X5

Frequency Multiplier

RMK-5-112+

50Ω Output 750 to 1100 MHz

The Big Deal

- Broadband, output from 750 to 1100 MHz
- Low conversion loss, 22 dB
- Excellent harmonic suppression:

F4, 57 dBc; F6, 55 dBc

CASE STYLE: TTT1114

Product Overview

Mini-Circuits' RMK-5-112+ frequency multiplier provides a multiplication factor of 5, converting input frequencies from 150 to 220 MHz into output frequencies from 750 to 1100 MHz, supporting applications including synthesizers, local oscillators, satellite up and down converters and more. This model provides an input power range from +22 to +24 dBm, low conversion loss and excellent harmonic suppression. The multiplier comes housed in a miniature, shielded surface-mount package (0.38 x 0.50 x 0.15") with wraparound terminations for excellent solderability.

Key Features

Feature	Advantages
Low conversion loss, 22 dB typ.	With a low conversion loss, RMK-5-112+ produces higher output power, reducing the need for amplification.
Excellent harmonic suppression • F4, 57 dBc • F6, 55 dBc	Reduces spurious signals and the need for additional filtering.
Broadband, 750 to 1100 MHz output	With an output frequency range spanning 750 to 1100 MHz, this multiplier covers a wide range of applications.
Low cost	Provides an easy, cost-effective solution for generating high-frequency signals from a lower frequency signal source.
Small size, 0.38 x 0.50 x 0.15"	Saves space in crowded PCB layouts.

X5 Frequency Multiplier

RMK-5-112+

50Ω Output 750 to 1100 MHz

CASE STYLE: TTT1114

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Input Power	25 dBm

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

Pin Connections

INPUT	2
OUTPUT	1
GROUND	3,4,5,6

Features

- higher input power, +23 dBm
- low conversion loss, 22 dB typ.
- high adjacent harmonic rejection, F4, 57 dBc typ., F6, 55 dBc typ.
- aqueous washable

Applications

- synthesizers
- local oscillators
- satellite up and down converters

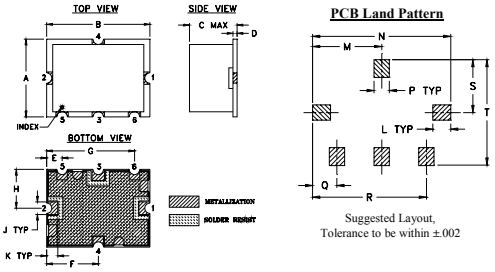
+RoHS Compliant

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

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	10, 20, 50, 100, 200
13"	500

Outline Drawing

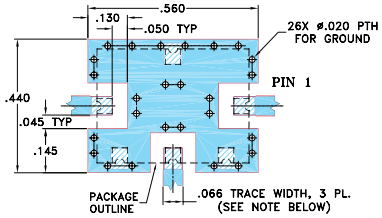


Outline Dimensions (inch / mm)

A	B	C	D	E	F	G	H	J	K
.38	.50	.15	.020	.075	.250	.425	.187	.050	.050
9.65	12.70	3.81	0.51	1.91	6.35	10.80	4.75	1.27	1.27

L	M	N	P	Q	R	S	T	WT.
.070	.270	.540	.060	.095	.445	.208	.415	GRAM
1.78	6.86	13.72	1.52	2.41	11.30	5.28	10.54	0.8

Demo Board MCL P/N: TB-12
Suggested PCB Layout (PL-079)



NOTE:

1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES TO EXPOSE METAL UNDER THE ENTIRE UNIT GROUND PAD FOR IMPROVED GROUNDING, IT IS RECOMMENDED A SOLDER MASK DAM BE APPLIED AROUND EACH GROUND PAD TO ENSURE FILLET AND CONNECTION AT GROUND PADS.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER), SEE NOTE 2.

