



MMIC SURFACE MOUNT

# Balun

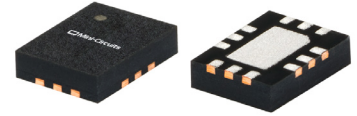
# MTX2-4143+

Mini-Circuits

50Ω 4 to 14 GHz

## THE BIG DEAL

- Wideband, 4 to 14 GHz
- Low Insertion Loss, Typ. 1.4 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

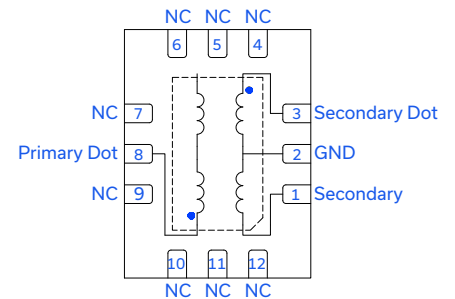


Generic photo used for illustration purposes only

## 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' MTX2-4143+ is a wideband MMIC balun transformer, with an impedance ratio of 1:2. This balun is ideal for a wide range of applications from 4 to 14 GHz. Fabricated using GaAs process technology, MTX2-4143+ provides outstanding repeatability with low insertion loss, low amplitude unbalance, low phase unbalance, and excellent common mode rejection.

## KEY FEATURES

Features	Advantages
Wideband, 4 to 14 GHz	Supports a broad variety of applications including Test and Measurement, 5G Microwave Radio, Radar, and Electronic Warfare.
Low Insertion Loss <ul style="list-style-type: none"> <li>• Typ. 1.4 dB (above 3.0 dB theoretical)</li> </ul>	Enables excellent signal power transmission from input to output.
Excellent Common Mode Rejection <ul style="list-style-type: none"> <li>• Typ. 37 dB</li> </ul>	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 with the PCB.

ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C, Z<sub>0</sub> = 50Ω UNLESS NOTED OTHERWISE

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Impedance Ratio (Secondary / Primary)			2		
Frequency Range		4		14	GHz
Insertion Loss <sup>2</sup>	4 - 8		1.2	2.7	dB
	8 - 12		1.4	2.8	
	12 - 14		2.2	5.7	
Amplitude Unbalance	4 - 8		0.1	0.6	dB
	8 - 12		0.2	1.0	
	12 - 14		0.3	1.6	
Phase Unbalance <sup>3</sup>	4 - 8		0.6	6.0	Degree
	8 - 12		2.0	12.1	
	12 - 14		3.5	12.5	
Common Mode Rejection Ratio	4 - 8		44		dB
	8 - 12		37		
	12 - 14		33		
Input Return Loss	4 - 8	8	12		dB
	8 - 12	6	14		
	12 - 14	4	11		

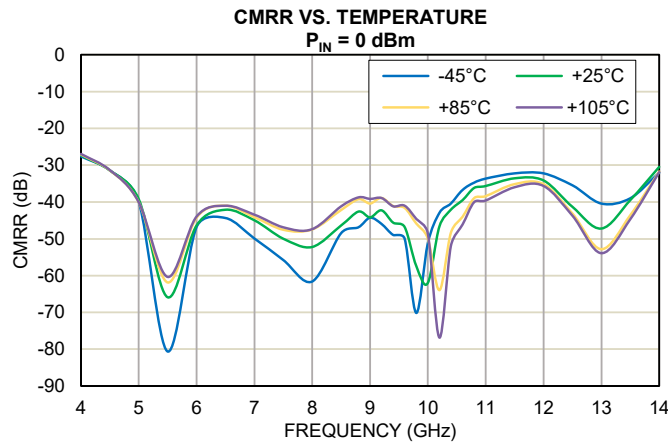
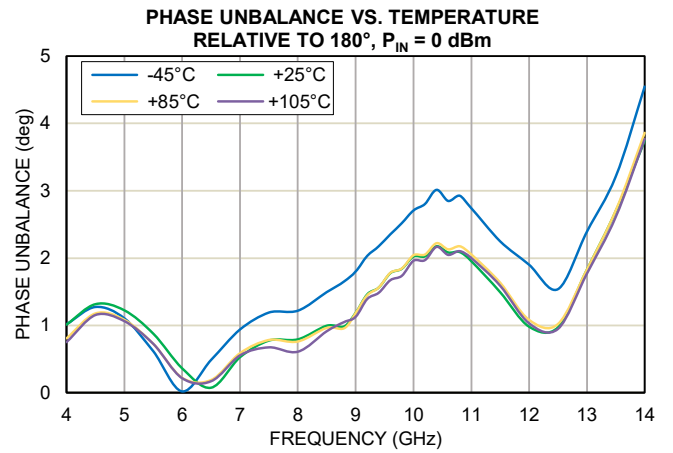
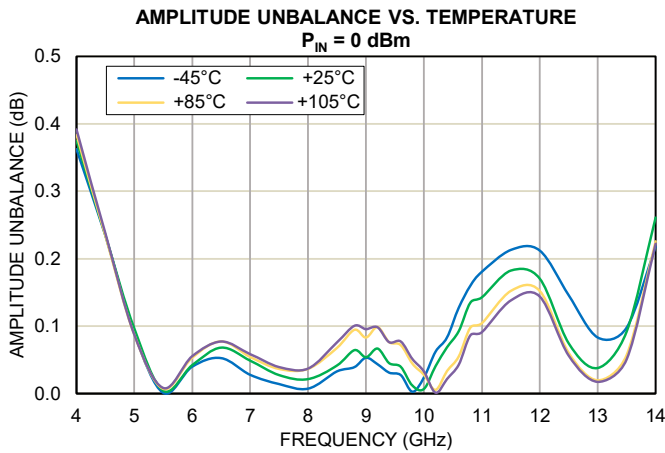
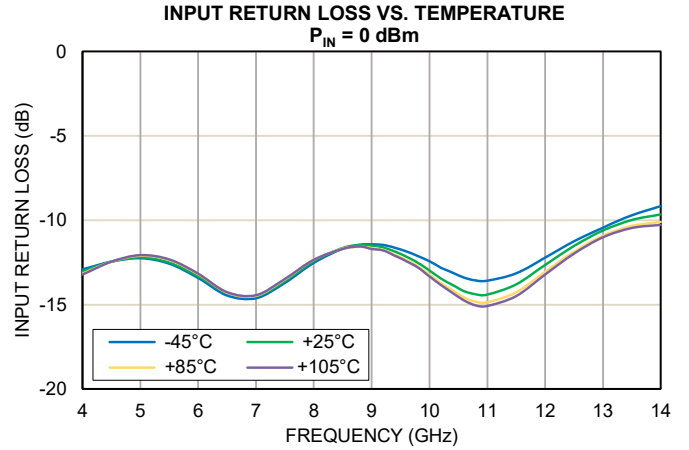
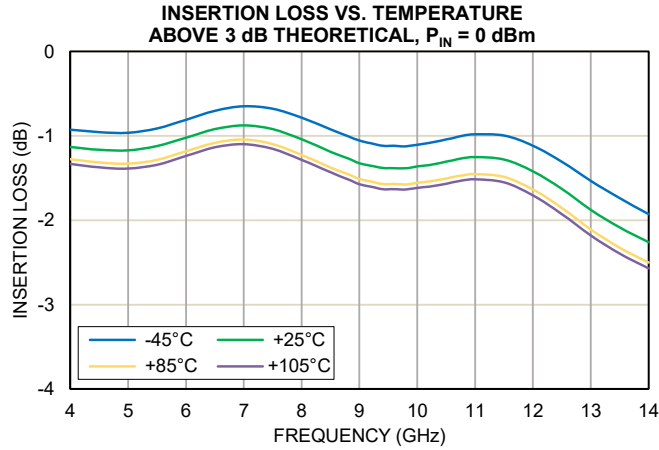
1. Tested on Mini-Circuits Evaluation Board TB-MTX2-4143C+. See Figure 2. Board loss de-embedded.

