MMIC SURFACE MOUNT

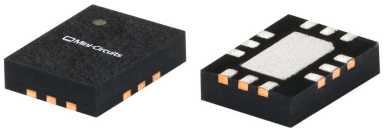
Balun

MTX2-133+

50Ω 1.5 to 13 GHz

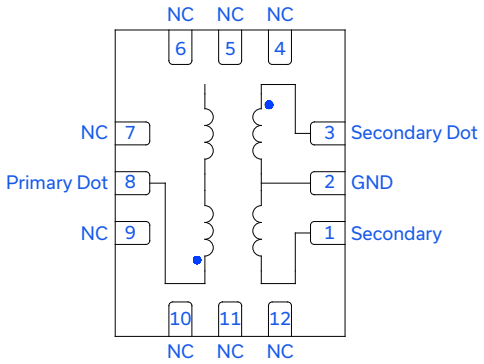
THE BIG DEAL

- Wideband, 1.5 to 13 GHz
- Low Insertion Loss, Typ. 2.2 dB
- Excellent Phase Unbalance, Typ. 2 Degrees
- Excellent Amplitude Unbalance, Typ. 0.2 dB
- Single Ended to Differential Conversion
- 3x4 mm 12-Lead QFN-Style Package



Generic photo used for illustration purposes only

FUNCTIONAL DIAGRAM



APPLICATIONS

- 5G MIMO and Back Haul Radio Systems
- Test and Measurement Equipment
- Radar, EW, and ECM Defense Systems
- Signal Distribution Networks

PRODUCT OVERVIEW

Mini-Circuits MTX2-133+ is a wideband MMIC balun transformer with an impedance ratio of 1:2 applicable for a wide range of applications from 1.5 to 13 GHz. Fabricated using GaAs process technology. The MMIC provides outstanding repeatability with low insertion loss, low amplitude unbalance, low phase unbalance, and excellent common mode rejection.

KEY FEATURES

Features	Advantages
Wideband, 1.5 to 13 GHz	Supports a broad variety of applications including Test and Measurement, WLAN, 5G Microwave Radio, Radar and Electronic Warfare
Low Insertion Loss • 2.2 dB typ. (above theoretical)	Enables excellent signal power transmission from input to output.
Excellent Common Mode Rejection • 35 dB typ.	Enables rejection of undesired signals
3x4 mm 12-Lead QFN-style package	Small footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB.

Balun

MTX2-133+

50Ω 1.5 to 13 GHz

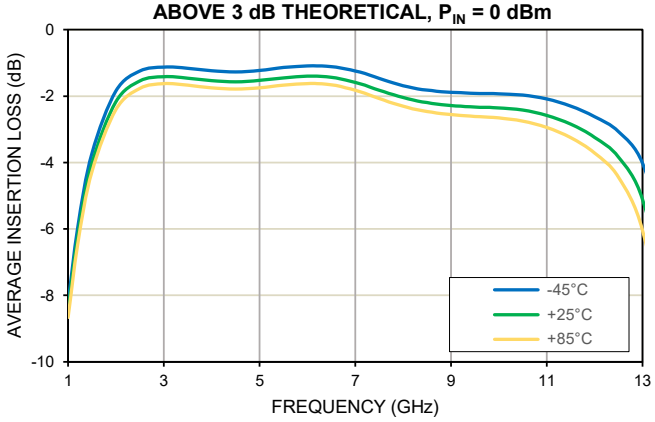
ELECTRICAL SPECIFICATIONS[1] AT +25°C, UNLESS NOTED OTHERWISE

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Impedance Ratio (Secondary / Primary)			2		
Frequency Range		1.5		13	GHz
Average Insertion Loss (Above 3 dB Theoretical)	1.5 - 3		2.1	4.3	dB
	3 - 10		1.8	2.6	
	10 - 13		3.1	6.4	
Amplitude Unbalance	1.5 - 3		0.7	1.1	dB
	3 - 10		0.2	1.1	
	10 - 13		0.2	1.3	
Phase Unbalance[2]	1.5 - 3		2	9	Degree
	3 - 10		1	8	
	10 - 13		2	10	
Common Mode Rejection Ratio (CMRR)	1.5 - 3		23		dB
	3 - 10		37		
	10 - 13		37		
Input Return Loss	1.5 - 3	4	11		dB
	3 - 10	8	13		
	10 - 13	9	17		

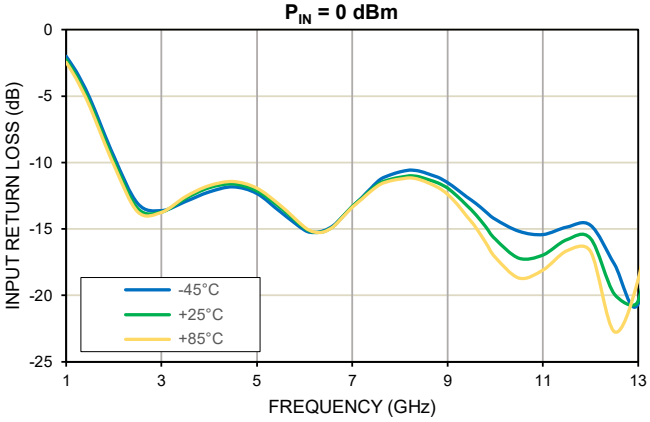
1. Tested in Mini-Circuits Evaluation Board TB-MTX2-133C+.
2. Relative to 180°

TYPICAL PERFORMANCE GRAPHS

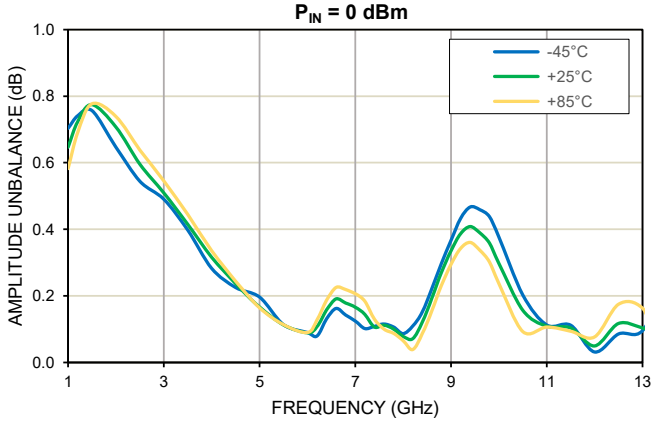
AVERAGE INSERTION LOSS VS. TEMPERATURE
ABOVE 3 dB THEORETICAL, P_{IN} = 0 dBm