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Electrical Specifications at 25°C

Parameter		Min.	Typ.	Max.	Unit
Multiplier Factor			5		
Frequency Range, Input (F1)		150		220	MHz
Frequency Range, Output (F5)		750		1100	MHz
Input Power		22	—	24	dBm
Conversion Loss		—	21	25.5	dB
Harmonic Ouput*	F1	-2	4	—	dBc
	F2	40	62	—	
	F3	-10	0	—	
	F4	40	57	—	
	F6	40	55	—	
	F7	1	6	—	

* Harmonics of input frequency below the power level of F5

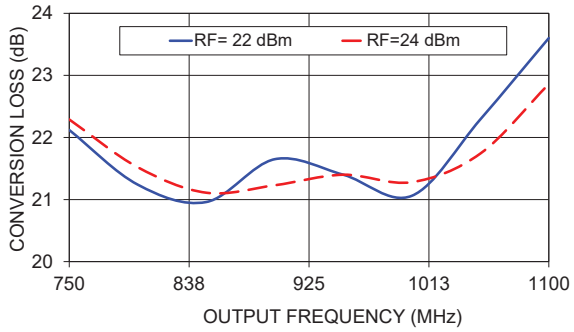
Typical Performance Data

Frequency Input (MHz)	Frequency Output (MHz)	Conv. Loss (dB) F5	Harmonic Rejection Below F5 (dBc) at RF Input Power 22 dBm F1	F2	F3	F4	F6	F7
150	750	22.12	11.41	79.43	3.63	60.86	64.35	6.74
160	800	21.24	11.01	74.19	2.96	60.63	60.81	8.21
170	850	20.96	10.23	71.19	2.01	58.98	58.95	9.51
180	900	21.65	8.72	69.26	0.34	58.35	57.84	11.28
190	950	21.40	7.86	67.32	0.80	57.53	57.52	11.42
200	1000	21.06	7.06	65.51	1.89	56.63	56.89	10.89
210	1050	22.29	5.32	63.83	3.79	56.39	55.60	12.25
220	1100	23.60	3.33	61.05	5.76	54.98	54.24	13.48
			at RF Input Power 24 dBm					
150	750	22.29	12.50	76.48	4.84	59.85	69.89	4.78
160	800	21.52	12.07	72.26	4.13	59.57	61.86	6.32
170	850	21.11	11.38	69.31	3.25	57.70	60.07	7.36
180	900	21.23	10.36	67.34	1.95	56.51	59.48	8.16
190	950	21.40	9.23	66.04	0.55	55.88	59.41	8.75
200	1000	21.28	8.25	64.59	0.70	55.03	59.06	8.55
210	1050	21.74	7.13	63.44	2.17	54.67	58.17	8.63
220	1100	22.86	5.42	61.60	4.01	54.56	56.39	9.64

