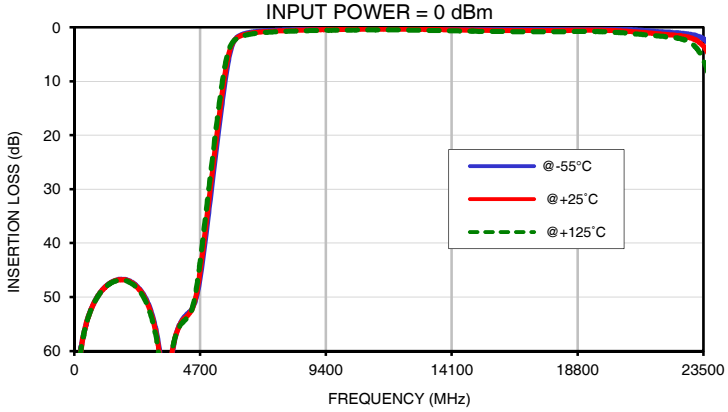
FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(MHz)	(dB)			(dB)			(dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
10	66.37	67.68	68.05	0.08	0.09	0.10	0.06	0.08	0.10
30	86.99	79.59	77.94	0.10	0.10	0.12	0.08	0.10	0.12
50	68.56	65.08	72.22	0.09	0.10	0.13	0.07	0.10	0.12
90	68.95	67.63	69.79	0.11	0.12	0.15	0.09	0.11	0.14
150	64.18	63.45	64.10	0.13	0.15	0.17	0.11	0.13	0.17
350	57.00	57.03	57.33	0.17	0.19	0.22	0.15	0.17	0.22
450	55.08	54.70	54.79	0.17	0.20	0.24	0.15	0.18	0.23
550	53.26	53.30	53.35	0.18	0.22	0.26	0.16	0.20	0.25
750	50.96	50.99	51.00	0.20	0.24	0.29	0.17	0.21	0.27
890	49.73	49.77	49.84	0.21	0.25	0.30	0.18	0.22	0.28
950	49.31	49.35	49.37	0.21	0.25	0.31	0.18	0.23	0.28
1050	48.66	48.72	48.74	0.21	0.26	0.31	0.18	0.23	0.29
1150	48.17	48.17	48.24	0.21	0.26	0.32	0.18	0.24	0.30
1250	47.73	47.75	47.81	0.22	0.27	0.32	0.19	0.24	0.30
1350	47.38	47.41	47.47	0.22	0.27	0.33	0.19	0.24	0.30
1500	47.01	47.04	47.10	0.22	0.28	0.33	0.19	0.25	0.31
1600	46.82	46.89	46.94	0.22	0.28	0.34	0.19	0.25	0.31
1700	46.73	46.80	46.88	0.23	0.29	0.34	0.19	0.25	0.31
1800	46.73	46.78	46.86	0.23	0.29	0.35	0.19	0.26	0.32
1900	46.76	46.80	46.92	0.23	0.29	0.35	0.19	0.26	0.32
2000	46.89	46.98	47.08	0.23	0.29	0.35	0.19	0.26	0.32
2100	47.08	47.21	47.36	0.22	0.29	0.35	0.19	0.26	0.32
2200	47.38	47.53	47.67	0.23	0.30	0.36	0.19	0.26	0.33
2300	47.81	47.92	48.12	0.22	0.30	0.36	0.19	0.27	0.33
2400	48.32	48.49	48.70	0.22	0.30	0.37	0.19	0.27	0.33
2500	48.85	49.04	49.29	0.22	0.30	0.37	0.19	0.27	0.34
3000	54.95	55.50	56.02	0.23	0.32	0.40	0.19	0.28	0.36
3500	69.41	67.83	66.19	0.24	0.35	0.44	0.20	0.31	0.40
4000	54.48	54.64	54.94	0.28	0.40	0.52	0.24	0.37	0.48
4900	39.26	37.54	35.30	0.51	0.70	0.93	0.49	0.69	0.92
5200	26.98	25.08	22.75	0.77	1.04	1.41	0.76	1.05	1.44
5300	22.90	21.02	18.72	0.92	1.25	1.73	0.93	1.29	1.79
5500	14.94	13.18	11.18	1.55	2.16	3.12	1.62	2.27	3.31
5900	3.34	3.06	2.90	9.43	12.28	15.91	10.08	13.41	18.10
6000	2.31	2.30	2.34	14.59	18.04	21.94	16.13	20.96	28.35
6010	2.24	2.25	2.30	15.21	18.70	22.58	16.91	22.00	30.05
6200	1.47	1.62	1.76	26.88	28.17	31.16	37.37	30.98	29.74
6400	1.13	1.29	1.45	28.41	31.17	39.58	26.14	26.83	27.91
6500	1.02	1.18	1.34	31.00	35.80	37.95	26.73	27.56	27.83
6600	0.93	1.09	1.25	36.22	37.46	31.48	27.94	27.97	26.94
6700	0.85	1.02	1.18	35.99	31.28	27.66	28.20	27.02	25.52
6800	0.79	0.96	1.11	29.99	27.07	25.14	26.83	25.21	24.08
6900	0.74	0.91	1.06	25.95	24.33	23.35	24.79	23.47	22.82
7000	0.70	0.86	1.01	23.50	22.48	22.16	22.98	22.07	21.88
7100	0.66	0.83	0.97	21.81	21.22	21.32	21.56	21.00	21.20
7200	0.64	0.80	0.94	20.64	20.30	20.78	20.61	20.20	20.77
7300	0.61	0.77	0.90	19.96	19.72	20.46	19.88	19.69	20.47
7400	0.58	0.74	0.87	19.41	19.30	20.25	19.39	19.30	20.28
7700	0.52	0.66	0.79	18.70	18.93	20.27	18.82	19.05	20.50
8000	0.46	0.61	0.74	19.00	19.41	20.97	19.22	19.71	21.57
8500	0.37	0.52	0.65	20.76	21.56	22.92	21.67	22.64	24.42
10000	0.26	0.40	0.54	27.78	27.43	28.16	38.05	34.15	34.17
11000	0.19	0.36	0.49	37.55	32.88	32.52	36.63	34.03	34.14
12000	0.17	0.34	0.49	25.73	24.74	24.64	25.09	24.86	25.14
13000	0.21	0.38	0.54	17.96	17.34	17.17	18.02	17.70	17.66
14000	0.27	0.46	0.64	13.63	13.57	13.36	13.84	13.91	13.79
16000	0.36	0.59	0.80	11.22	11.20	11.15	11.68	11.70	11.72
18000	0.33	0.59	0.83	11.91	12.24	12.11	12.59	13.00	12.85
20000	0.31	0.57	0.89	18.13	18.39	17.12	22.27	21.90	21.31
23500	2.14	3.46	6.07	22.68	14.94	9.21	10.94	8.78	6.00

