MMIC SURFACE MOUNT

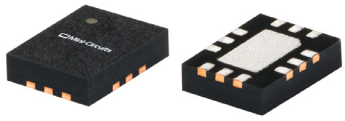
Balun

MTX2-4143+

50Ω 4 to 14 GHz

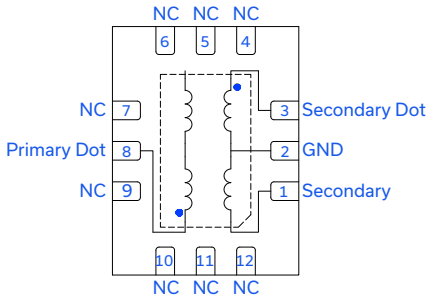
THE BIG DEAL

- 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

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' MTX2-4143+ 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 • Typ. 1.4 dB (above 3.0 dB theoretical)	Enables excellent signal power transmission from input to output.
Excellent Common Mode Rejection • Typ. 37 dB	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.

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50Ω 4 to 14 GHz

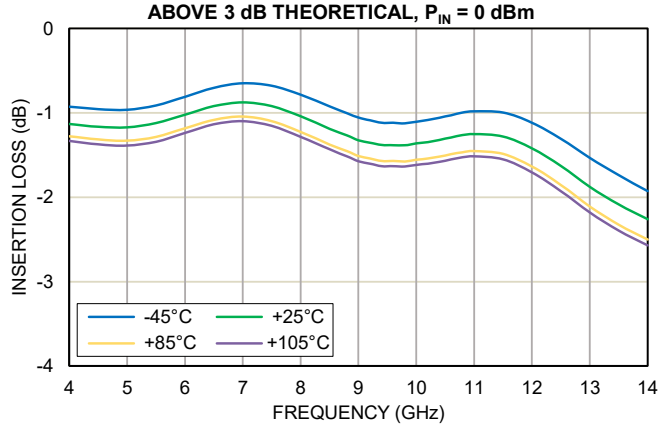
ELECTRICAL SPECIFICATIONS[1] AT +25°C, Zo = 50Ω UNLESS NOTED OTHERWISE

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Impedance Ratio (Secondary / Primary)			2		
Frequency Range		4		14	GHz
Insertion Loss[2]	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[3]	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		

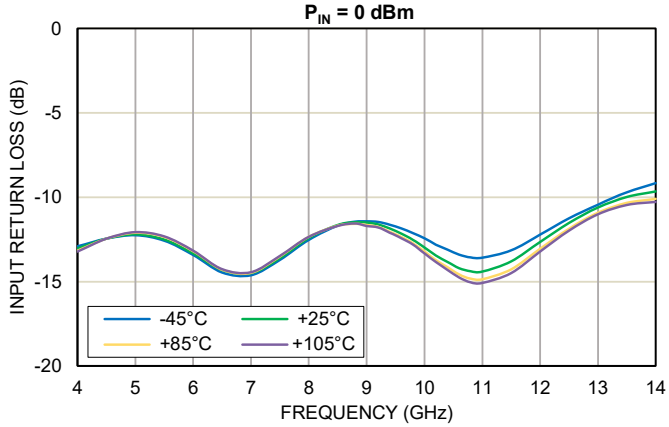
1. Tested on Mini-Circuits Evaluation Board TB-MTX2-4143C+. See Figure 2. Board loss de-embedded.
2. Average of S21 & S31, above the 3 dB theoretical loss.
3. Relative to 180°.

TYPICAL PERFORMANCE GRAPHS

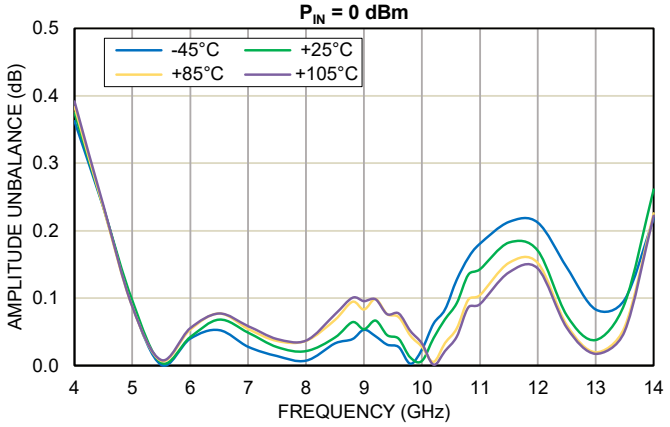
INSERTION LOSS VS. TEMPERATURE
ABOVE 3 dB THEORETICAL, P_{IN} = 0 dBm