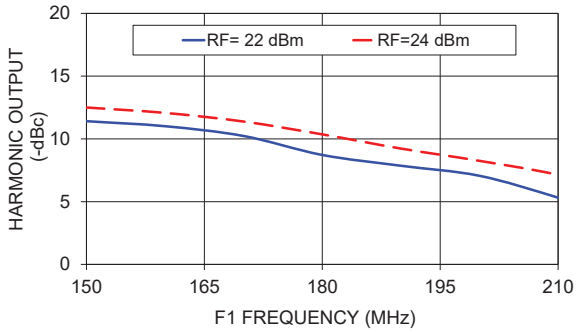
Notes

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

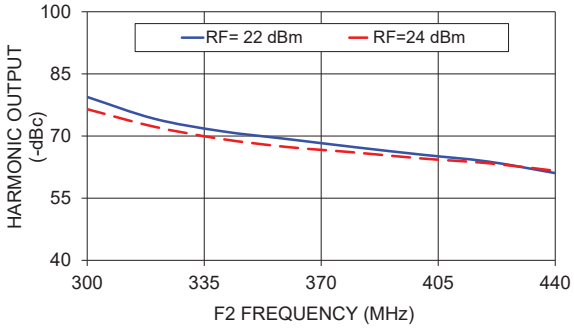
RMK-5-112+
CONVERSION LOSS



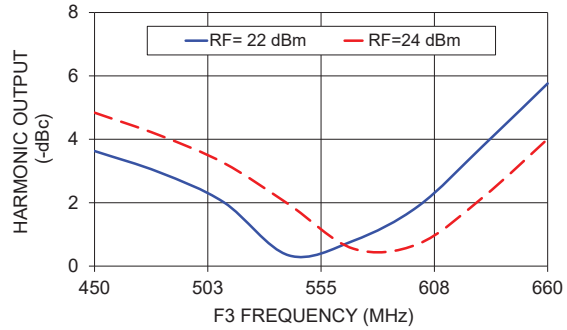
RMK-5-112+
HARMONIC OUTPUT F1



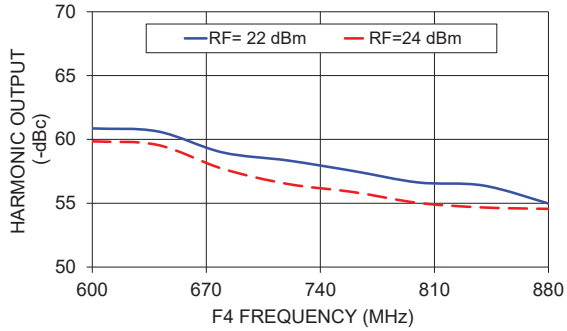
RMK-5-112+
HARMONIC OUTPUT F2



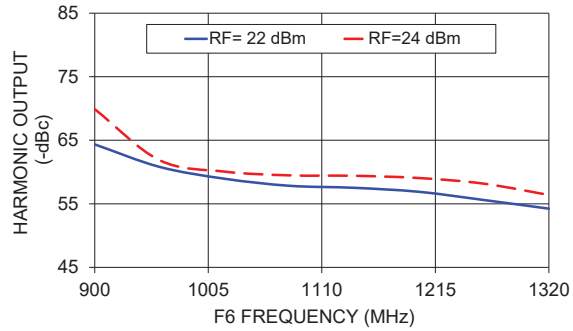
RMK-5-112+
HARMONIC OUTPUT F3



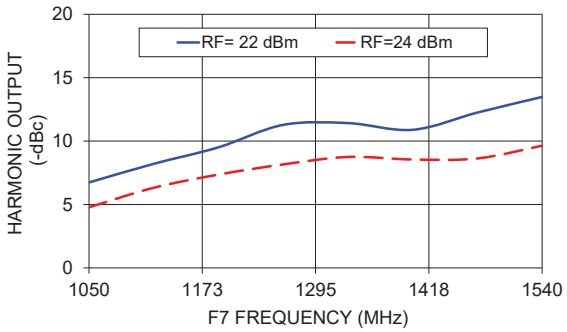
RMK-5-112+
HARMONIC OUTPUT F4



RMK-5-112+
HARMONIC OUTPUT F6



RMK-5-112+
HARMONIC OUTPUT F7



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Frequency Multiplier (X5) RMK-5-112+

Typical Performance Data

FREQUENCY (MHz)							CONVERSION LOSS (dB)	RF IN = +22 dBm HARMONIC OUTPUT* (-dBc)					
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT	X5 OUTPUT	X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X6 OUTPUT	X7 OUTPUT
120	240	360	480	600	720	840	25.11	12.05	51.86	4.78	42.85	36.08	0.31
130	260	390	520	650	780	910	23.40	12.36	58.99	4.87	53.08	43.70	1.94
140	280	420	560	700	840	980	22.28	12.33	74.86	4.58	70.30	56.26	4.21
150	300	450	600	750	900	1050	22.12	11.41	79.43	3.63	60.86	64.35	6.74
160	320	480	640	800	960	1120	21.24	11.01	74.19	2.96	60.63	60.81	8.21
170	340	510	680	850	1020	1190	20.96	10.23	71.19	2.01	58.98	58.95	9.51
180	360	540	720	900	1080	1260	21.65	8.72	69.26	0.34	58.35	57.84	11.28
190	380	570	760	950	1140	1330	21.40	7.86	67.32	-0.80	57.53	57.52	11.42
200	400	600	800	1000	1200	1400	21.06	7.06	65.51	-1.89	56.63	56.89	10.89
210	420	630	840	1050	1260	1470	22.29	5.32	63.83	-3.79	56.39	55.60	12.25
220	440	660	880	1100	1320	1540	23.60	3.33	61.05	-5.76	54.98	54.24	13.48
230	460	690	920	1150	1380	1610	24.34	1.69	58.33	-7.29	52.62	53.56	13.80

* Harmonic Output below power level of X5 Output.

