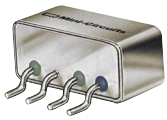
Surface Mount

Attenuator/Switch

50Ω Bi-Phase 2 to 400 MHz

TFAS-1SM+



CASE STYLE: NNN150
PRICE: $18.20 ea. QTY. (1-9)

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

Maximum Ratings

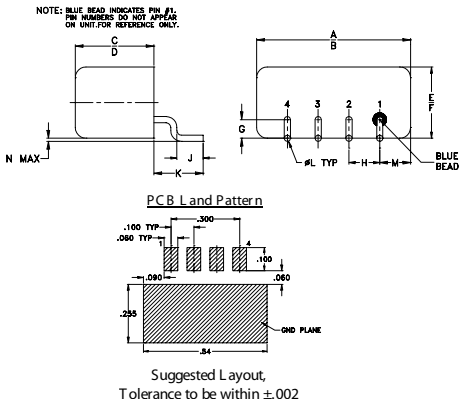
Operating Temperature	-55°C to 100°C
Storage Temperature	-55°C to 100°C
Control Current	30mA

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

Pin Connections

INPUT	1
OUTPUT	4
CONTROL	2
GROUND EXT.	3
CASE GROUND	3

Outline Drawing



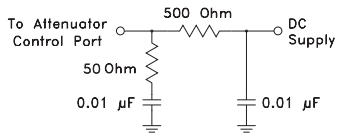
Suggested Layout,
Tolerance to be within ±.002

Outline Dimensions (inch / mm)

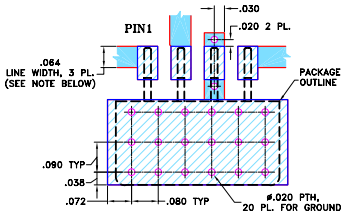
A	B	C	D	E	F	G
.50	.48	.255	.240	.23	.21	.06
12.70	12.19	6.48	6.10	5.84	5.33	1.52

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.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Features

- low insertion loss, 1.6 dB typ.
- excellent phase and amplitude unbalance

Applications

- electronic attenuator

Attenuator/Switch Electrical Specifications

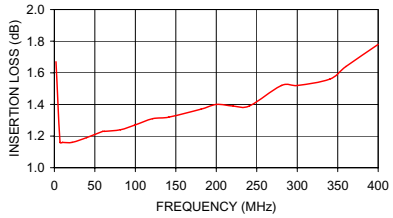
FREQUENCY (MHz)		INSERTION LOSS (dB) ±20 mA				MAX. INPUT PWR (dBm) ±20 mA		IN-OUT ISOLATION (dB) 0 mA						BI-PHASE $\overline{X}$ (±20 mA) Typ.			
		Mid-Band		Total Range				L		M		U		Δ AMP (dB)		Phase (deg.) deviation from 180°	
IN	CON					1 dB	no								Total		Total
f_L-f_U		Typ.	Max.	Typ.	Max.	compr.	damage	Typ.	Min.	Typ.	Min.	Typ.	Min.	m	Range	m	Range
2-400	DC-0.05	1.4	2.0	1.6	3.0	20*	25	65	45	45	33	35	25	0.1	0.1	1.0	2.0

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]
* 15 dBm from 2-10 MHz.
Performance specifications apply for input power up to 10 dB below stated 1 dB compression.

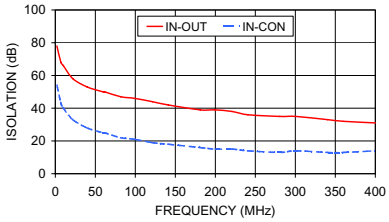
Typical Performance Data

Freq. (MHz)	I. Loss (dB) at 20mA		±Control ΔΔAMP (dB)	20mA ΔΔPhase (deg.)	Isolation (dB) (in-out)	Isolation (dB) (in-con)	Input R. Loss (dB)	Control Current (mA)	Attenuation (dB) 2 MHz	200 MHz	400 MHz	Phase Δ ref at 15mA Ctrl 2 MHz deg.	200 MHz deg.	400 MHz deg.	Input VSWR 2 MHz	200 MHz	400 MHz
	$\overline{x}$	σ	$\overline{x}$	$\overline{x}$	$\overline{x}$	$\overline{x}$	$\overline{x}$										
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

