LTCC SURFACE MOUNT

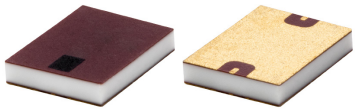
High Pass Filter

HFCU-223+

50Ω 22.8 to 39 GHz

THE BIG DEAL

- Low Insertion Loss, Typ. 2.7 dB
- Stopband Rejection, Typ. 50 dB
- Passband Return Loss, Typ. 19 dB
- 1812 Surface Mount Footprint
- Power Handling: 7 W

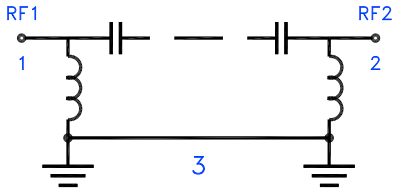


Generic photo used for illustration purposes only

APPLICATIONS

- Test & Measurement Equipment
- Radar, EW, and ECM Defense System
- 5G MIMO and Back Haul Radio

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

Mini-Circuits' HFCU-223+ is a miniature low temperature co-fired ceramic (LTCC) high pass filter with a 22.8 to 39 GHz passband that supports a variety of applications. This model provides 2.7 dB typical insertion loss over a wide band due to its rugged monolithic construction. Housed in an 1812 ceramic form factor, this filter 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, 16.2 GHz	This filter has a very wide passband, from 22.8 to 39 GHz.
LTCC Construction	The use of LTCC technology allows for repeatable performance in a rugged ceramic package, well suited for tough environments such as high humidity and temperature extremes. See Mini-Circuits Environmental Rating ENV06T10 for more information.
Small Size, 1812	1812 package allows for space to be saved in dense circuit board layouts, while also minimizing the effects of parasitics.
Rugged Power Handling, 7 W	Handles up to 7 Watts in a small 1812 package.

High Pass Filter

HFCU-223+

50Ω 22.8 to 39 GHz

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

Parameter		F#	Frequency (GHz)	Min.	Typ.	Max.	Units
Passband	Insertion Loss	F3-F4	22.8 - 25	—	2.4	—	dB
		F4-F5	25 - 36	—	2.7	3.2	
		F5-F6	36 - 39	—	3.0	—	
	Return Loss	F3-F4	22.8 - 25	—	19	—	dB
		F4-F5	25 - 36	—	11	—	
		F5-F6	36 - 39	—	15	—	
Stopband	Rejection	DC-F1	DC - 14	41	50	—	dB
		F1-F2	14 - 18.5	20	28	—	
	Freq. Cut-Off[4]	Fc	22	—	3	—	dB

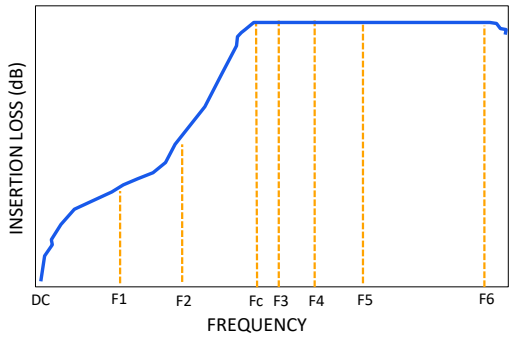
1. Tested on Evaluation Board P/N TB-HFCU-223+.
2. Bi-directional RF1 and RF2 ports can be interchanged.
3. This component should not be used as a DC-block. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.
4. 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]	7 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 1.3 W at +125°C.