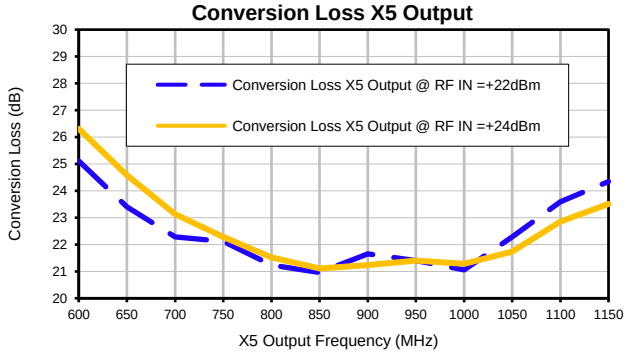
FREQUENCY (MHz)							CONVERSION LOSS (dB)	RF IN = +24 dBm HARMONIC OUTPUT* (-dBc)					
X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X5 OUTPUT	X6 OUTPUT	X7 OUTPUT	X5 OUTPUT	X1 OUTPUT	X2 OUTPUT	X3 OUTPUT	X4 OUTPUT	X6 OUTPUT	X7 OUTPUT
120	240	360	480	600	720	840	26.31	12.34	53.12	5.32	50.64	41.17	-0.63
130	260	390	520	650	780	910	24.58	12.70	53.00	5.41	46.86	38.36	1.10
140	280	420	560	700	840	980	23.13	12.90	84.74	5.35	59.89	69.11	3.01
150	300	450	600	750	900	1050	22.29	12.50	76.48	4.84	59.85	69.89	4.78
160	320	480	640	800	960	1120	21.52	12.07	72.26	4.13	59.57	61.86	6.32
170	340	510	680	850	1020	1190	21.11	11.38	69.31	3.25	57.70	60.07	7.36
180	360	540	720	900	1080	1260	21.23	10.36	67.34	1.95	56.51	59.48	8.16
190	380	570	760	950	1140	1330	21.40	9.23	66.04	0.55	55.88	59.41	8.75
200	400	600	800	1000	1200	1400	21.28	8.25	64.59	-0.70	55.03	59.06	8.55
210	420	630	840	1050	1260	1470	21.74	7.13	63.44	-2.17	54.67	58.17	8.63
220	440	660	880	1100	1320	1540	22.86	5.42	61.60	-4.01	54.56	56.39	9.64
230	460	690	920	1150	1380	1610	23.51	3.91	59.19	-5.48	53.49	55.41	10.12

* Harmonic Output below power level of X5 Output.

