

Ceramic

# Bandpass Filter

**BFTC-415+**

50Ω 330 to 500 MHz

## The Big Deal

- LTCC construction
- Temperature stable from -40°C to +85°C
- Small size (0.150 x 0.150 x 0.059")



*Generic photo used for illustration purposes only*  
CASE STYLE: FR933-1

## Product Overview

The BFTC-415+ LTCC bandpass filter covers the 330 to 500 MHz passband with 25 dB upper/lower stopband rejection. This model handles up to 4W RF input power and provides a wide operating temperature range from -40 to +85°C. Utilizing LTCC multi-layer construction, the filter achieves excellent repeatability of performance and comes in a tiny ceramic package saving space in dense PCB layouts.

## Key Features

Feature	Advantages
LTCC Construction	Provides a rugged package well suited for tough environments such as high humidity and temperature extremes.
Tiny size (0.150 x 0.150 x 0.059")	Saves space in dense circuit boards and minimizes the effects of parasitics.
Wide operating temperature range, -40 to +85°C	Enables reliable performance in extreme environments

### 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)



# Ceramic Bandpass Filter

50Ω 330 to 500 MHz

## BFTC-415+



Generic photo used for illustration purposes only  
CASE STYLE: FR933-1

### Features

- Good VSWR 1.5 typ. @ passband
- Small size
- Hermetically sealed
- Temperature stable
- LTCC construction

### Applications

- Test and measurement
- Harmonic rejection
- Transmitters / Receivers

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

Parameter	F#	Frequency (MHz)	Min.	Typ.	Max.	Unit
Pass Band	Center Frequency	—	—	415	—	MHz
	Insertion Loss	F1-F2	—	4.0	5.5	dB
	VSWR	F1-F2	330-500	—	1.5	:1
Stop Band, Lower	Insertion Loss	F3-F4	1-240	25	36	dB
	VSWR	F3-F4	1-240	—	18	:1
Stop Band, Upper	Insertion Loss	F5-F6	650-1800	25	36	dB
	VSWR	F5-F6	650-1800	—	10	:1

1. Measured on Mini-Circuits Characterization Test Board TB-233

2. This filter is not intended for use as a DC Blocking circuit element. In Application where DC voltage is present at either input or output ports, blocking capacitors are required at the corresponding RF port.

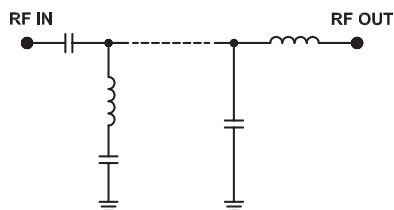
### Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input*	4W max @ +25°C

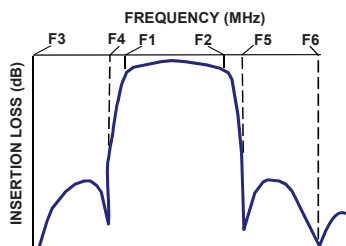
\*Passband rating, derate linearly to 2W at 85°C ambient

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

### Functional Schematic



### Typical Frequency Response

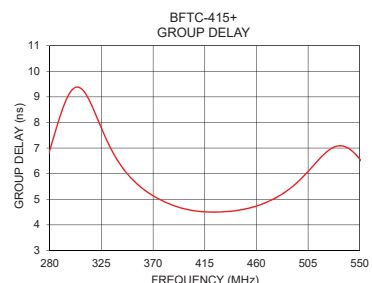
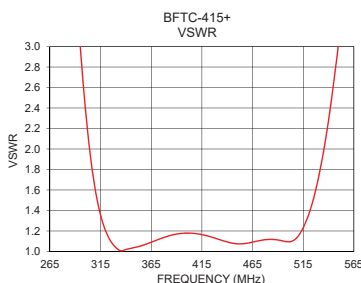
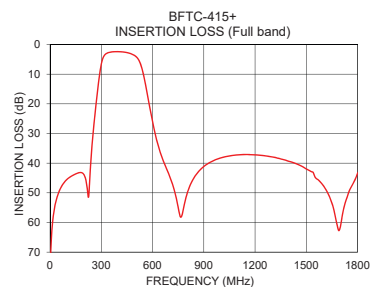
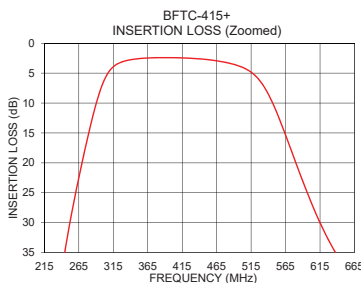