2. Average of S<sub>21</sub> & S<sub>31</sub>, above the 3 dB theoretical loss.

3. Relative to 180°.



### TYPICAL PERFORMANCE GRAPHS



**ABSOLUTE MAXIMUM RATINGS<sup>4</sup>**

Parameter	Ratings
Operating Temperature (ground lead)	-45°C to +105°C
Storage Temperature	-65°C to +150°C
RF Input Power	2 W

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

**ESD RATING**

	Class	Voltage Range	Reference Standard
HBM	1C	1000 to < 2000 V	ANSI/ESDA/JEDEC JS-001-2023
CDM	C3	≥ 1000 V	ANSI/ESDA/JEDEC JS-002-2022



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

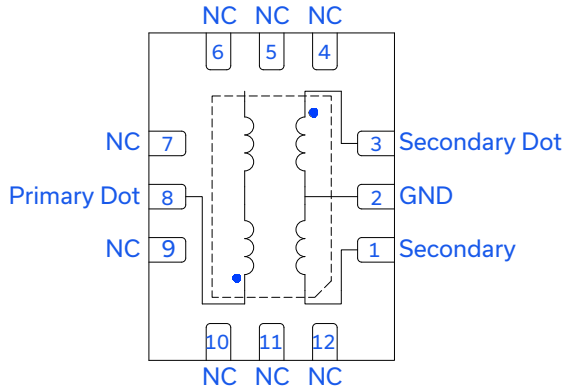


Figure 1. MTX2-4143+ Functional Diagram

### 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, Paddle	External ground
NC	4-7, 9-12	No connection. Connected to ground on the test board.

### EVALUATION BOARD

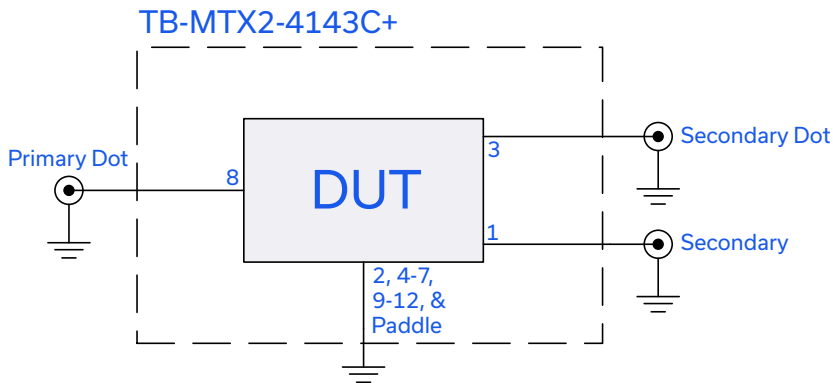


Figure 2. MTX2-4143+ Evaluation Board.