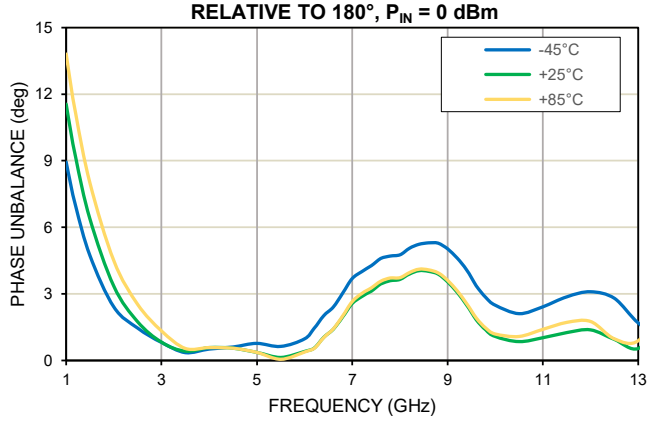
INPUT RETURN LOSS VS. TEMPERATURE
P_{IN} = 0 dBm



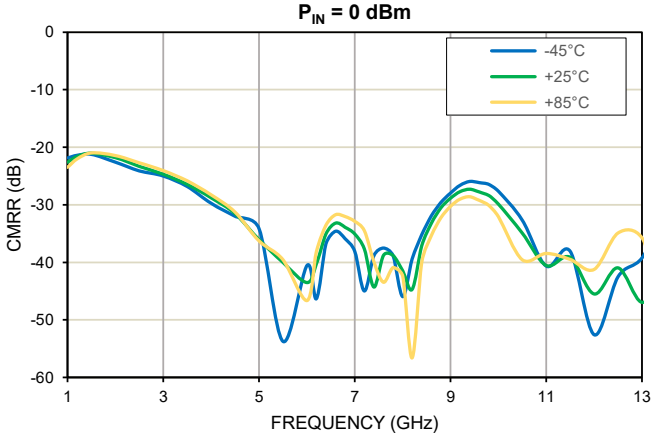
AMPLITUDE UNBALANCE VS. TEMPERATURE
P_{IN} = 0 dBm



PHASE UNBALANCE VS. TEMPERATURE
RELATIVE TO 180°, P_{IN} = 0 dBm



CMRR VS. TEMPERATURE
P_{IN} = 0 dBm



ABSOLUTE MAXIMUM RATINGS[3]

Parameter	Ratings
Operating Temperature (ground lead)	-45°C to +85°C
Storage Temperature	-65°C to +150°C
RF Input Power	2 W

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

ESD RATING

	Class	Voltage Range	Reference Standard
HBM	1C	1000 to < 2000V	ANSI/ESDA/JEDEC JS-001-2017

ESD HANDLING PRECAUTION: This device is designed to be Class 1C for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E/JEDEC J-STD-033C

FUNCTIONAL DIAGRAM

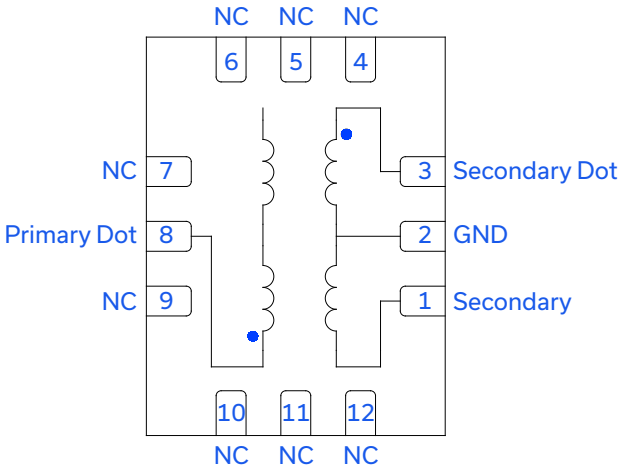


Figure 1. MTX2-133+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description (Refer to Fig 2)
Primary Dot	8	Common UnBalanced RF Port
Secondary Dot	3	Balanced RF Port
Secondary	1	Balanced RF Port
GND	2	External ground.
NC	4-7, 9-12	No connection. Connected to ground on the test board.

EVALUATION BOARD

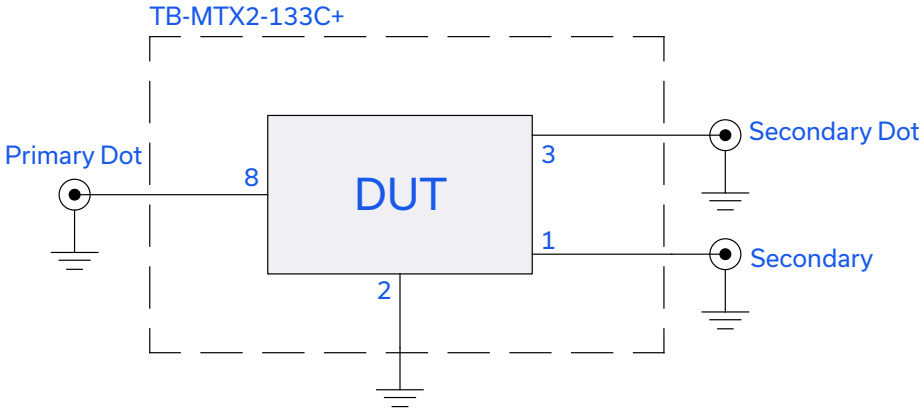


Figure 2. DUT soldered on Mini-Circuits Evaluation Board: TB-MTX2-133C+

Electrical Parameters and Conditions
Insertion Loss, Amplitude Unbalance, Phase Unbalance, Common Mode Rejection measured using N5242A PNA-X microwave network analyzer.