### Typical Performance Data at 25°C

Frequency (MHz)	Insertion Loss (dB)	VSWR (:1)	Frequency (MHz)	Group Delay (nsec)
1	82.97	6144.30	330	7.27
10	63.43	2622.39	334	6.91
100	45.44	35.84	338	6.59
240	38.50	8.47	340	6.45
252	30.02	7.76	350	5.87
268	20.84	6.49	360	5.45
290	10.17	3.68	370	5.14
310	4.56	1.59	380	4.90
330	3.04	1.04	390	4.72
415	2.46	1.16	410	4.53
500	3.92	1.09	415	4.51
530	6.62	1.72	420	4.50
550	10.97	3.04	430	4.51
580	20.00	5.89	440	4.54
616	30.25	9.21	450	4.62
650	37.22	12.18	460	4.73
750	54.87	21.24	470	4.90
1000	38.23	39.93	480	5.13
1500	41.96	52.16	490	5.44
1800	43.43	53.55	500	5.85

### +RoHS Compliant

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



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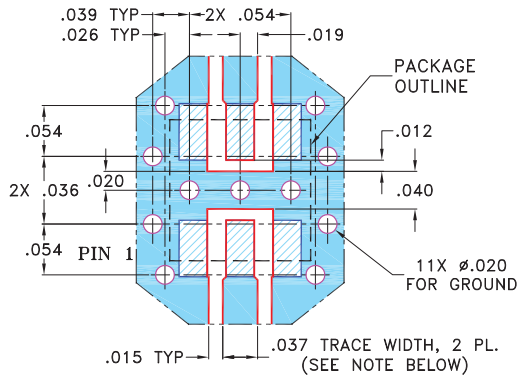


## Pad Connections

RF IN	2
RF OUT	5
GROUND	1,3,4,6

## Product Marking: 347

Demo Board MCL P/N: TB-233  
Suggested PCB Layout (PL-112)

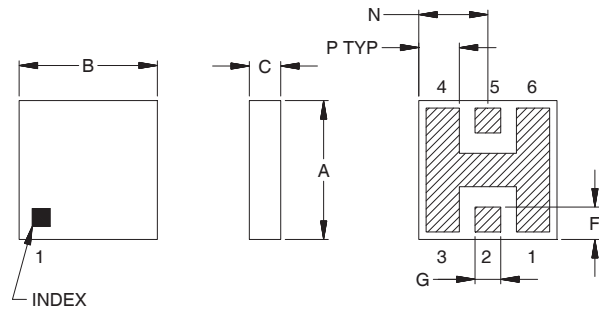


NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS  $0.020" \pm 0.0015"$ ; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.

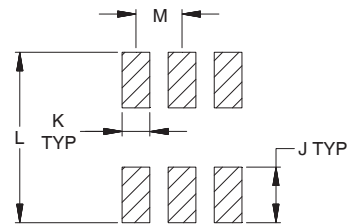
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
- DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

## Outline Drawing



## PCB Land Pattern



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

## Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H
.150	.150	.059	--	--	.035	.028	--
3.81	3.81	1.50	--	--	.89	.71	--
J	K	L	M	N	P	Wt.	
.060	.030	.184	.050	.075	.044	grams	
1.52	.76	4.67	1.27	1.91	1.12	0.15	

