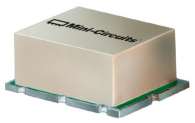
Surface Mount

Attenuator/Switch

SYAS-2+

50Ω Bi-Phase 10 to 1000 MHz



CASE STYLE: TTT166

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Control Current	30mA

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

Pin Connections

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

Features

- wideband 10 to 1000 MHz
- excellent amplitude and phase unbalance

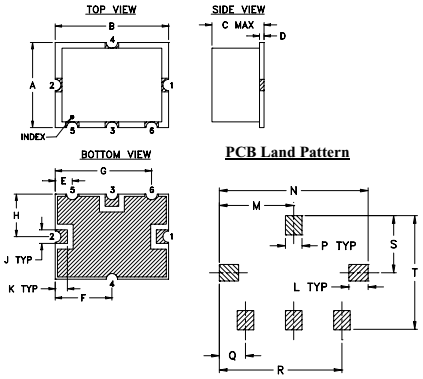
Applications

- bi-phase modulator

+RoHS Compliant

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

Outline Drawing



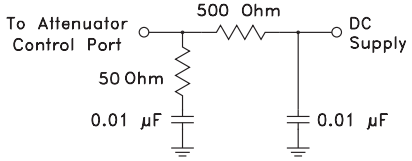
Suggested Layout,
Tolerance to be within ±.002

Outline Dimensions (inch / mm)

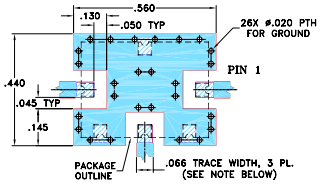
A	B	C	D	E	F	G	H	J	K
.38	.50	.23	.020	.075	.250	.425	.187	.050	.050
9.65	12.70	5.84	0.51	1.91	6.35	10.80	4.75	1.27	1.27

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

suggested control port biasing configuration



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

Attenuator/Switch Electrical Specifications

FREQUENCY (MHz)		INSERTION LOSS (dB) ±20 mA				MAX. INPUT PWR (dBm) ±20 mA		IN-OUT ISOLATION (dB) 0 mA						BI-PHASE $\overline{X}$ (±20 mA) Typ.			
		Mid-Band m		Total Range				L		M		U		Δ AMP (dB)		Phase (deg.) deviation from 180°	
IN f_L-f_U	CON	Typ.	Max.	Typ.	Max.	1 dB compr.	no damage	Typ.	Min.	Typ.	Min.	Typ.	Min.	m	Total Range	m	Total Range
10-1000	DC-0.05	4.0	6.0	4.5	7.0	17*	25	59	40	42	28	28	20	0.1	0.3	2.0	3.0

L = low range [f_L to 10 f_L] M = mid range [10 f_L to f_U/2] U = upper range [f_U/2 to f_U] m = [2 f_L to f_U/2]

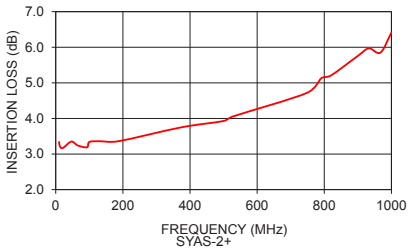
* 13 dBm from 10-500 MHz.

Performance specifications apply for input power up to 10 dB below stated 1 dB compression.