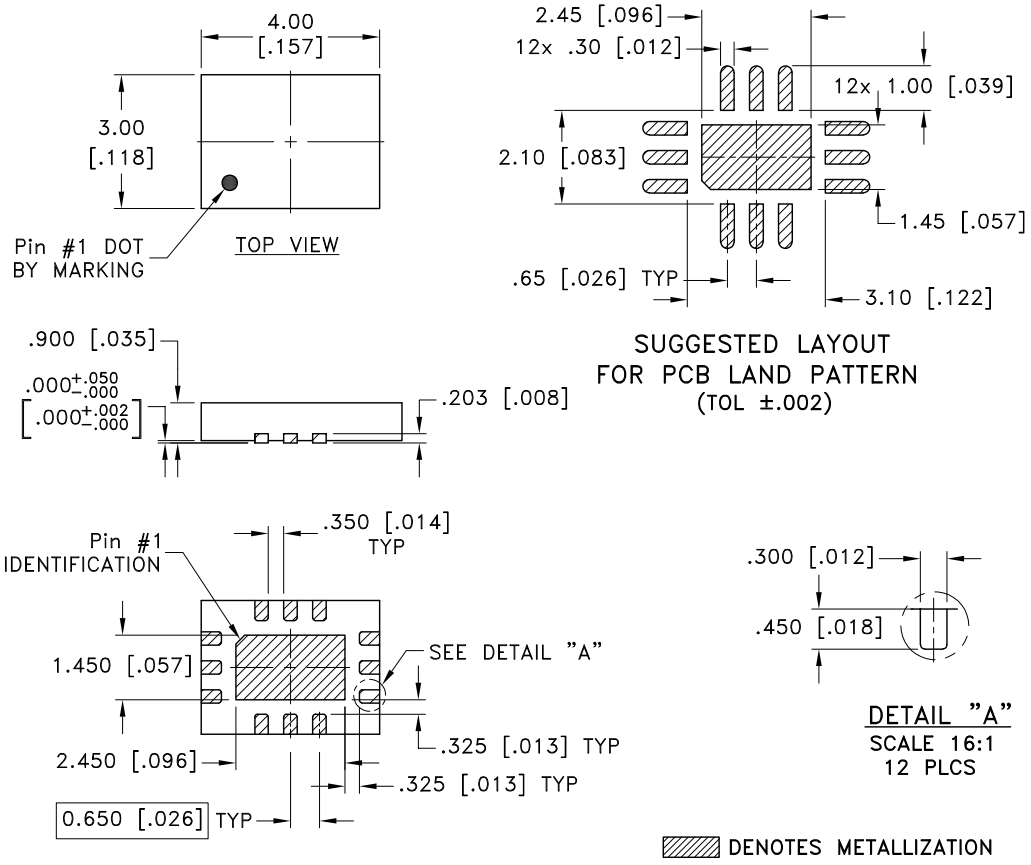
Conditions:
1. P_{IN} = 0 dBm

Balun

MTX2-133+

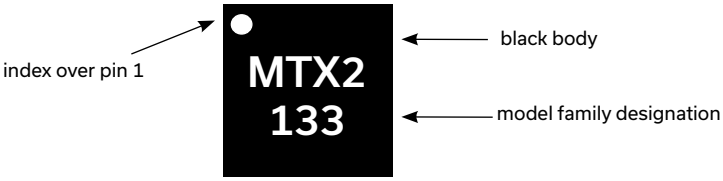
50Ω 1.5 to 13 GHz

CASE STYLE DRAWING



Weight: 0.032 grams
Dimensions are in mm [inches]. Tolerances 3 Pl. ±0.05 [0.002] mm [Inch]

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

Balun

MTX2-133+

50Ω 1.5 to 13 GHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD CLICK HERE

Performance Data & Graphs	Data Graphs S-Parameter (S3P Files) Data Set (.zip file)
Case Style	DG3006. Plastic package, exposed paddle, Lead Finish: Matte-Tin
RoHS Status	Compliant
Tape & Reel **Standard quantities available on reel**	F68 7" or 13" reels with 20, 50, 100, 200, 500, 1K, 2K, 3K or 4K devices
Suggested Layout for PCB Design	PL-754
Evaluation Board	TB-MTX2-133C+ Gerber File
Environmental Ratings	ENV08T1

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/terms/viewterm.html

RF Transformer MTX2-133+

Typical Performance Data

Temperature = +25°C

FREQUENCY (GHz)	AVERAGE INSERTION LOSS[1] (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE[2] (deg.)	CMRR (dB)
1.0	8.45	2.26	0.65	11.55	22.58
1.2	6.24	3.40	0.72	9.13	21.61
1.5	4.02	5.54	0.77	6.39	21.02
2.0	2.17	9.88	0.71	3.34	21.80
2.5	1.54	13.45	0.60	1.75	23.30
3.0	1.41	13.72	0.51	0.82	24.66
3.5	1.46	12.70	0.42	0.42	26.43
4.0	1.53	11.90	0.32	0.58	28.77
4.5	1.57	11.61	0.24	0.55	31.52
5.0	1.53	12.12	0.17	0.36	36.03
5.5	1.45	13.41	0.11	0.14	40.00
6.0	1.40	14.93	0.09	0.41	43.51
6.2	1.40	15.25	0.11	0.55	40.27
6.4	1.42	15.20	0.16	1.04	35.06
6.6	1.46	14.81	0.19	1.41	33.17
6.8	1.52	14.06	0.18	1.95	33.88
7.0	1.59	13.30	0.17	2.56	35.07
7.2	1.67	12.68	0.14	2.88	37.68
7.4	1.77	12.03	0.11	3.13	44.30
7.6	1.87	11.51	0.11	3.44	38.77
7.8	1.96	11.26	0.10	3.59	38.80
8.0	2.04	11.12	0.08	3.65	41.48
8.2	2.12	11.00	0.07	3.90	44.70
8.4	2.17	11.07	0.12	4.05	37.15
8.6	2.22	11.29	0.19	4.01	33.21
8.8	2.26	11.53	0.27	3.89	30.54
9.0	2.28	11.92	0.34	3.55	28.84
9.2	2.30	12.52	0.39	3.07	27.71
9.4	2.32	13.21	0.41	2.51	27.29
9.6	2.33	13.95	0.39	1.84	27.77
9.8	2.34	14.84	0.36	1.37	28.39
10.0	2.35	15.77	0.30	1.08	29.87
10.5	2.42	17.20	0.16	0.85	34.90
11.0	2.58	16.95	0.11	1.03	40.53
11.5	2.84	15.81	0.10	1.25	39.10
12.0	3.24	15.71	0.05	1.38	45.50
12.5	3.83	19.91	0.12	0.94	40.93
13.0	5.11	20.38	0.10	0.54	46.94
13.5	8.41	9.83	0.08	1.73	42.51
14.0	16.27	5.55	0.07	2.42	45.61