Typical Performance Data

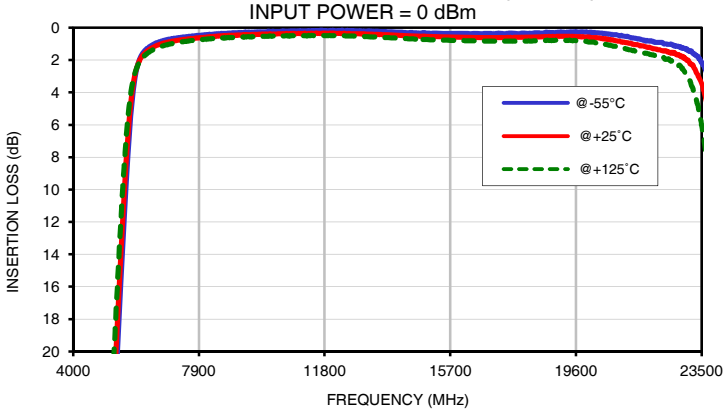
FREQ. (MHz)	GROUP DELAY (nsec)		
	@-55°C	@+25°C	@+125°C
6400	0.33	0.32	0.30
6500	0.30	0.29	0.27
6800	0.23	0.23	0.22
7100	0.19	0.19	0.18
7400	0.16	0.16	0.15
7700	0.14	0.14	0.14
8000	0.13	0.12	0.12
8300	0.11	0.11	0.11
8600	0.10	0.10	0.10
8900	0.10	0.09	0.09
9200	0.09	0.09	0.09
9500	0.08	0.08	0.08
9800	0.08	0.08	0.08
10100	0.08	0.07	0.07
10400	0.07	0.07	0.07
10700	0.07	0.07	0.07
11000	0.07	0.07	0.07
11300	0.06	0.06	0.06
11600	0.06	0.06	0.06
11900	0.06	0.06	0.06
12200	0.06	0.06	0.06
12500	0.06	0.06	0.06
12800	0.06	0.06	0.06
13100	0.06	0.06	0.06
13400	0.06	0.05	0.06
13700	0.05	0.05	0.06
14000	0.05	0.05	0.05
14300	0.05	0.05	0.05
14600	0.05	0.05	0.05
14900	0.05	0.05	0.05
15200	0.05	0.05	0.05
15500	0.05	0.05	0.05
15800	0.05	0.05	0.05
16100	0.05	0.05	0.05
16400	0.05	0.05	0.05
16700	0.05	0.05	0.06
17000	0.05	0.05	0.06
18000	0.06	0.06	0.06
19000	0.06	0.06	0.07
20000	0.07	0.07	0.07