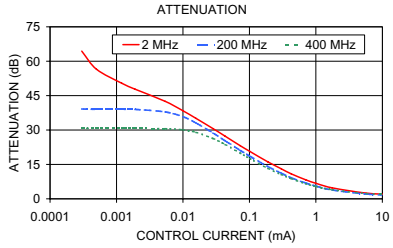
TFAS-1SM+
INSERTION LOSS



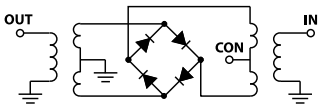
TFAS-1SM+
ISOLATION



TFAS-1SM+
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.
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Attenuator/Switch TFAS-1SM+

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
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

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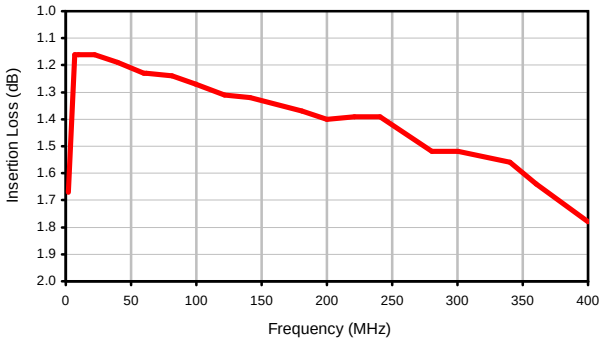
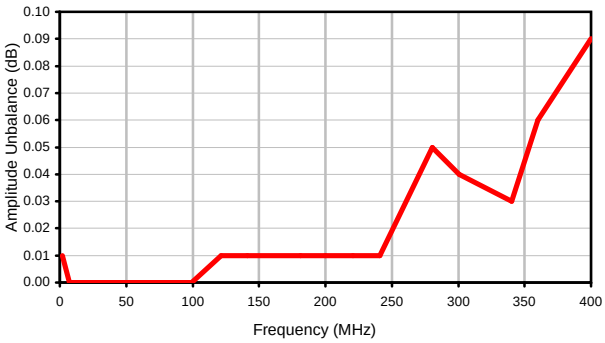
Typical Performance Curves

