

# Surface Mount Attenuator/Switch

50Ω Bi-Phase 2 to 400 MHz

RAS-1+



Generic photo used for illustration purposes only  
CASE STYLE: TT241

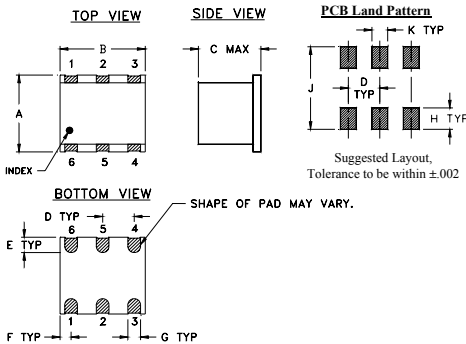
## Maximum Ratings

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	4
OUTPUT	1
CONTROL	5
GROUND	2,3,6

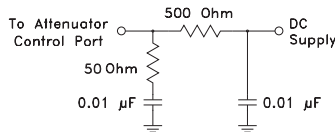
## Outline Drawing



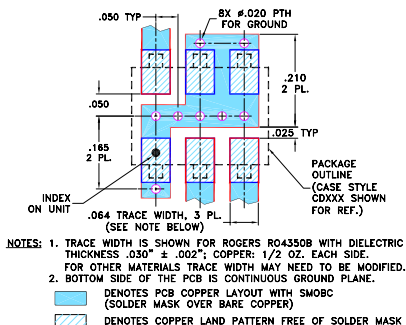
## Outline Dimensions (inch/mm)

A	B	C	D	E	F
.250	.31	.275	.100	.050	.055
6.35	7.87	6.99	2.54	1.27	1.40
G	H	J	K	wt	
.040	.070	.270	.050	grams	
1.02	1.78	6.86	1.27	0.50	

## suggested control port biasing configuration



## Demo Board MCL P/N: TB-03 Suggested PCB Layout (PL-052)



## Notes

- 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.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.
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## Features

- wideband, 2 to 400 MHz
- low conversion loss, 1.6 dB typ.
- excellent phase and amplitude unbalance

## Applications

- bi-phase modulator

## Attenuator/Switch Electrical Specifications

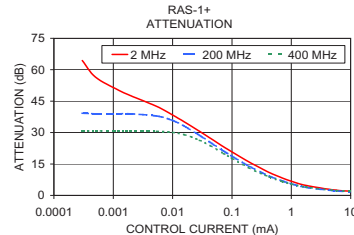
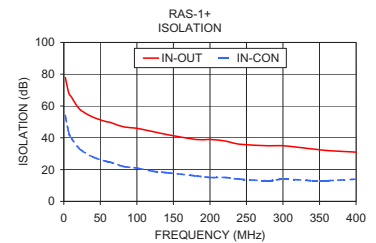
FREQUENCY (MHz)	CON	INSERTION LOSS (dB) ±20 mA		MAX. INPUT PWR (dBm) ±20 mA	IN-OUT ISOLATION (dB) 0 mA			BI-PHASE X (±20 mA) Typ.									
		Mid-Band m	Total Range		L	M	U	Δ AMP (dB)	Phase (deg.) deviation from 180°								
f <sub>L</sub> -f <sub>U</sub>		Typ.	Max.	1 dB compr.	no damage	Typ.	Min.	Typ.	Min.	Total Range	Total Range						
2-400	DC-0.05	1.4	2.4	1.6	3.2	20*	25	65	45	45	28	32	22	0.10	0.1	1.0	2.0

L = low range [f<sub>L</sub> to 10 f<sub>L</sub>] M = mid range [10 f<sub>L</sub> to f<sub>U</sub>/2] U = upper range [f<sub>U</sub>/2 to f<sub>U</sub>] m = [2 f<sub>L</sub> to f<sub>U</sub>/2]  
\* 15 dBm from 2-10 MHz.

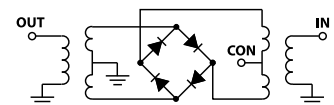
Performance specifications apply for input power up to 10 dB below stated 1 dB compression.