Typical Performance Curves

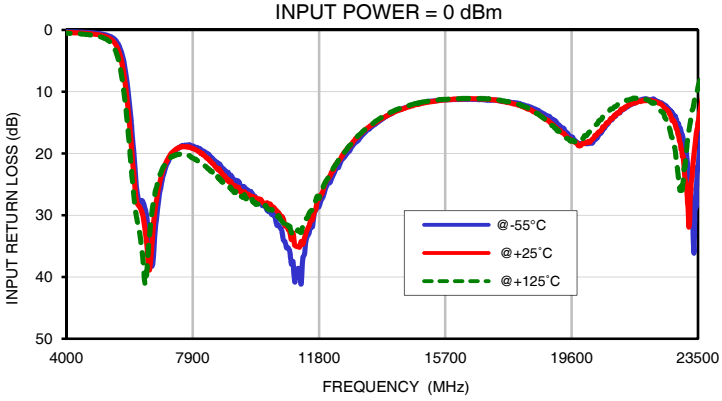
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



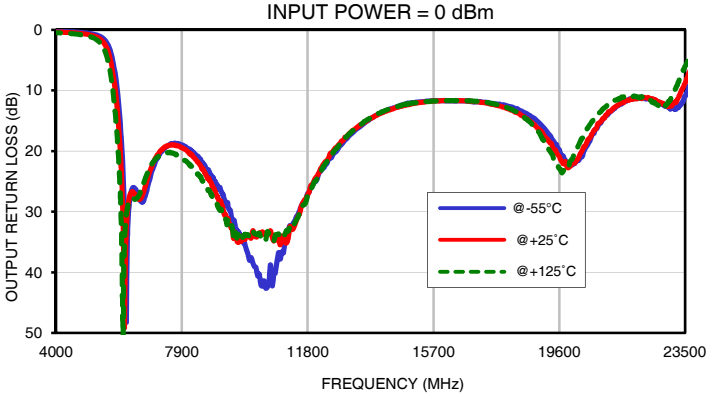
INSERTION LOSS vs. TEMPERATURE (Zoomed)
INPUT POWER = 0 dBm



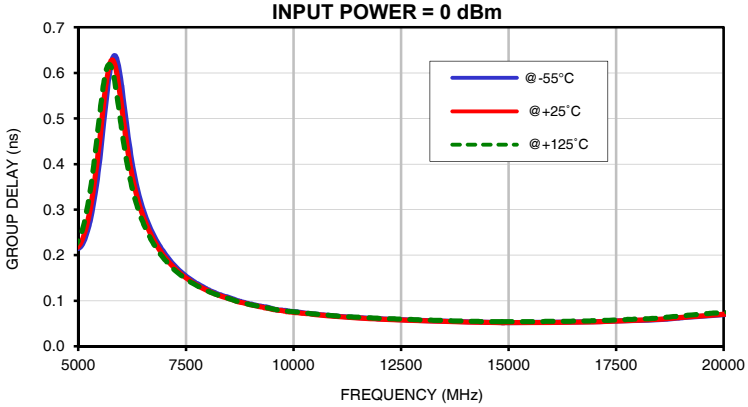
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