[1] Above 3 dB theoretical loss

[2] Relative to 180°

Typical Performance Data

Temperature = -45°C

FREQUENCY (GHz)	AVERAGE INSERTION LOSS[1] (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE[2] (deg.)	CMRR (dB)
1.0	8.21	2.00	0.70	8.95	21.85
1.2	5.97	3.08	0.74	6.94	21.40
1.5	3.71	5.16	0.76	4.74	21.22
2.0	1.85	9.53	0.65	2.41	22.57
2.5	1.25	13.08	0.54	1.46	24.08
3.0	1.12	13.62	0.49	0.81	24.99
3.5	1.16	12.95	0.40	0.36	26.82
4.0	1.23	12.22	0.28	0.51	29.74
4.5	1.27	11.83	0.22	0.61	31.99
5.0	1.23	12.32	0.20	0.77	34.09
5.5	1.14	13.73	0.11	0.63	53.74
6.0	1.09	15.09	0.09	0.98	40.52
6.2	1.09	15.26	0.08	1.44	46.35
6.4	1.10	15.13	0.13	2.01	36.80
6.6	1.13	14.75	0.16	2.40	34.58
6.8	1.18	14.05	0.14	3.03	35.90
7.0	1.24	13.31	0.12	3.69	38.09
7.2	1.32	12.65	0.10	4.00	44.97
7.4	1.42	11.89	0.11	4.27	38.82
7.6	1.51	11.25	0.12	4.59	37.51
7.8	1.61	10.91	0.11	4.70	38.88
8.0	1.68	10.70	0.09	4.76	45.95
8.2	1.75	10.57	0.11	5.06	39.45
8.4	1.80	10.64	0.15	5.24	35.22
8.6	1.83	10.86	0.22	5.30	31.91
8.8	1.86	11.11	0.30	5.28	29.60
9.0	1.88	11.50	0.37	5.03	27.93
9.2	1.90	12.03	0.43	4.62	26.59
9.4	1.91	12.57	0.47	4.08	25.94
9.6	1.92	13.09	0.46	3.37	26.13
9.8	1.92	13.69	0.44	2.85	26.45
10.0	1.93	14.28	0.38	2.48	27.64
10.5	1.97	15.18	0.20	2.11	32.65
11.0	2.09	15.41	0.11	2.42	40.66
11.5	2.30	14.86	0.11	2.87	38.10
12.0	2.62	14.71	0.03	3.09	52.59
12.5	3.07	17.66	0.09	2.80	42.51
13.0	4.02	20.61	0.10	1.69	39.20
13.5	6.66	10.36	0.24	1.03	31.25
14.0	13.25	5.34	0.38	1.77	27.28

[1] Above 3 dB theoretical loss
[2] Relative to 180°

Typical Performance Data

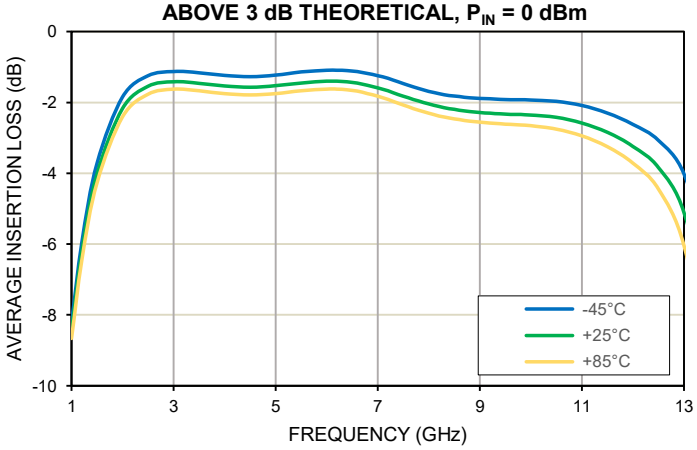
Temperature = +85°C

FREQUENCY (GHz)	AVERAGE INSERTION LOSS[1] (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE[2] (deg.)	CMRR (dB)
1.0	8.66	2.45	0.58	13.81	23.48
1.2	6.47	3.63	0.69	11.10	22.01
1.5	4.26	5.80	0.78	8.01	20.99
2.0	2.41	10.18	0.74	4.49	21.42
2.5	1.76	13.70	0.64	2.52	22.69
3.0	1.62	13.74	0.55	1.33	24.07
3.5	1.67	12.57	0.44	0.54	25.84
4.0	1.75	11.74	0.34	0.58	28.25
4.5	1.79	11.43	0.24	0.55	31.25
5.0	1.75	11.92	0.16	0.37	36.27
5.5	1.67	13.24	0.11	0.06	39.56
6.0	1.62	14.86	0.09	0.38	46.62
6.2	1.62	15.23	0.13	0.55	38.17
6.4	1.64	15.21	0.19	1.02	33.56
6.6	1.68	14.82	0.23	1.42	31.72
6.8	1.75	14.10	0.22	2.00	32.05
7.0	1.83	13.37	0.21	2.65	32.86
7.2	1.91	12.76	0.18	3.02	34.49
7.4	2.02	12.13	0.13	3.27	39.88
7.6	2.12	11.61	0.10	3.58	43.45
7.8	2.22	11.37	0.09	3.71	40.91
8.0	2.30	11.25	0.07	3.74	42.41
8.2	2.38	11.16	0.04	3.96	56.62
8.4	2.44	11.27	0.09	4.11	40.07
8.6	2.49	11.54	0.16	4.08	35.38
8.8	2.53	11.87	0.23	3.96	32.24
9.0	2.56	12.39	0.29	3.61	30.28
9.2	2.58	13.15	0.34	3.13	29.01
9.4	2.60	14.01	0.36	2.57	28.60
9.6	2.62	14.93	0.34	1.92	29.24
9.8	2.63	16.03	0.30	1.47	30.12
10.0	2.66	17.13	0.24	1.19	32.09
10.5	2.75	18.69	0.09	1.08	39.54
11.0	2.94	18.09	0.11	1.40	38.43
11.5	3.25	16.65	0.09	1.71	39.48
12.0	3.71	16.68	0.08	1.75	41.21
12.5	4.44	22.74	0.17	0.97	34.88
13.0	6.04	18.77	0.16	0.89	35.71
13.5	9.96	9.31	0.05	2.49	46.01
14.0	19.32	5.66	0.46	5.95	25.76