### Electrical Parameters and Conditions

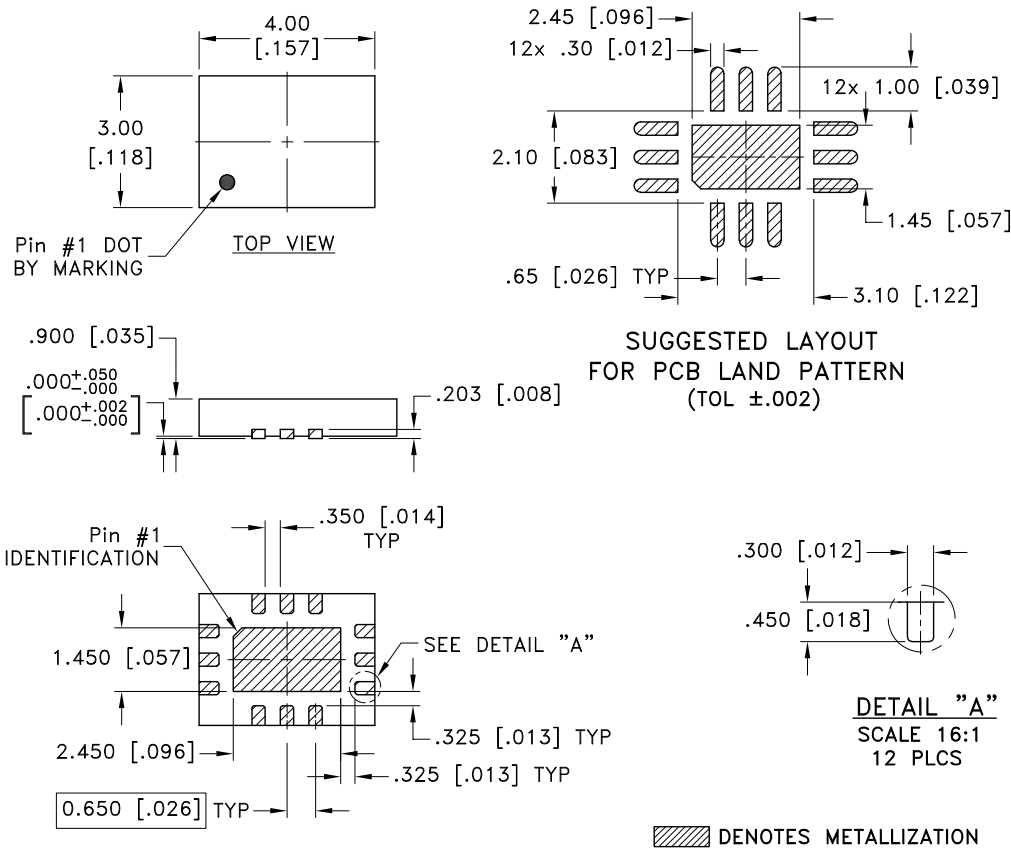
Insertion Loss, Amplitude Unbalance, Phase Unbalance, Common Mode Rejection, and Return Loss measured using N5242A PNA-X microwave network analyzer.

#### Conditions:

1.  $P_{IN} = 0$  dBm

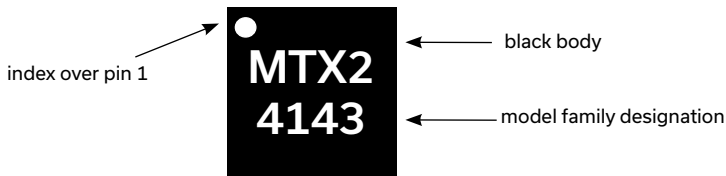


### CASE STYLE DRAWING



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

## MTX2-4143+

50Ω 4 to 14 GHz

 Mini-Circuits

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD

[CLICK HERE](#)

<b>Performance Data &amp; Graphs</b>	Data Graphs S-Parameter (S3P Files) Data Set (.zip file)
<b>Case Style</b>	DG3006. Plastic package, exposed paddle, Lead Finish: Matte-Tin
<b>RoHS Status</b>	Compliant
<b>Tape &amp; Reel</b> Standard quantities available on reel	F68 7" or 13" reels with 20, 50, 100, 200, 500, 1K, 2K, 3K, or 4K devices
<b>Suggested Layout for PCB Design</b>	PL-754
<b>Evaluation Board</b>	TB-MTX2-4143C+ Gerber File
<b>Environmental Ratings</b>	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](http://www.minicircuits.com/terms/viewterm.html)