Note: Please refer to case style drawing for details

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# Ceramic Band Pass Filter

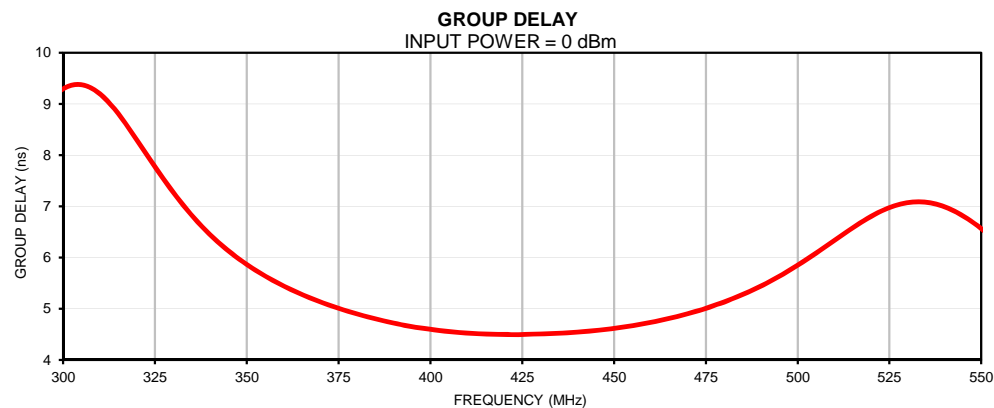
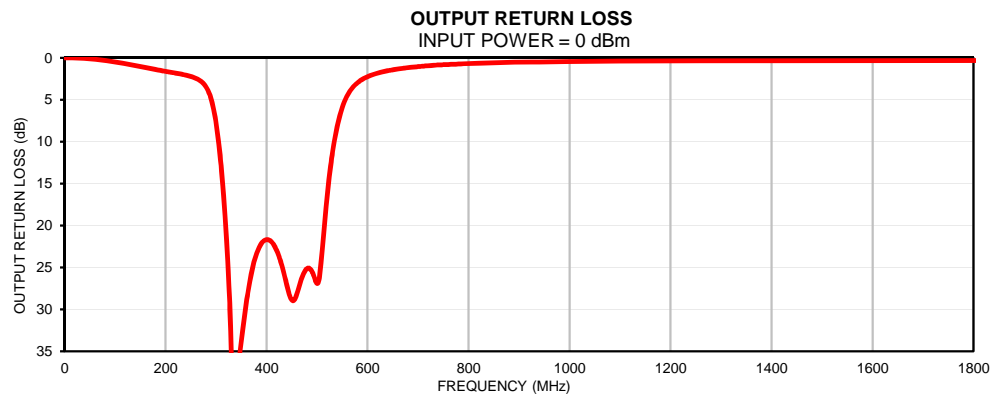
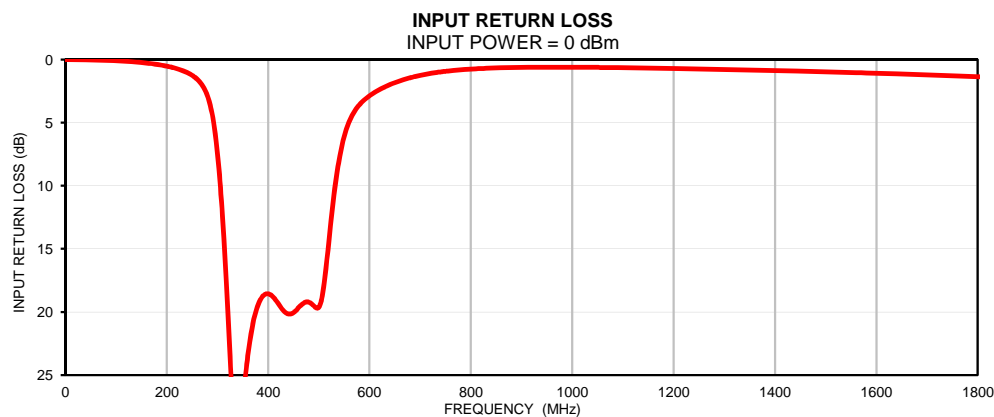
# BFTC-415+