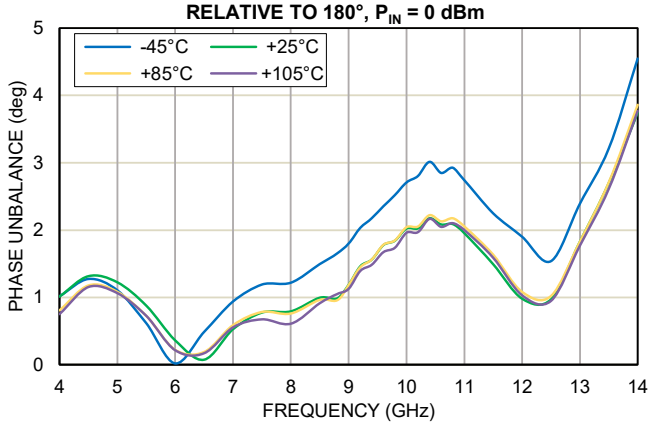
INPUT RETURN LOSS VS. TEMPERATURE
P_{IN} = 0 dBm



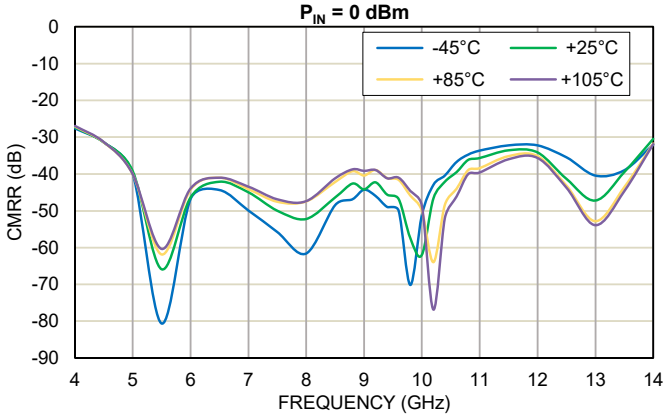
AMPLITUDE UNBALANCE VS. TEMPERATURE
P_{IN} = 0 dBm



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



CMRR VS. TEMPERATURE
P_{IN} = 0 dBm



ABSOLUTE MAXIMUM RATINGS[4]

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

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FUNCTIONAL DIAGRAM

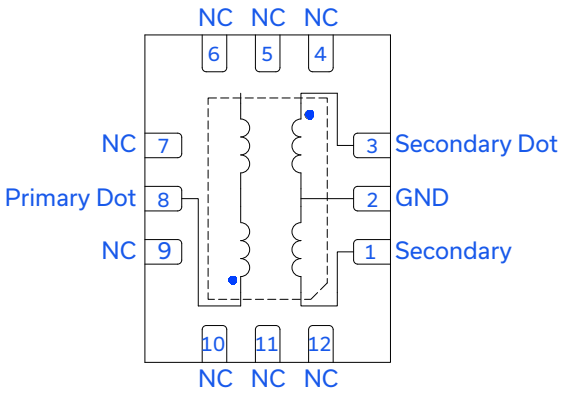

Figure 1. MTX2-4143+ Functional Diagram

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

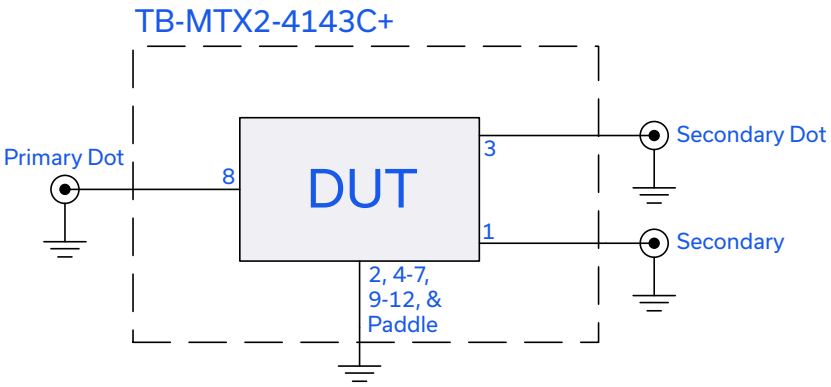

Figure 2. MTX2-4143+ Evaluation Board.

