



MMIC SURFACE MOUNT

Balun

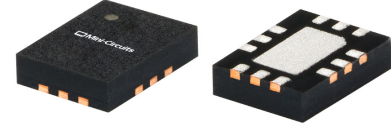
MTX2-133+

Mini-Circuits

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

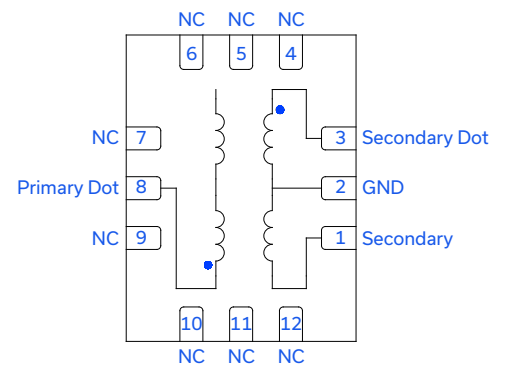


Generic photo used for illustration purposes only

APPLICATIONS

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

FUNCTIONAL DIAGRAM



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.

**ELECTRICAL SPECIFICATIONS¹ 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		

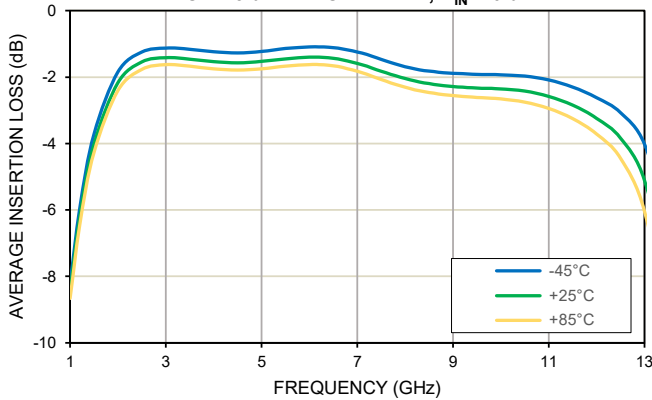
1. Tested in Mini-Circuits Evaluation Board TB-MTX2-133C+.

2. Relative to 180°

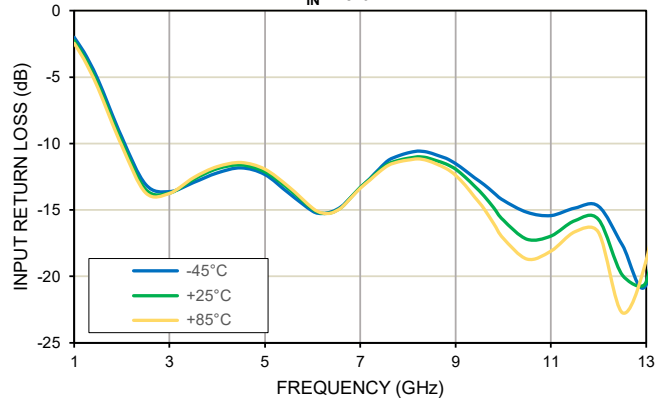


TYPICAL PERFORMANCE GRAPHS

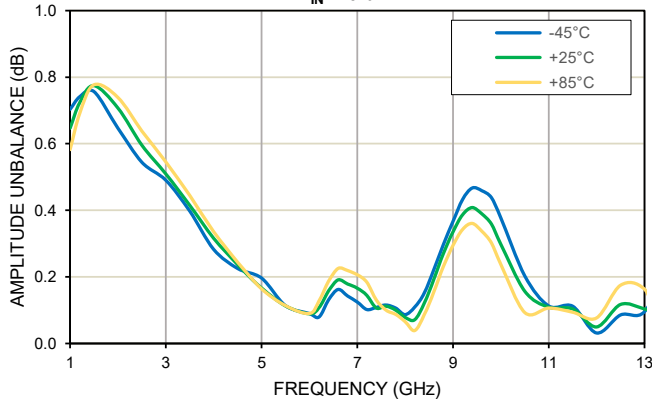
AVERAGE INSERTION LOSS VS. TEMPERATURE
ABOVE 3 dB THEORETICAL, $P_{IN} = 0$ dBm



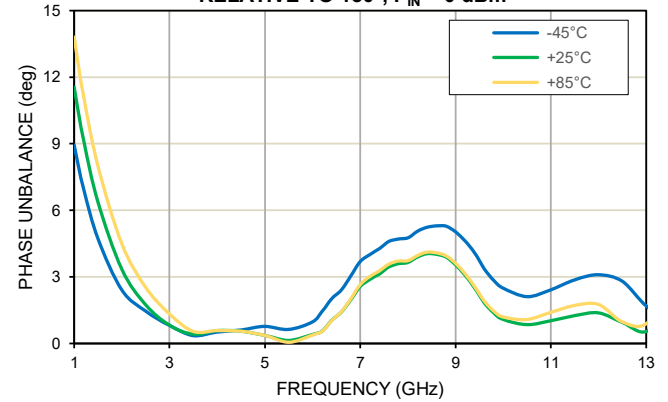
INPUT RETURN LOSS VS. TEMPERATURE
 $P_{IN} = 0$ dBm