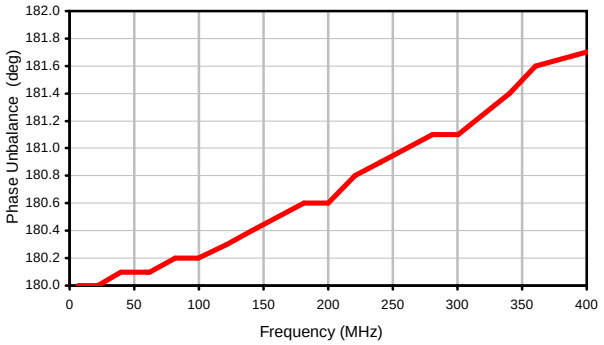
Insertion Loss @ 20 mA



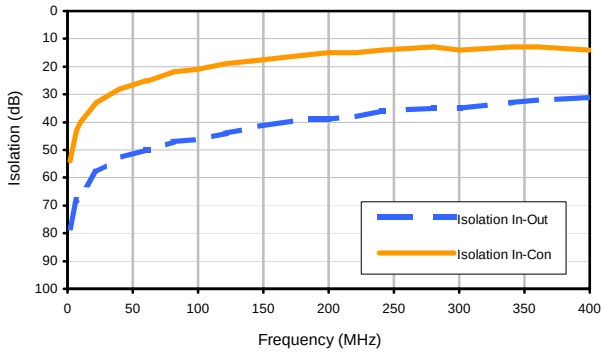
Amplitude Unbalance @ ± 20mA



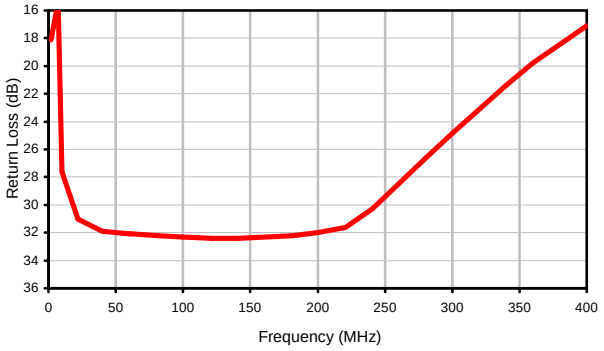
Phase Unbalance @ ± 20mA



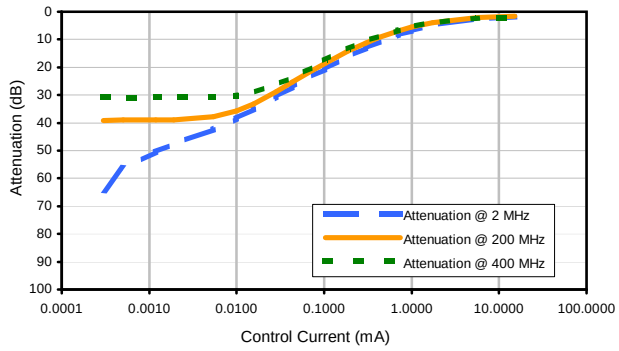
Isolation @ 0 mA



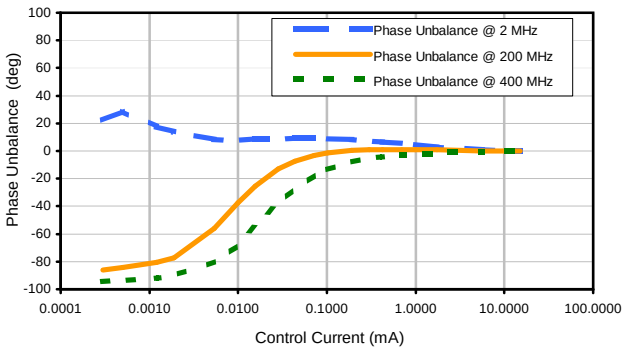
Return Loss Input



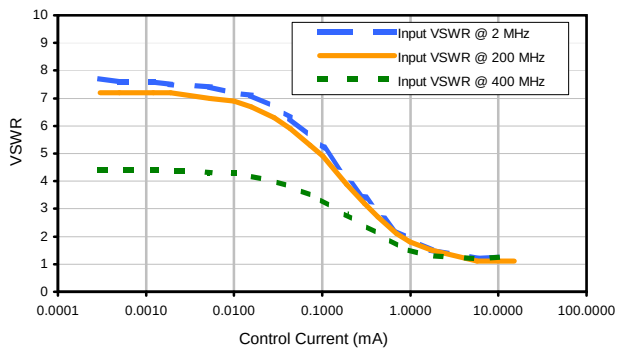
Attenuation



Phase Unbalance ref @ 15 mA



Input VSWR



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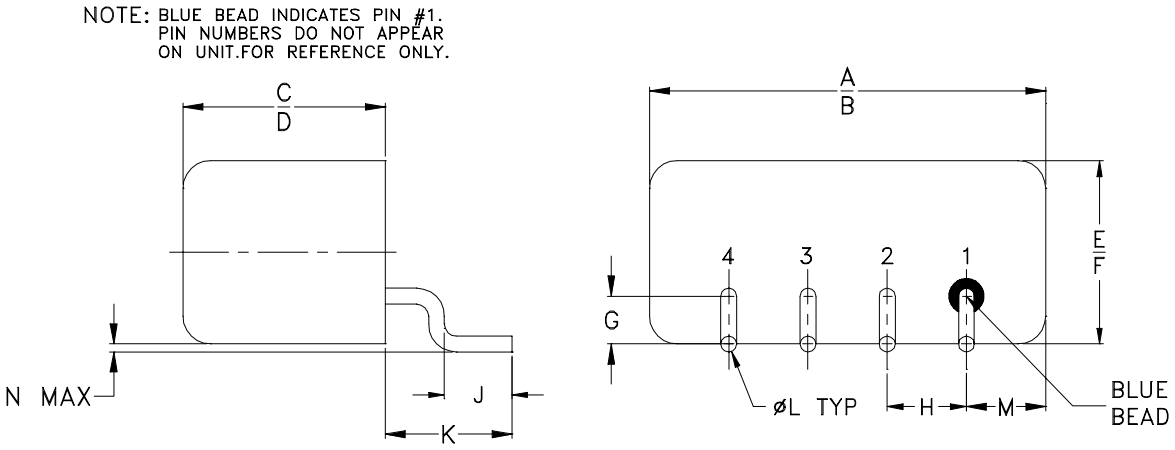
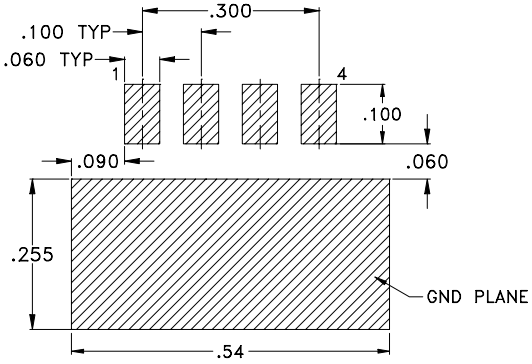
Case Style NNN

Outline Dimensions

NNN150



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.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. ± .03; 3 Pl. ± .015

Notes:

1. Header material C.R.S. Pin material #52 alloy.
2. Finish: Electro-Tin, hot-oil flowed or electro-Tin-Silver.
3. Cover material: Cupro-Nickel.
4. Pin's meniscus 0.015 inch max.
5. Special Tolerances: Pin diameter ± .005 inch.

