

Surface Mount Attenuator/Switch

50Ω Bi-Phase 10 to 1000 MHz

TFAS-2SM+



Generic photo used for illustration purposes only
CASE STYLE: NNN150

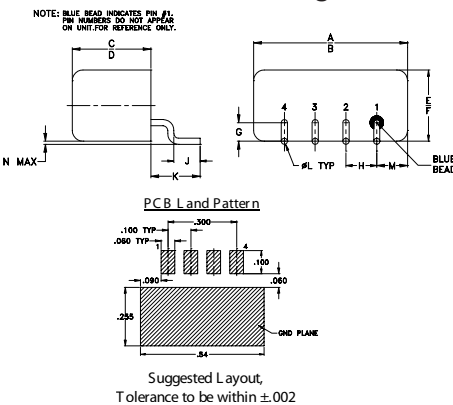
Maximum Ratings

Operating Temperature	-55°C to 100°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	4
CONTROL	2
GROUND	3
CASE GROUND	3

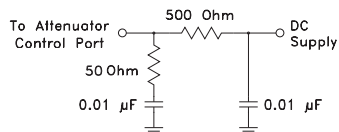
Outline Drawing



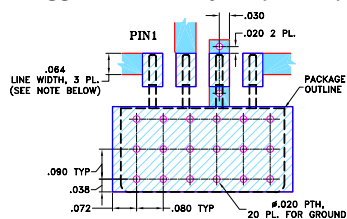
Outline Dimensions (inch/mm)

A	B	C	D	E	F	G
.50	.48	.255	.240	.23	.21	.06
12.70	12.19	6.48	6.10	5.84	5.33	1.52
H	J	K	L	M	N	wt
.100	.09	.16	.020	.09	.005	grams
2.54	2.29	4.06	0.51	2.29	0.13	1.9

suggested control port biasing configuration



Demo Board MCL P/N: TB-201 Suggested PCB Layout (PL-081)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS: 0.030" ± 0.002"; 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.
3. DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
4. DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

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/MCLStore/terms.jsp

Features

- wideband, 10 to 1000 MHz
- high in-out isolation

Applications

- bi-phase modulator

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 X (±20 mA) Typ.			
IN	CON	Mid-Band m		Total Range		1 dB compr.	no damage	L		M		U		Δ AMP (dB)	Phase (deg.) deviation from 180°
f _L -f _U		Typ.	Max.	Typ.	Max.			Typ.	Min.	Typ.	Min.	Typ.	Min.	m	Total Range
10-1000	DC-0.5	3.7	4.5	5.0	8.0	17*	25	50	30	42	20	31	20	0.1	0.2

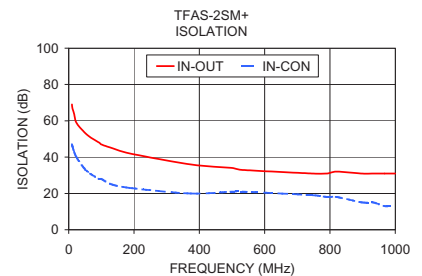
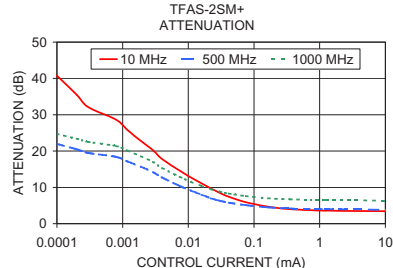
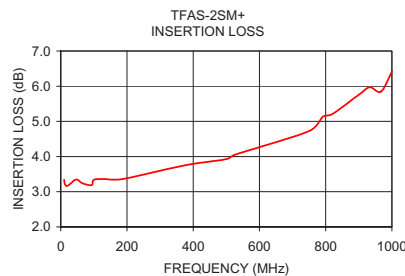
L = low range [f_L to 10 f_L] M = mid range [10 f_L to f_U/2] U = upper range [f_U/2 to f_U] m = [2 f_L to f_U/2]

* 13 dBm from 10-500 MHz.

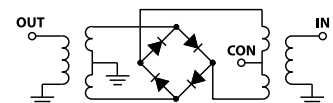
Performance specifications apply for input power up to 10 dB below stated 1 dB compression.