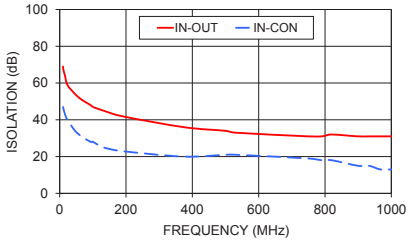
Typical Performance Data

Freq. (MHz)	I. Loss (dB) at 20mA		±Control ΔAMP (dB)	20mA ΔPhase (deg.)	Isolation (dB) (in-out)	Isolation (dB) (in-con)	Input R. Loss (dB)	Control Current (mA)	Attenuation (dB) 10 MHz	500 MHz	1000 MHz	Phase Δ ref at 15mA Ctrl 10 MHz deg.	500 MHz deg.	1000 MHz deg.	Input VSWR 10 MHz	500 MHz	1000 MHz
	$\overline{X}$	σ	$\overline{X}$	$\overline{X}$	$\overline{X}$	$\overline{X}$	$\overline{X}$										
10.0	3.34	0.009	0.00	180.0	69	47	11.4	0.0000	51.3	24.7	27.2	76.7	40.6	0.5	3.3	2.3	4.2
11.4	3.24	0.006	0.01	180.0	67	46	11.6	0.0001	40.8	22.0	24.7	67.8	31.3	-6.7	3.2	2.2	4.0
16.1	3.17	0.004	0.01	180.1	64	43	12.2	0.0002	35.5	20.5	23.4	61.3	25.4	-10.4	3.2	2.2	3.8
23.2	3.18	0.003	0.00	180.1	59	40	12.5	0.0003	32.1	19.5	22.5	59.5	21.4	-12.8	3.1	2.1	3.7
46.5	3.35	0.002	0.01	180.3	54	34	12.5	0.0008	28.6	18.4	21.4	55.8	17.3	-14.7	3.0	2.0	3.6
65.8	3.24	0.002	0.01	180.5	51	31	12.4	0.0012	25.7	17.1	20.1	53.7	14.1	-15.8	2.9	1.9	3.4
93.1	3.19	0.030	0.01	180.7	48	28	12.4	0.0019	22.8	15.7	18.6	51.0	10.9	-16.0	2.7	1.9	3.2
100.2	3.34	0.003	0.01	180.7	47	28	12.4	0.0029	20.2	14.2	17.0	47.8	8.6	-15.1	2.6	1.7	3.1
131.8	3.36	0.004	0.01	180.9	45	25	12.4	0.0040	17.8	12.7	15.3	45.1	6.8	-13.6	2.4	1.6	2.9
186.6	3.36	0.005	0.02	181.3	42	23	12.3	0.0074	14.6	10.4	12.9	40.1	4.7	-10.7	2.1	1.5	2.7
373.8	3.75	0.008	0.02	182.1	36	20	11.4	0.0110	12.7	9.1	11.5	36.8	3.7	-8.7	1.9	1.4	2.6
500.8	3.93	0.015	0.03	182.5	34	21	11.3	0.0159	11.1	8.0	10.4	33.2	2.8	-7.2	1.7	1.4	2.6
529.1	4.06	0.018	0.04	182.5	33	21	11.2	0.0221	9.7	7.0	9.5	29.5	2.2	-5.3	1.5	1.4	2.5
748.8	4.72	0.055	0.10	182.6	31	19	10.7	0.0301	8.5	6.3	8.8	25.9	1.7	-4.3	1.3	1.4	2.6
791.0	5.13	0.050	0.15	182.8	31	18	10.3	0.0416	7.4	5.8	8.3	22.4	1.0	-3.4	1.2	1.5	2.6
820.5	5.21	0.052	0.15	182.4	32	18	10.1	0.0753	5.9	5.1	7.6	16.2	0.7	-2.1	1.2	1.6	2.6
899.0	5.75	0.063	0.20	182.4	31	15	9.5	0.1640	4.7	4.5	7.0	9.2	0.2	-1.4	1.4	1.8	2.7
932.5	5.97	0.089	0.27	182.0	31	15	9.3	0.3543	4.0	4.2	6.7	5.0	0.0	-0.8	1.6	1.9	2.7
967.2	5.85	0.077	0.24	181.8	31	13	9.1	1.2309	3.6	4.0	6.5	1.7	-0.1	-0.5	1.8	2.0	2.7
1000.0	6.41	0.111	0.38	181.4	31	13	8.8	15.1064	3.4	3.8	6.3	0.0	0.0	-0.1	1.9	2.0	2.7