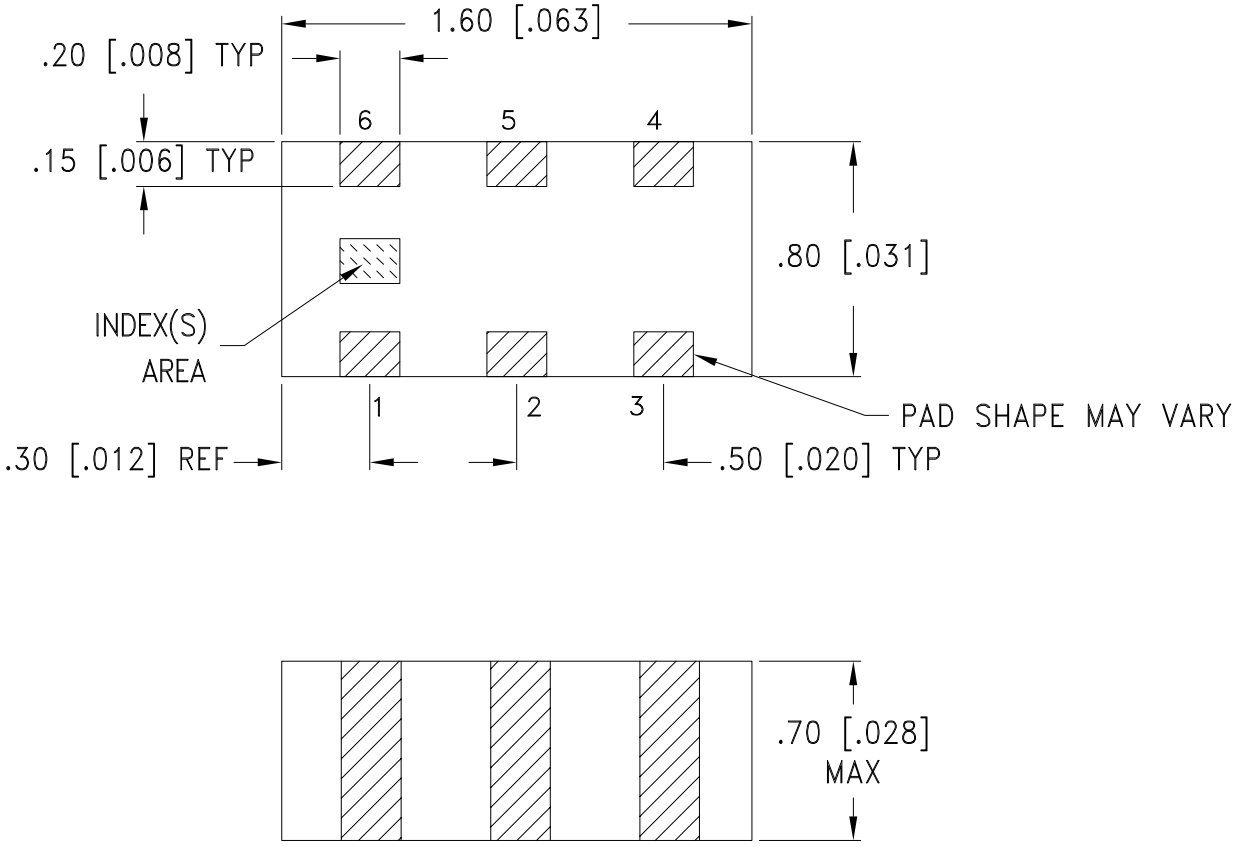
GROUP DELAY vs. TEMPERATURE
INPUT POWER = 0 dBm



Case Style JC

Outline Dimensions

JC0603C



METALLIZATION

Weight: .005 grams

Dimensions are in mm [inch]. Tolerances: ±0.13 mm

Notes:

1. Open style, ceramic base.
2. Termination finish:
   For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.

Tape & Reel Packaging TR-F114

DEVICE ORIENTATION IN T&R

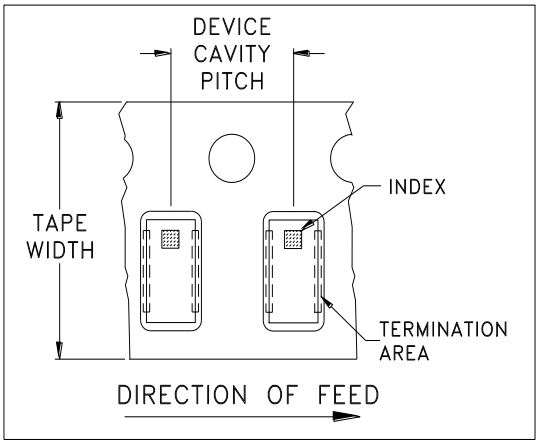


ILLUSTRATION 1

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

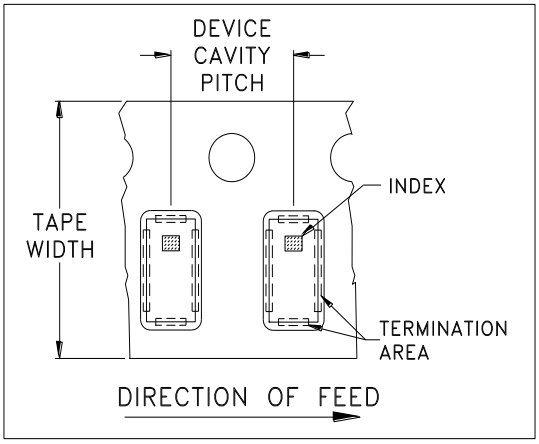


ILLUSTRATION 2

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
				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

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INTERNET http://www.minicircuits.com
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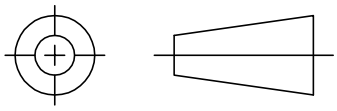
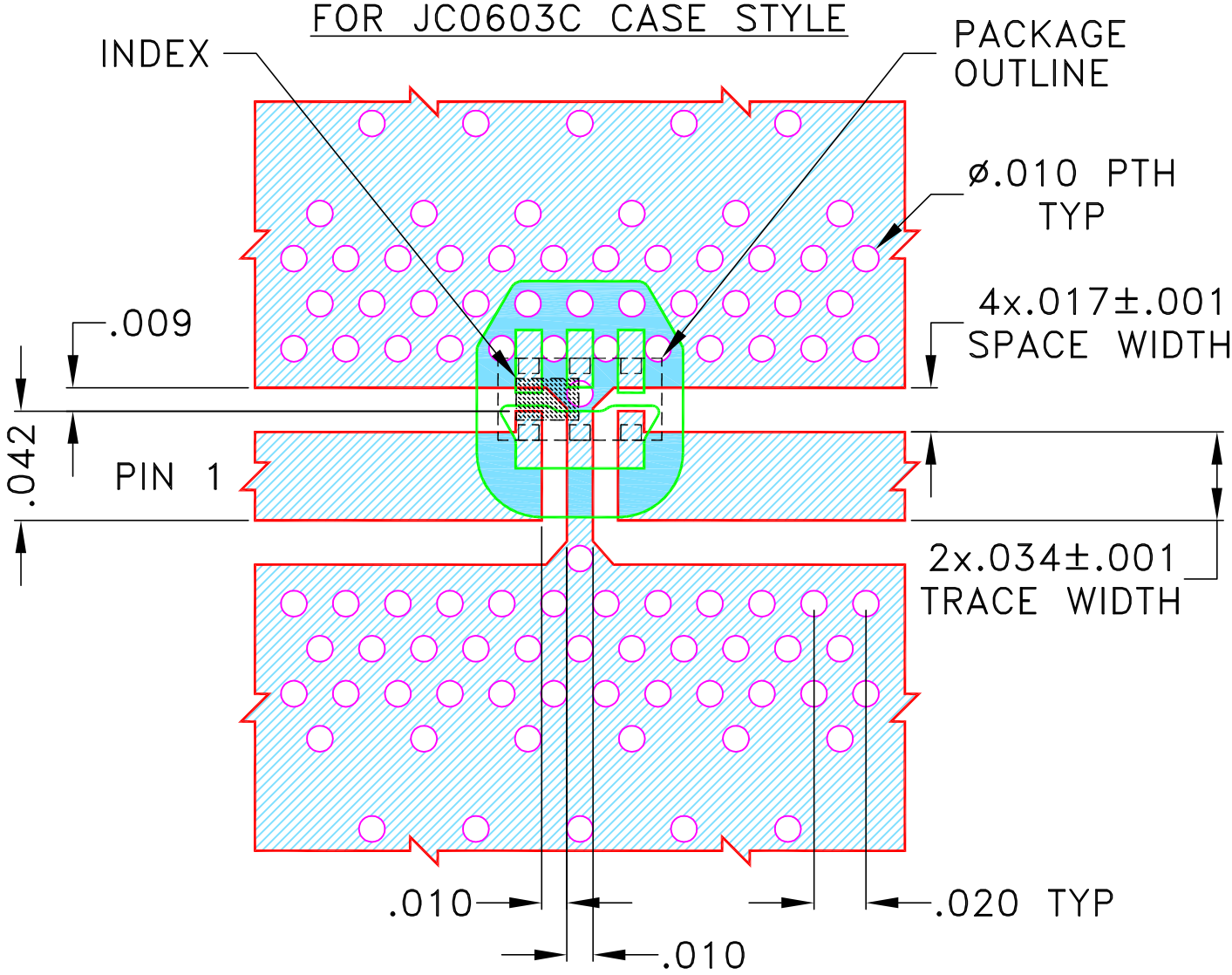
THIRD ANGLE PROJECTION



REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-006344	NEW RELEASE	FEB 21	DDR	VC

SUGGESTED MOUNTING CONFIGURATION FOR JC0603C CASE STYLE



NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (RO4350B) WITH DIELECTRIC THICKNESS .0200±.0015. 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 PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	DDR	17 FEB 21
TOLERANCES ON:	CHECKED	RV	17 FEB 21
2 PL DECIMALS ±	APPROVED	RKS	17 FEB 21
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

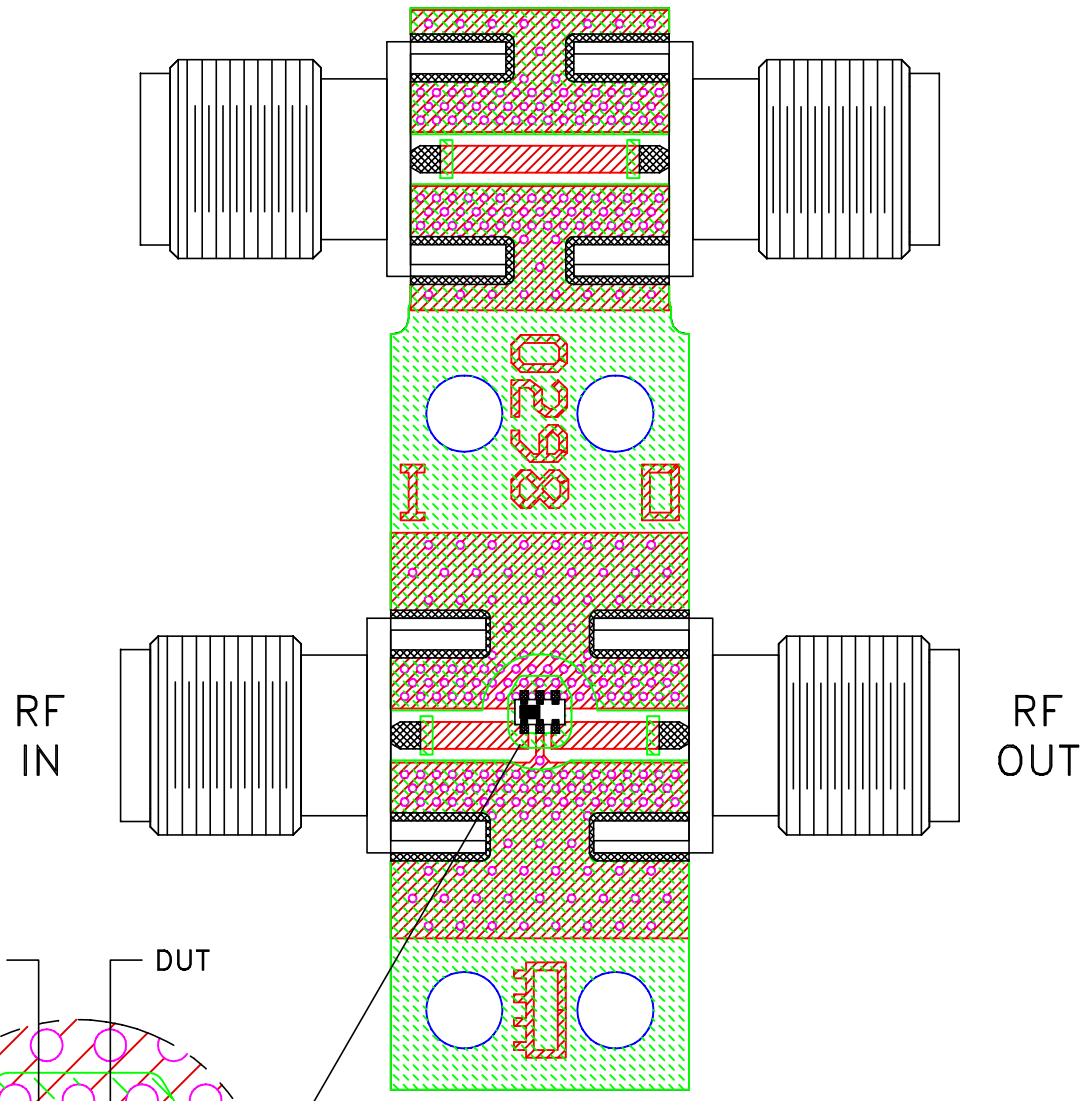
Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