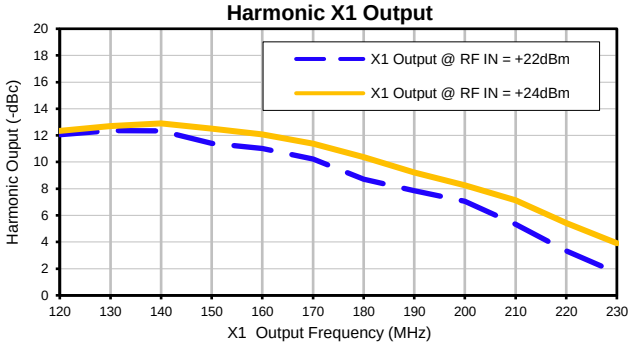
Frequency Multiplier (X5) RMK-5-112+

Typical Performance Curves

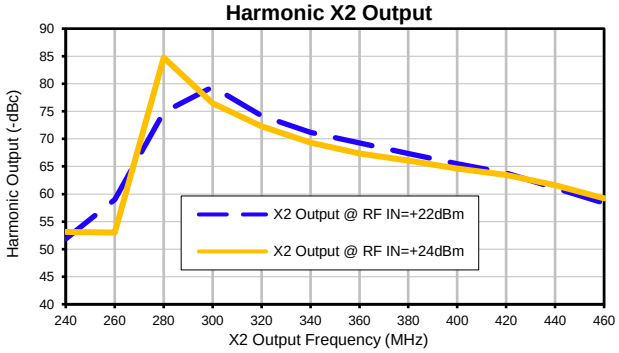
Conversion Loss X5 Output



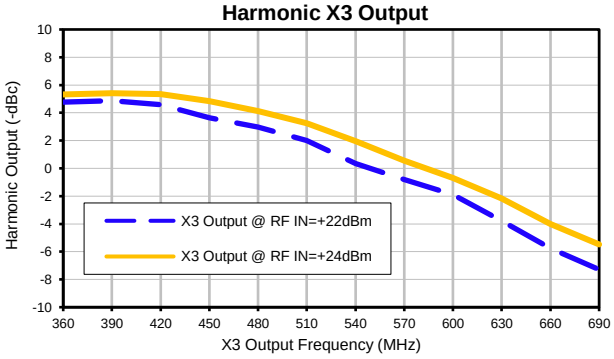
Harmonic X1 Output



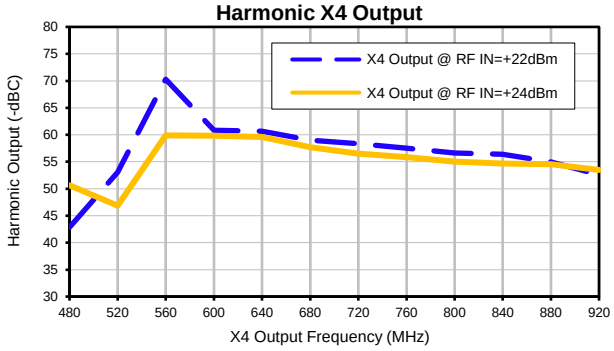
Harmonic X2 Output



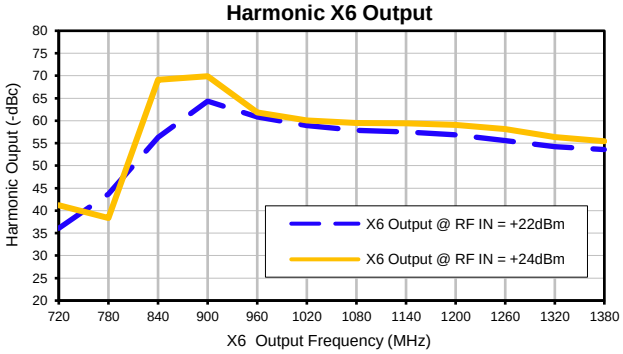
Harmonic X3 Output



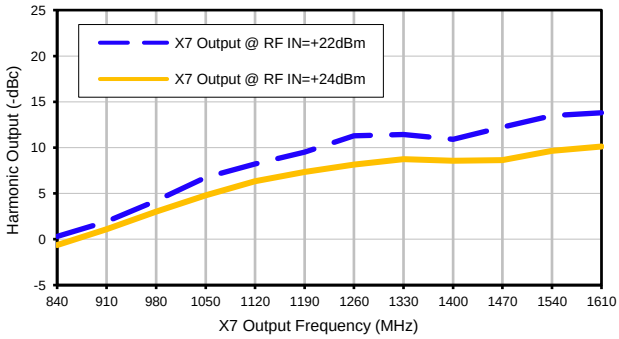
Harmonic X4 Output



Harmonic X6 Output



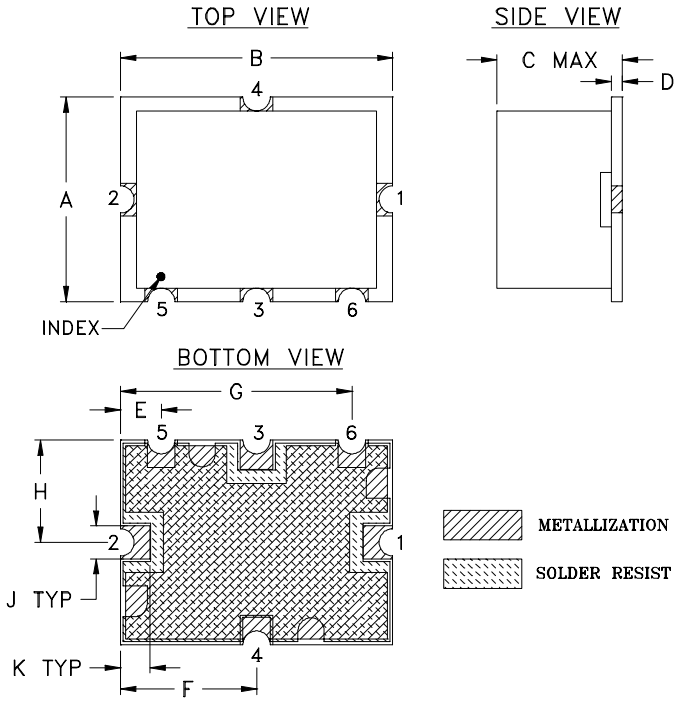
Harmonic X7 Output



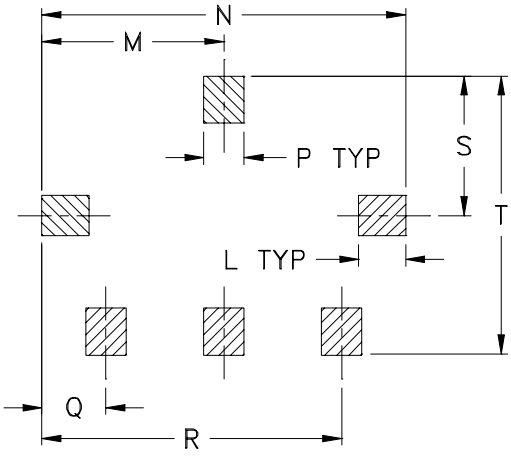
Case Style TTT

Outline Dimensions

TTT1114



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE #	A	B	C	D	E	F	G	H	J	K	L	M	N
TTT1114	.38 (9.65)	.50 (12.70)	.15 (3.81)	.020 (0.51)	.075 (1.91)	.250 (6.35)	.425 (10.80)	.187 (4.75)	.050 (1.27)	.050 (1.27)	.070 (1.78)	.270 (6.86)	.540 (13.72)

CASE #	P	Q	R	S	T	WT. GRAM
TTT1114	.060 (1.52)	.095 (2.41)	.445 (11.30)	.208 (5.28)	.415 (10.54)	.8