## Typical Performance Data

Freq. (MHz)	I. Loss (dB) at 20mA	±Control ΔΔAMP (dB)		20mA ΔΔPhase (deg.)	Isolation (dB) (in-out)		Input R. Loss (dB)	Control Current (mA)	Attenuation (dB)			Phase Δ ref at 15mA Ctrl deg.			Input VSWR		
		2	200		2	200			400	2	200	400	2	200	400		
X	σ	X	X	X	X	X	X		2 MHz	200 MHz	400 MHz	2 MHz	200 MHz	400 MHz	2 MHz	200 MHz	400 MHz
2.0	1.67	0.000	0.01	179.9	78	54	18.1	0.0000	72.7	39.0	30.6	27.2	-87.7	-95.3	7.7	7.2	4.4
7.0	1.16	0.001	0.00	180.0	68	43	15.4	0.0003	64.4	39.2	30.7	22.2	-86.0	-94.6	7.7	7.2	4.4
10.0	1.16	0.001	0.00	180.0	66	40	27.6	0.0005	56.5	39.0	30.8	28.6	-84.3	-93.7	7.6	7.2	4.4
21.9	1.16	0.001	0.00	180.0	58	33	31.0	0.0012	50.4	39.0	30.7	17.6	-80.5	-92.0	7.6	7.2	4.4
39.8	1.19	0.001	0.00	180.1	53	28	31.9	0.0019	47.8	39.0	30.7	14.1	-77.4	-90.3	7.5	7.2	4.4
59.7	1.23	0.001	0.00	180.1	50	25	32.1	0.0054	42.5	37.9	30.6	8.2	-56.2	-79.9	7.4	7.0	4.3
61.7	1.23	0.001	0.00	180.1	50	25	32.1	0.0100	38.4	35.8	30.1	7.6	-37.3	-67.6	7.2	6.9	4.3
81.6	1.24	0.001	0.00	180.2	47	22	32.2	0.0157	35.1	33.1	29.0	8.8	-25.3	-55.1	7.1	6.7	4.2
99.5	1.27	0.001	0.00	180.2	46	21	32.3	0.0284	30.6	28.7	26.3	8.8	-12.8	-37.6	6.7	6.3	4.0
121.4	1.31	0.001	0.01	180.3	44	19	32.4	0.0433	27.3	25.3	23.7	9.2	-7.2	-26.9	6.3	5.9	3.8
141.3	1.32	0.001	0.01	180.4	42	18	32.4	0.0722	23.2	21.2	20.0	9.3	-3.1	-17.7	5.6	5.3	3.5
181.1	1.37	0.001	0.01	180.6	39	16	32.2	0.1012	20.7	18.6	17.6	9.0	-1.4	-13.2	5.2	4.9	3.3
200.0	1.40	0.001	0.01	180.6	39	15	32.0	0.1898	16.1	14.1	13.3	8.2	0.4	-8.0	4.1	3.9	2.8
220.9	1.39	0.001	0.01	180.8	38	15	31.6	0.3008	13.1	11.2	10.6	7.4	0.9	-5.5	3.4	3.2	2.4
240.8	1.39	0.001	0.01	180.9	36	14	30.3	0.4259	10.9	9.2	8.8	6.7	1.1	-4.2	2.9	2.7	2.1
280.6	1.52	0.001	0.05	181.1	35	13	26.6	0.7017	8.3	6.9	6.6	5.4	1.1	-2.8	2.2	2.1	1.7
300.5	1.52	0.001	0.04	181.1	35	14	24.8	0.9968	6.8	5.6	5.4	4.4	0.9	-2.1	1.9	1.8	1.5
340.3	1.56	0.001	0.03	181.4	33	13	21.4	1.7486	4.8	3.9	4.0	3.0	0.7	-1.3	1.5	1.5	1.3
360.2	1.64	0.002	0.06	181.6	32	13	19.8	5.6920	2.5	2.1	2.3	0.9	0.2	-0.3	1.2	1.1	1.2
400.0	1.78	0.003	0.09	181.7	31	14	17.1	15.1258	1.8	1.5	1.8	0.0	0.0	0.1	1.3	1.1	1.3