# RF Transformer

# MTX2-4143+

## Typical Performance Data

Temperature = +25°C

FREQUENCY (GHz)	AVERAGE INSERTION LOSS <sup>(1)</sup> (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE <sup>(2)</sup> (deg.)	CMRR (dB)
4.0	1.13	13.03	0.37	1.01	27.31
4.5	1.17	12.45	0.23	1.32	31.38
5.0	1.17	12.20	0.10	1.22	39.14
5.5	1.12	12.50	0.00	0.88	65.90
6.0	1.02	13.32	0.04	0.36	46.33
6.5	0.92	14.31	0.07	0.07	42.09
7.0	0.88	14.50	0.05	0.53	44.96
7.5	0.92	13.61	0.03	0.77	49.94
8.0	1.04	12.41	0.02	0.79	52.19
8.5	1.19	11.64	0.04	0.99	46.37
8.8	1.27	11.49	0.06	0.99	42.61
9.0	1.32	11.50	0.05	1.19	44.16
9.2	1.35	11.62	0.07	1.46	42.28
9.4	1.38	11.86	0.05	1.56	45.64
9.6	1.38	12.16	0.04	1.78	46.81
9.8	1.39	12.52	0.01	1.84	57.38
10.0	1.36	12.98	0.01	2.02	62.06
10.2	1.35	13.45	0.04	2.03	46.58
10.4	1.32	13.83	0.07	2.18	42.07
10.6	1.29	14.20	0.09	2.08	39.47
10.8	1.26	14.39	0.14	2.09	36.17
11.0	1.25	14.41	0.14	1.96	35.69
11.5	1.28	13.80	0.18	1.49	33.57
12.0	1.42	12.64	0.17	0.98	34.15
12.5	1.63	11.53	0.07	0.97	41.31
13.0	1.88	10.61	0.04	1.83	47.21
13.5	2.09	9.99	0.09	2.70	39.50
14.0	2.26	9.66	0.26	3.74	30.45

<sup>(1)</sup> Above 3 dB theoretical loss

<sup>(2)</sup> Relative to 180°



# RF Transformer

# MTX2-4143+

## Typical Performance Data

Temperature = -45°C

FREQUENCY (GHz)	AVERAGE INSERTION LOSS <sup>(1)</sup> (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE <sup>(2)</sup> (deg.)	CMRR (dB)
4.0	0.93	12.90	0.36	1.02	27.60
4.5	0.96	12.46	0.23	1.27	31.40
5.0	0.96	12.25	0.09	1.11	39.80
5.5	0.91	12.57	0.00	0.61	80.60
6.0	0.81	13.42	0.04	0.02	46.82
6.5	0.70	14.46	0.05	0.49	44.33
7.0	0.65	14.62	0.03	0.94	49.86
7.5	0.68	13.72	0.01	1.19	55.77
8.0	0.79	12.52	0.01	1.22	61.58
8.5	0.92	11.69	0.03	1.49	48.46
8.8	1.00	11.45	0.04	1.65	46.88
9.0	1.06	11.42	0.05	1.80	44.25
9.2	1.09	11.47	0.04	2.03	45.99
9.4	1.12	11.63	0.03	2.18	48.93
9.6	1.12	11.85	0.03	2.35	50.01
9.8	1.12	12.11	0.00	2.52	70.14
10.0	1.10	12.43	0.02	2.71	51.27
10.2	1.08	12.81	0.06	2.80	42.92
10.4	1.06	13.11	0.08	3.02	40.39
10.6	1.03	13.40	0.13	2.85	36.70
10.8	1.00	13.57	0.16	2.92	34.70
11.0	0.98	13.58	0.18	2.74	33.66
11.5	1.00	13.15	0.21	2.25	32.22
12.0	1.12	12.22	0.21	1.90	32.24
12.5	1.31	11.25	0.15	1.54	35.49
13.0	1.53	10.43	0.08	2.40	40.39
13.5	1.74	9.70	0.10	3.21	38.96
14.0	1.93	9.16	0.22	4.55	32.02

<sup>(1)</sup> Above 3 dB theoretical loss

<sup>(2)</sup> Relative to 180°

# RF Transformer

# MTX2-4143+

## Typical Performance Data

Temperature = +85°C

FREQUENCY (GHz)	AVERAGE INSERTION LOSS <sup>(1)</sup> (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE <sup>(2)</sup> (deg.)	CMRR (dB)
4.0	1.28	13.17	0.38	0.81	27.10
4.5	1.32	12.46	0.23	1.18	31.41
5.0	1.33	12.10	0.09	1.08	40.02
5.5	1.28	12.36	0.01	0.72	61.84
6.0	1.18	13.20	0.05	0.22	44.25
6.5	1.08	14.29	0.08	0.19	41.00
7.0	1.04	14.49	0.05	0.59	44.08
7.5	1.10	13.51	0.04	0.78	47.55
8.0	1.22	12.35	0.04	0.76	47.47
8.5	1.38	11.69	0.07	0.96	42.14
8.8	1.45	11.58	0.09	0.96	39.27
9.0	1.51	11.64	0.08	1.18	40.38
9.2	1.54	11.76	0.10	1.45	38.90
9.4	1.57	12.04	0.08	1.56	41.11
9.6	1.57	12.35	0.07	1.78	41.63
9.8	1.58	12.73	0.04	1.84	45.86
10.0	1.56	13.22	0.03	2.04	49.85
10.2	1.54	13.74	0.01	2.05	63.96
10.4	1.52	14.15	0.03	2.22	48.35
10.6	1.49	14.58	0.05	2.13	43.99
10.8	1.47	14.83	0.10	2.17	38.95
11.0	1.45	14.86	0.10	2.06	38.40
11.5	1.49	14.28	0.15	1.63	35.14
12.0	1.63	13.06	0.15	1.08	35.12
12.5	1.85	11.87	0.06	1.02	43.16
13.0	2.11	10.92	0.02	1.83	52.80
13.5	2.33	10.33	0.06	2.71	43.64
14.0	2.50	10.10	0.23	3.86	31.72