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

Note:

1. Case material: Nickel-Silver alloy.
2. Base material: Printed wiring laminate.
3. Termination finish:
   For RoHS Case Styles: 3-5 µ inch (.08-.13 microns) Gold over 120-240 µ inch (3.05-6.10 microns) Nickel plate. All models, (+) suffix.
   For RoHS -5 Case Style: Tin-Lead plate. All models, no (+) suffix.

Mini-Circuits®
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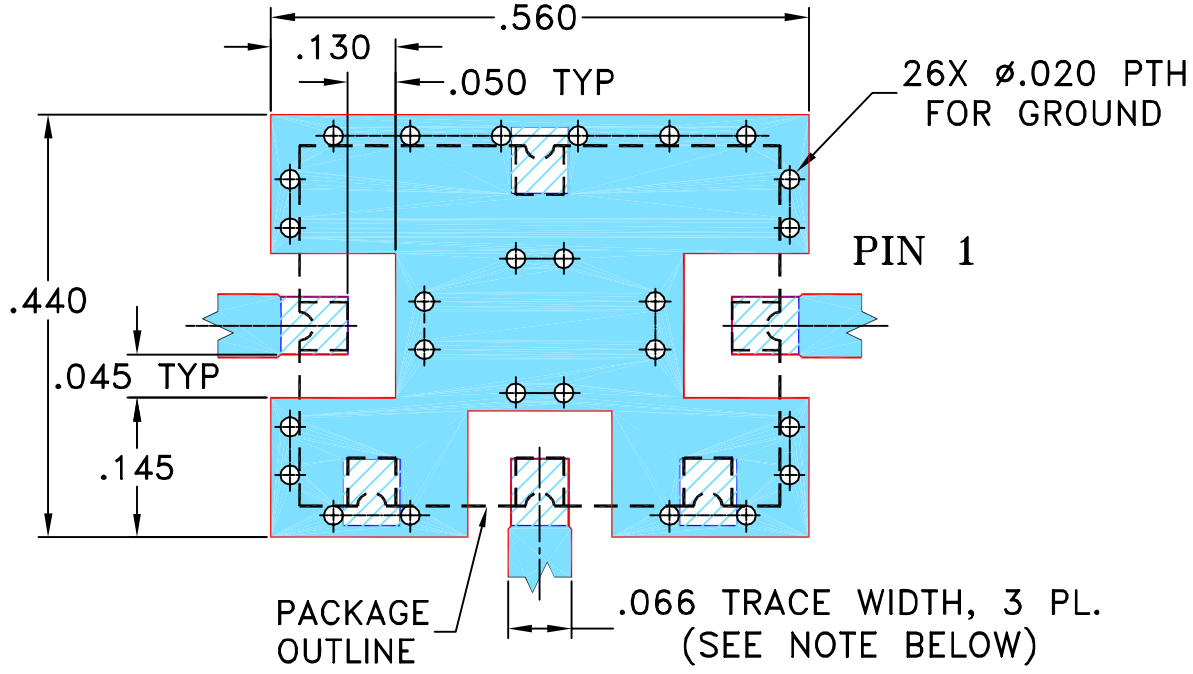
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
A	M86762	ADDED CONNECTIONS "lp & lq"	05/23/03	MMG	WL
B	M94598	ADDED CONNECTION "hk"	10/08/04	MMG	HY
C	M102713	UPDATED NOTES & DESCRIPTION	01/14/06	GF	IL
D	M132989	UPDATED NOTE 2	08/24/11	GF	DJ

SUGGESTED MOUNTING CONFIGURATION FOR TTT166/167 CASE STYLE, "hk"/"lp"/"lq" "x"/"ck"/"ec" PIN CONNECTIONS



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

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER), SEE NOTE 2.