## electrical schematic



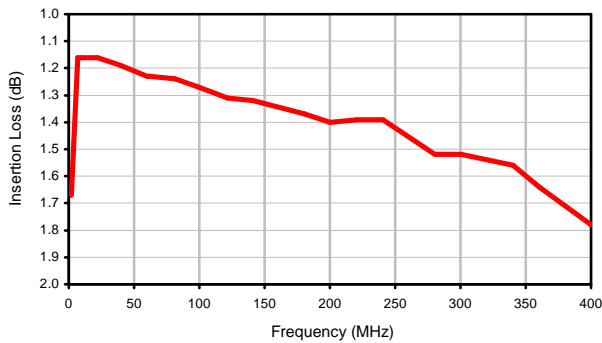
## Typical Performance Data

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) Input
				In-Out	In-Con	
2.0	1.67	0.01	179.9	78	54	18.1
7.0	1.16	0.00	180.0	68	43	15.4
10.0	1.16	0.00	180.0	66	40	27.6
21.9	1.16	0.00	180.0	58	33	31.0
39.8	1.19	0.00	180.1	53	28	31.9
59.7	1.23	0.00	180.1	50	25	32.1
61.7	1.23	0.00	180.1	50	25	32.1
81.6	1.24	0.00	180.2	47	22	32.2
99.5	1.27	0.00	180.2	46	21	32.3
121.4	1.31	0.01	180.3	44	19	32.4
141.3	1.32	0.01	180.4	42	18	32.4
181.1	1.37	0.01	180.6	39	16	32.2
200.0	1.40	0.01	180.6	39	15	32.0
220.9	1.39	0.01	180.8	38	15	31.6
240.8	1.39	0.01	180.9	36	14	30.3
280.6	1.52	0.05	181.1	35	13	26.6
300.5	1.52	0.04	181.1	35	14	24.8
340.3	1.56	0.03	181.4	33	13	21.4
360.2	1.64	0.06	181.6	32	13	19.8
400.0	1.78	0.09	181.7	31	14	17.1

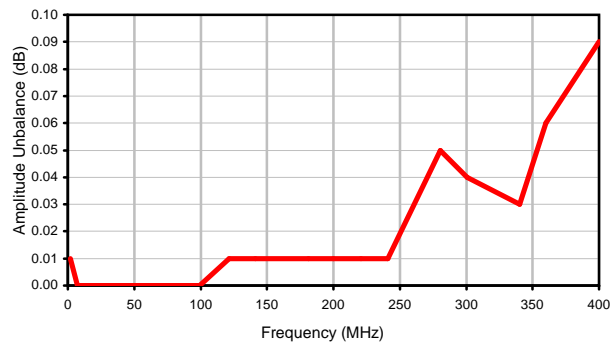
CONTROL CURRENT (mA)	ATTENUATION (dB)			PHASE UNBALANCE REF AT 15 mA CONTROL (deg.)			INPUT VSWR (:1)		
	2 MHz	200 MHz	400 MHz	2 MHz	200 MHz	400 MHz	2 MHz	200 MHz	400 MHz
0.0000	72.7	39.0	30.6	27.2	-87.7	-95.3	7.7	7.2	4.4
0.0003	64.4	39.2	30.7	22.2	-86.0	-94.6	7.7	7.2	4.4
0.0005	56.5	39.0	30.8	28.6	-84.3	-93.7	7.6	7.2	4.4
0.0012	50.4	39.0	30.7	17.6	-80.5	-92.0	7.6	7.2	4.4
0.0019	47.8	39.0	30.7	14.1	-77.4	-90.3	7.5	7.2	4.4
0.0054	42.5	37.9	30.6	8.2	-56.2	-79.9	7.4	7.0	4.3
0.0100	38.4	35.8	30.1	7.6	-37.3	-67.6	7.2	6.9	4.3
0.0157	35.1	33.1	29.0	8.8	-25.3	-55.1	7.1	6.7	4.2
0.0284	30.6	28.7	26.3	8.8	-12.8	-37.6	6.7	6.3	4.0
0.0433	27.3	25.3	23.7	9.2	-7.2	-26.9	6.3	5.9	3.8
0.0722	23.2	21.2	20.0	9.3	-3.1	-17.7	5.6	5.3	3.5
0.1012	20.7	18.6	17.6	9.0	-1.4	-13.2	5.2	4.9	3.3
0.1898	16.1	14.1	13.3	8.2	0.4	-8.0	4.1	3.9	2.8
0.3008	13.1	11.2	10.6	7.4	0.9	-5.5	3.4	3.2	2.4
0.4259	10.9	9.2	8.8	6.7	1.1	-4.2	2.9	2.7	2.1
0.7017	8.3	6.9	6.6	5.4	1.1	-2.8	2.2	2.1	1.7
0.9968	6.8	5.6	5.4	4.4	0.9	-2.1	1.9	1.8	1.5
1.7486	4.8	3.9	4.0	3.0	0.7	-1.3	1.5	1.5	1.3
5.6920	2.5	2.1	2.3	0.9	0.2	-0.3	1.2	1.1	1.2
15.1258	1.8	1.5	1.8	0.0	0.0	0.1	1.3	1.1	1.3