Typical Performance Data

Freq. (MHz)	I. Loss (dB) at 20mA		±Control ΔAMP (dB)		20mA ΔPhase (deg.)		Isolation (dB) (in-out) (in-con)		Input R. Loss (dB)	Control Current (mA)	Attenuation (dB)			Phase Δ ref at 15mA Ctrl			Input VSWR		
											10 MHz	500 MHz	1000 MHz	10 MHz	500 MHz	1000 MHz	10 MHz	500 MHz	1000 MHz
	X	σ	X	σ	X	σ	X	σ	X					deg.	deg.	deg.			
10.0	3.34	0.009	0.00		180.0		69		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		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		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		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		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		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		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		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		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		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		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		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		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		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		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		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		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		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		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		8.8	15.1064	3.4	3.8	6.3	0.0	0.0	-0.1	1.9	2.0	2.7



electrical schematic



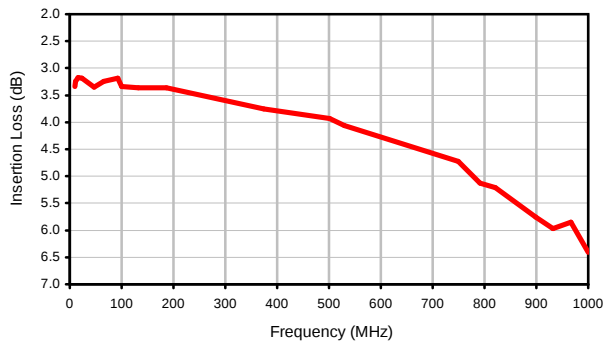
Typical Performance Data

FREQ. (MHz)	INSERTION LOSS (dB) at 20mA Control Current	AMP. UNBAL. (dB) at ± 20 mA Control Current	PHASE UNBAL. (deg.) at ± 20 mA Control Current	ISOLATION at 0 mA Control Current (dB)		RETURN LOSS (dB) Input
				In-Out	In-Con	
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

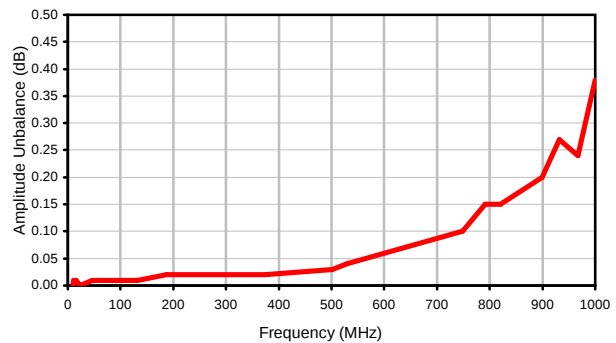
CONTROL CURRENT (mA)	ATTENUATION (dB)			PHASE UNBALANCE REF AT 15 mA CONTROL (deg.)			INPUT VSWR (:1)		
	10 MHz	500 MHz	1000 MHz	10 MHz	500 MHz	1000 MHz	10 MHz	500 MHz	1000 MHz
0.0000	51.3	24.7	27.2	76.7	40.6	0.5	3.3	2.3	4.2
0.0001	40.8	22.0	24.7	67.8	31.3	-6.7	3.2	2.2	4.0
0.0002	35.5	20.5	23.4	61.3	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