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	GF	03/18/03
TOLERANCES ON:	CHECKED	IL	04/15/03
2 PL DECIMALS ±	APPROVED	DJ	04/15/03
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

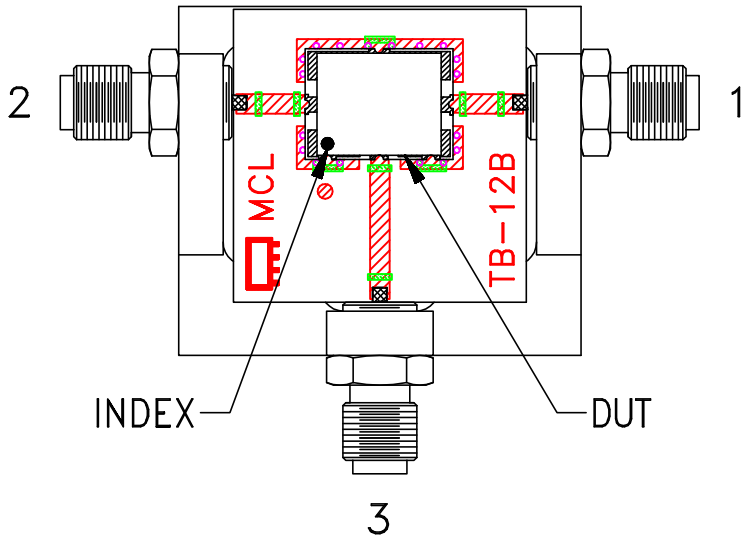
PL, hk/lp/lq/x/ck/ec, TTT166/167, SYM/HJK/SYAS/SYPD, TB-12

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-079	D

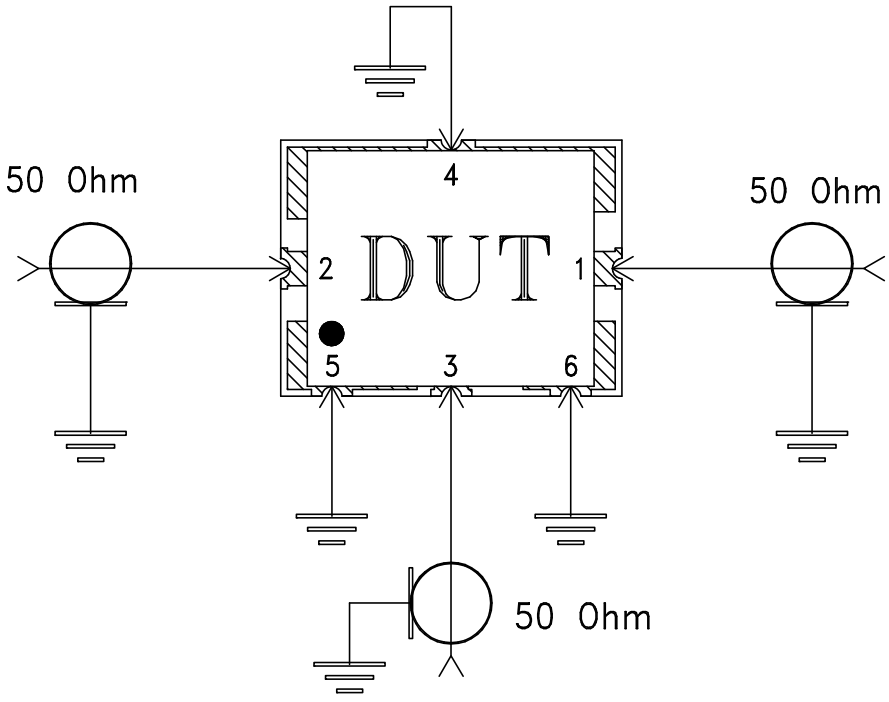
FILE:	SCALE:	SHEET:
98PL079	5:1	1 OF 1

Evaluation Board and Circuit

For Pin Connections Refer to Data Sheet of the DUT



TB-12



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers RO4350 or equivalent, Dielectric Constant=3.5, Thickness=.030 inch.

Mini-Circuits®

Mini-Circuits

Environmental Specifications ENV02T1

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