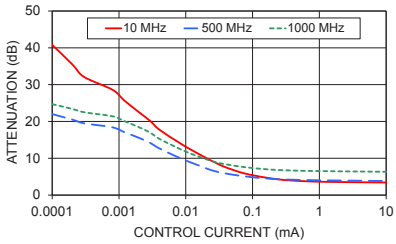
SYAS-2+
INSERTION LOSS



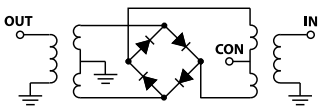
SYAS-2+
ISOLATION



SYAS-2+
ATTENUATION



electrical schematic



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

Attenuator/Switch SYAS-2+

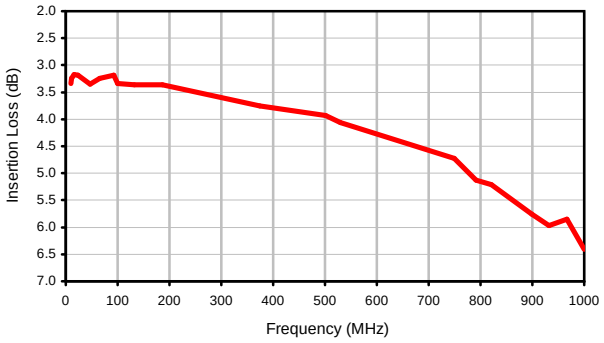
Typical Performance Data

FREQ. (MHz)	INSERTION LOSS (dB) at 20mA Control Current	AMP. UNBAL. (dB) at ± 20mA Control Current	PHASE UNBAL. (deg.) at ± 20mA Control Current	ISOLATION at 0 mA Control Current (dB)		RETURN LOSS (dB)
				In-Out	In-Con	Input
10.0	3.34	0.00	180.0	69	47	11.4
11.4	3.24	0.01	180.0	67	46	11.6
16.1	3.17	0.01	180.1	64	43	12.2
23.2	3.18	0.00	180.1	59	40	12.5
46.5	3.35	0.01	180.3	54	34	12.5
65.8	3.24	0.01	180.5	51	31	12.4
93.1	3.19	0.01	180.7	48	28	12.4
100.2	3.34	0.01	180.7	47	28	12.4
131.8	3.36	0.01	180.9	45	25	12.4
186.6	3.36	0.02	181.3	42	23	12.3
373.8	3.75	0.02	182.1	36	20	11.4
500.8	3.93	0.03	182.5	34	21	11.3
529.1	4.06	0.04	182.5	33	21	11.2
748.8	4.72	0.10	182.6	31	19	10.7
791.0	5.13	0.15	182.8	31	18	10.3
820.5	5.21	0.15	182.4	32	18	10.1
899.0	5.75	0.20	182.4	31	15	9.5
932.5	5.97	0.27	182.0	31	15	9.3
967.2	5.85	0.24	181.8	31	13	9.1
1000.0	6.41	0.38	181.4	31	13	8.8

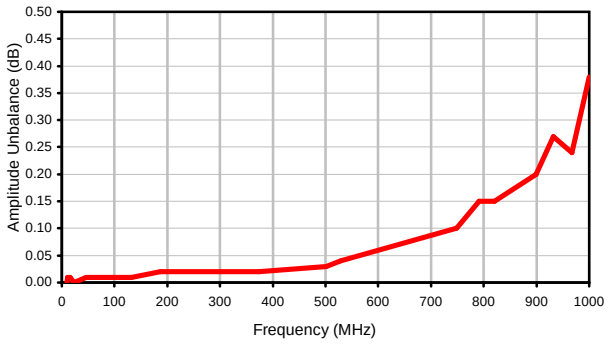
CONTROL CURRENT (mA)	ATTENUATION (dB)			PHASE UNBALANCE REF AT 15 mA CONTROL (deg.)			INPUT VSWR (:1)		
	10 MHz	500 MHz	1000 MHz	10 MHz	500 MHz	1000 MHz	10 MHz	500 MHz	1000 MHz
0.0000	51.3	24.7	27.2	76.7	40.6	0.5	3.3	2.3	4.2
0.0001	40.8	22.0	24.7	67.8	31.3	-6.7	3.2	2.2	4.0
0.0002	35.5	20.5	23.4	61.3	25.4	-10.4	3.2	2.2	3.8
0.0003	32.1	19.5	22.5	59.5	21.4	-12.8	3.1	2.1	3.7
0.0008	28.6	18.4	21.4	55.8	17.3	-14.7	3.0	2.0	3.6
0.0012	25.7	17.1	20.1	53.7	14.1	-15.8	2.9	1.9	3.4
0.0019	22.8	15.7	18.6	51.0	10.9	-16.0	2.7	1.9	3.2
0.0029	20.2	14.2	17.0	47.8	8.6	-15.1	2.6	1.7	3.1
0.0040	17.8	12.7	15.3	45.1	6.8	-13.6	2.4	1.6	2.9
0.0074	14.6	10.4	12.9	40.1	4.7	-10.7	2.1	1.5	2.7
0.0110	12.7	9.1	11.5	36.8	3.7	-8.7	1.9	1.4	2.6
0.0159	11.1	8.0	10.4	33.2	2.8	-7.2	1.7	1.4	2.6
0.0221	9.7	7.0	9.5	29.5	2.2	-5.3	1.5	1.4	2.5
0.0301	8.5	6.3	8.8	25.9	1.7	-4.3	1.3	1.4	2.6
0.0416	7.4	5.8	8.3	22.4	1.0	-3.4	1.2	1.5	2.6
0.0753	5.9	5.1	7.6	16.2	0.7	-2.1	1.2	1.6	2.6
0.1640	4.7	4.5	7.0	9.2	0.2	-1.4	1.4	1.8	2.7
0.3543	4.0	4.2	6.7	5.0	0.0	-0.8	1.6	1.9	2.7
1.2309	3.6	4.0	6.5	1.7	-0.1	-0.5	1.8	2.0	2.7
15.1064	3.4	3.8	6.3	0.0	0.0	-0.1	1.9	2.0	2.7