<sup>(1)</sup> Above 3 dB theoretical loss

<sup>(2)</sup> Relative to 180°

# RF Transformer

# MTX2-4143+

## Typical Performance Data

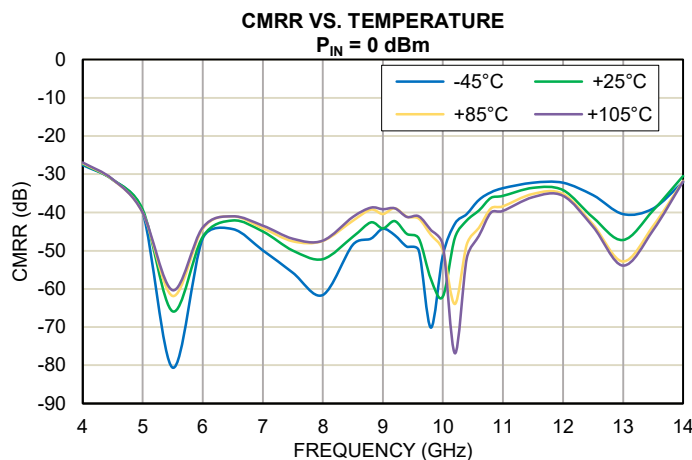
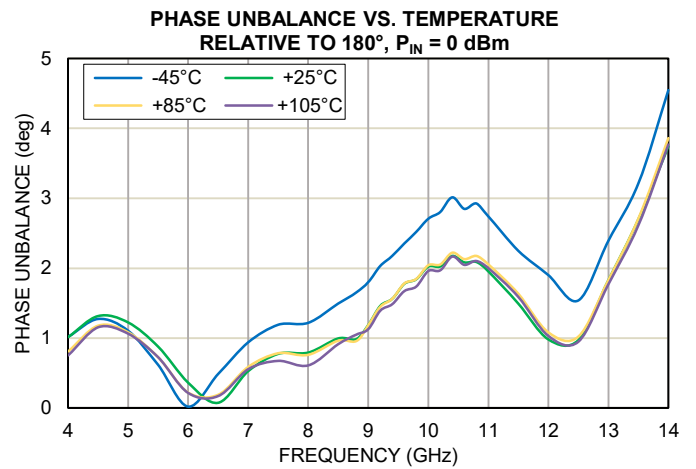
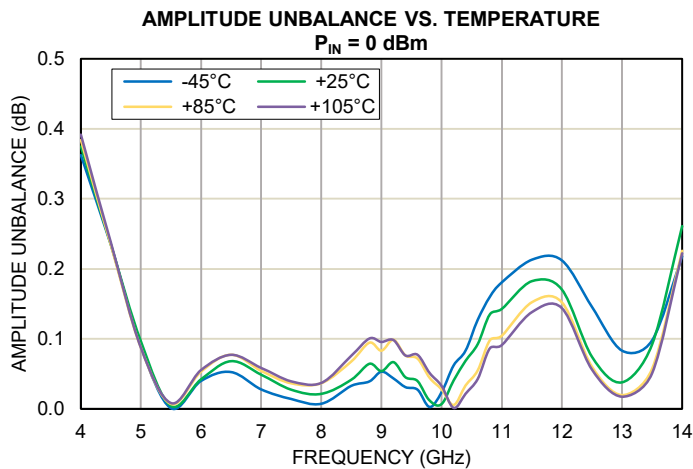
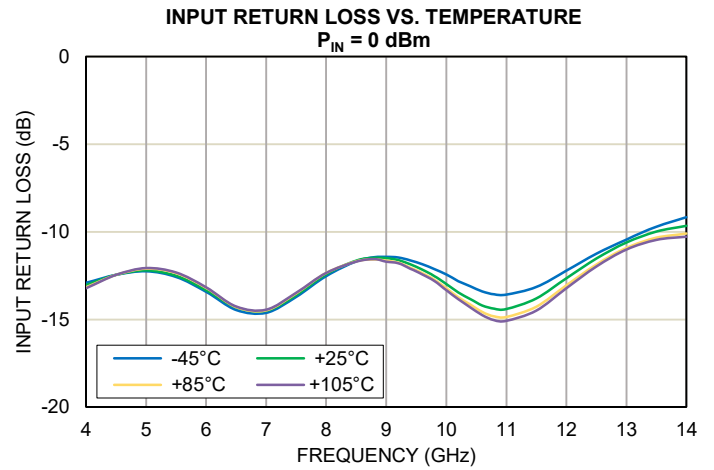
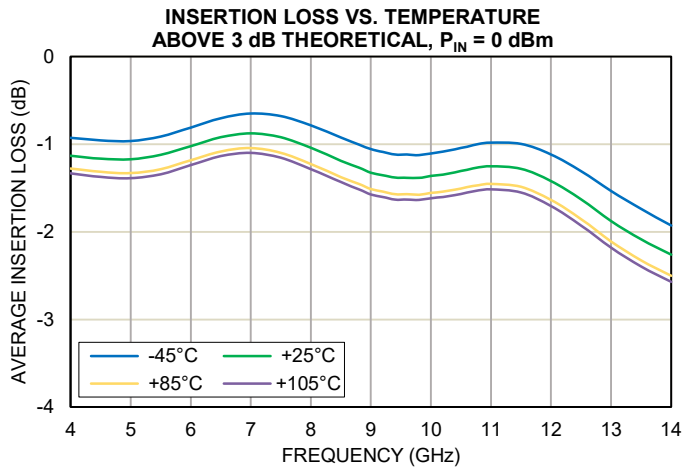
Temperature = +105°C