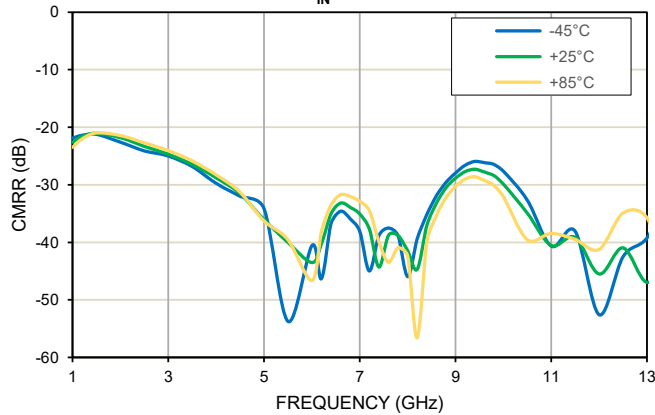
AMPLITUDE UNBALANCE VS. TEMPERATURE
 $P_{IN} = 0$ dBm



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



CMRR VS. TEMPERATURE
 $P_{IN} = 0$ dBm



**ABSOLUTE MAXIMUM RATINGS³**

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

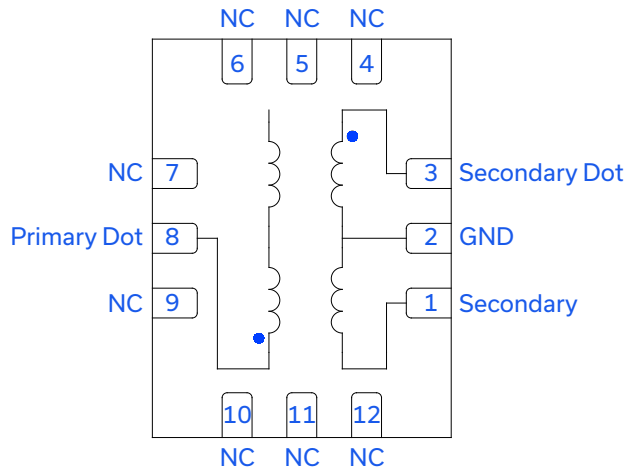


Figure 1. MTX2-133+ Functional Diagram

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

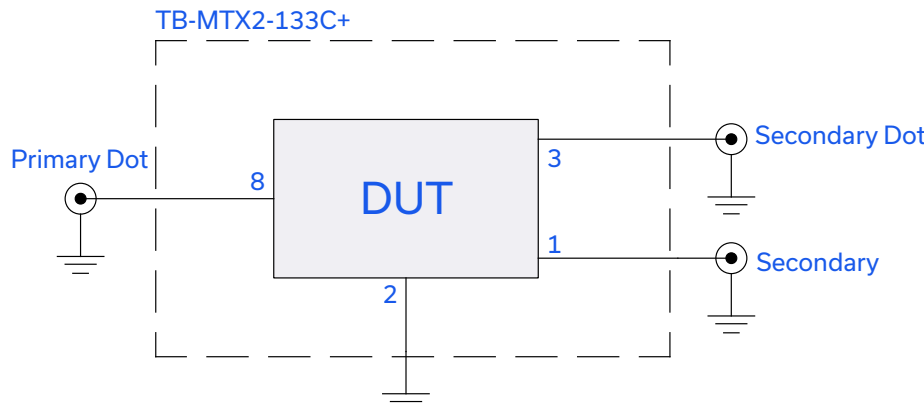


Figure 2. DUT soldered on Mini-Circuits Evaluation Board: TB-MTX2-133C+

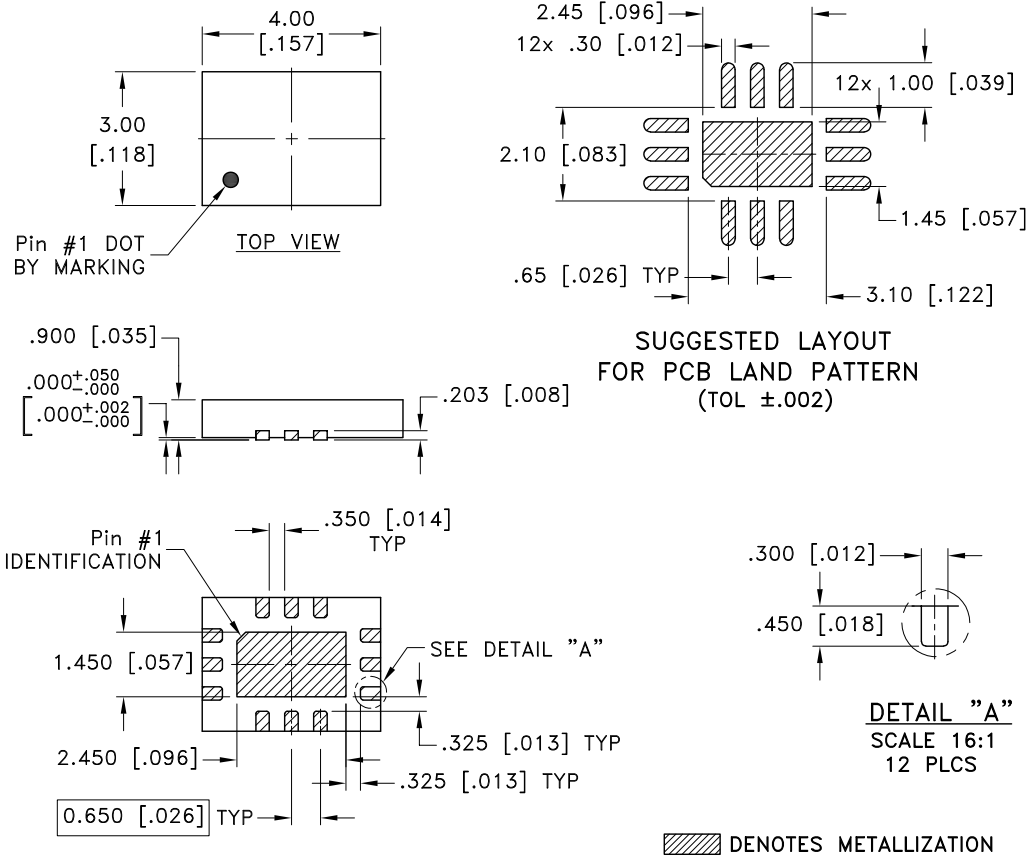
Electrical Parameters and Conditions

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

Conditions:
1. $P_{IN} = 0$ dBm

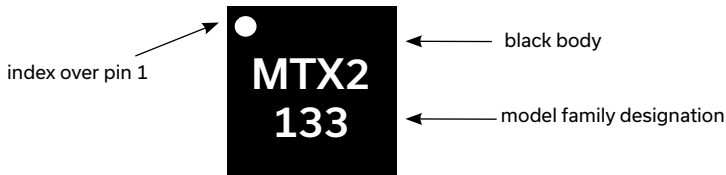


CASE STYLE DRAWING



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



MMIC SURFACE MOUNT

Balun

MTX2-133+

 Mini-Circuits

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

- 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-Circuit's applicable established test performance criteria and measurement instructions.
- 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°