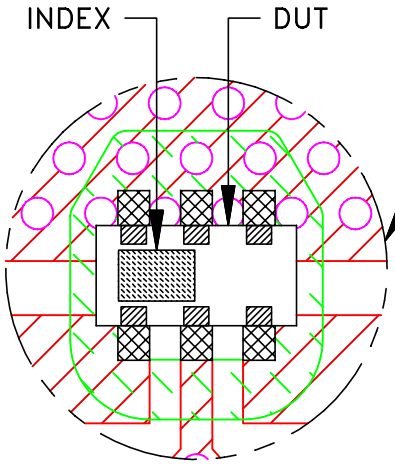
PL DWG, JC0603C C.S, 50 OHM, HFCW

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-703	OR
FILE: 98PL703		SCALE: 15:1	SHEET: 1 OF 1

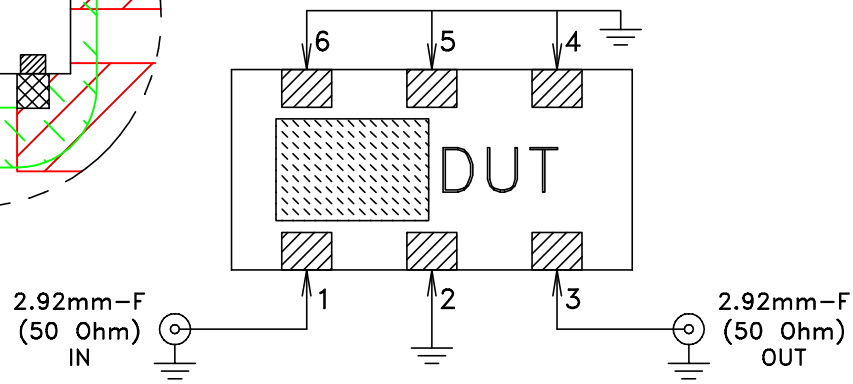
Evaluation Board and Circuit

TB-HFCW-6010+





Schematic diagram



Notes:

1. PCB Material: ROGERS (RO4350B) OR Equivalent, Dielectric Constant=3.48±.05
Dielectric Thickness: .020±.0015
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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Environmental Specifications ENV06

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