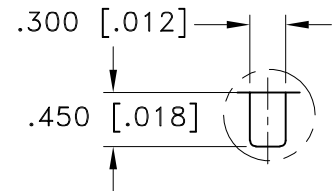
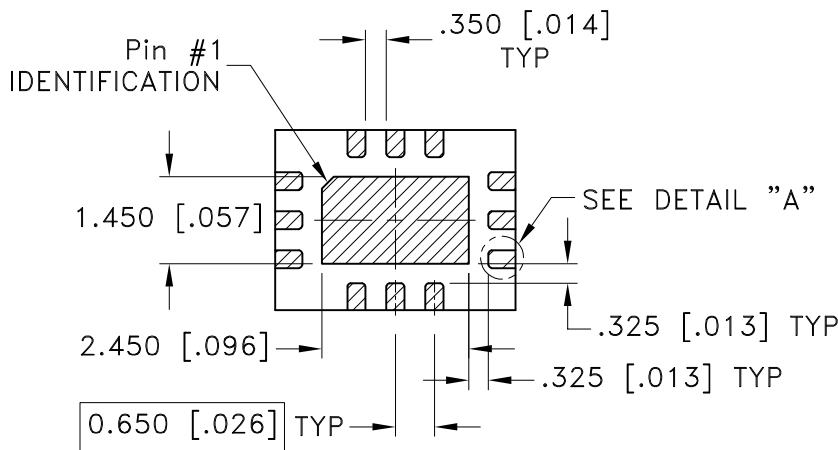
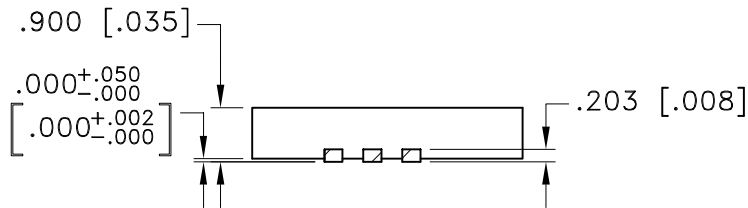
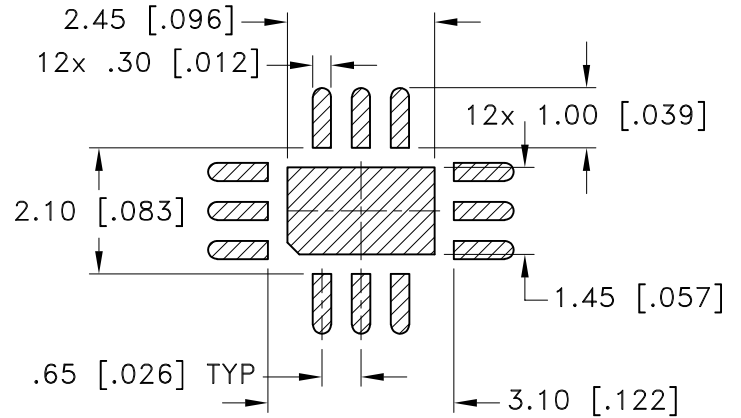
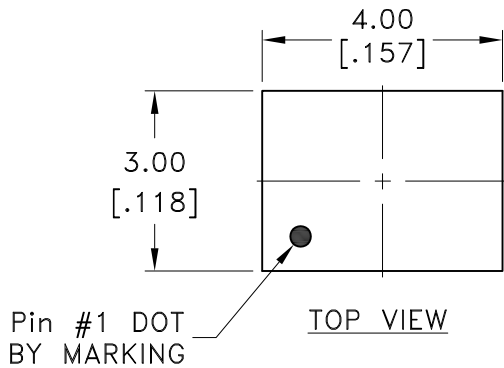
FREQUENCY (GHz)	AVERAGE INSERTION LOSS <sup>(1)</sup> (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE <sup>(2)</sup> (deg.)	CMRR (dB)
4.0	1.33	13.22	0.39	0.75	26.93
4.5	1.37	12.46	0.24	1.15	31.28
5.0	1.39	12.07	0.09	1.06	39.99
5.5	1.34	12.32	0.01	0.72	60.36
6.0	1.24	13.16	0.06	0.22	43.93
6.5	1.14	14.27	0.08	0.17	41.04
7.0	1.10	14.45	0.06	0.55	43.40
7.5	1.15	13.47	0.04	0.67	46.83
8.0	1.28	12.34	0.04	0.61	47.41
8.5	1.43	11.70	0.08	0.91	41.16
8.8	1.51	11.55	0.10	1.05	38.72
9.0	1.57	11.70	0.10	1.13	39.15
9.2	1.60	11.79	0.10	1.39	38.93
9.4	1.63	12.10	0.08	1.49	41.14
9.6	1.63	12.43	0.08	1.67	41.02
9.8	1.64	12.80	0.05	1.74	44.60
10.0	1.62	13.33	0.03	1.96	48.42
10.2	1.60	13.84	0.00	1.97	76.84
10.4	1.58	14.31	0.02	2.17	52.01
10.6	1.55	14.75	0.04	2.05	46.15
10.8	1.53	15.05	0.09	2.10	40.03
11.0	1.52	15.08	0.09	2.00	39.59
11.5	1.55	14.49	0.14	1.59	35.98
12.0	1.70	13.22	0.14	1.03	35.62
12.5	1.93	11.97	0.06	0.95	43.76
13.0	2.18	11.01	0.02	1.77	53.90
13.5	2.40	10.46	0.05	2.61	44.69
14.0	2.57	10.27	0.22	3.77	31.84