TYPICAL FREQUENCY RESPONSE AT +25°C



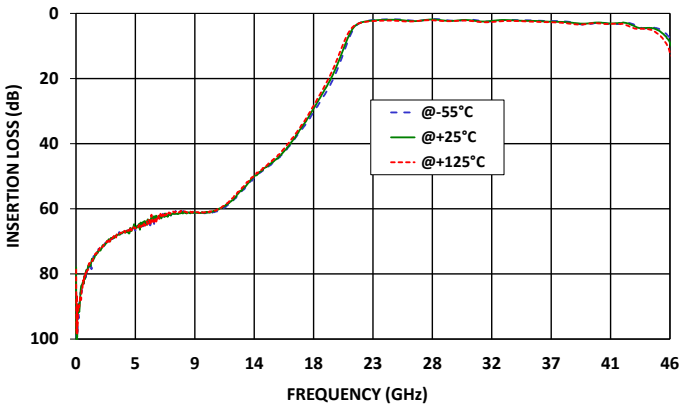
High Pass Filter

HFCU-223+

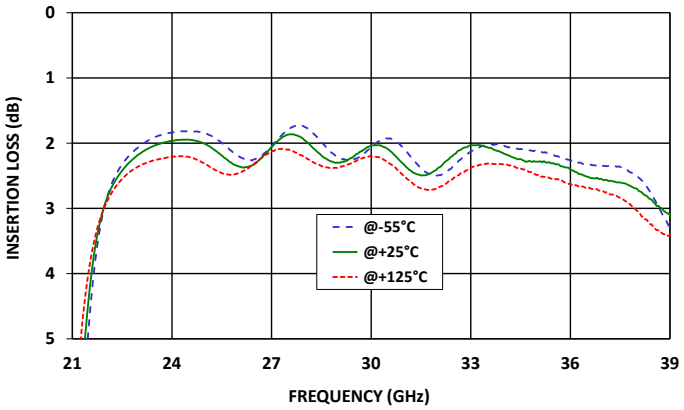
50Ω 22.8 to 39 GHz

TYPICAL PERFORMANCE GRAPHS

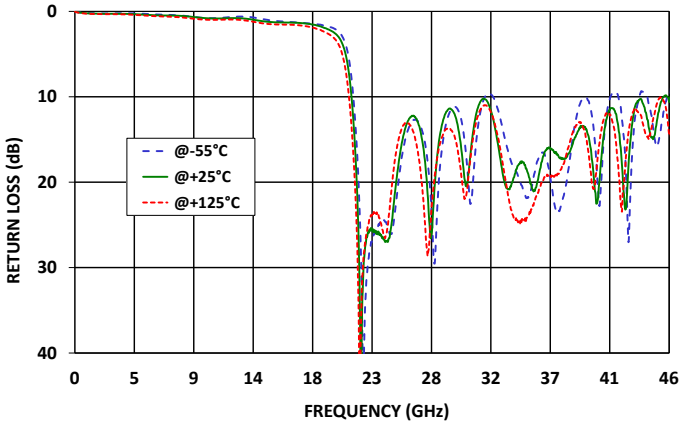
HFCU-223+
INSERTION LOSS



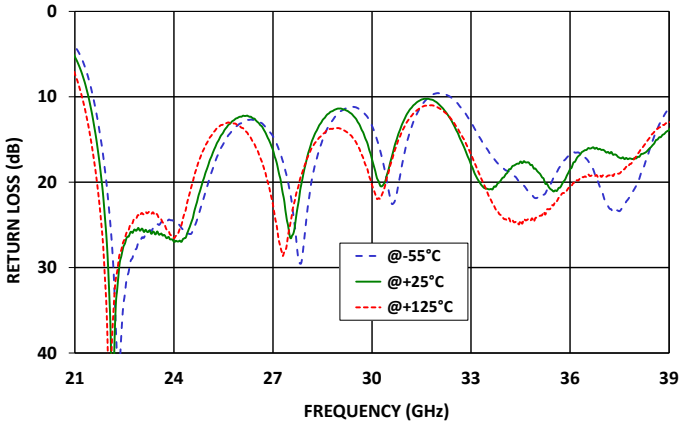
HFCU-223+
INSERTION LOSS (Zoomed)



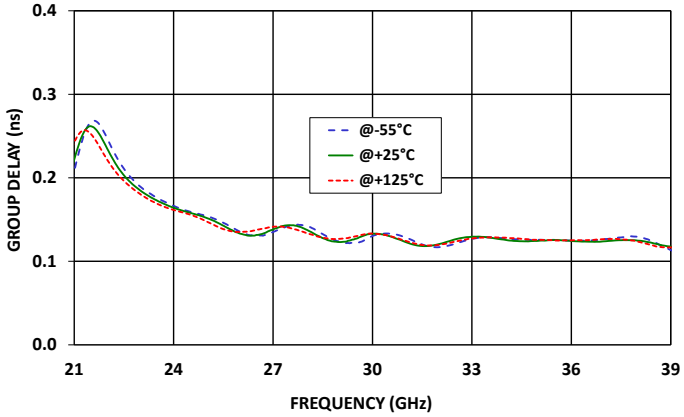
HFCU-223+
RETURN LOSS



HFCU-223+
RETURN LOSS (Zoomed)



HFCU-223+
GROUP DELAY



High Pass Filter

HFCU-223+

50Ω 22.8 to 39 GHz

FUNCTIONAL DIAGRAM

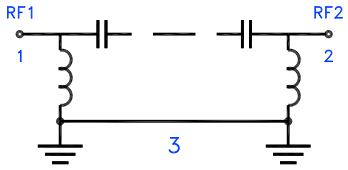
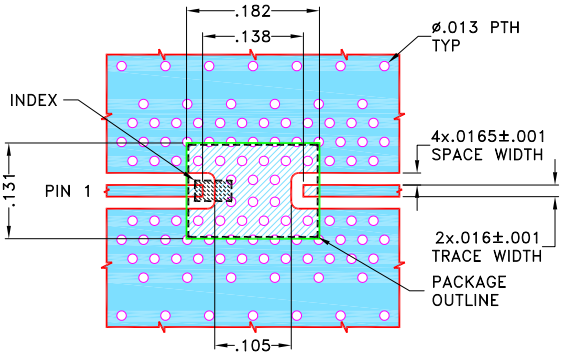


Figure 1. HFCU-223+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
RF1[2]	1	Connects to RF Input Port
RF2[2]	2	Connects to RF Output Port
GROUND	3	Connects to Ground on PCB, (See drawing PL-708)

SUGGESTED PCB LAYOUT (PL-708)