## Typical Performance Curves

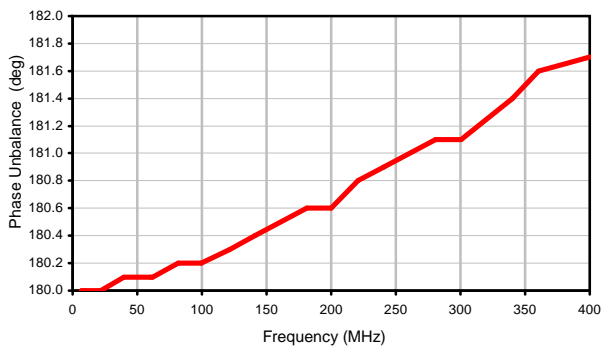
Insertion Loss @ 20 mA



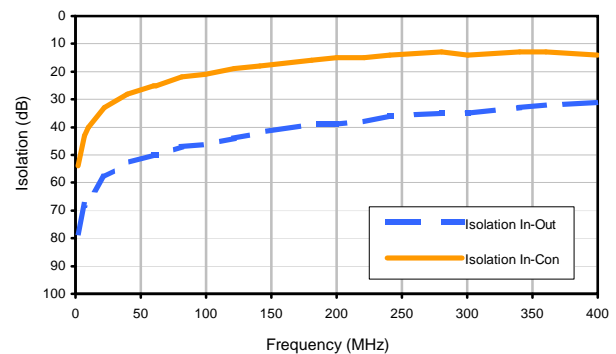
Amplitude Unbalance @ ± 20mA



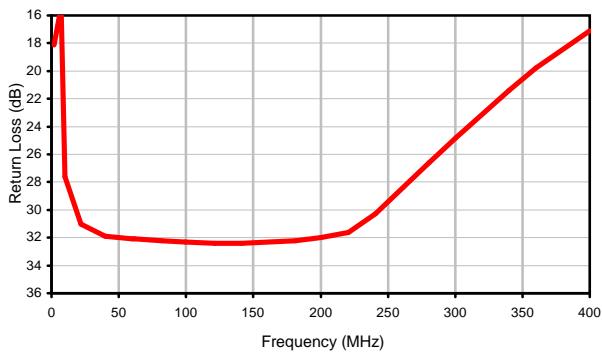
Phase Unbalance @ ± 20mA



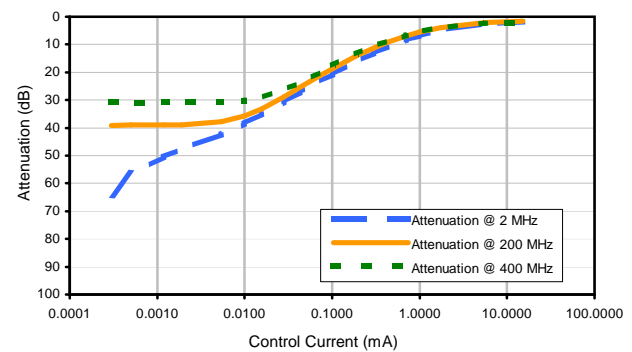
Isolation @ 0 mA



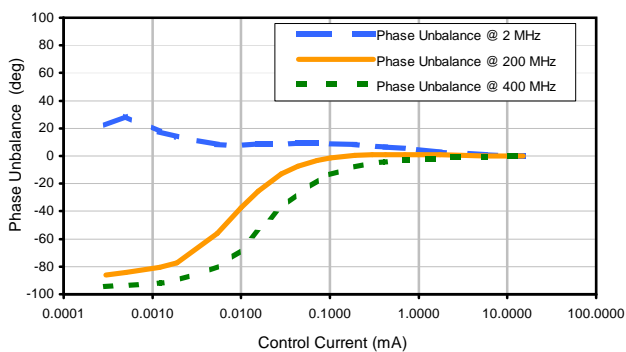
Return Loss Input



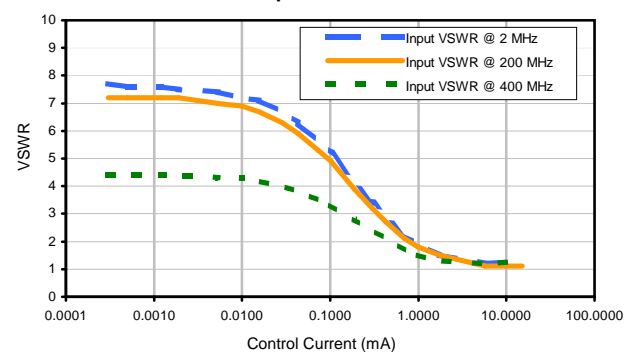
Attenuation



Phase Unbalance ref @ 15 mA

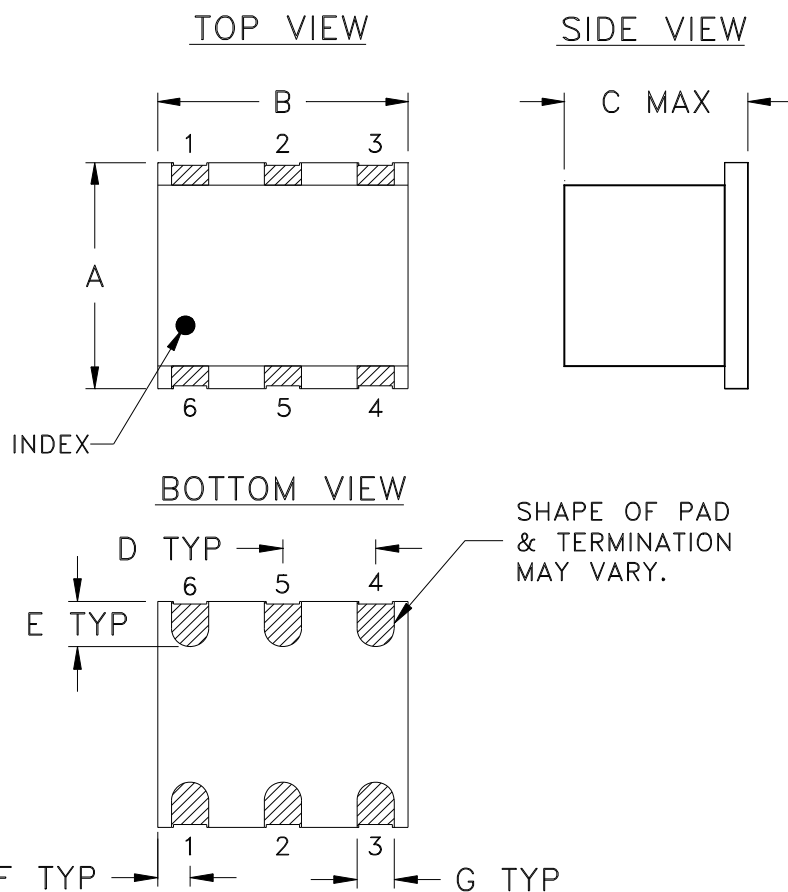


Input VSWR

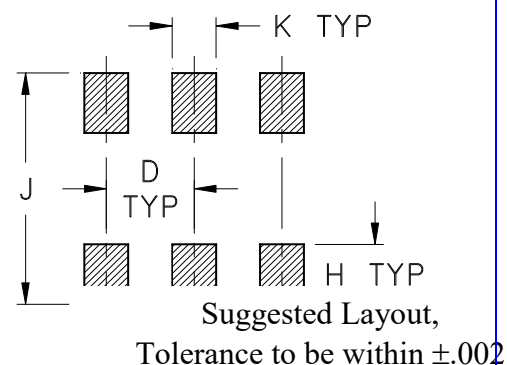


## TT241

### Outline Dimensions



### PCB Land Pattern



CASE #	A	B	C	D	E	F	G	H	J	K	WT. GRAM
TT241	.250 (6.35)	.31 (7.87)	.27 (6.99)	.100 (2.54)	.050 (1.27)	.055 (1.40)	.040 (1.02)	.070 (1.78)	.270 (6.86)	.050 (1.27)	.50

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

### Notes:

- Case material: Ceramic.
- Termination finish:
  - For RoHS Case Styles: 2-10 $\mu$  inch (.05-.25 microns) Gold plate over 100-300  $\mu$  inch (2.54-7.62 microns) Nickel plate. All models, (+) suffix.
  - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.