<sup>(1)</sup> Above 3 dB theoretical loss

<sup>(2)</sup> Relative to 180°

## Typical Performance Data





**DETAIL "A"**  
SCALE 16:1  
12 PLCS

 DENOTES METALLIZATION

Weight: 0.032 grams

Dimensions are in mm [inches] . Tolerances: 3 Pl.  $\pm 0.05$  [0.002] mm [Inch]

### Notes:

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



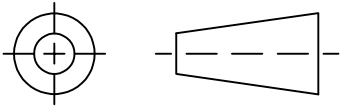
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

RF/IF MICROWAVE COMPONENTS

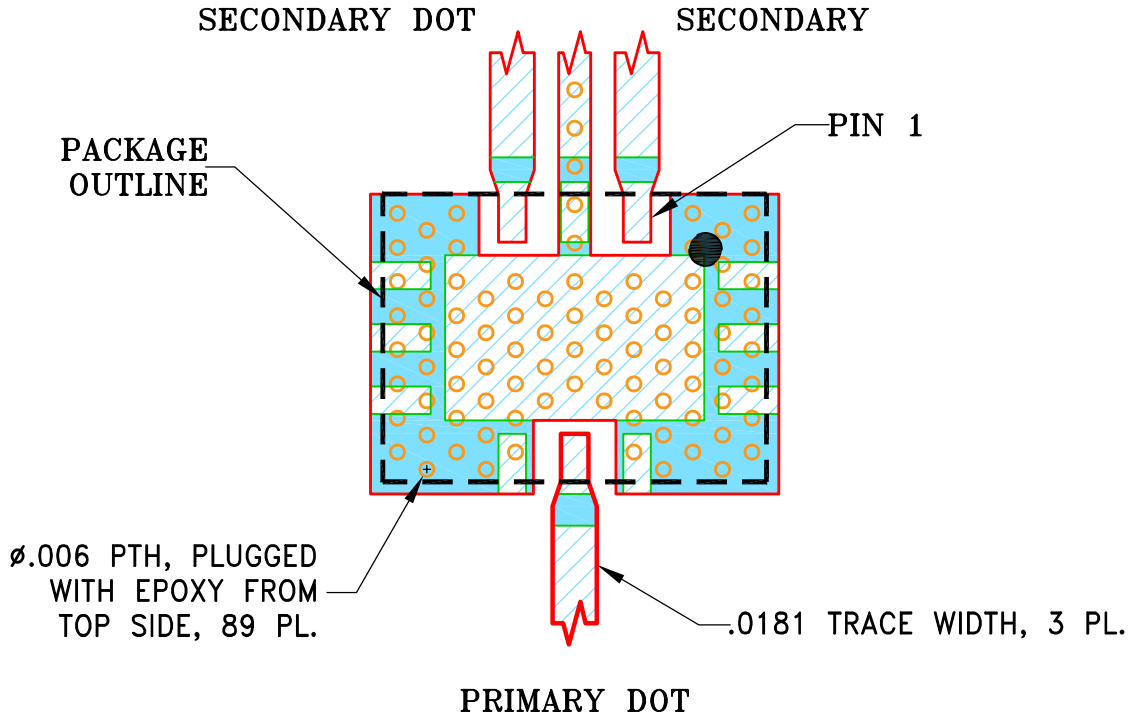
THIRD ANGLE PROJECTION



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

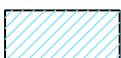


NOTES:

- TRACE WIDTH IS SHOWN FOR ROGERS R04003C WITH DIELECTRIC THICKNESS .008"; COPPER: 1 OZ. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
- 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

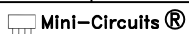
UNLESS OTHERWISE SPECIFIED	INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN NP	06/15/23
TOLERANCES ON:	CHECKED IL	06/15/23
2 PL DECIMALS ±	APPROVED CM	06/15/23
3 PL DECIMALS ± .005		
ANGLES ±		
FRACTIONS ±		



Mini-Circuits®

13 Neptune Avenue  
Brooklyn NY 11235

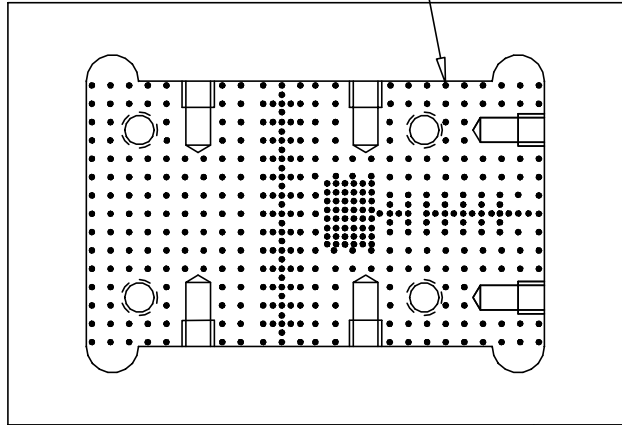
PL, DG3006, TB-MTX2-133/183C+



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SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-754	OR
FILE:	98PL754	SCALE: 12:1	SHEET: 1 OF 1