RF Transformer

MTX2-133+

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°

RF Transformer

MTX2-133+

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

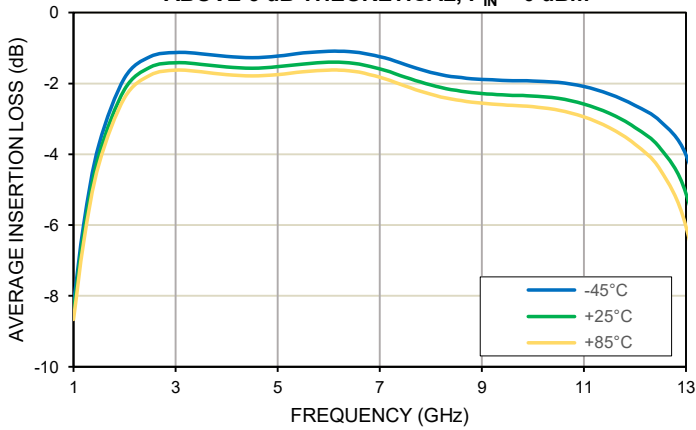
⁽¹⁾ Above 3 dB theoretical loss

⁽²⁾ Relative to 180°

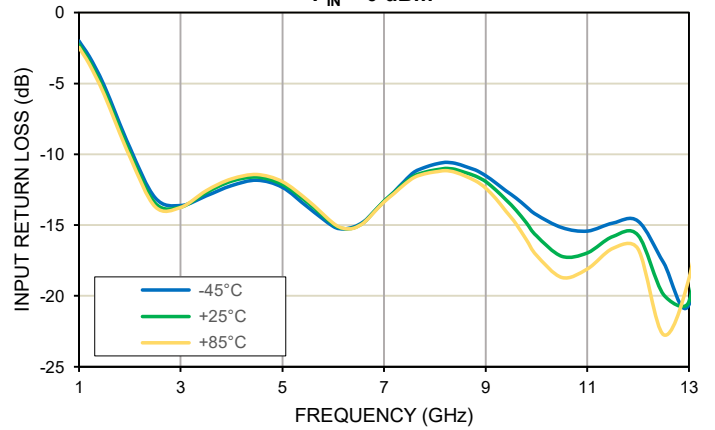


Typical Performance Data

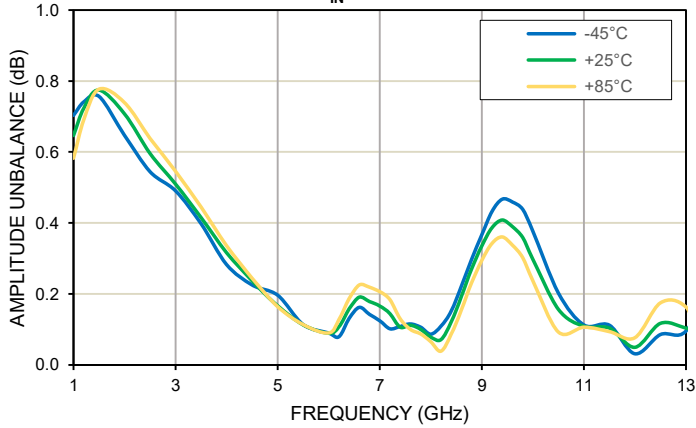
AVERAGE INSERTION LOSS VS. TEMPERATURE
ABOVE 3 dB THEORETICAL, $P_{IN} = 0$ dBm



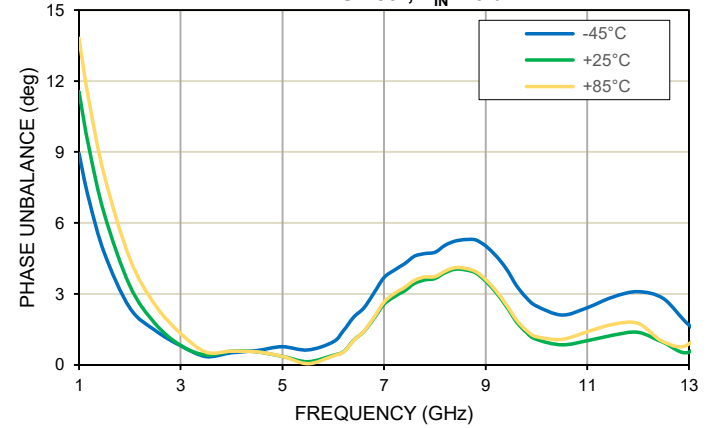
INPUT RETURN LOSS VS. TEMPERATURE
 $P_{IN} = 0$ dBm



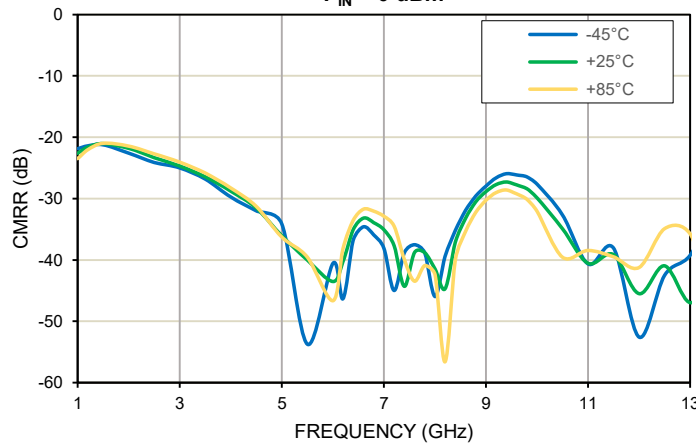
AMPLITUDE UNBALANCE VS. TEMPERATURE
 $P_{IN} = 0$ dBm