## Typical Performance Data

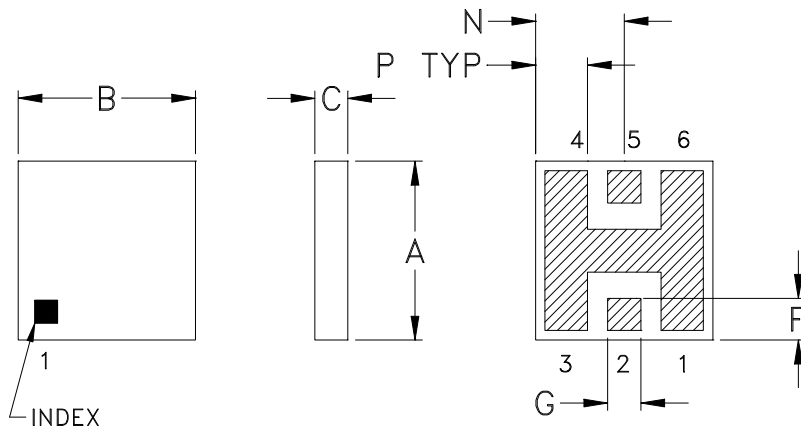
FREQ.	Insertion Loss	Input Return Loss	Output Return Loss	FREQ.	Group Delay
(MHz)	(dB)	(dB)	(dB)	(MHz)	(ns)
1	82.97	0.00	0.00	330	7.27
10	63.43	0.00	0.01	332	7.09
20	57.48	0.00	0.02	334	6.91
50	49.99	0.02	0.12	336	6.75
100	45.44	0.08	0.48	338	6.59
150	43.64	0.23	1.04	340	6.45
175	43.17	0.34	1.33	342	6.32
200	44.01	0.52	1.61	344	6.19
220	49.75	0.72	1.83	346	6.08
240	38.50	1.02	2.06	348	5.97
250	31.29	1.24	2.21	350	5.87
252	30.02	1.29	2.25	352	5.77
268	20.84	1.91	2.70	354	5.68
286	11.89	3.63	4.16	356	5.60
290	10.17	4.37	4.85	358	5.52
296	7.91	5.94	6.34	360	5.45
300	6.67	7.36	7.73	362	5.38
320	3.53	19.43	20.83	364	5.31
330	3.04	27.72	34.49	366	5.25
340	2.77	31.99	40.66	368	5.19
350	2.61	27.45	33.86	370	5.14
360	2.51	23.47	29.25	372	5.08
380	2.42	19.46	23.40	374	5.03
400	2.42	18.56	21.70	376	4.99
415	2.46	19.06	22.38	378	4.94
440	2.62	20.17	27.08	380	4.90
460	2.86	19.66	28.20	382	4.86
480	3.26	19.22	25.15	384	4.82
500	3.92	19.63	26.92	386	4.79
520	5.31	14.34	16.55	388	4.75
540	8.51	7.98	8.17	390	4.72
560	13.83	4.91	4.50	394	4.66
580	20.00	3.59	2.98	398	4.62
600	25.98	2.87	2.25	402	4.58
618	30.74	2.42	1.86	406	4.55
620	31.22	2.37	1.82	410	4.53
630	33.47	2.17	1.67	414	4.51
640	35.46	1.99	1.54	415	4.51
650	37.22	1.82	1.43	422	4.50
700	44.42	1.25	1.05	426	4.50
750	54.87	0.93	0.82	430	4.51
800	50.75	0.75	0.69	434	4.52
850	44.27	0.66	0.58	438	4.53
900	41.12	0.61	0.52	442	4.56
950	39.33	0.60	0.47	446	4.58
1000	38.23	0.60	0.44	450	4.62
1050	37.57	0.62	0.41	454	4.66
1100	37.22	0.64	0.39	458	4.71
1150	37.08	0.67	0.38	462	4.76
1200	37.21	0.71	0.36	466	4.83
1250	37.45	0.75	0.36	470	4.90
1300	37.92	0.78	0.35	474	4.99
1350	38.59	0.83	0.34	478	5.08
1400	39.41	0.87	0.34	482	5.19
1450	40.42	0.91	0.33	486	5.31
1500	41.96	0.97	0.33	490	5.44
1600	47.63	1.07	0.32	494	5.59
1700	61.22	1.22	0.32	496	5.68
1760	48.28	1.29	0.32	498	5.76
1800	43.43	1.36	0.32	500	5.85



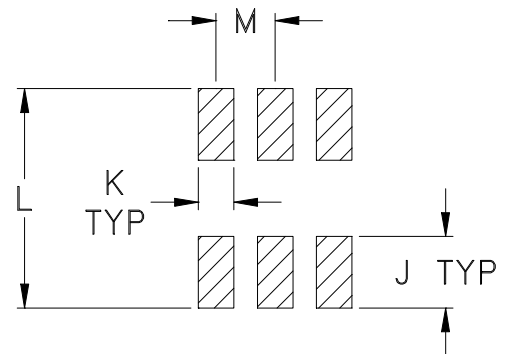
Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