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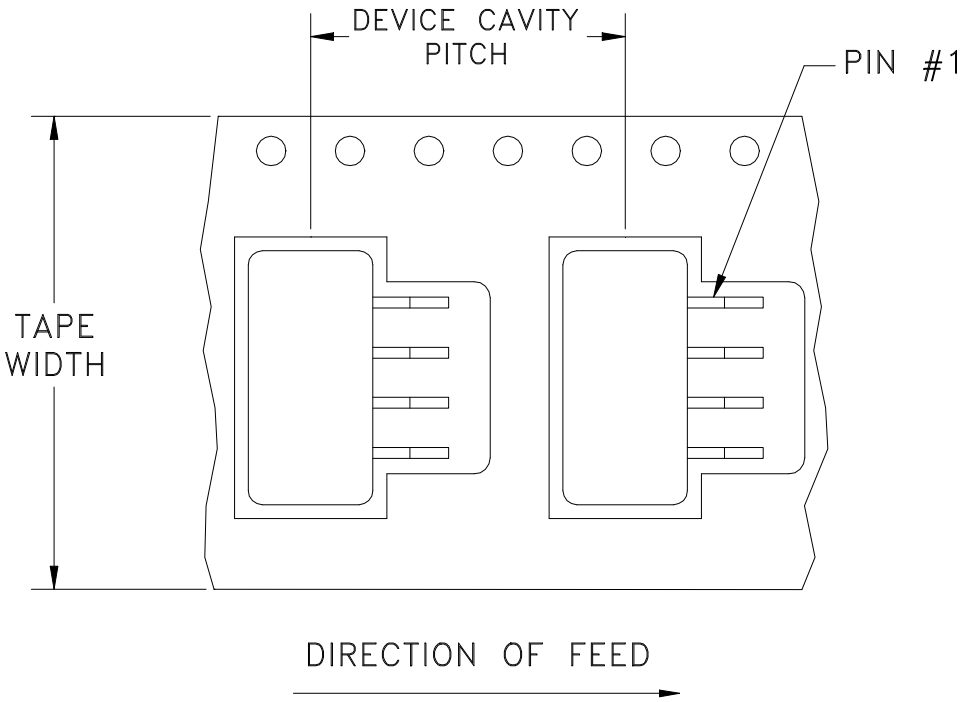
Tape & Reel Packaging TR-F9

DEVICE ORIENTATION IN T&R



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.

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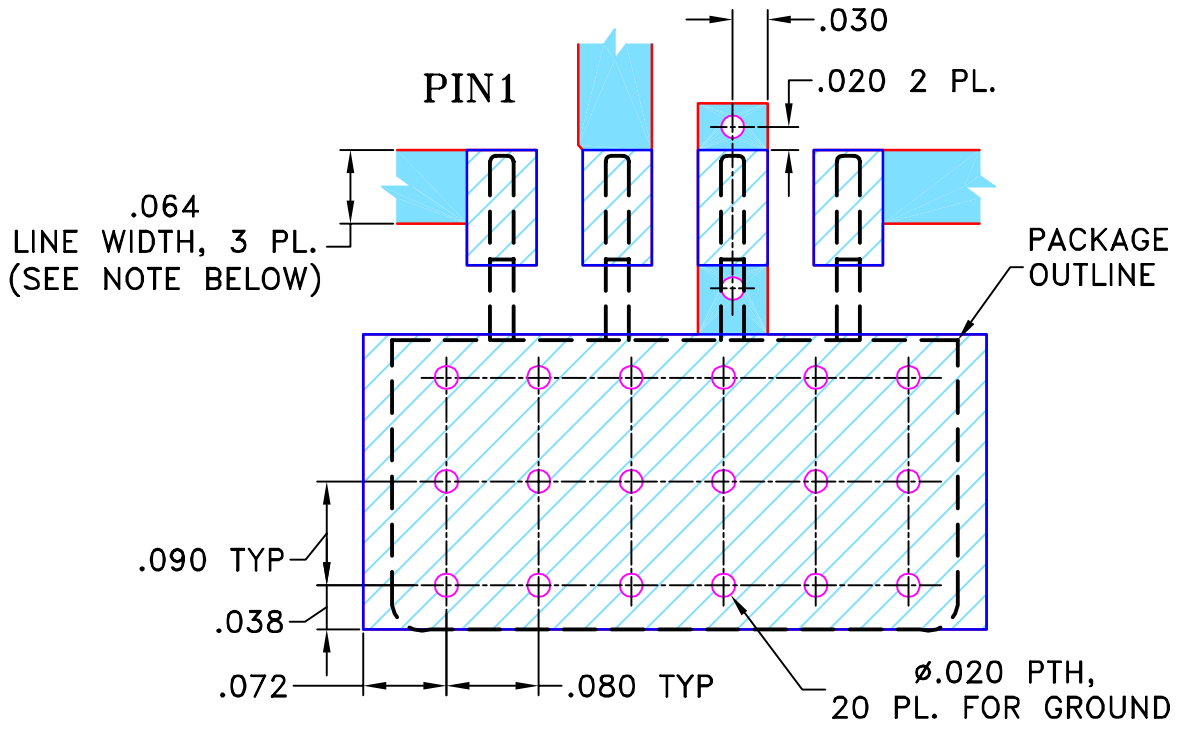
THIRD ANGLE PROJECTION