Typical Performance Curves

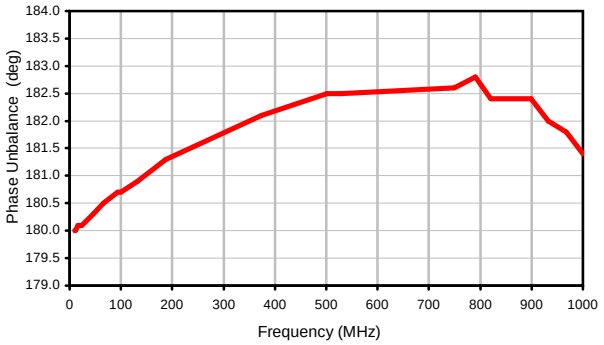
Insertion Loss @ 20 mA



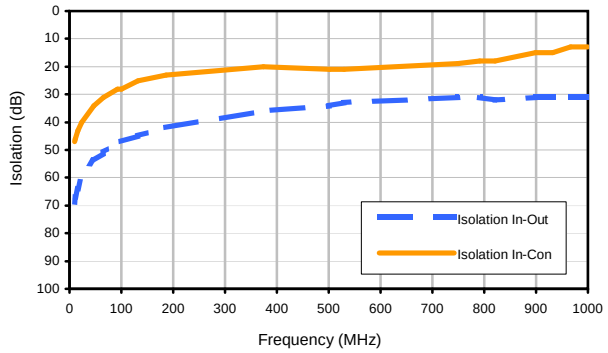
Amplitude Unbalance @ ± 20mA



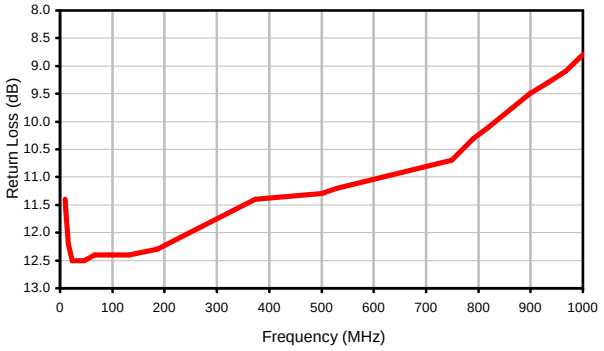
Phase Unbalance @ ± 20mA



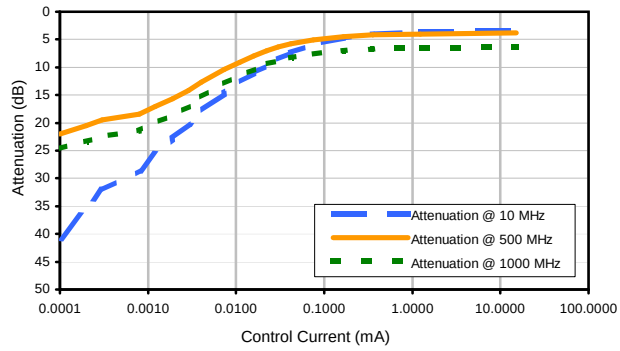
Isolation @ 0 mA



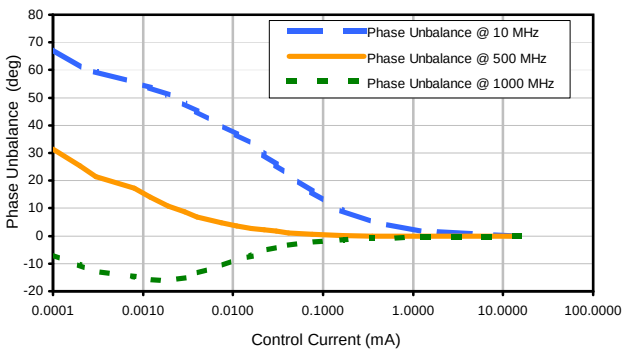
Return Loss Input



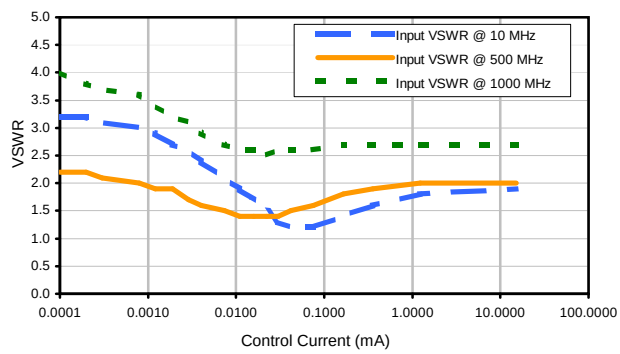
Attenuation



Phase Unbalance ref @ 15 mA



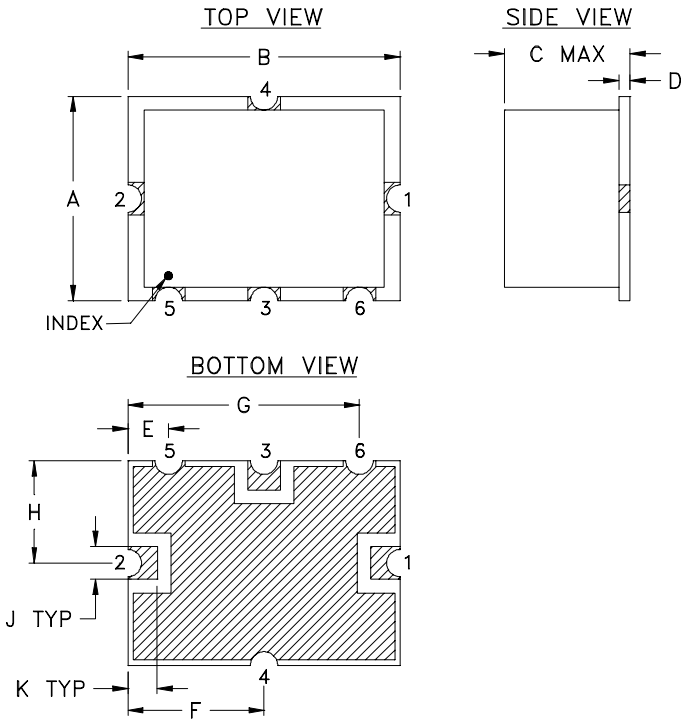
Input VSWR



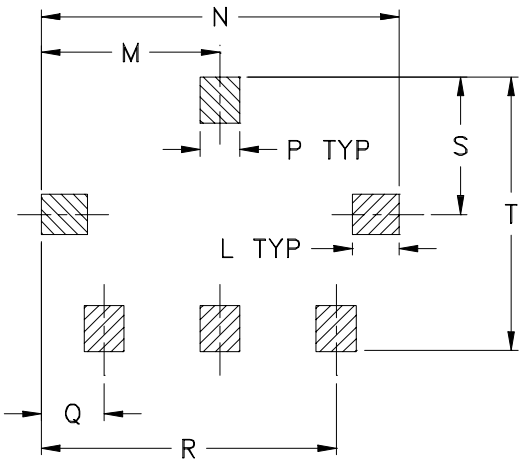
Case Style TTT

Outline Dimensions

TTT166
TTT167



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE #	A	B	C	D	E	F	G	H	J	K	L	M	N
TTT166	.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)
TTT167			.23 (5.84)										

CASE #	P	Q	R	S	T	WT. GRAM
TTT166	.060 (1.52)	.095 (2.41)	.445 (11.30)	.208 (5.28)	.415 (10.54)	.8
TTT167						.8

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

Note:

1. Case material: Plastic.
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 Styles: Tin-Lead plate. All models, no (+) suffix.