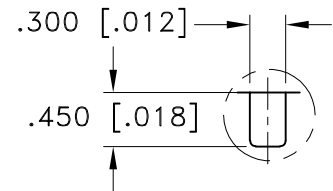
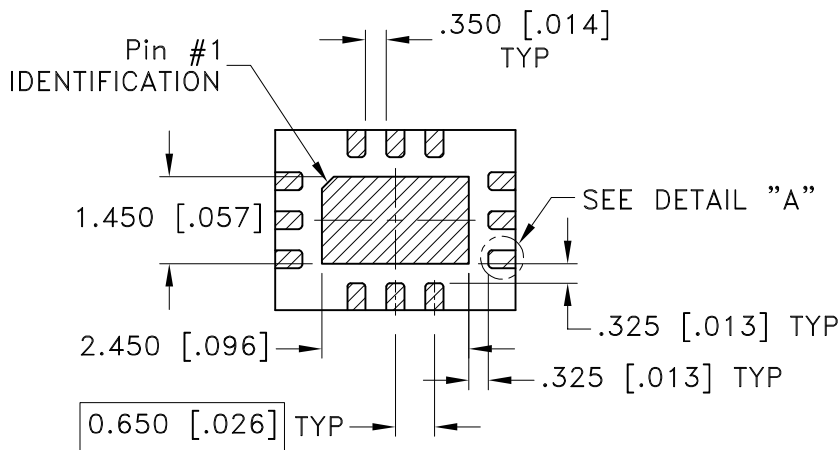
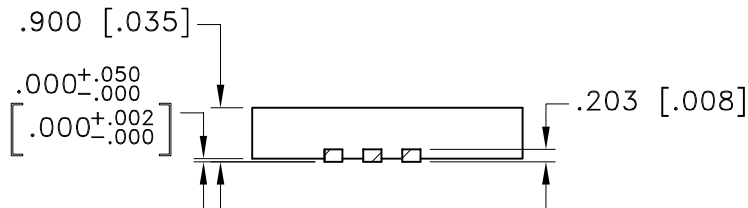
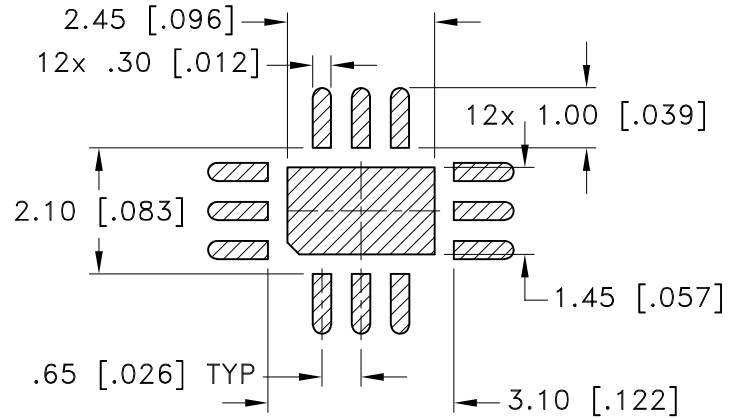
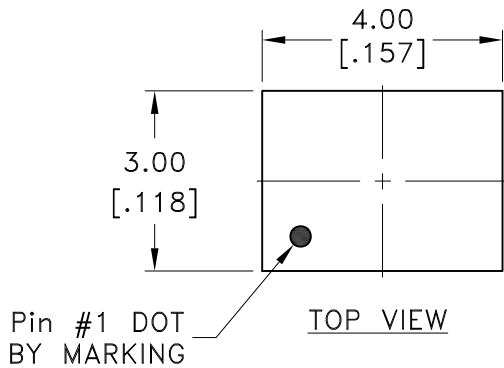


PHASE UNBALANCE VS. TEMPERATURE
RELATIVE TO 180°, $P_{IN} = 0$ dBm



CMRR VS. TEMPERATURE
 $P_{IN} = 0$ dBm





DETAIL "A"
SCALE 16:1
12 PLCS

DENOTES METALLIZATION

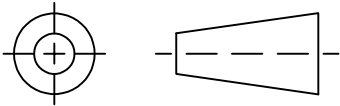
Weight: 0.032 grams

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

Notes:

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

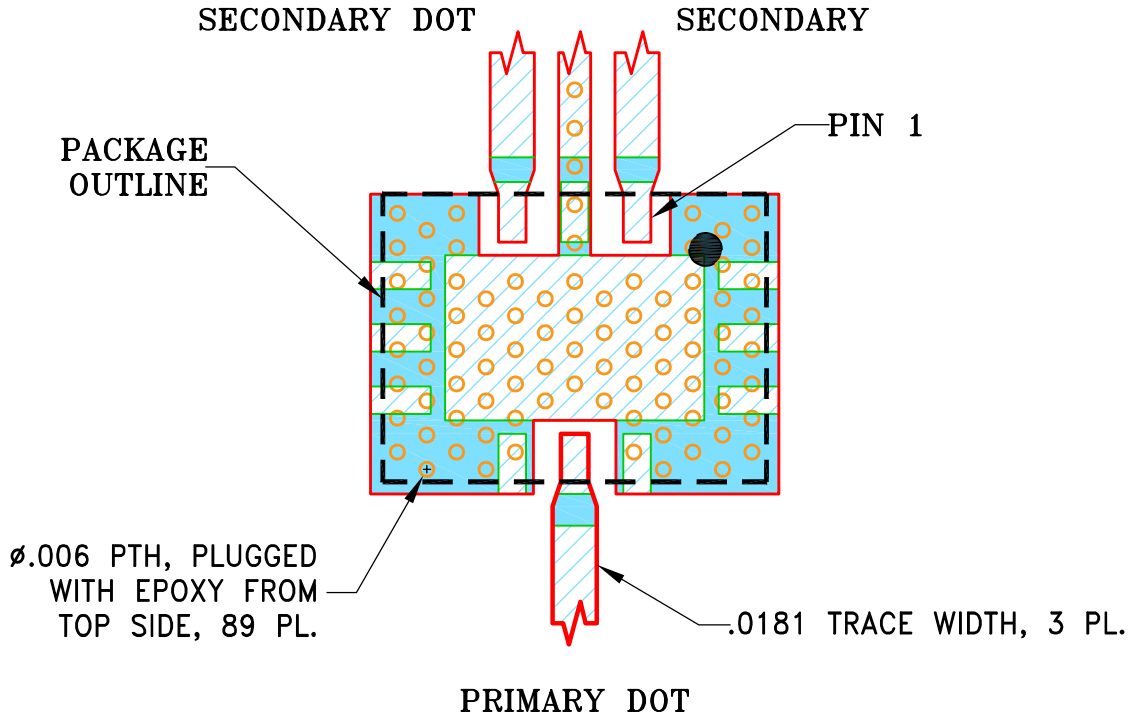
THIRD ANGLE PROJECTION



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

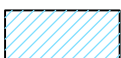


NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS R04003C 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

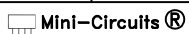
UNLESS OTHERWISE SPECIFIED	INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN NP	06/15/23
TOLERANCES ON:	CHECKED IL	06/15/23
2 PL DECIMALS ±	APPROVED CM	06/15/23
3 PL DECIMALS ± .005		
ANGLES ±		
FRACTIONS ±		