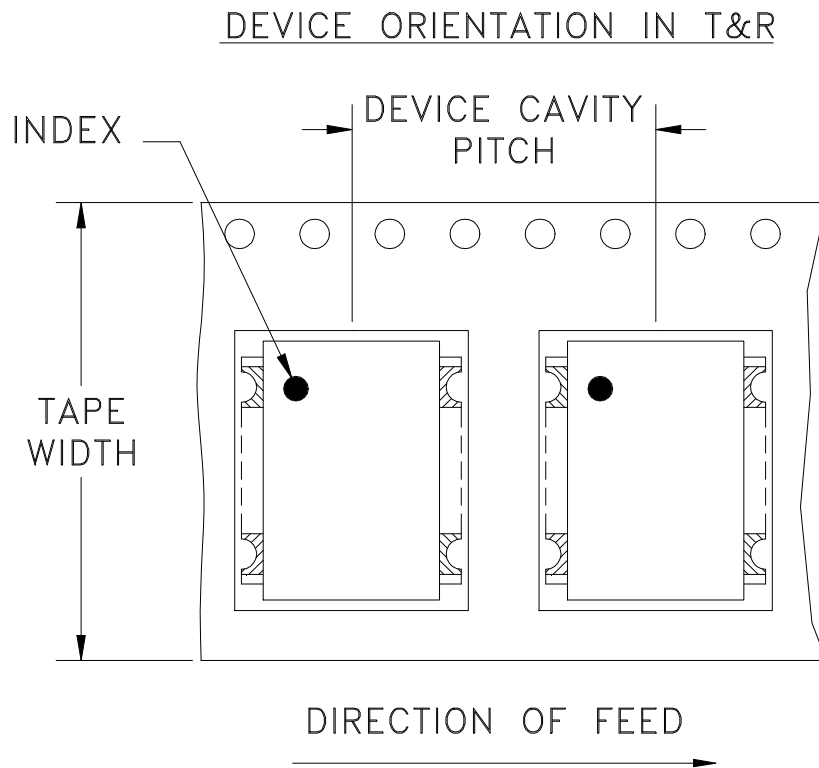
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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RF/IF MICROWAVE COMPONENTS

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<b>Tape Width, mm</b>	<b>Device Cavity Pitch, mm</b>	<b>Reel Size, inches</b>	<b>Devices per Reel</b>
24	12	13	500

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.

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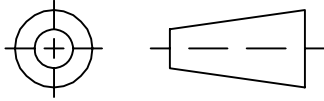
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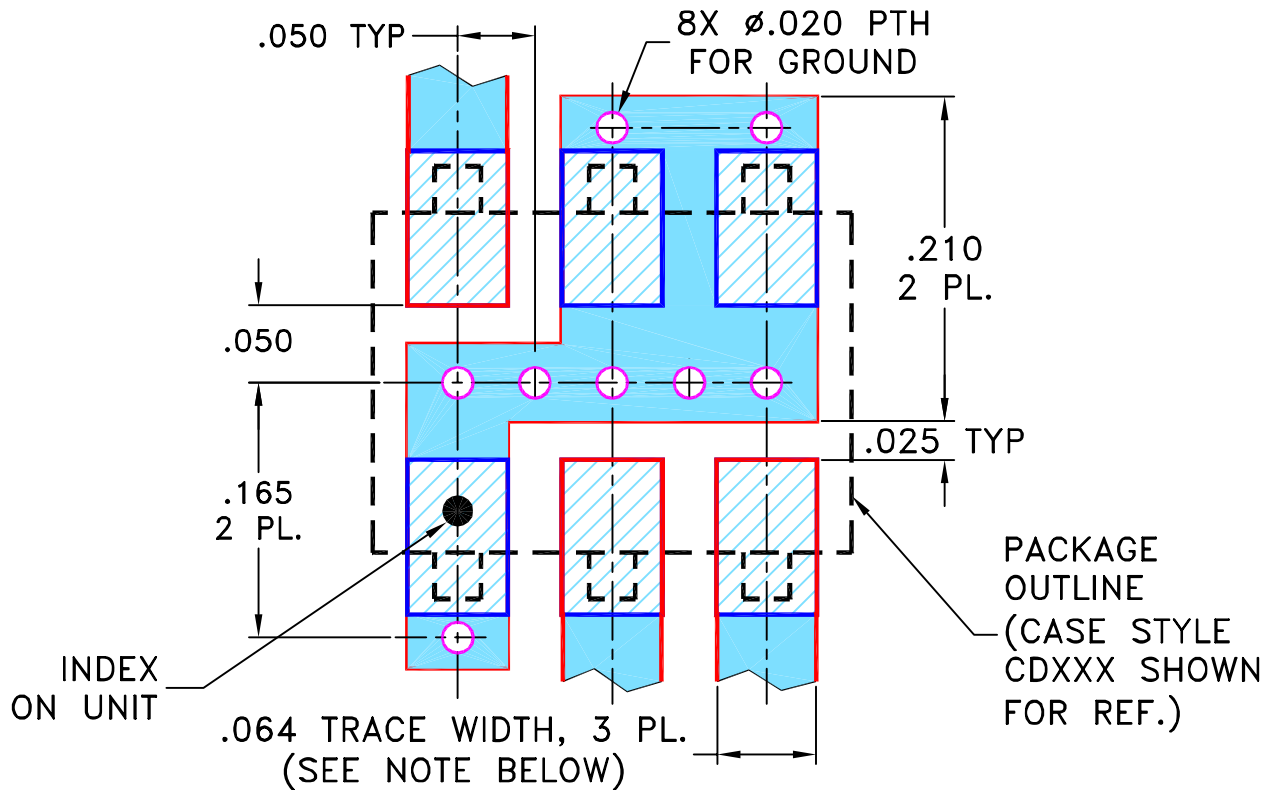
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
A	M101143	ADDED "gk" PIN CONNECTION, TT100 CASE STYLE & NOTE 2	10/10/05	MMG	DJ
B	M102713	ADDED "...WITH SMOBC"	01/17/06	MMG	IL
C	M108637	REMOVED "PIN 1", ADDED INDEX ON UNIT	12/01/06	MYG	FL