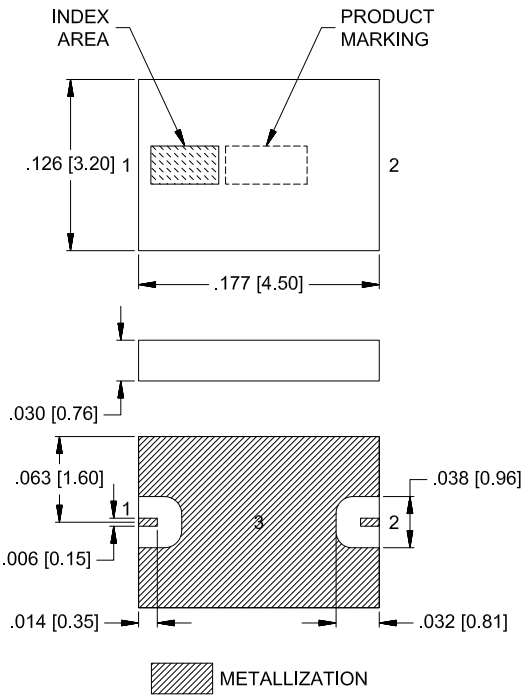


NOTES:
1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (RO4835 Lo Pro) WITH DIELECTRIC THICKNESS .0073±.0007; COPPER: 1/2 Oz. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

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

Figure 2. Suggested PCB Layout PL-708

CASE STYLE DRAWING



Weight: .04 grams

Dimensions are in inches [mm]. Tolerances: 2Pl. ± .01; 3Pl. ± .005

PRODUCT MARKING*: F557

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

LTCC SURFACE MOUNT

High Pass Filter

HFCU-223+

50Ω 22.8 to 39 GHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD. CLICK HERE

Performance Data and Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads
Case Style	NM1812C-5 Lead Finish: Gold over Nickel Plating.
RoHS Status	Compliant
Tape and Reel	F77
Suggested Layout for PCB Design	PL-708
Evaluation Board	TB-HFCU-223+
	Gerber File
Environmental Rating	ENV06T10