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

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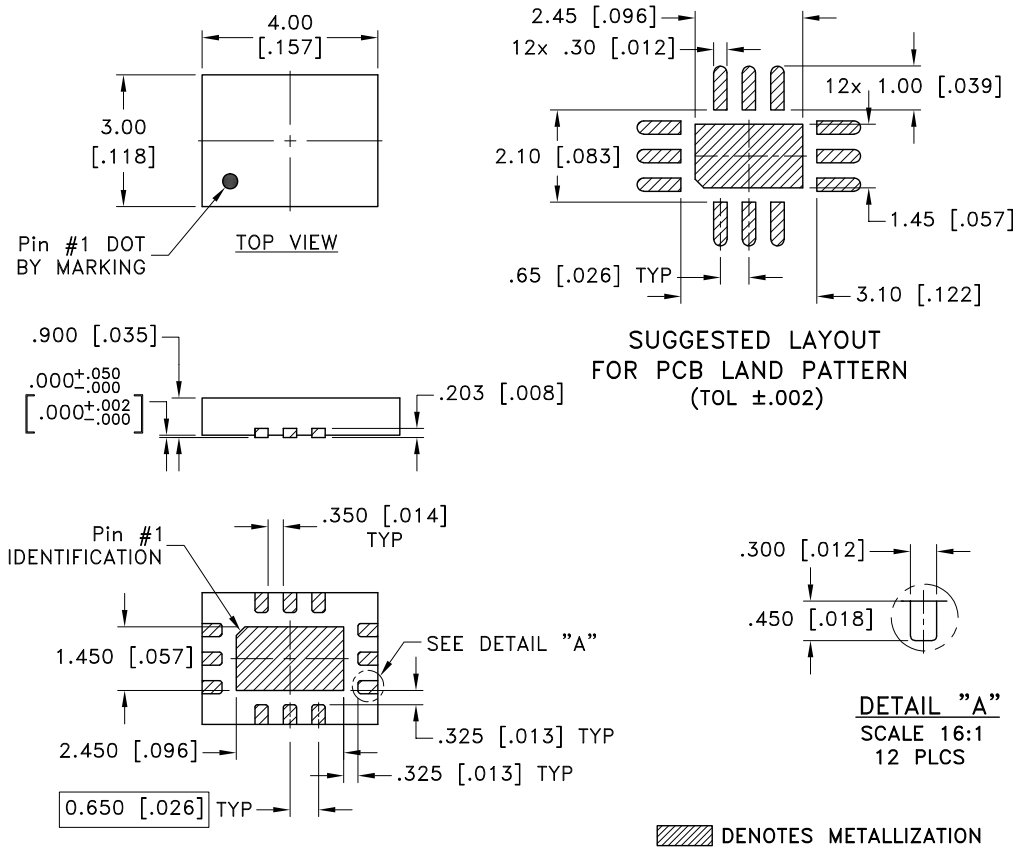
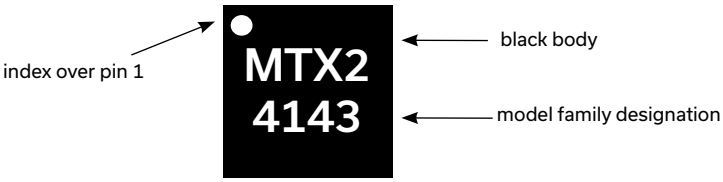
CASE STYLE DRAWING



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

MTX2-4143+

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD 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-MTX2-4143C+ 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

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)
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

[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)
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

[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)
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