SUGGESTED MOUNTING CONFIGURATION  
FOR BH292, CD541/542/636/637, TT100/240 CASE  
STYLES, "gk", "ht", "hu", "nd", "w" PIN CONNECTIONS



- NOTES:** 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030" ± .002"; 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	DRAWN <b>MMG</b>	07/17/02
TOLERANCES ON:	CHECKED <b>WL</b>	08/02/02
2 PL DECIMALS ±	APPROVED <b>DJ</b>	08/05/02
3 PL DECIMALS ± .005		
ANGLES ±		
FRACTIONS ±		

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 Brooklyn NY 11235

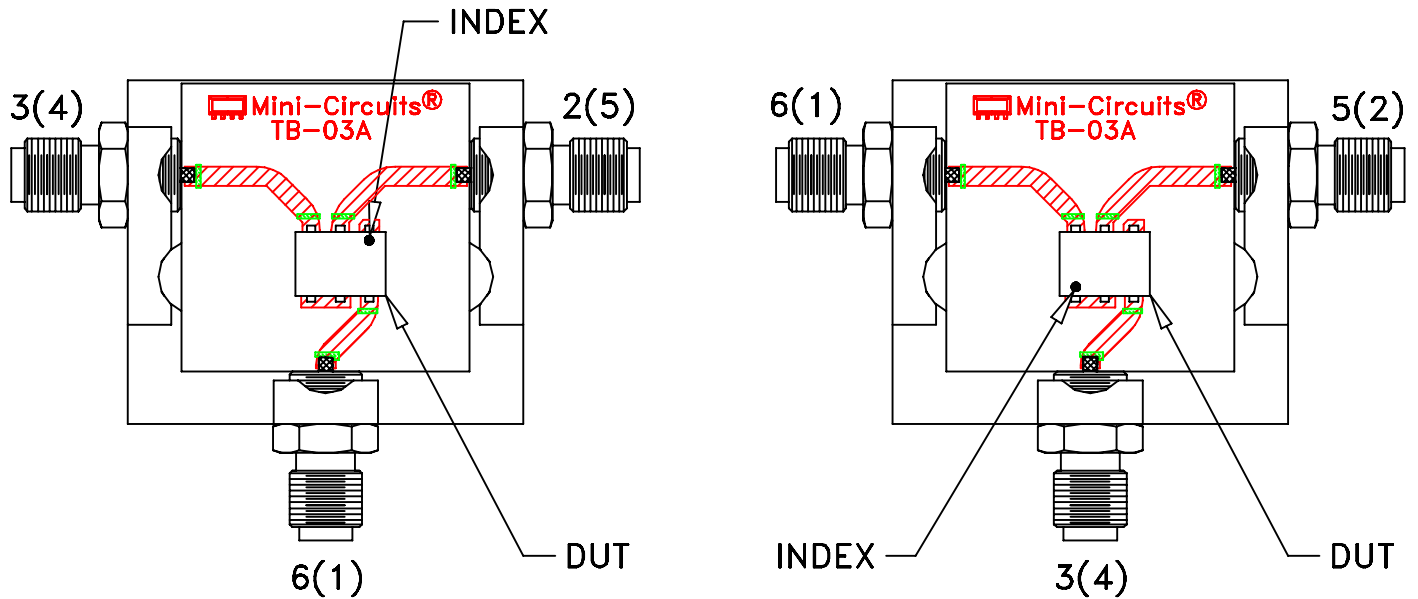
PL, gk/ht/hu/nd/w, BH292,  
 CD541/542/636/637, TT100/240, TB-03