Mini-Circuits®

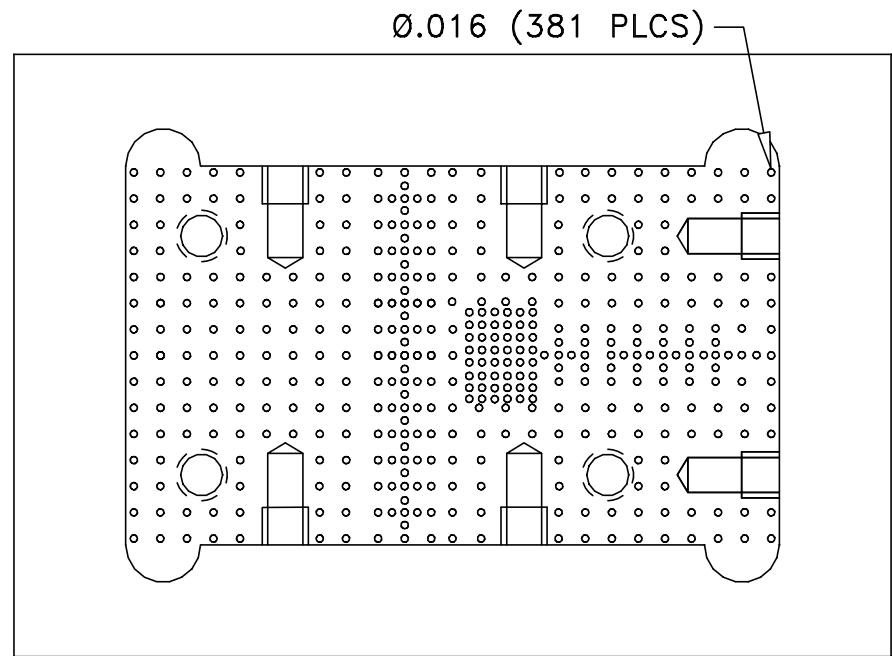
13 Neptune Avenue
Brooklyn NY 11235

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

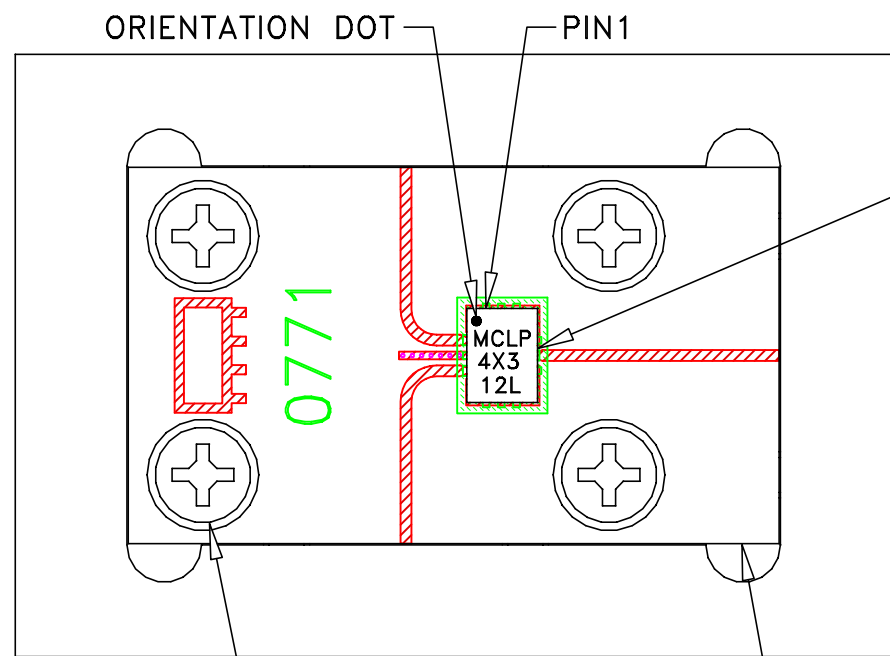