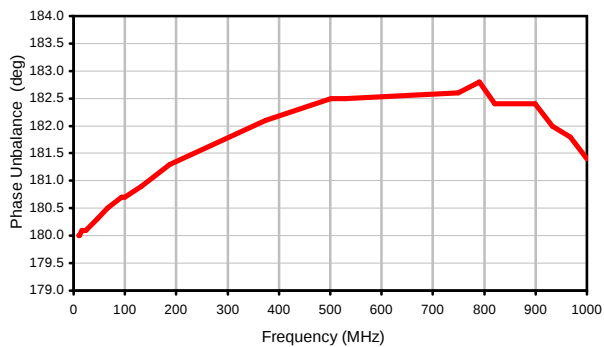
Insertion Loss @ 20 mA



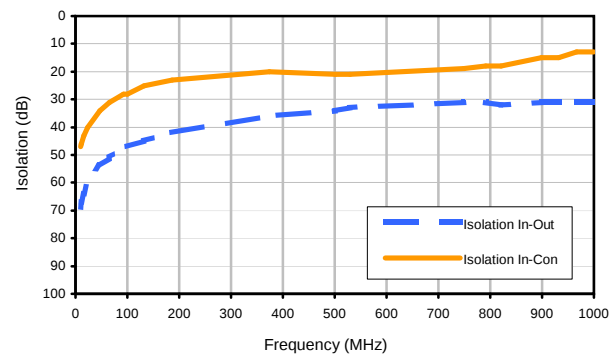
Amplitude Unbalance @ ± 20 mA



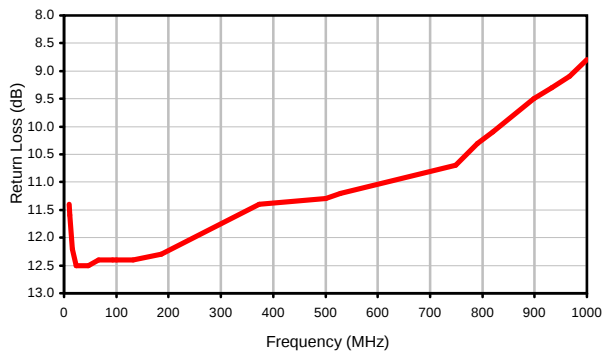
Phase Unbalance @ ± 20 mA



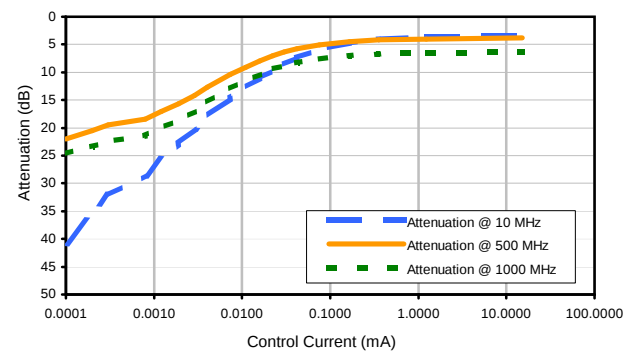
Isolation @ 0 mA



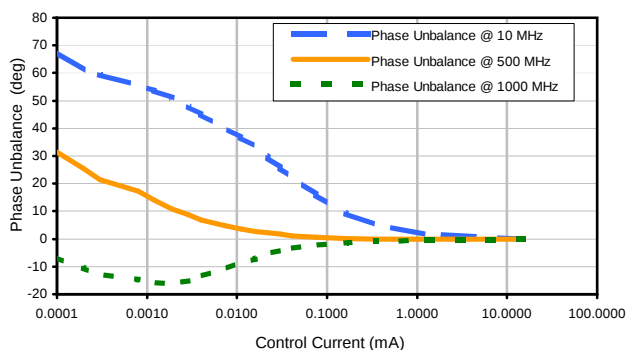
Return Loss Input



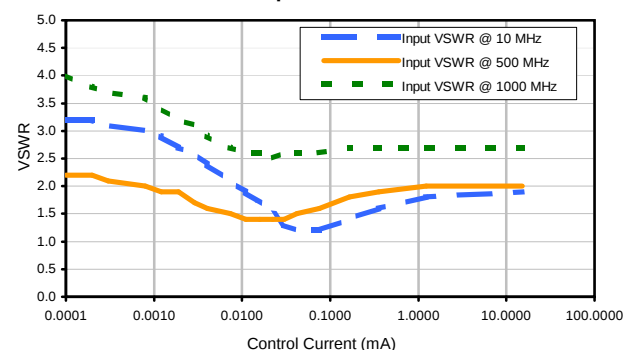
Attenuation



Phase Unbalance ref @ 15 mA



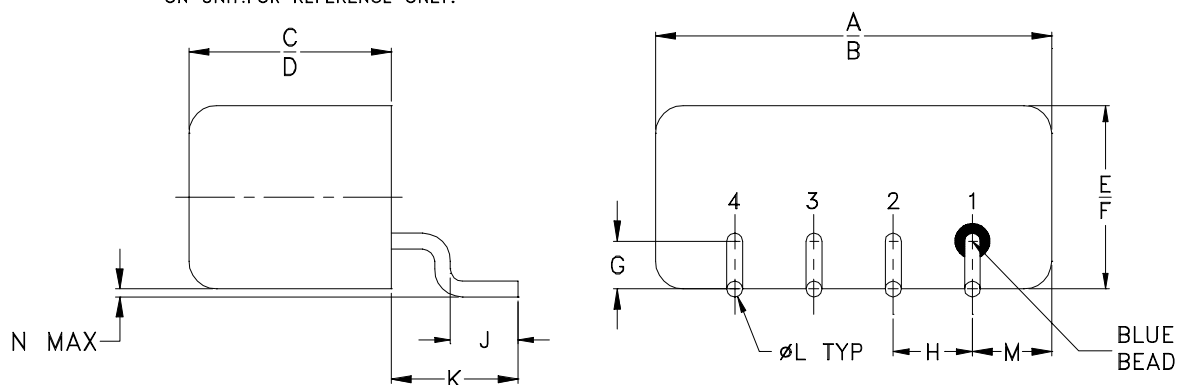
Input VSWR



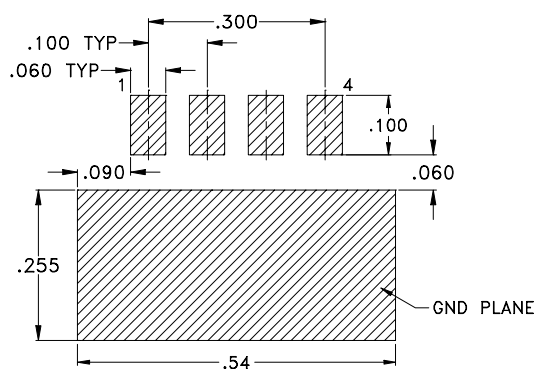
Outline Dimensions

NNN150

NOTE: BLUE BEAD INDICATES PIN #1.
PIN NUMBERS DO NOT APPEAR
ON UNIT.FOR REFERENCE ONLY.



PCB Land Pattern