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

CASE #	A	B	C	D	E	F	G	H	J	K	L	M
FR933-1	.150 (3.81)	.150 (3.81)	.059 (1.50)	-- --	-- --	.035 (0.89)	.028 (0.71)	-- --	.060 (1.52)	.030 (0.76)	.184 (4.67)	.050 (1.27)

CASE #	N	P	WT. GRAM
FR933-1	.075 (1.91)	.044 (1.12)	0.15

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

#### Notes:

1. Open style, Ceramic Base.
2. Termination finish: Palladium Silver.



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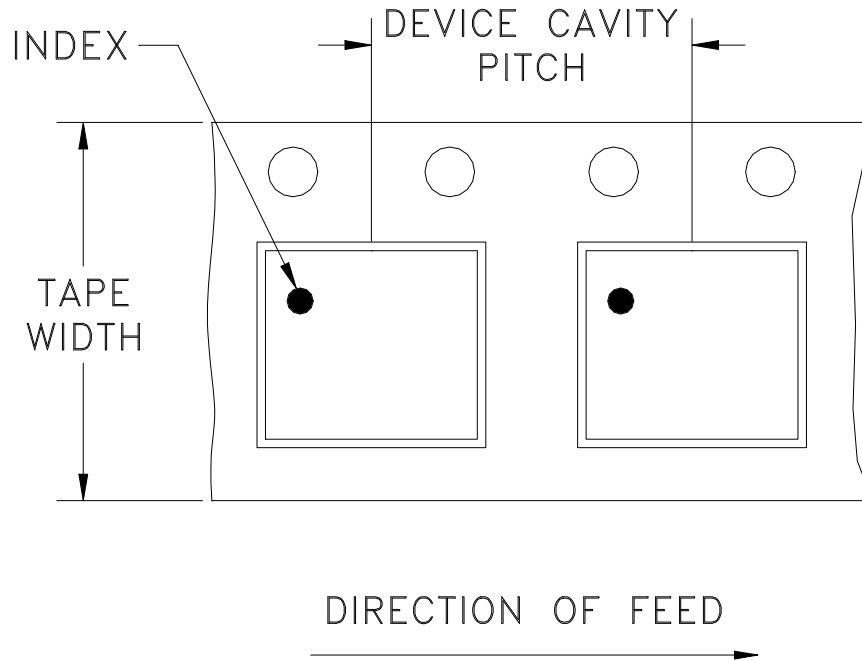
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# Tape & Reel Packaging TR-F68

## DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
12	8	7	Small quantity standard	20
				50
				100
				200
				500
		7	Standard	1000
		13	Standard	2000
				3000
				4000

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)