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 HFCU-223+

Typical Performance Data

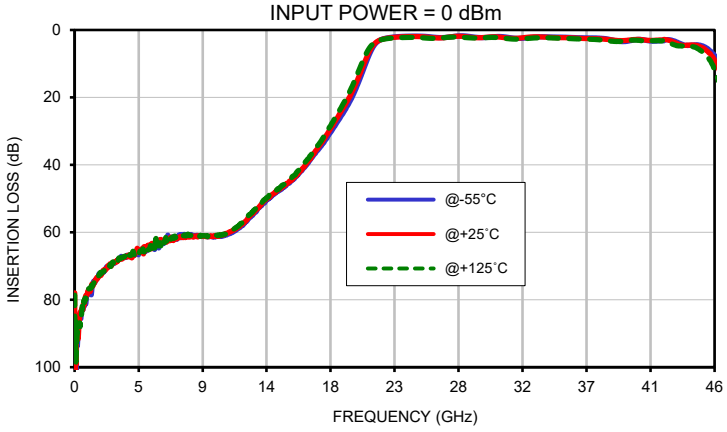
FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(GHz)	(dB)			(dB)			(dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
0.01	85.73	77.96	78.63	0.01	0.02	0.03	0.03	0.04	0.05
0.05	92.95	117.40	94.57	0.03	0.05	0.07	0.04	0.06	0.08
0.10	101.42	91.85	98.50	0.05	0.06	0.09	0.06	0.08	0.11
0.20	93.68	89.30	89.54	0.08	0.10	0.13	0.09	0.11	0.15
0.30	87.95	88.63	88.03	0.10	0.12	0.16	0.12	0.14	0.18
0.40	85.64	83.75	87.94	0.12	0.14	0.19	0.14	0.17	0.21
0.50	82.92	82.97	84.42	0.14	0.16	0.21	0.16	0.19	0.23
0.60	83.02	82.89	82.94	0.16	0.18	0.23	0.17	0.20	0.25
0.70	81.92	81.53	80.85	0.17	0.19	0.24	0.19	0.22	0.27
0.80	81.30	78.77	79.96	0.18	0.21	0.25	0.20	0.24	0.28
0.90	78.54	78.52	78.86	0.20	0.22	0.27	0.21	0.25	0.29
1.00	78.07	77.50	76.75	0.20	0.23	0.28	0.21	0.26	0.30
1.50	74.13	74.01	73.80	0.23	0.26	0.30	0.24	0.29	0.33
2.00	71.95	72.10	71.79	0.24	0.27	0.31	0.25	0.30	0.34
2.50	69.78	69.64	70.14	0.24	0.28	0.32	0.25	0.30	0.34
3.00	68.80	68.70	68.26	0.23	0.27	0.33	0.23	0.29	0.34
3.50	67.55	67.59	67.41	0.22	0.28	0.34	0.22	0.29	0.35
4.00	66.74	67.23	66.62	0.22	0.29	0.36	0.23	0.31	0.37
4.50	65.76	64.73	66.00	0.23	0.32	0.40	0.25	0.34	0.41
5.00	65.11	64.23	65.81	0.26	0.35	0.44	0.28	0.38	0.47
5.50	64.37	64.94	64.04	0.30	0.40	0.49	0.31	0.43	0.51
6.00	63.52	62.39	63.55	0.34	0.44	0.54	0.35	0.47	0.56
6.50	62.48	62.06	62.58	0.37	0.46	0.58	0.37	0.49	0.60
7.00	61.40	62.06	61.88	0.40	0.48	0.61	0.39	0.52	0.63
7.50	60.76	61.45	60.77	0.42	0.49	0.63	0.42	0.54	0.66
8.00	60.86	61.20	61.05	0.46	0.51	0.67	0.45	0.57	0.70
8.50	61.02	61.25	60.98	0.53	0.56	0.74	0.51	0.62	0.77
9.00	61.11	61.23	61.21	0.61	0.62	0.82	0.58	0.69	0.84
9.50	61.32	61.22	61.09	0.70	0.71	0.91	0.65	0.77	0.92
10.00	61.15	61.23	61.08	0.77	0.78	0.96	0.70	0.82	0.95
10.50	61.13	60.79	60.78	0.80	0.82	0.99	0.72	0.86	0.97
11.00	60.58	60.25	60.17	0.78	0.83	0.98	0.71	0.86	0.96
11.50	59.64	59.13	58.84	0.74	0.82	0.97	0.66	0.83	0.94
12.00	57.97	57.76	57.34	0.67	0.79	0.95	0.62	0.81	0.94
12.50	56.04	55.60	54.96	0.62	0.79	0.97	0.59	0.81	0.97
13.00	54.06	53.42	53.00	0.61	0.83	1.03	0.61	0.86	1.05
13.50	51.65	51.27	50.96	0.65	0.90	1.13	0.68	0.95	1.18
14.00	49.88	49.69	48.86	0.76	1.02	1.27	0.80	1.08	1.31
15.00	46.72	46.19	45.94	1.02	1.23	1.48	1.02	1.24	1.46
17.80	33.90	33.19	32.34	1.37	1.40	1.71	1.22	1.43	1.65
18.45	30.09	28.92	27.98	1.46	1.55	1.92	1.30	1.59	1.86
18.50	29.76	28.55	27.62	1.46	1.55	1.93	1.30	1.60	1.87
19.00	26.59	25.20	24.11	1.55	1.76	2.17	1.42	1.78	2.11
19.90	20.34	18.77	17.13	1.90	2.33	2.91	1.71	2.20	2.71
20.00	19.44	17.88	16.26	1.96	2.42	3.05	1.76	2.27	2.82
20.50	14.58	13.09	11.30	2.49	3.18	4.15	2.24	2.90	3.76
21.00	9.16	8.03	6.68	4.09	5.32	7.32	3.66	4.72	6.41
22.00	2.91	2.90	2.94	21.76	29.34	40.42	15.34	16.76	18.65
22.80	2.15	2.25	2.42	27.99	25.54	24.30	26.59	23.96	23.64
23.00	2.06	2.17	2.35	26.76	25.58	23.72	29.18	25.59	23.78
24.00	1.84	1.97	2.21	24.58	26.97	26.57	33.22	32.39	28.75
25.00	1.85	2.01	2.32	20.58	18.46	15.40	22.50	19.26	15.73
30.00	2.07	2.04	2.20	13.39	17.31	20.34	12.64	17.82	20.76
31.00	2.09	2.33	2.51	16.31	12.48	13.38	14.45	12.47	12.89
32.00	2.50	2.39	2.68	9.57	10.79	11.26	8.67	10.32	10.65
34.00	2.04	2.16	2.32	18.45	19.40	24.31	18.33	21.15	26.26
36.00	2.26	2.41	2.62	16.78	18.48	20.56	20.46	22.78	25.27
37.00	2.35	2.57	2.74	21.47	16.20	19.19	22.82	17.21	20.67
38.00	2.50	2.70	3.03	20.43	17.22	16.99	22.98	18.33	16.88
39.00	3.28	3.11	3.40	11.25	13.89	13.01	10.50	13.89	12.94

Typical Performance Data

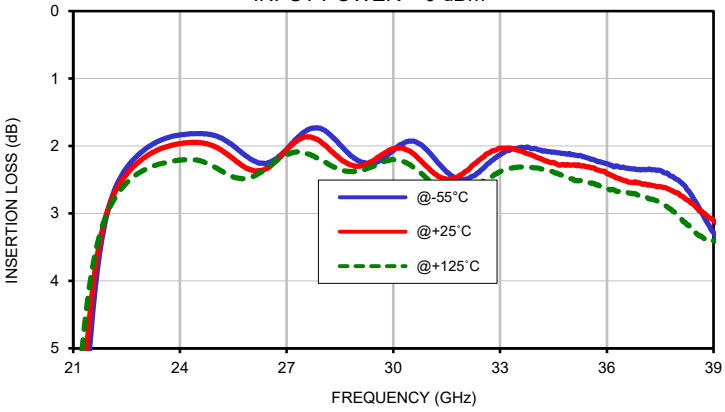
FREQ. (GHz)	GROUP DELAY (nsec)		
	@-55°C	@+25°C	@+125°C
22.80	0.20	0.19	0.19
23.00	0.19	0.18	0.18
23.50	0.18	0.17	0.17
24.00	0.17	0.16	0.16
24.50	0.16	0.16	0.16
25.00	0.15	0.15	0.15
25.50	0.15	0.14	0.14
26.00	0.14	0.13	0.13
26.50	0.13	0.13	0.14
27.00	0.14	0.14	0.14
27.50	0.14	0.14	0.14
28.00	0.14	0.14	0.13
28.50	0.13	0.13	0.13
29.00	0.12	0.12	0.13
29.50	0.12	0.13	0.13
30.00	0.13	0.13	0.13
30.50	0.13	0.13	0.13
31.00	0.13	0.12	0.12
31.30	0.12	0.12	0.12
31.50	0.12	0.12	0.12
31.60	0.12	0.12	0.12
31.70	0.12	0.12	0.12
31.80	0.12	0.12	0.12
31.90	0.12	0.12	0.12
32.00	0.12	0.12	0.12
32.10	0.12	0.12	0.12
32.30	0.12	0.12	0.12
35.00	0.13	0.12	0.13
35.10	0.13	0.12	0.13
35.20	0.13	0.12	0.13
35.30	0.13	0.13	0.13
35.50	0.13	0.13	0.12
36.00	0.12	0.12	0.13
36.50	0.12	0.12	0.13
37.00	0.13	0.12	0.13
37.50	0.13	0.13	0.13
38.00	0.13	0.12	0.12
38.50	0.12	0.12	0.12
38.70	0.12	0.12	0.12
39.00	0.11	0.12	0.12