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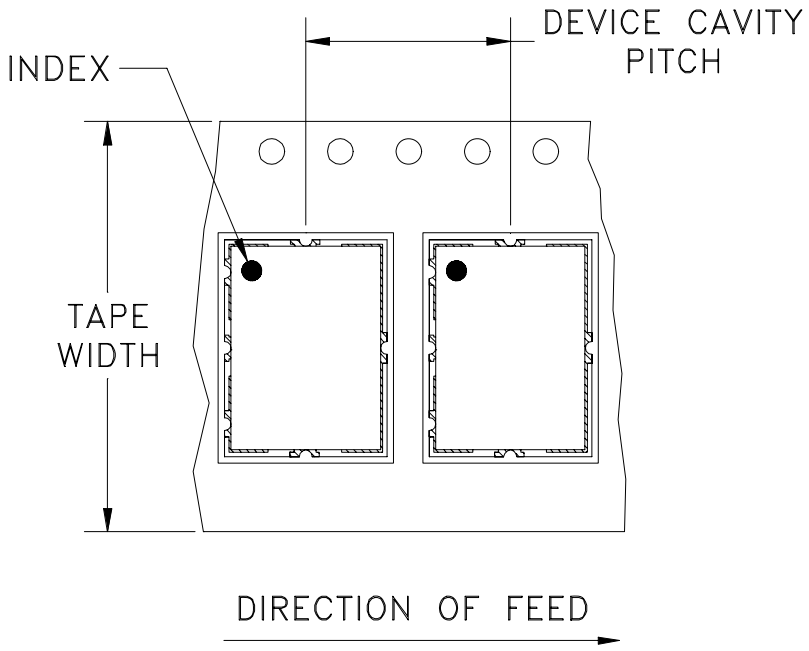
Mini-Circuits ISO 9001 & ISO 14001 Certified

Tape & Reel Packaging TR-F12

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
24	12	7	Small quantity standards (see note)	10
				20
				50
				100
				200
		13	Standard	500

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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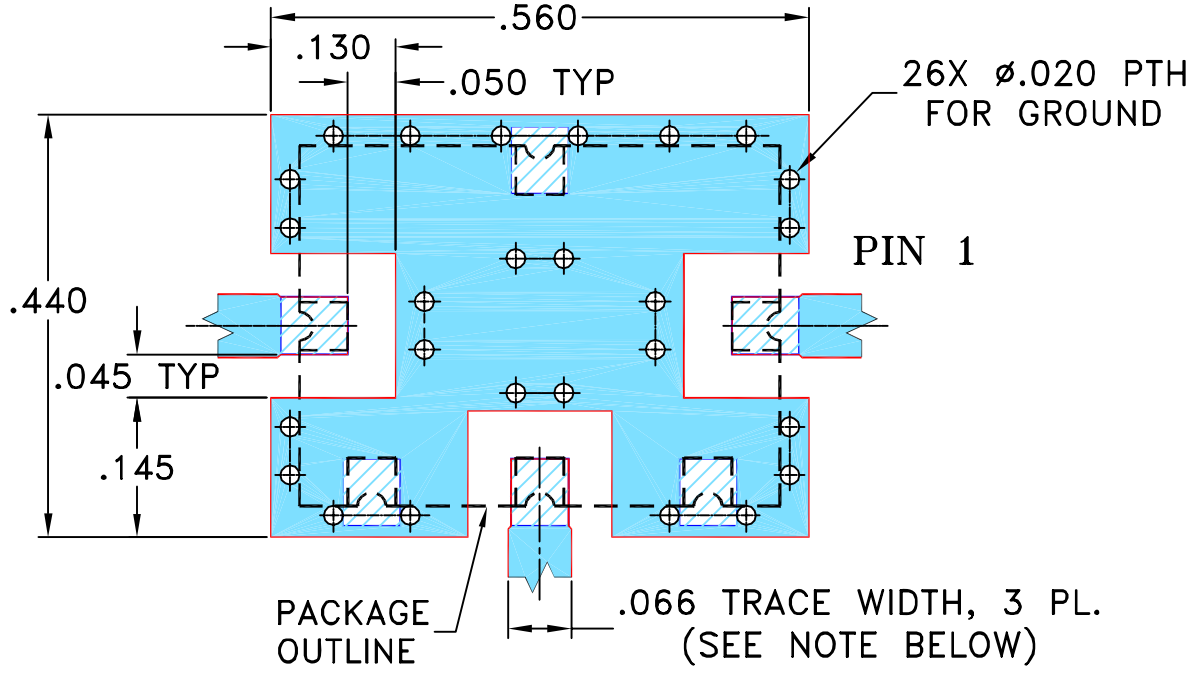
THIRD ANGLE PROJECTION