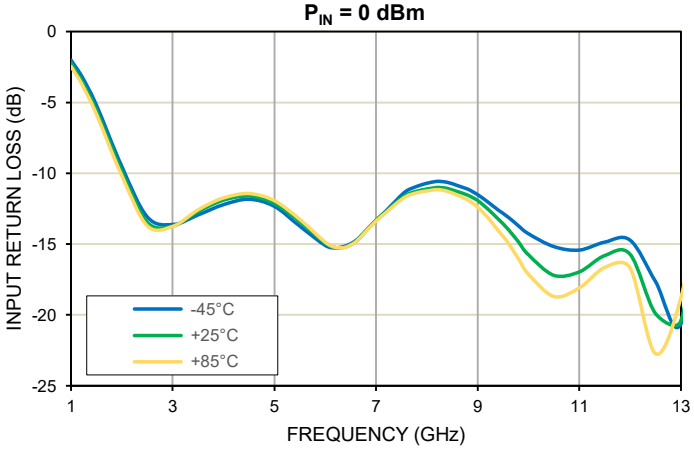
[1] Above 3 dB theoretical loss
[2] Relative to 180°

Typical Performance Data

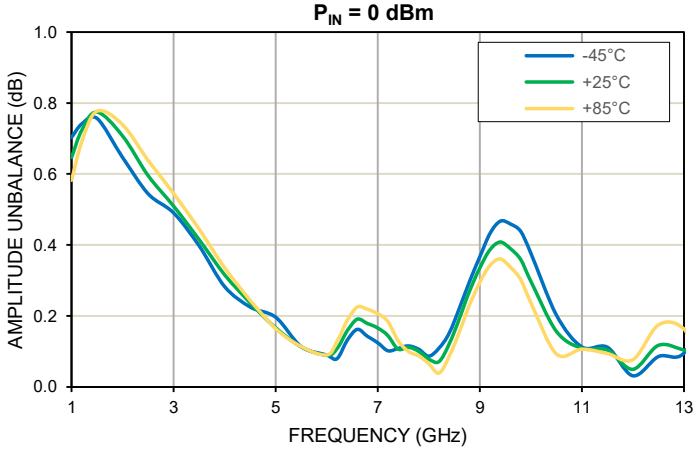
AVERAGE INSERTION LOSS VS. TEMPERATURE
ABOVE 3 dB THEORETICAL, P_{IN} = 0 dBm



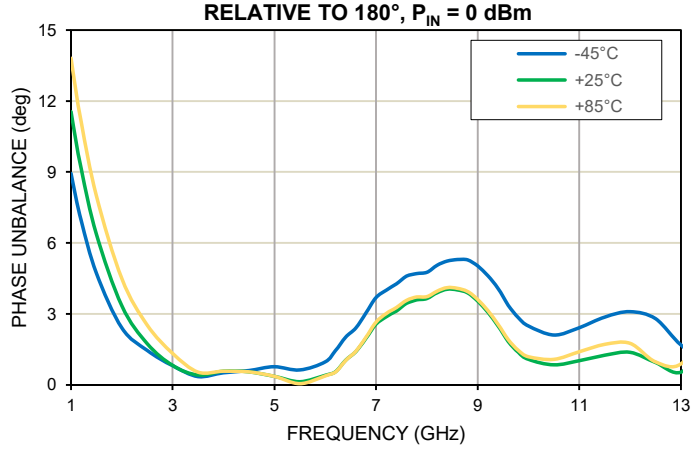
INPUT RETURN LOSS VS. TEMPERATURE
P_{IN} = 0 dBm



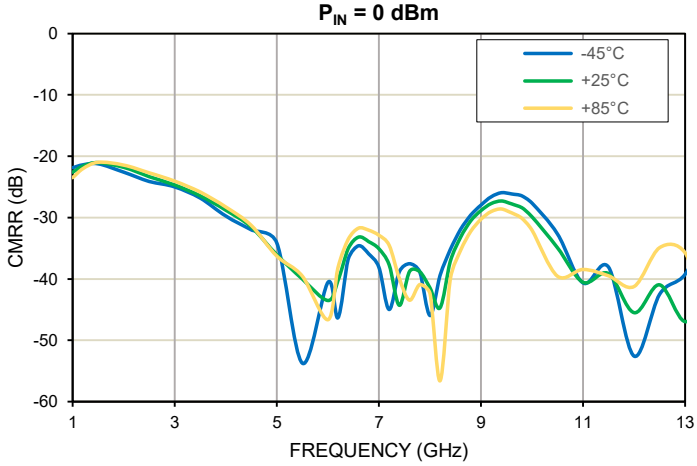
AMPLITUDE UNBALANCE VS. TEMPERATURE
P_{IN} = 0 dBm