Typical Performance Curves

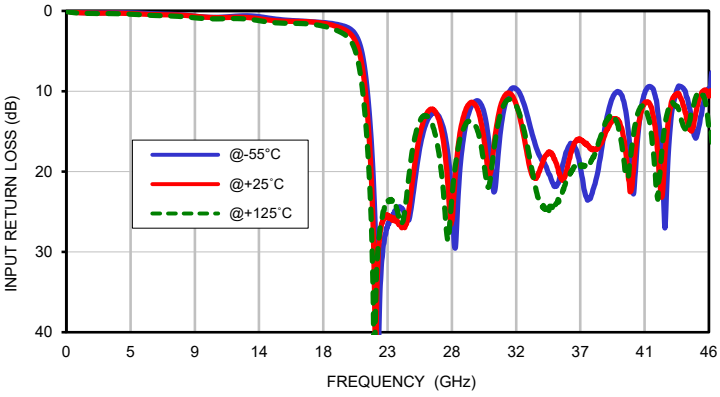
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



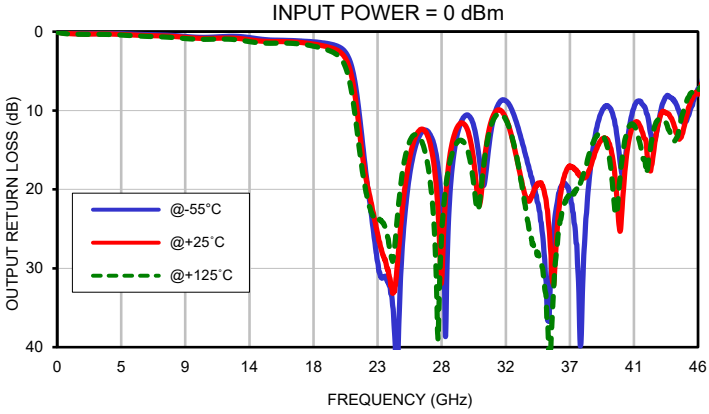
INSERTION LOSS vs. TEMPERATURE (Zoomed)
INPUT POWER = 0 dBm



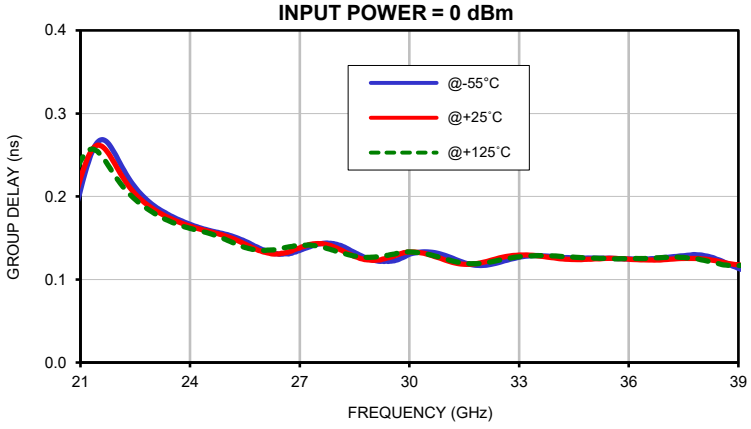
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm

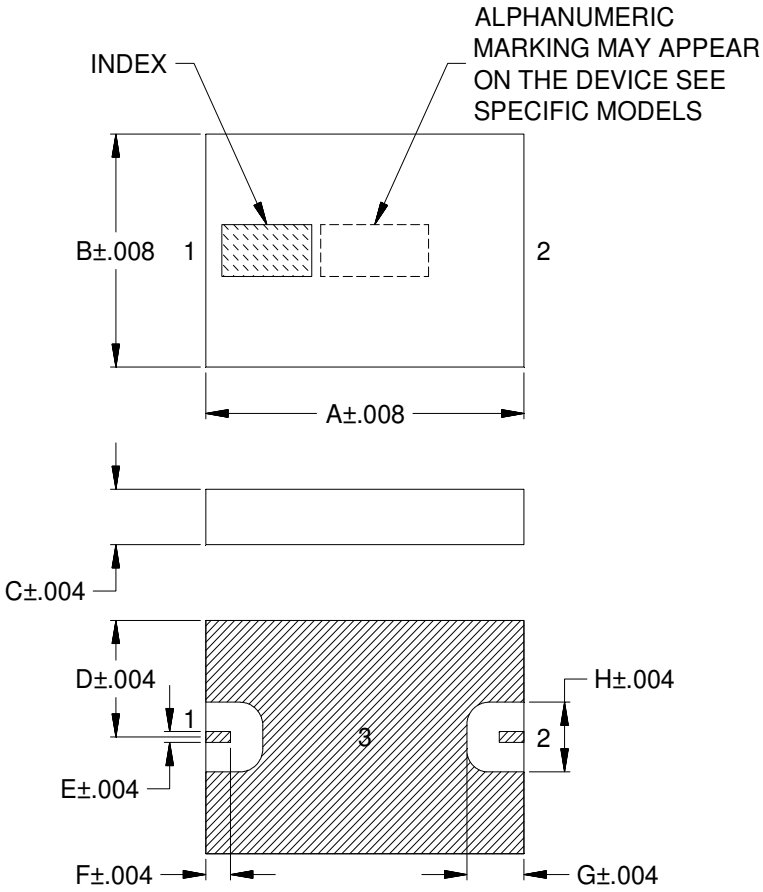


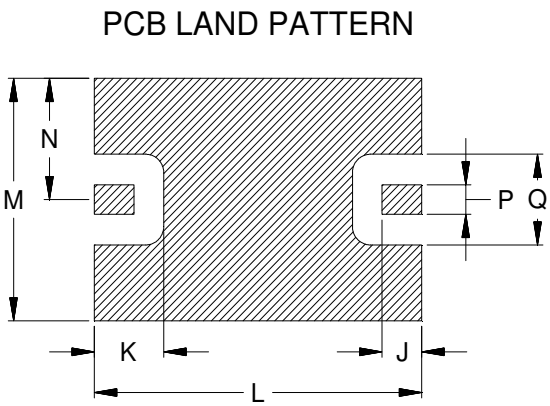
GROUP DELAY vs. TEMPERATURE
INPUT POWER = 0 dBm



Case Style NM

Outline Dimensions NM1812C-5





CASE#	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	WT.GRAM
NM1812C-5	.177 (4.50)	.126 (3.20)	.030 (0.76)	.063 (1.60)	.006 (0.15)	.014 (0.35)	.032 (0.81)	.038 (0.96)	.022 (0.56)	.039 (0.98)	.182 (4.63)	.131 (3.33)	.065 (1.66)	.016 (0.41)	.049 (1.24)	0.04

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

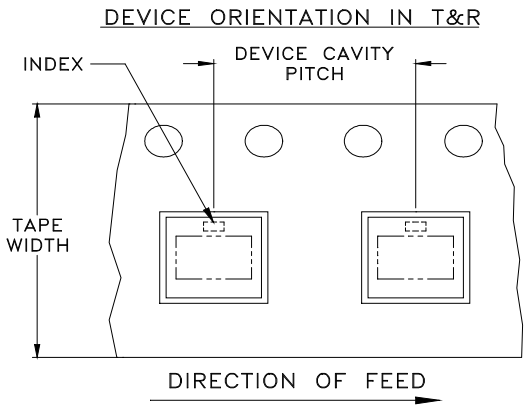
Notes:

1. Open style, Ceramic base.
2. Termination finish: **as shown below or indicated on Data Sheet.**
   For RoHS Case Styles: Gold plate over Nickel plate. All models, (+) suffix.
3. Pad tolerance is non-cumulative. Minimum spacing between each pad is .004.

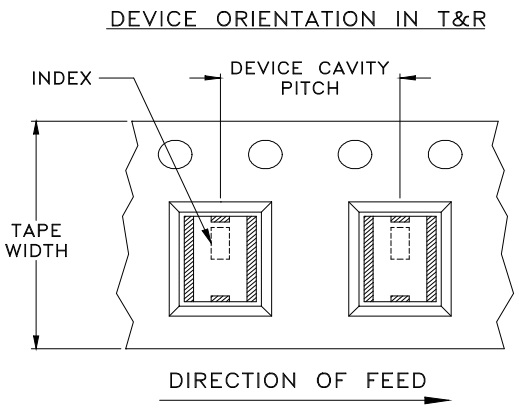
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RF/IF MICROWAVE COMPONENTS

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Tape & Reel Packaging TR-F77



Note: The shape of the pocket may differ



Note: The location and shape of the metallization may differ

Applicable Case Styles
GU1604, GU1804, GU2644, TT1618-2

Applicable Case Styles
MZ4532C, NM1812C, NM1812C-1, NM1812C-2, NM1812C-3, NM1812C-5, NM1812C-6, NM3237 NM1812C-9

Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
12	8	7	Small quantity standards (see note)	20
				50
				100
				200
				500
				1000
		13	Standard	2000