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

Typical Performance Data

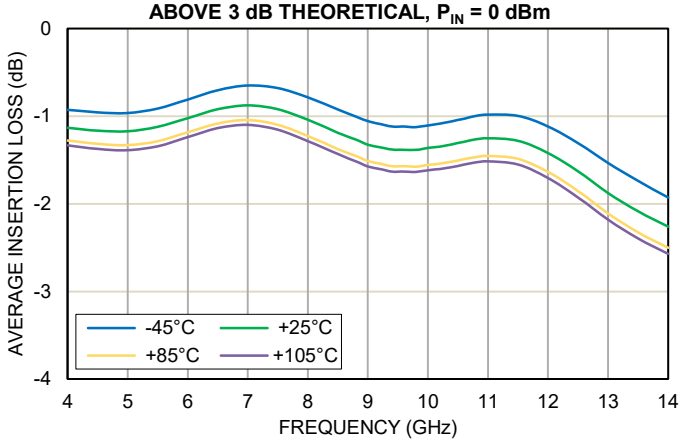
Temperature = +105°C

FREQUENCY (GHz)	AVERAGE INSERTION LOSS[1] (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE[2] (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

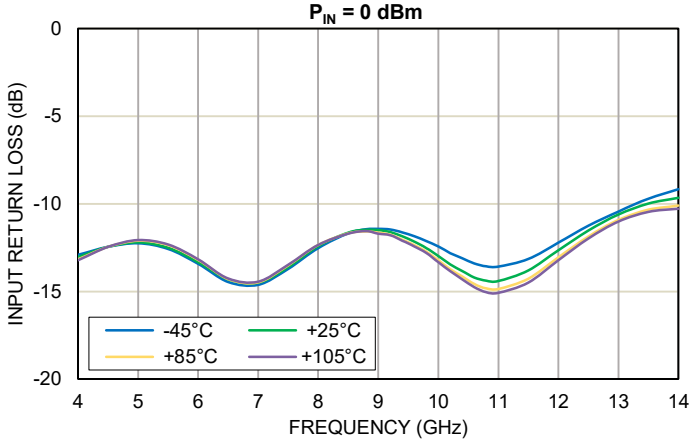
[1] Above 3 dB theoretical loss
[2] Relative to 180°

Typical Performance Data

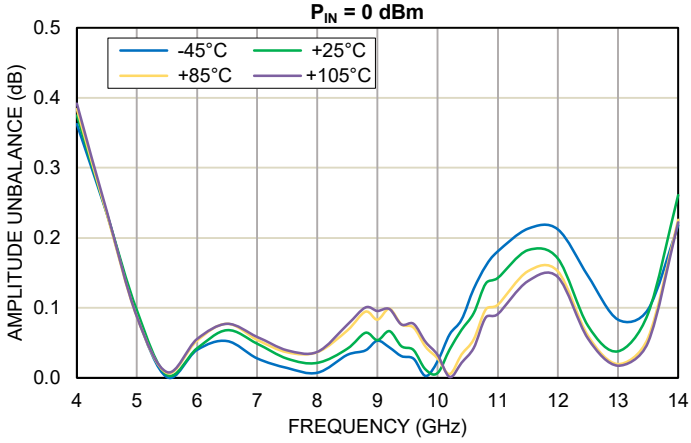
INSERTION LOSS VS. TEMPERATURE
ABOVE 3 dB THEORETICAL, P_{IN} = 0 dBm



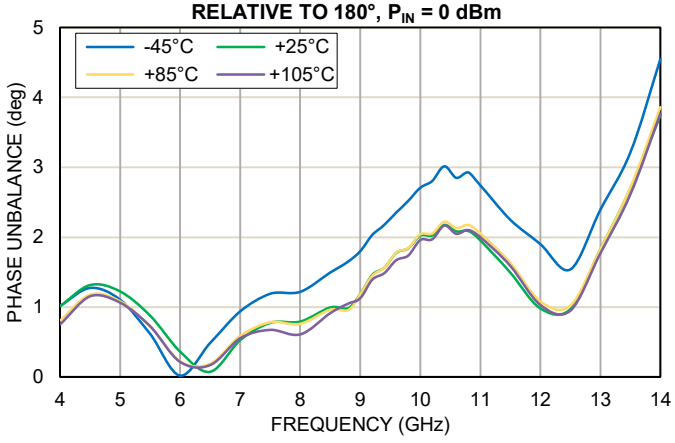
INPUT RETURN LOSS VS. TEMPERATURE
P_{IN} = 0 dBm