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

CASE #.	A	B	C	D	E	F	G	H	J	K	L	M	N	WT, GRAM
NNN150	.50 (12.70)	.48 (12.19)	.255 (6.48)	.240 (6.10)	.23 (5.84)	.21 (5.33)	.06 (1.52)	.100 (2.54)	.09 (2.29)	.16 (4.06)	.020 (0.51)	.09 (2.29)	.005 (0.13)	1.9

Dimensions are in inches (mm). Tolerances: 2 Pl. $\pm .03$; 3 Pl. $\pm .015$

Notes:

- Header material C.R.S. Pin material #52 alloy.
- Finish: Electro-Tin, hot-oil flowed or electro-Tin-Silver.
- Cover material: Cupro-Nickel.
- Pin's meniscus 0.015 inch max.
- Special Tolerances: Pin diameter $\pm .005$ inch.



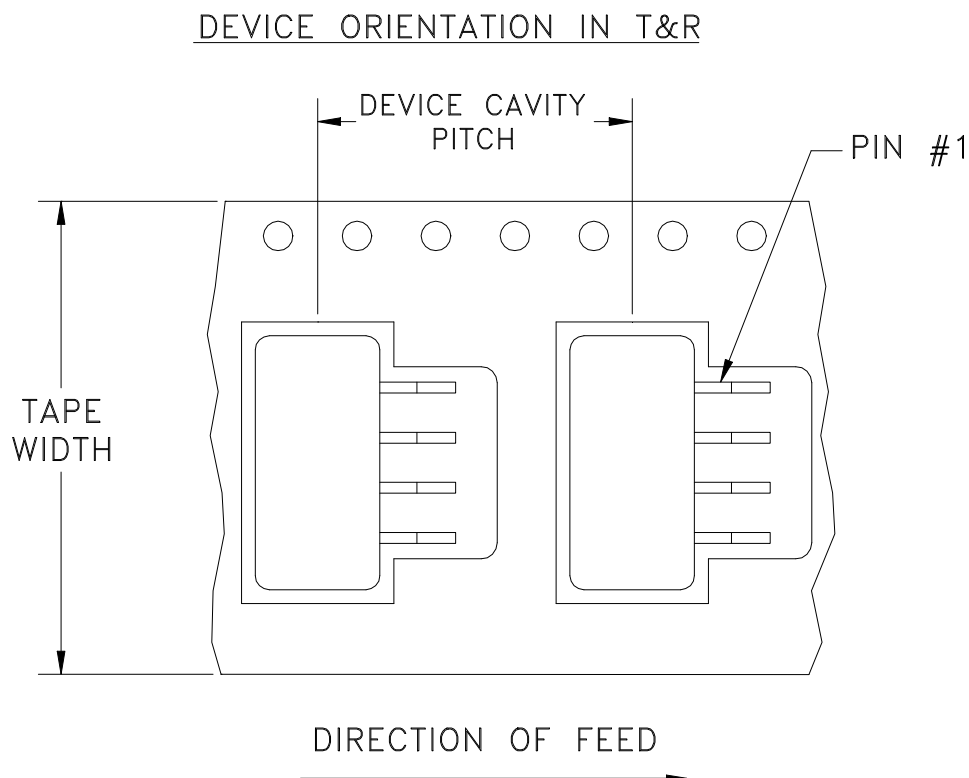
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Tape & Reel Packaging TR-F9