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

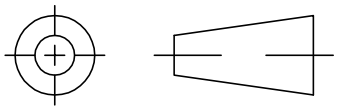
Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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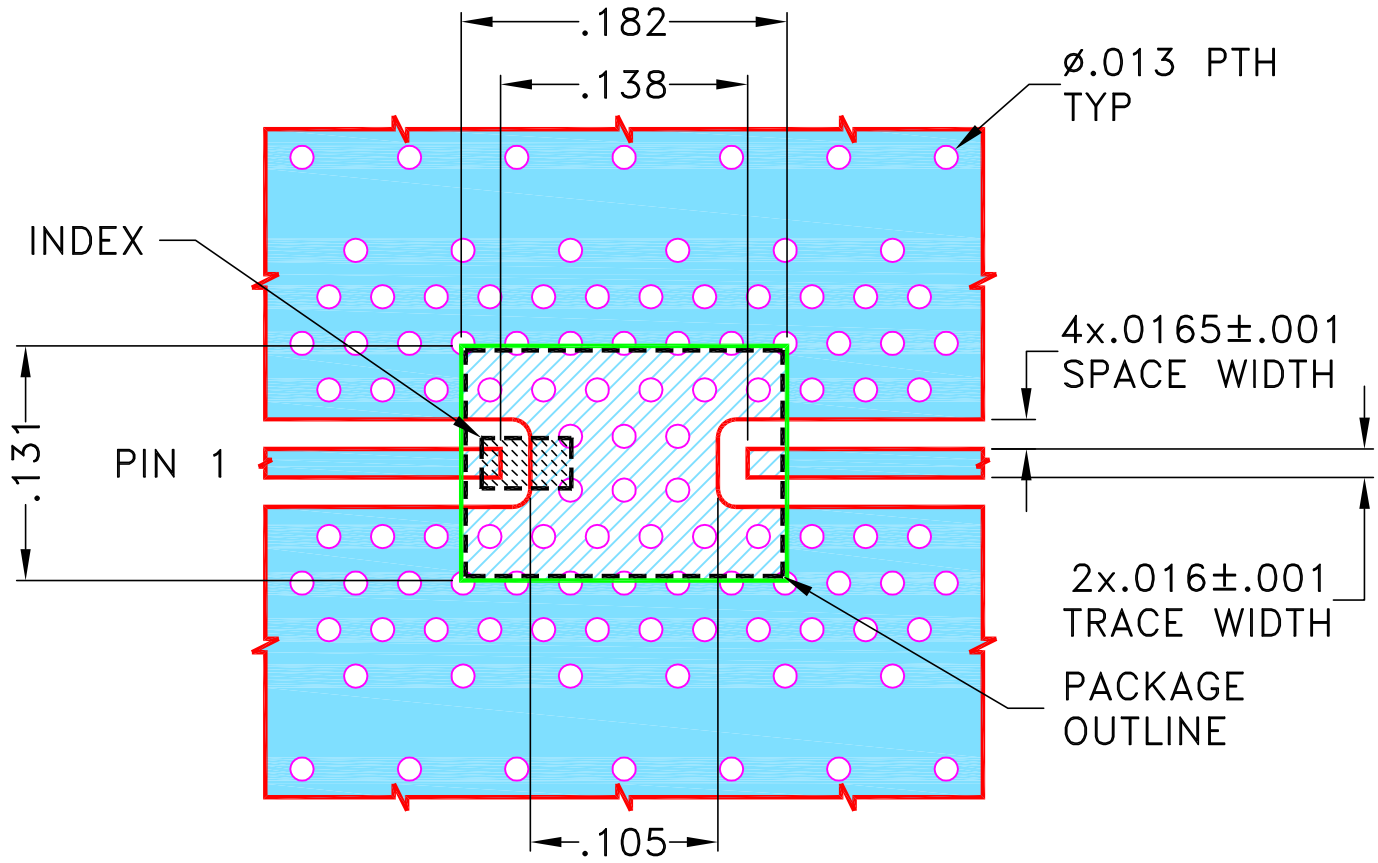
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THIRD ANGLE PROJECTION



REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-015456	NEW RELEASE	OCT 22	DDR	VC

SUGGESTED MOUNTING CONFIGURATION FOR NM1812C-5 CASE STYLE



NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (RO4835 Lo Pro) WITH DIELECTRIC THICKNESS .0073±.0007; 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	20 OCT 22
TOLERANCES ON:	CHECKED	GTP	20 OCT 22
2 PL DECIMALS ±	APPROVED	RKS	20 OCT 22
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