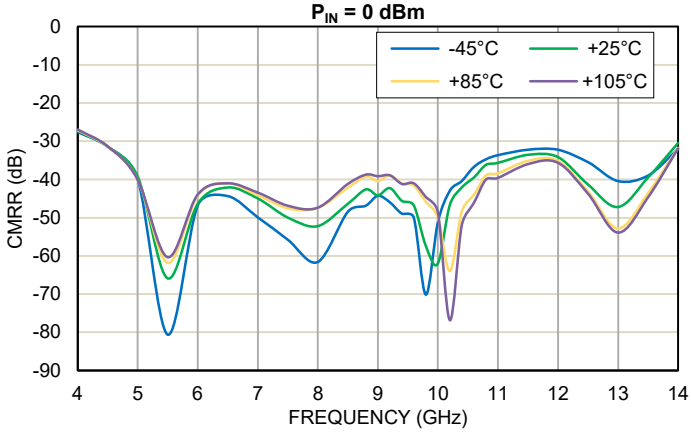
AMPLITUDE UNBALANCE VS. TEMPERATURE
P_{IN} = 0 dBm



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



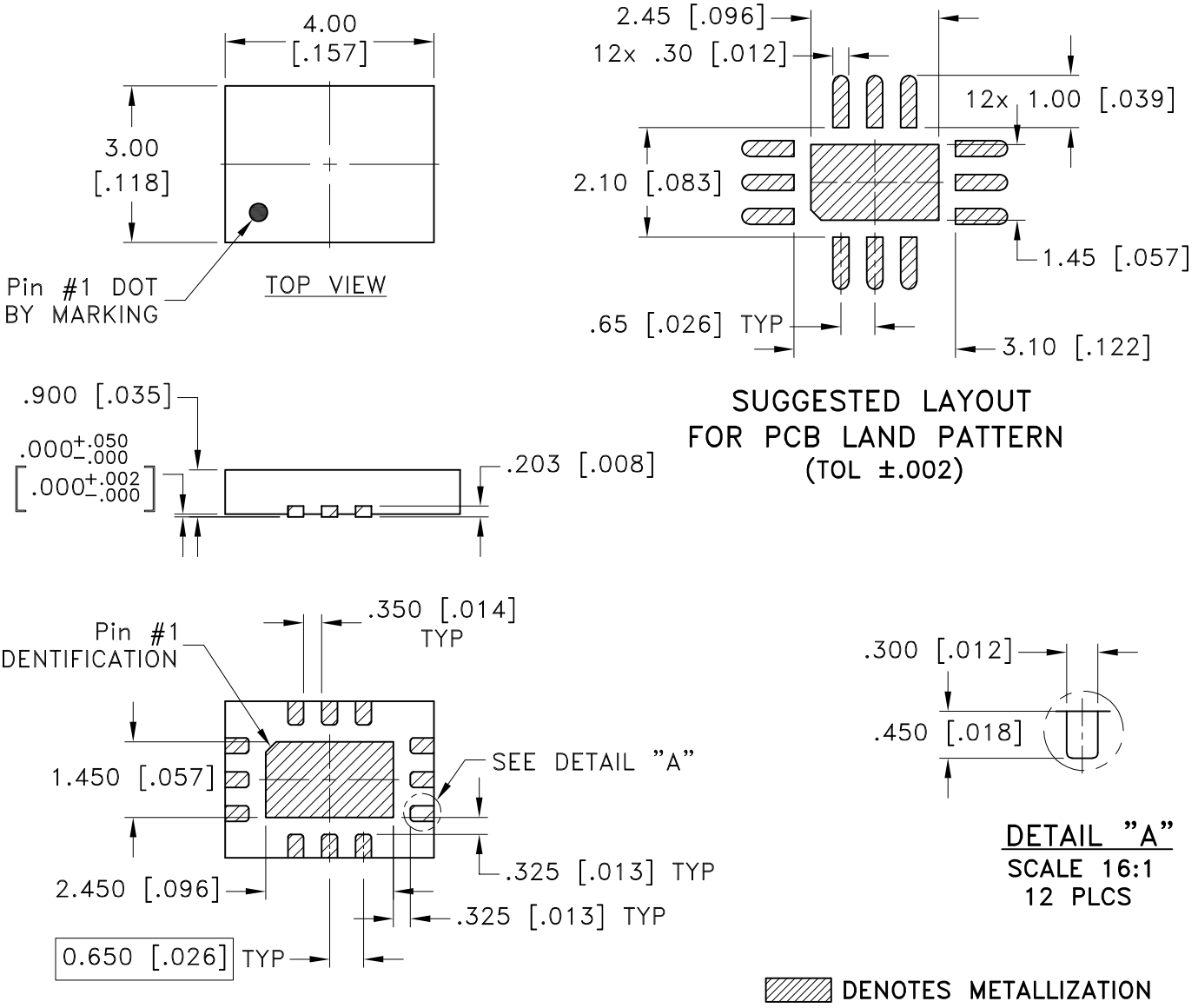
CMRR VS. TEMPERATURE
P_{IN} = 0 dBm



Case Style DG

Outline Dimensions

DG3006



Weight: 0.032 grams

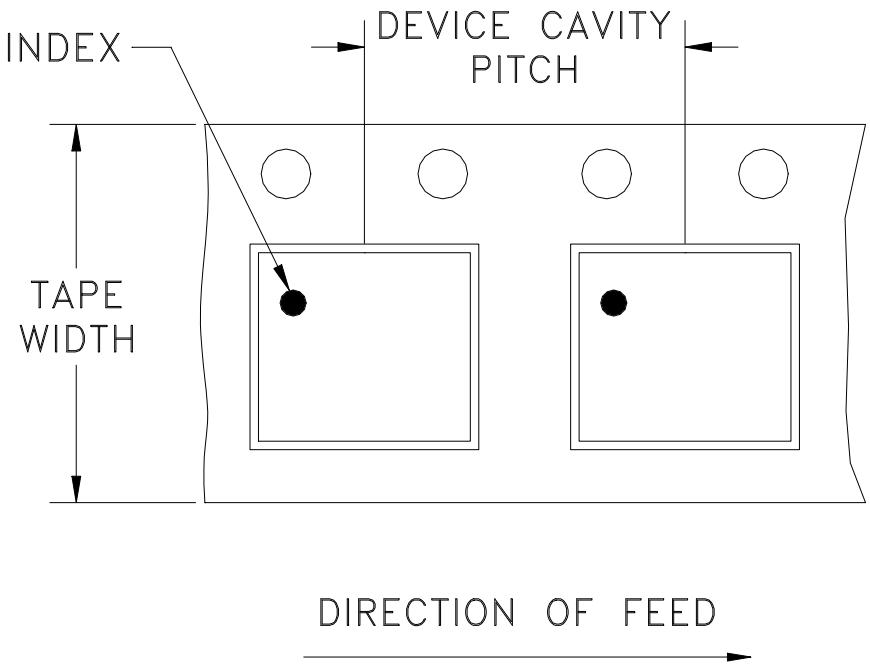
Dimensions are in mm [inches] . Tolerances:3 Pl. ±0.05 [0.002] mm [Inch]

Notes:

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

Tape & Reel Packaging TR-F68

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
12	8	7	Small quantity standard	20
				50
				100
				200
				500
		7	Standard	1000
		13	Standard	2000
				3000
				4000