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel
24	16	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.

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



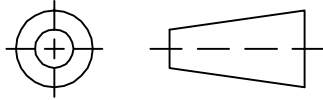
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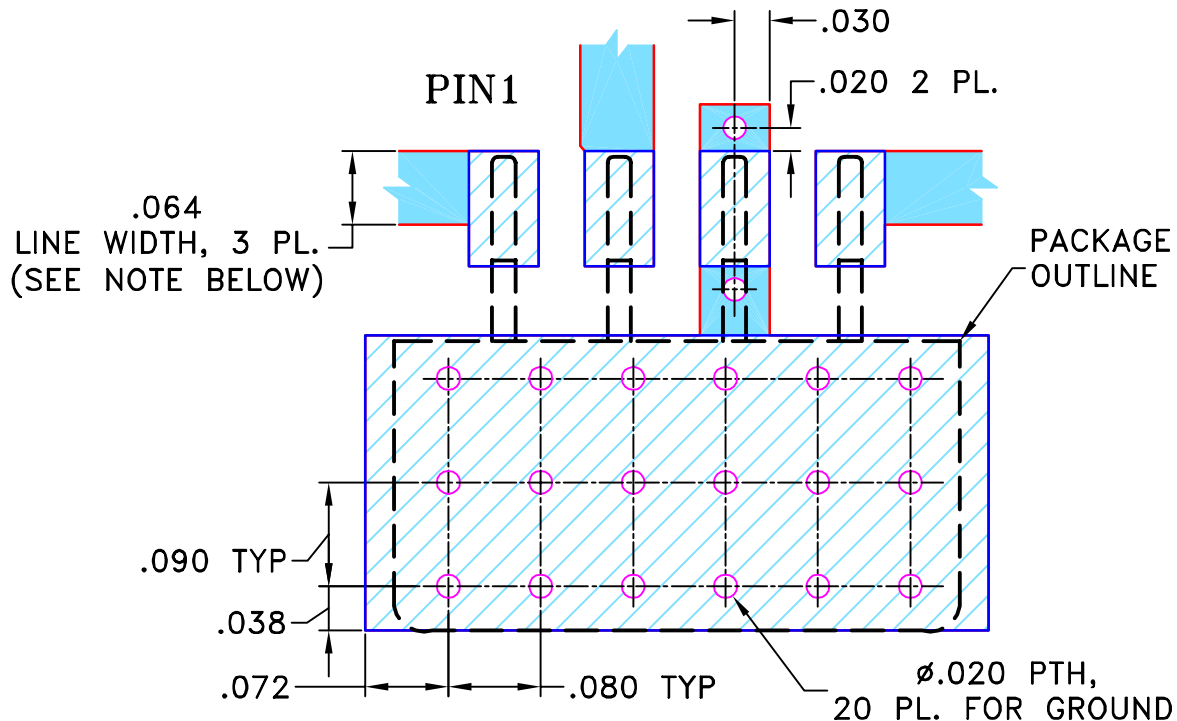
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M86549	NEW RELEASE	04/15/03	GF	DJ
A	M102713	UPDATED NOTES & DISCRIPTION	01/14/06	GF	IL

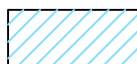
SUGGESTED MOUNTING CONFIGURATION
FOR NNN150 CASE STYLE, "z"/"cm" PIN CONNECTIONS.



NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS $0.030" \pm 0.002"$; 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

TOLERANCES ON:

2 PL DECIMALS $\pm$ 3 PL DECIMALS $\pm$.005ANGLES $\pm$ FRACTIONS $\pm$

DRAWN

GF

04/11/03

CHECKED

AV

04/15/03

APPROVED

DJ

04/15/03



Mini-Circuits®

13 Neptune Avenue
Brooklyn NY 11235

PL, z/cm NNN150, TUF/TFAS-SM, TB-201

SIZE
ACODE IDENT
15542DRAWING NO:
98-PL-081REV:
A

FILE: 98PL081

SCALE: 6:1

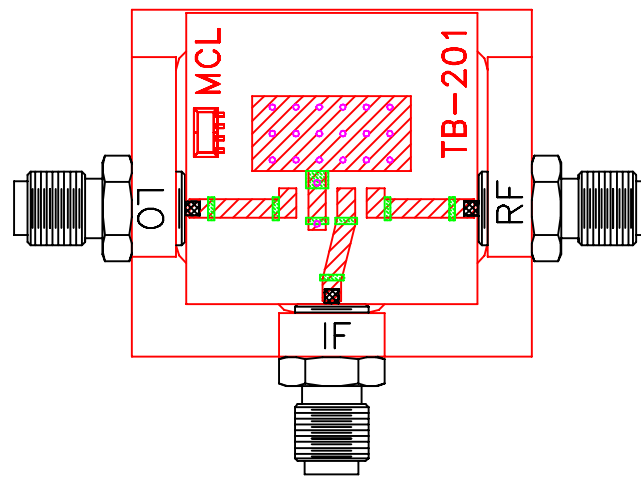
SHEET: 1 OF 1

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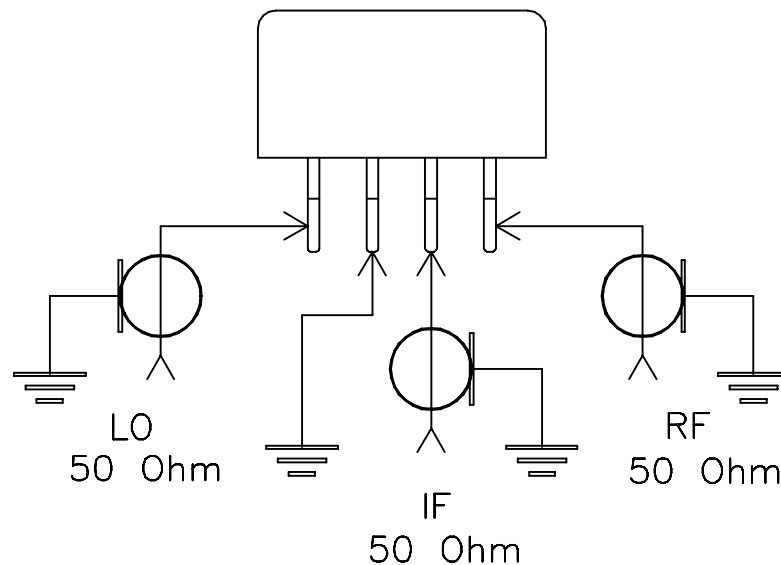
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ASHEETA1.DWG REV:A DATE:01/12/95

Evaluation Board and Circuit



TB-201



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,
Dielectric Constant=3.5, Thickness=.030 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	-55° to 100°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
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
Moisture Resistance	10 cycles, 24 hours per cycle	MIL-STD-202, Method 106, Condition A, except 50°C and end point electrical test done within 12 hours
Solderability	10X Magnification	J-STD-002, 95% Coverage
Resistance to Solder Heat	260°C for 10 seconds	MIL-STD-202, Method 210, Condition B
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
Terminal Strength	4 1/2 Pound Pull	MIL-STD-202, Method 211, Condition A



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
Barometric Pressure	100,000 Feet	MIL-STD-202, Method 105, Condition D