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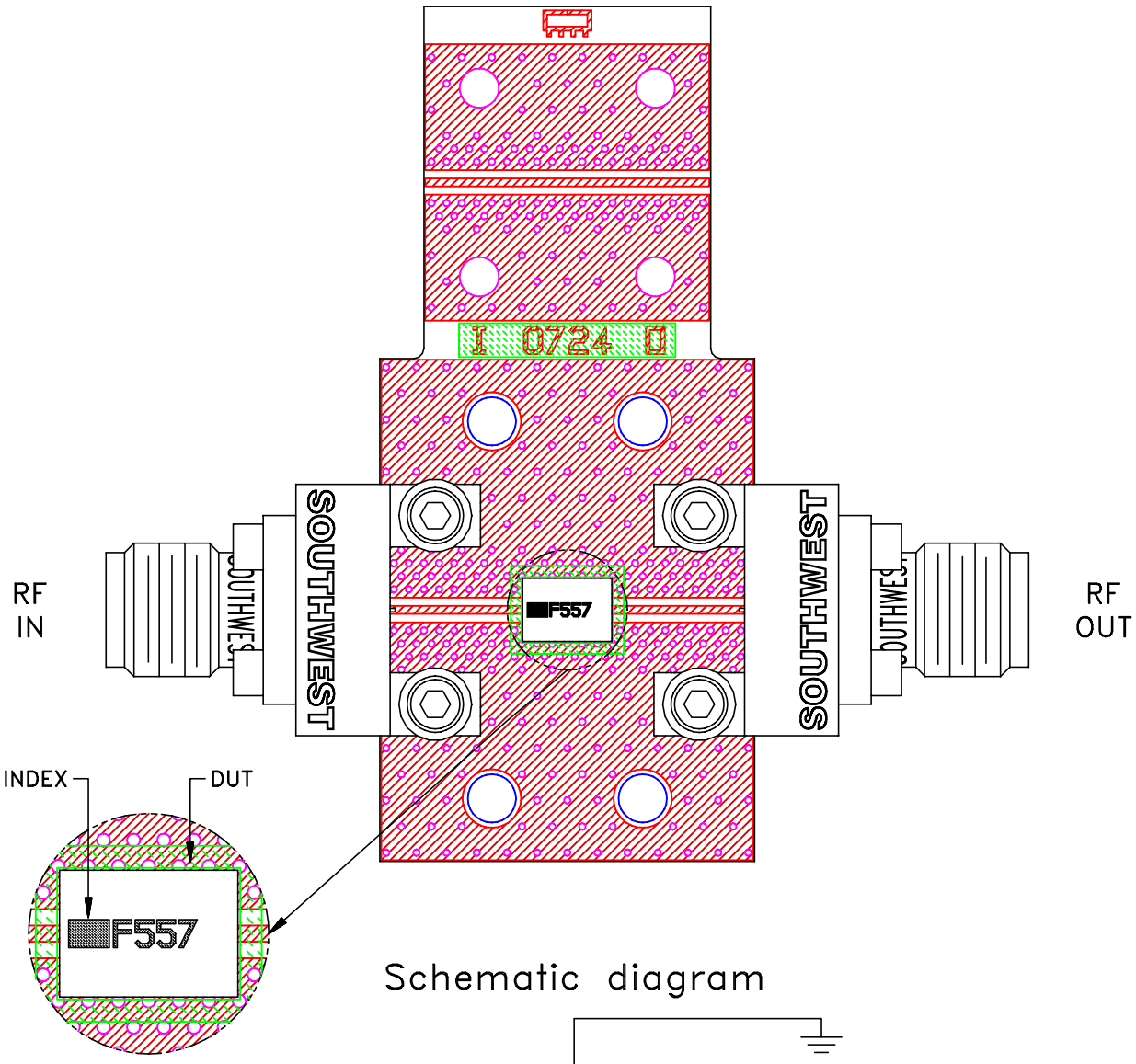
PL DWG NM1812C-5 C.S 50 OHM HFHK

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-708	OR

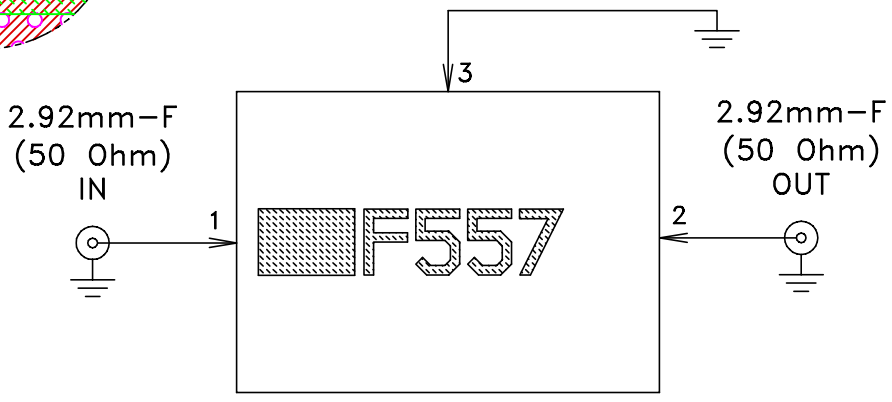
FILE:	SCALE:	SHEET:
98-PL-708	9:1	1 OF 1

Evaluation Board and Circuit

TB-HFCU-223+



Schematic diagram



Notes:

1. PCB Material: ROGERS (RO4835 Lo Pro) OR Equivalent, Dielectric Constant=3.48±.05 Dielectric Thickness: .0073±.0007
2. 50 Ohm 2.92mm Female Connectors.

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Environmental Specifications ENV06T10

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, Test B,B1, 95% Coverage
Thermal Shock	-55° to +125°C, 15 min dwell,250 cycles	MIL-STD-202, Method 107
Bend Test	1mm, deflection for 5 seconds Span of bending: 2.75"	--
High Temp Storage	125°C to 1000 Hrs	---

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