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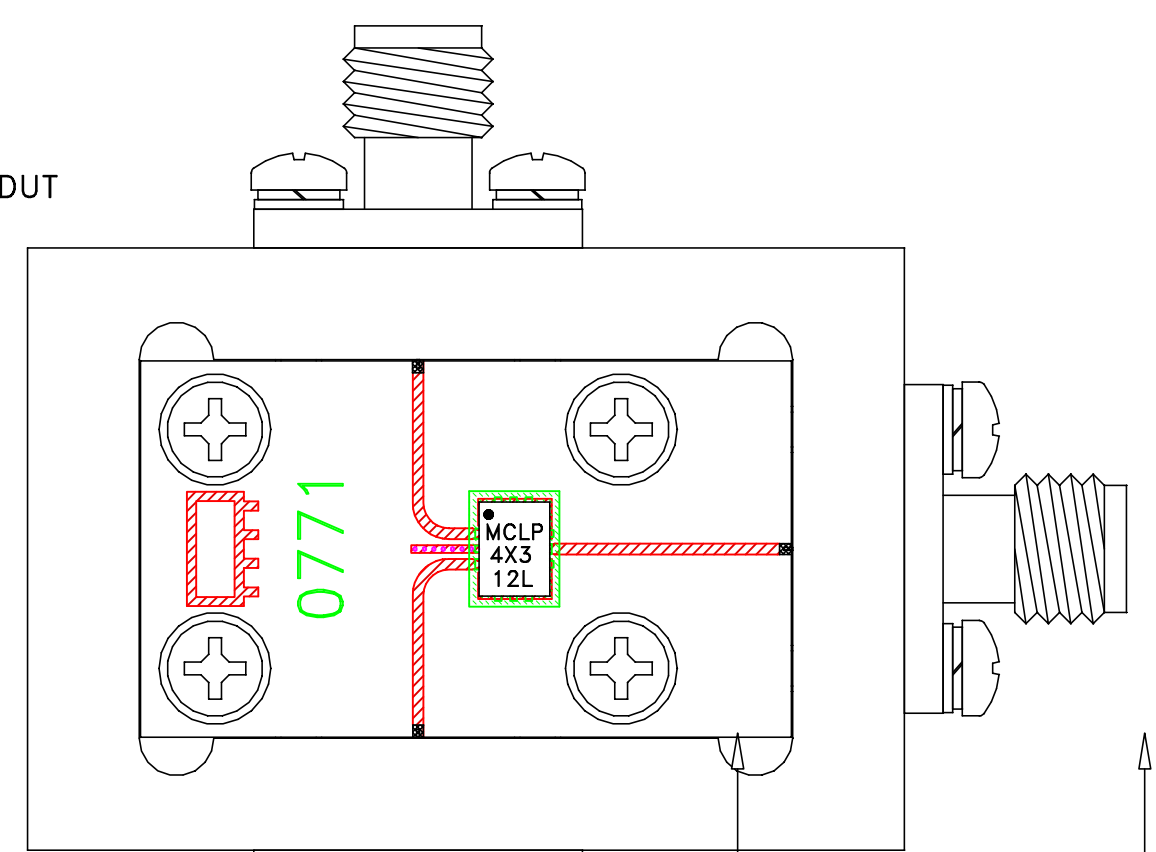
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A	15542	98-PL-754	OR
FILE:	98PL754	SCALE: 12:1	SHEET: 1 OF 1