PHASE UNBALANCE VS. TEMPERATURE
RELATIVE TO 180°, P_{IN} = 0 dBm



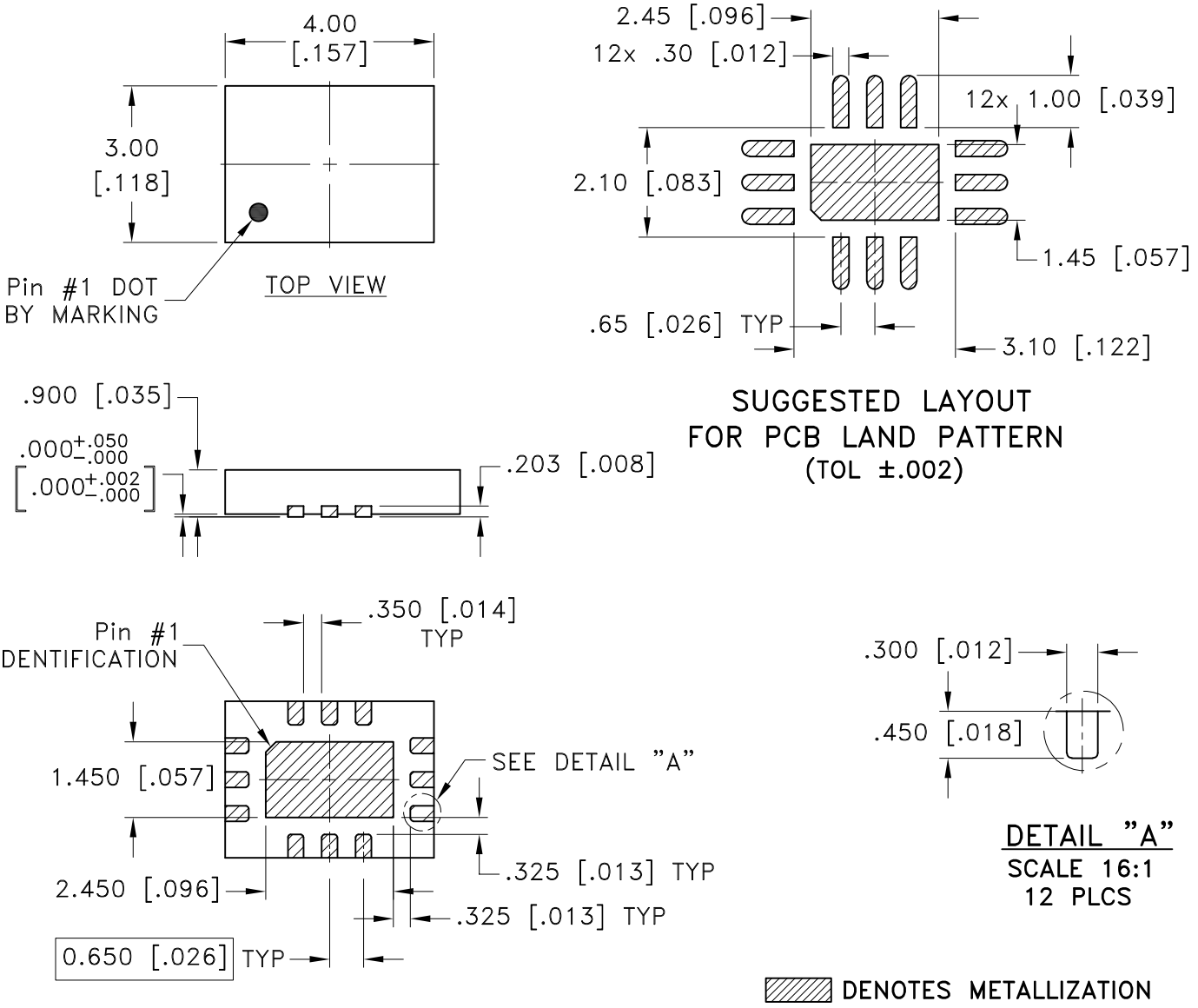
CMRR VS. TEMPERATURE
P_{IN} = 0 dBm



Case Style DG

Outline Dimensions

DG3006



Weight: 0.032 grams

Dimensions are in mm [inches] . Tolerances:3 Pl. ±0.05 [0.002] mm [Inch]

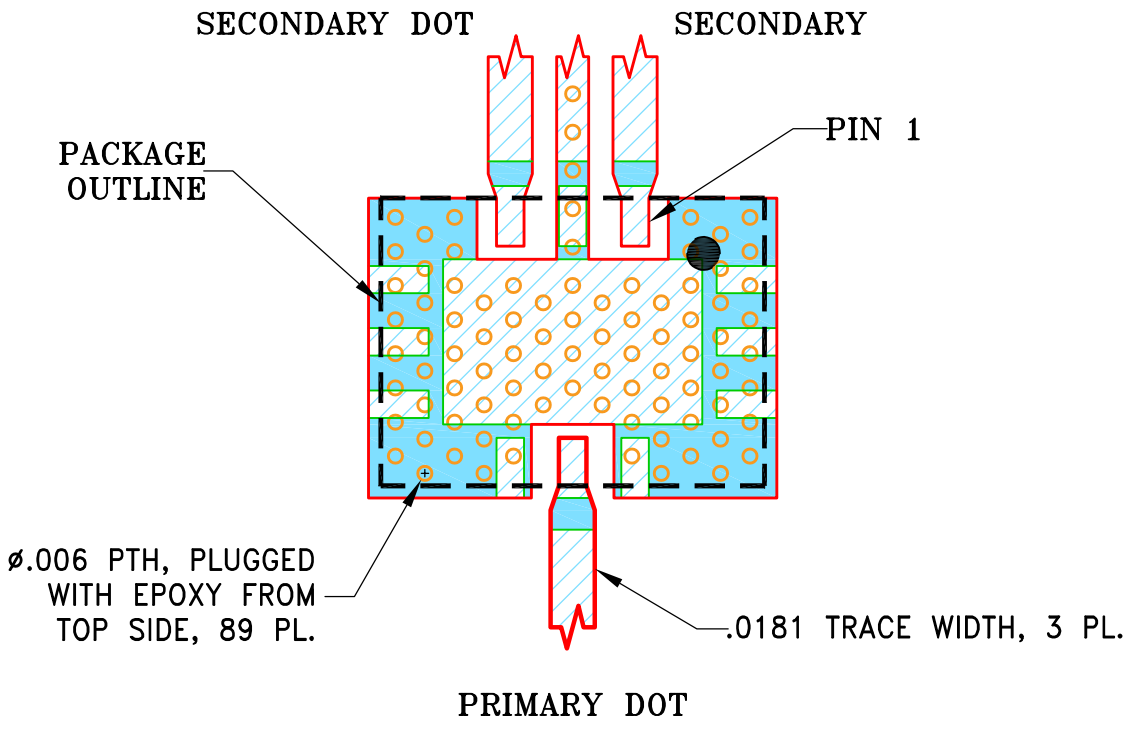
Notes:

1. Case material: Plastic.
2. Termination finish: MATTE TIN

THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-018141	NEW RELEASE	06/15/23	NP	CM

SUGGESTED MOUNTING CONFIGURATION FOR DG3006 CASE STYLE



NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS RO4003C WITH DIELECTRIC THICKNESS .008"; COPPER: 1 OZ. 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	NP	06/15/23
TOLERANCES ON:	CHECKED	IL	06/15/23
2 PL DECIMALS ±	APPROVED	CM	06/15/23
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

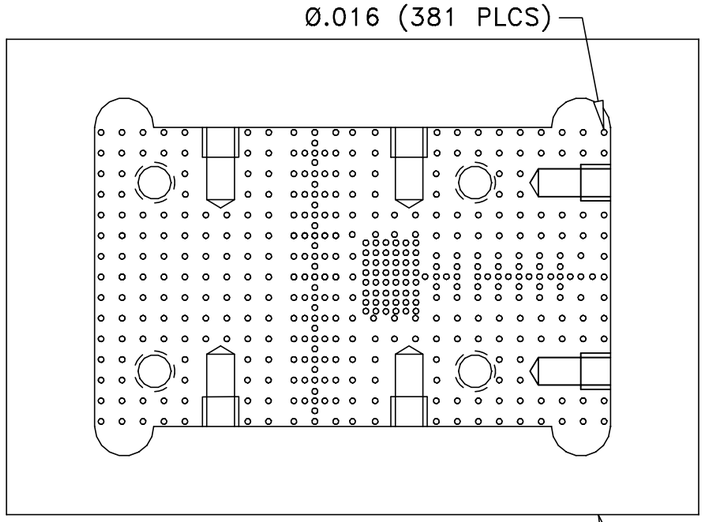
ASHEETA1.DWG REV:A DATE:01/12/95

Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

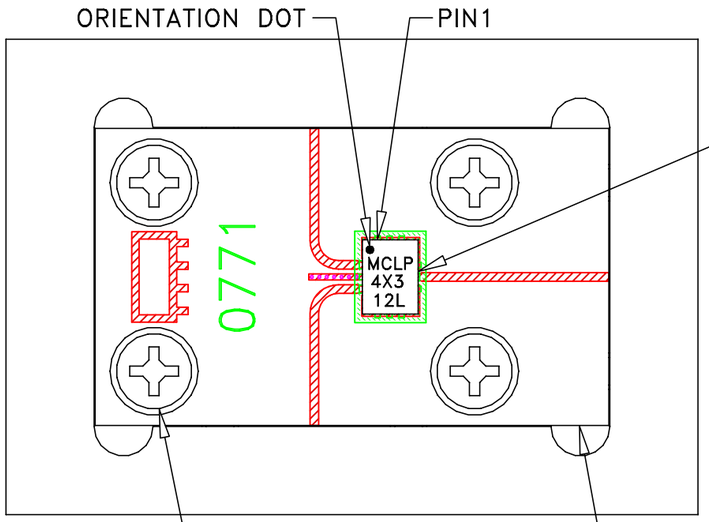
PL, DG3006, TB-MTX2-133/183C+

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-754	OR

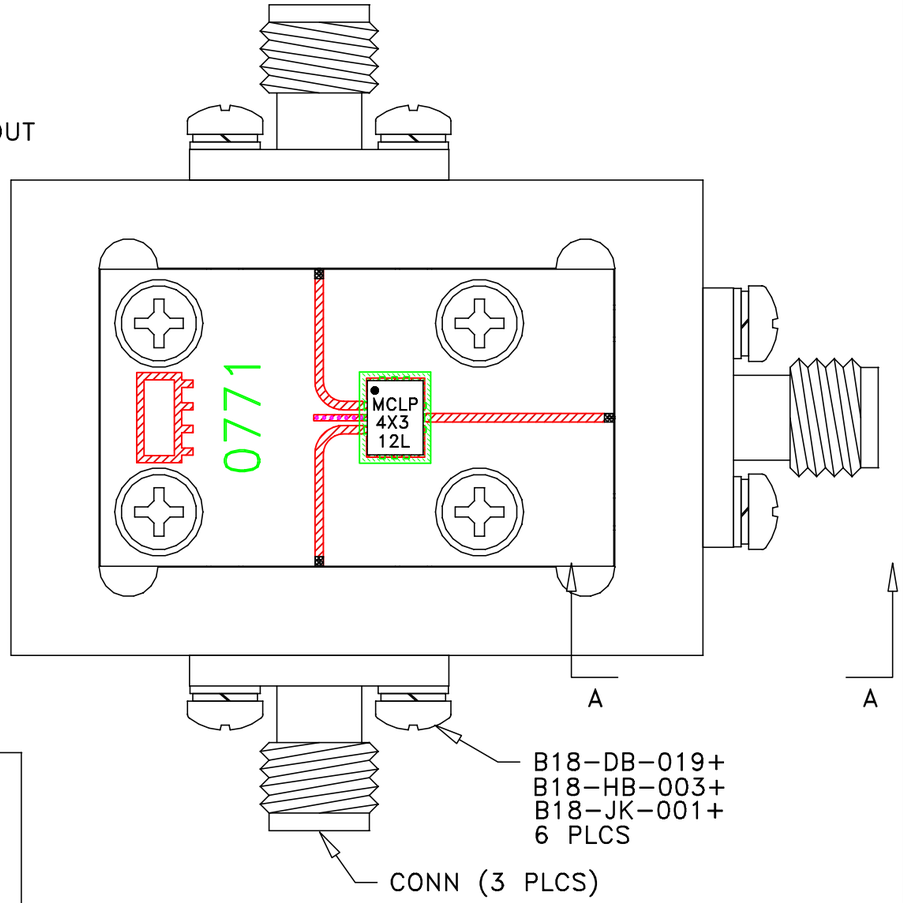
FILE:	SCALE:	SHEET:
98PL754	12:1	1 OF 1

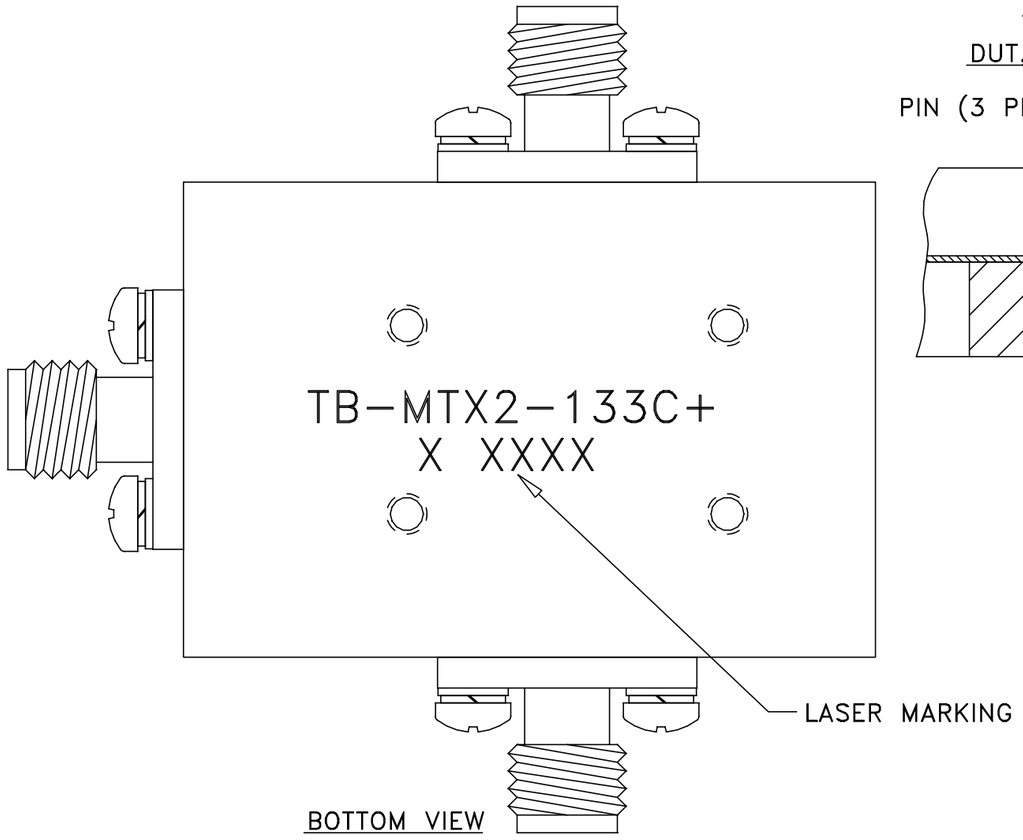


TOP VIEW
SOLDER PASTE DISPENCING

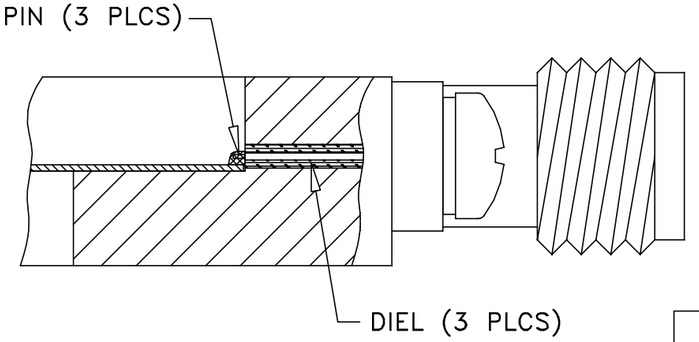


DUT, PCB INSTALLATION



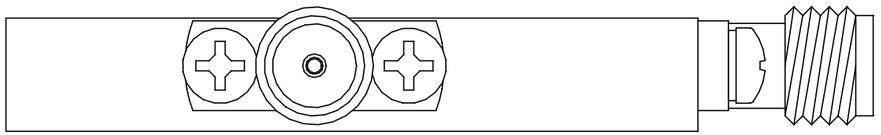


BOTTOM VIEW



VIEW "A-A"
(SCALE 5:1)

CONNECTORS INSTALLATION, SOLDERING



NOTE:

FOR ITEM DESCRIPTIONS REFER TO -09 PAGE.
DESIGNATION NUMBERS ON -20 PAGE CORRESPOND TO THE NUMBERS ON -09 PAGE.

THIRD ANGLE PROJECTION

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	NPO-003538	NEW RELEASE	05/09/23	IK	CM

REVISIONS