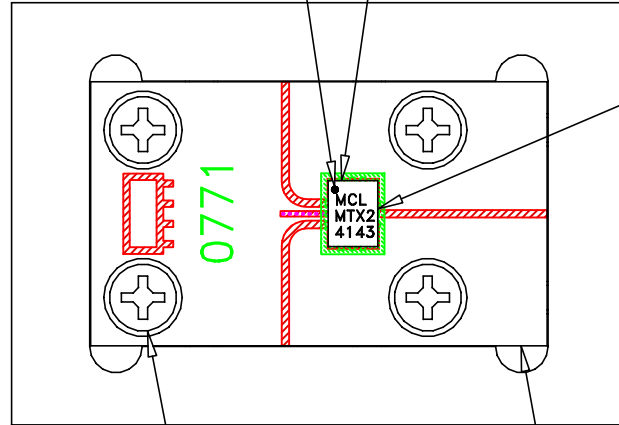
Ø.012 (412 PLCS)



TOP VIEW  
SOLDER PASTE DISPENSING

11

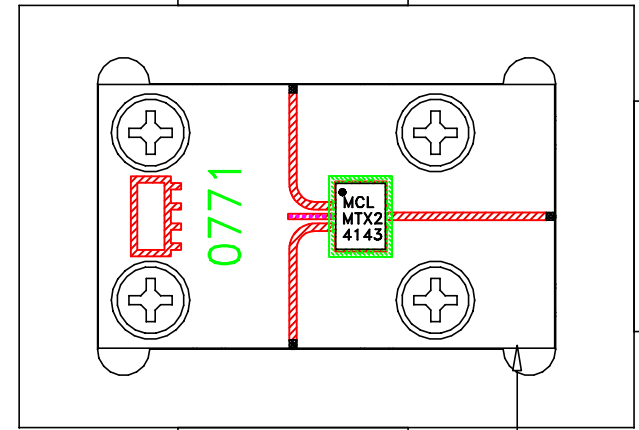
ORIENTATION DOT  
PIN1



DUT, PCB INSTALLATION

3 4 6 (4 PLCS)

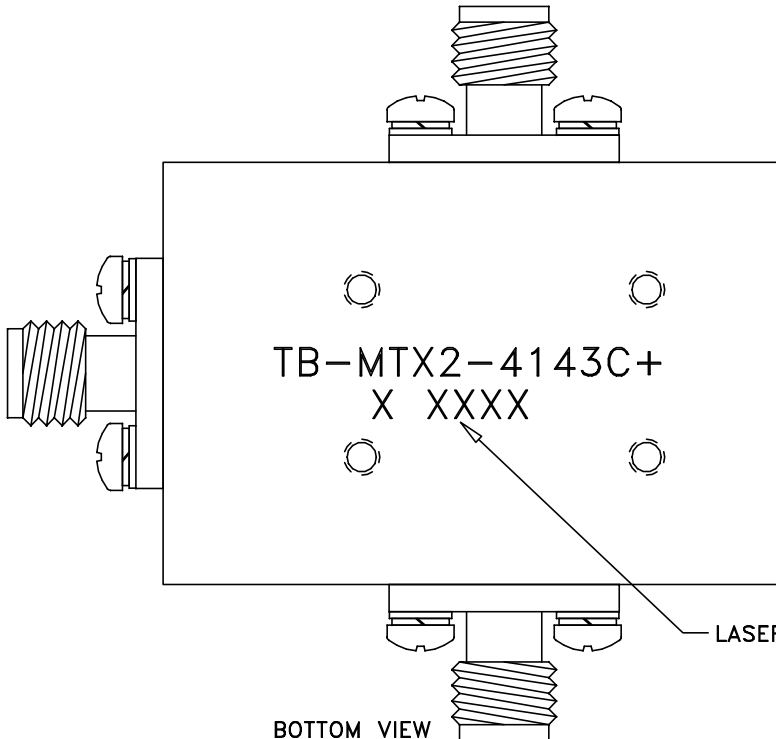
1



CONNECTORS INSTALLATION, SOLDERING

3 5 7 (6 PLCS)

10 (3 PLCS)

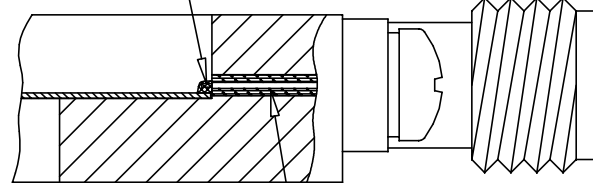


BOTTOM VIEW

TB-MTX2-4143C+  
X XXXX

LASER MARKING

PIN (3 PLCS)



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

DIEL (3 PLCS)

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	SM	19 AUG 24
TOLERANCES ON:	CHECKED	CT
2 PL DECIMALS ±	APPROVED	CT
3 PL DECIMALS ±		
ANGLES ±		
FRACTIONS ±		

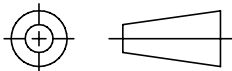
**Mini-Circuits®** 13 Neptune Avenue  
Brooklyn NY 11235

TEST BOARD FOR MTX2-4143+ W/CONN

OR NPO-004582	NEW RELEASE	AUG 24	SM	CT
REV ECN No.	DESCRIPTION	DATE	DR	AUTH
REVISIONS				

SIZE	CODE IDENT	DRAWING NO:	REV:
B	15542	TB-MTX2-4143C-20+	OR
FILE:	SCALE:	SHEET:	
WTB-MTX2-4143C+	3:1	1 OF 1	

THIRD ANGLE PROJECTION



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

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.

<b>Specification</b>	<b>Test/Inspection Condition</b>	<b>Reference/Spec</b>
	monoethanolamine at 63°C to 70°C	