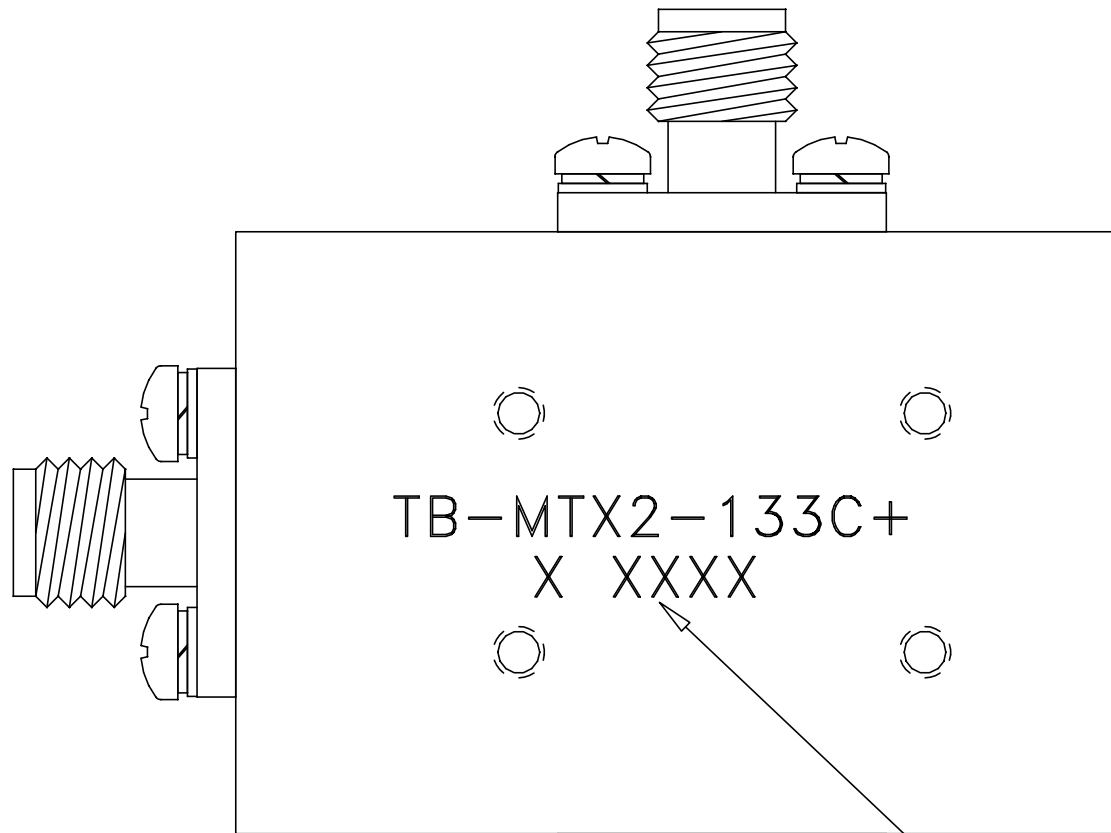
TOP VIEW
SOLDER PASTE DISPENSING



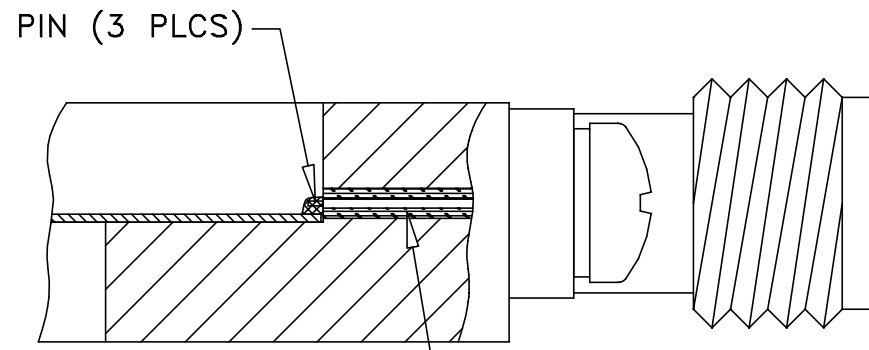
B18-DB-019+
B18-HB-002+
B18-JB-001+
4 PLCS
DUT, PCB INSTALLATION



CONNECTORS INSTALLATION, SOLDERING



BOTTOM VIEW



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

NOTE:

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



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

Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

TEST BOARD FOR MTX2-133C+ W/CONN

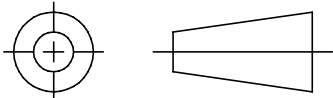
OR	NPO-003538	NEW RELEASE	05/09/23	IK	CM
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
		REVISIONS			

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

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

THIRD ANGLE PROJECTION



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	