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES TOLERANCES ON: 2 PL DECIMALS ± 3 PL DECIMALS ± ANGLES ± FRACTIONS ±	DRAWN	IK	05/09/23
	CHECKED	IL	05/09/23
	APPROVED	CM	05/09/23

BSHEETA1.DWG REV:A DATE:01/12/94

Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

TEST BOARD FOR MTX2-133C+ W/CONN

SIZE	CODE IDENT	DRAWING NO:	REV:
B	15542	TB-MTX2-133C-20+	OR
FILE: WTBMTX2-133C+	SCALE: 3:1	SHEET: 1 OF 1	

Mini-Circuits

Environmental Specifications ENV08T1

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 or -45° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° 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
Mechanical Shock	1.5Kg, 0.5 ms, 5 shock pulses, Y1 direction only	MIL-STD-883, Method 2002, Condition B, except Y1 direction only
Vibration (Variable Frequency)	50g peak	MIL-STD-883, Method 2007, Condition B
Autoclave	15 psig, 100% RH, 121°C, 96 hours	JESD22-A102, Condition C
HAST	130°C, 85% RH, 96 hours	JESD22-A110
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Solder Reflow Heat	Sn-Pb Eutetic Process: 240°C peak Pb-Free Process: 260°C peak	J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1
Moisture Sensitivity: Level 1	Bake at 125°C for 24 hours Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 260°C peak	J-STD-020
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether +	MIL-STD-202, Method 215

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
	monoethanolamine at 63°C to 70°C	