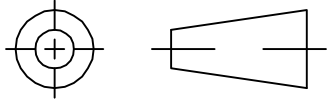
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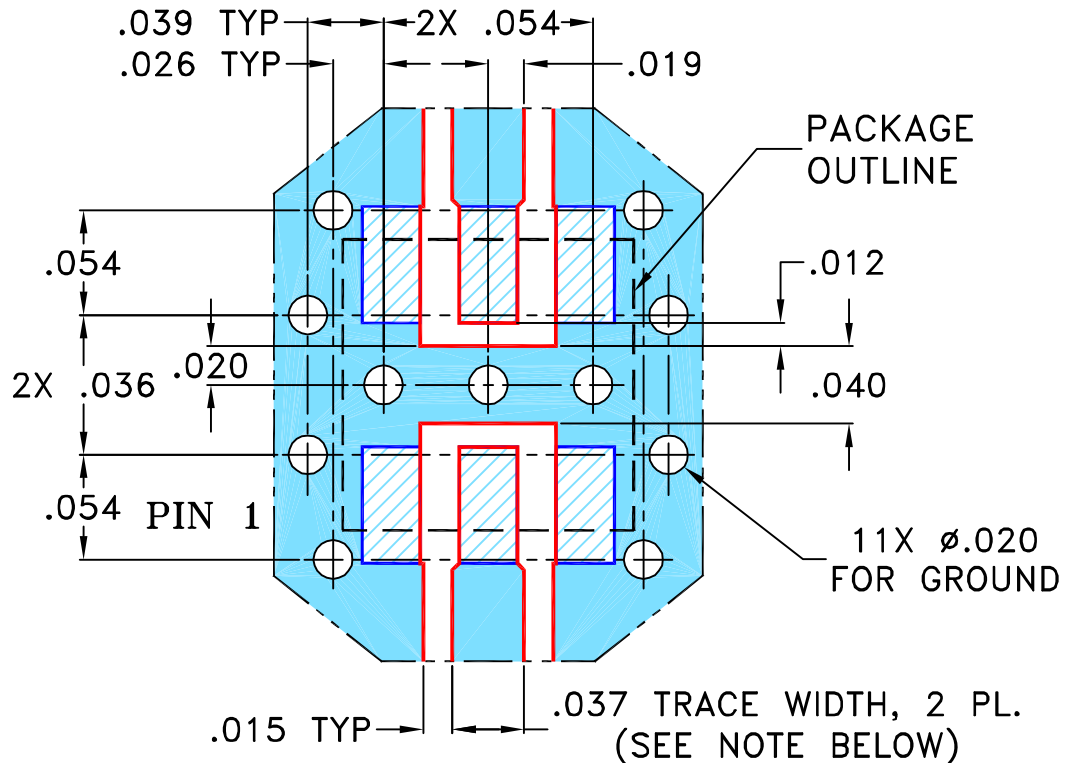
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M83007	NEW RELEASE	09/04/02	MMG	LER
A	M83501	CNG LAYOUT AS PER B14-TB-233	10/01/02	MMG	ABD
B	M102713	ADDED "...WITH SMOBC"	01/14/06	GF	IL
C	M164713	ADDED "933-1 & 06FL03"	11/15/17	CA	IL

**SUGGESTED MOUNTING CONFIGURATION  
FOR FR932/933/933-1 CASE STYLE, "06FL03" PIN CONNECTION**



NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS 0.020" ± 0.0015"; 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 SOLDER MASK

UNLESS OTHERWISE SPECIFIED	INITIALS		DATE
DIMENSIONS ARE IN INCHES TOLERANCES ON: 2 PL DECIMALS ± 3 PL DECIMALS ± ANGLES ± FRACTIONS ±	DRAWN	MMG	09/04/02
	CHECKED		
	APPROVED	LER(BC)	09/04/02



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Brooklyn NY 11235

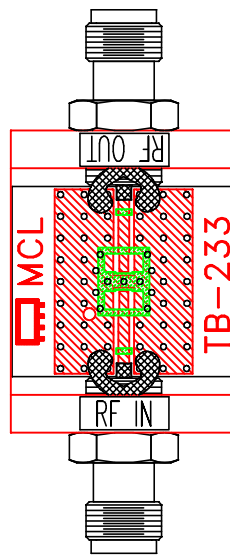
PL, 06FL03, FR932/933/933-1, TB-233

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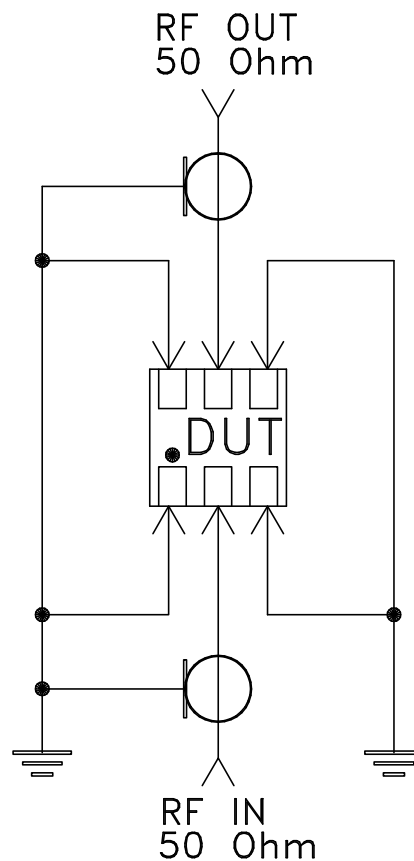
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A	15542	98-PL-112	C
FILE:	98PL112	SCALE:	10:1
		SHEET:	1 OF 1



# Evaluation Board and Circuit




TB-233



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,  
Dielectric Constant=3.5, 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
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 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, 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
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