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 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.

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	GF	04/11/03
TOLERANCES ON:	CHECKED	AV	04/15/03
2 PL DECIMALS ±	APPROVED	DJ	04/15/03
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

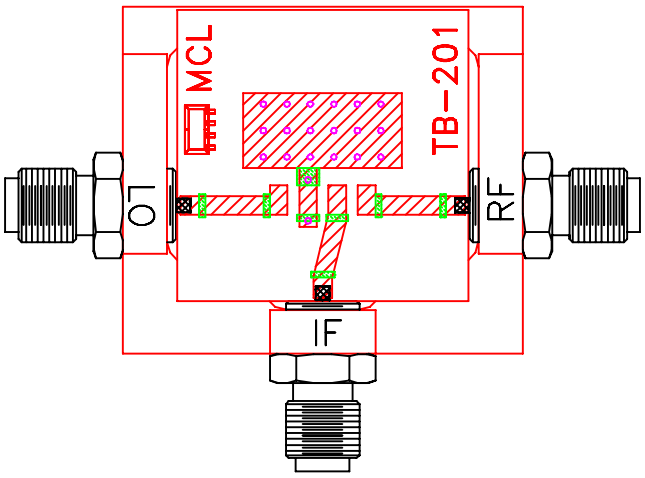
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

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

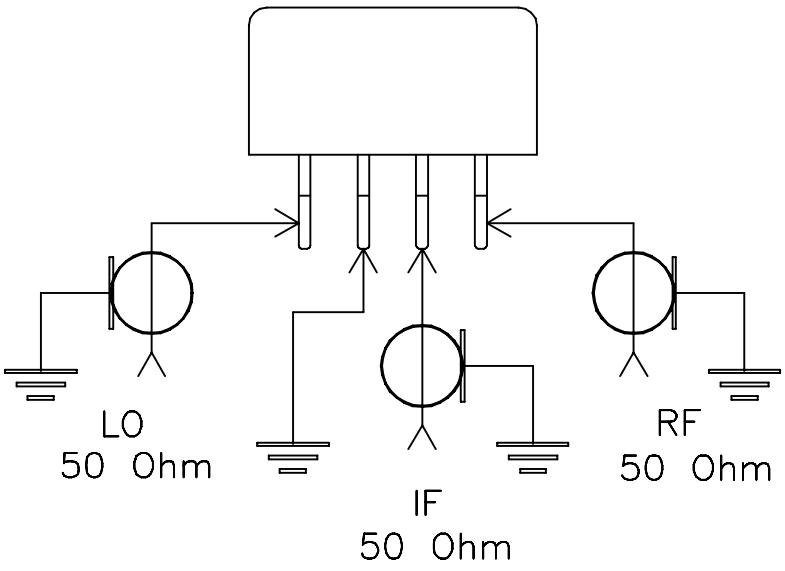
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-081	A

FILE:	SCALE:	SHEET:
98PL081	6:1	1 OF 1

Evaluation Board and Circuit



TB-201



Schematic Diagram

Notes:

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

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Environmental Specifications ENV30

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

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Specification	Test/Inspection Condition	Reference/Spec
Barometric Pressure	100,000 Feet	MIL-STD-202, Method 105, Condition D

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