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-052	C
FILE:	98PL052	SCALE: 8:1	SHEET: 1 OF 1

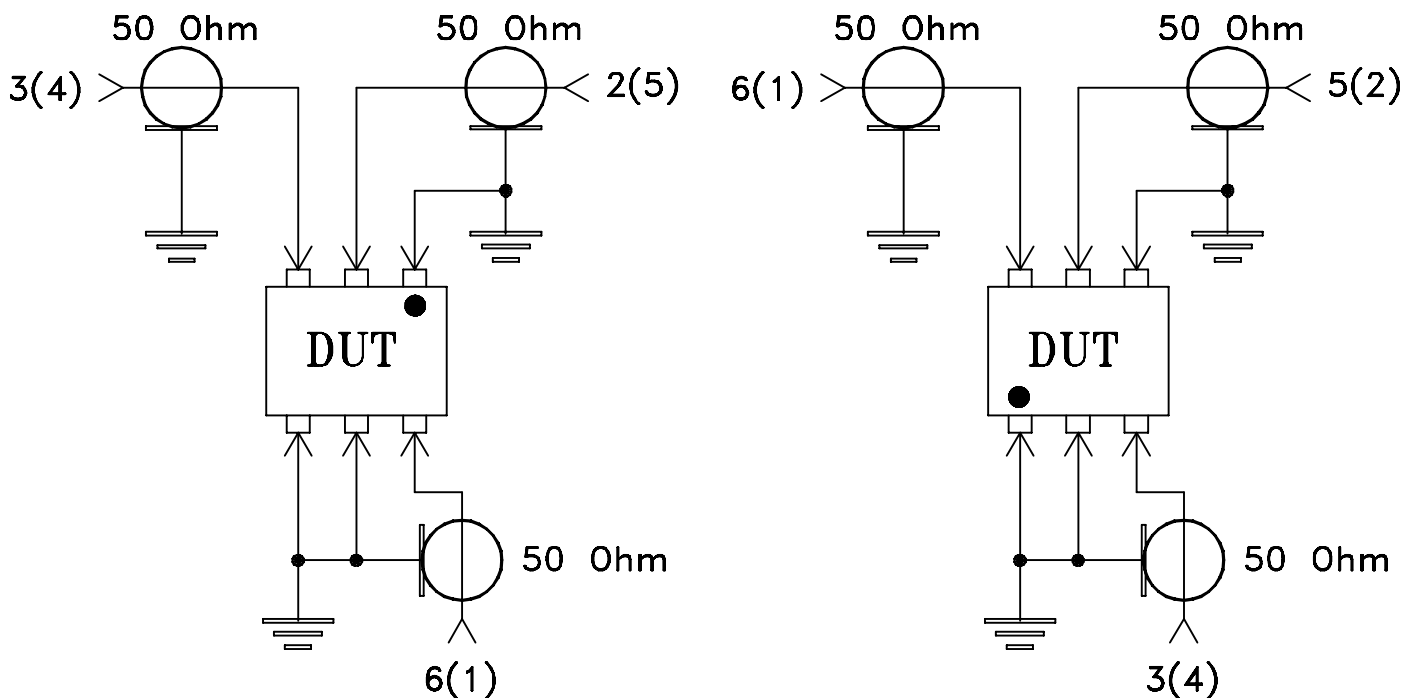
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# Evaluation Board and Circuit

For Pin Connections and DUT Orientation Refer to  
Data Sheet of the DUT




TB-03



Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.030 inch.

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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