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



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

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

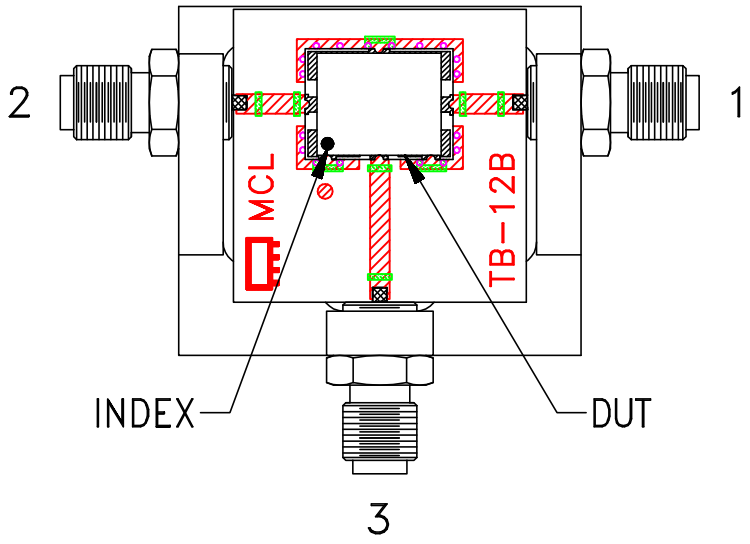
PL, hk/lp/lq/x/ck/ec, TTT166/167, SYM/HJK/SYAS/SYPD, TB-12

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

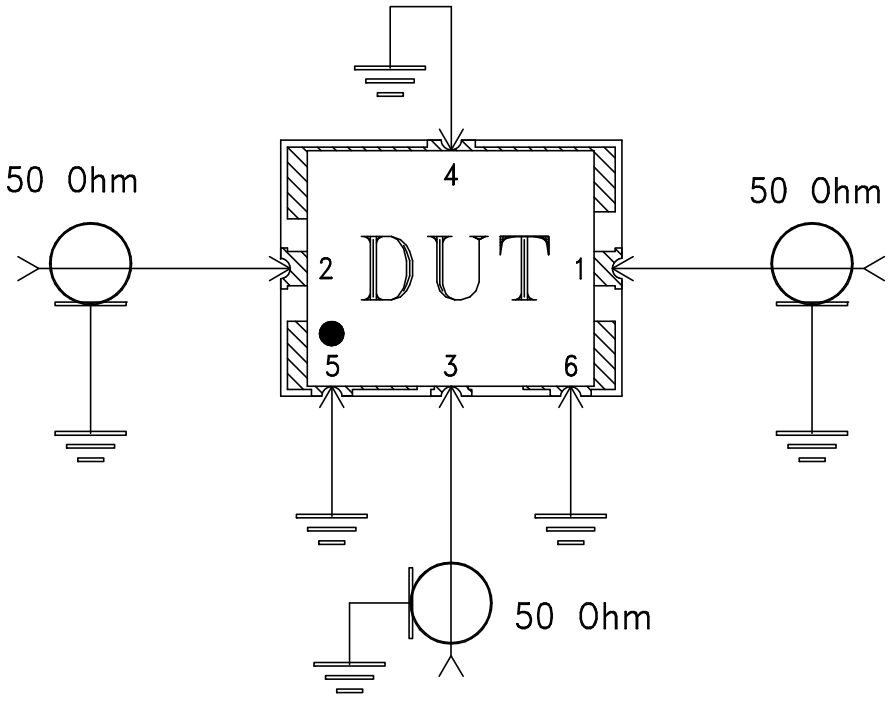
FILE:	SCALE:	SHEET:
98PL079	5:1	1 OF 1

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®

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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