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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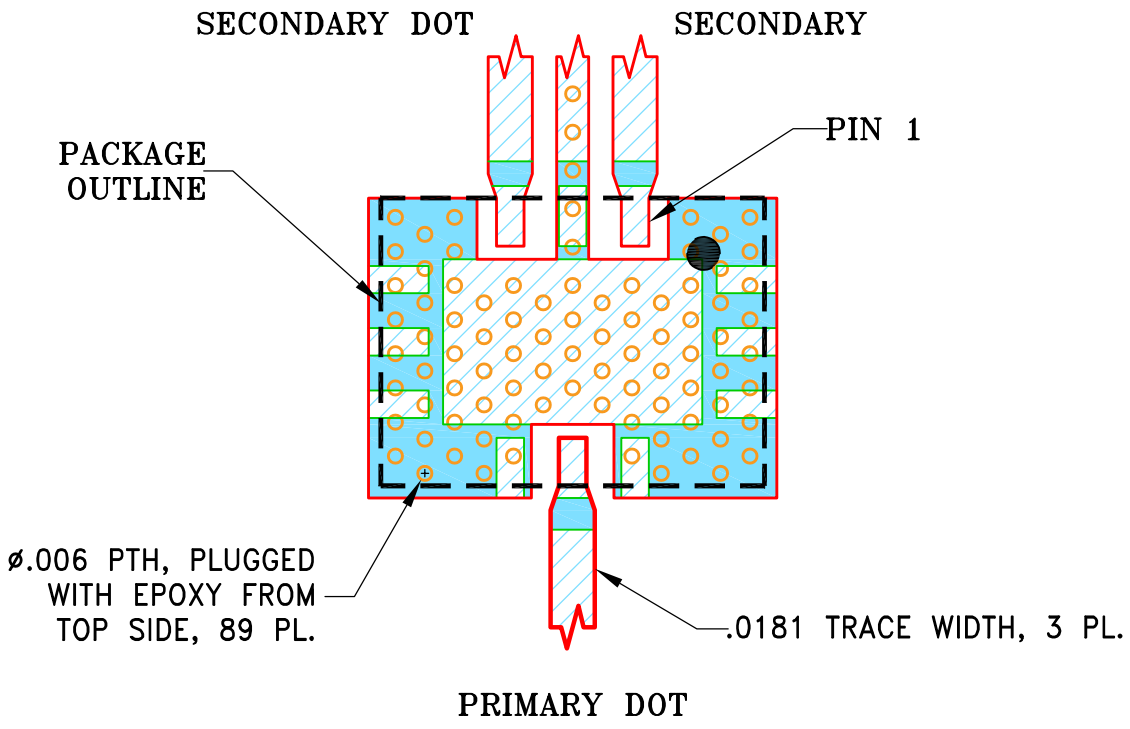
Mini-Circuits ISO 9001 & ISO 14001 Certified

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

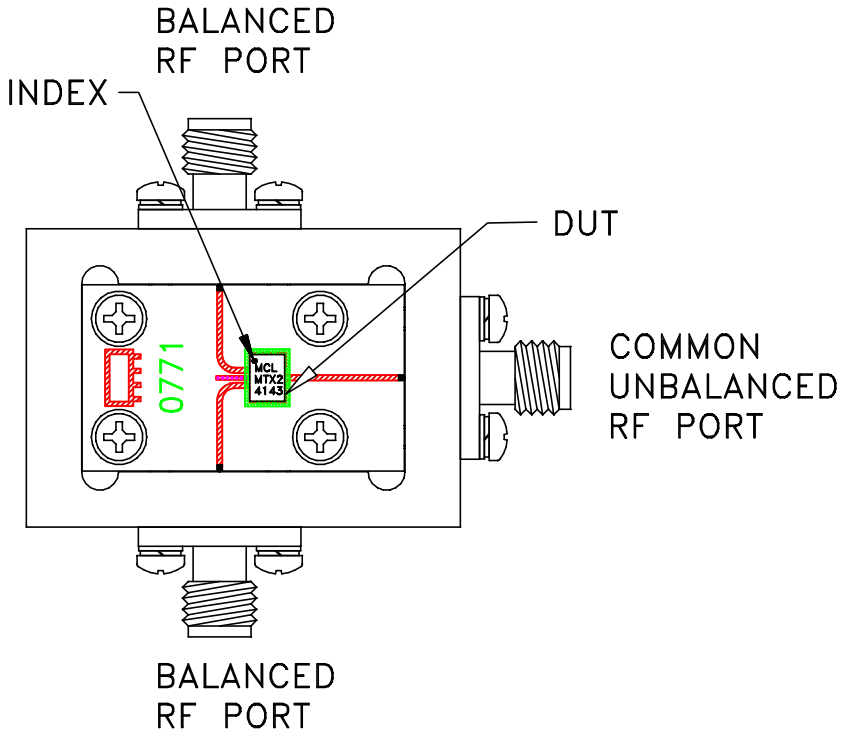
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

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

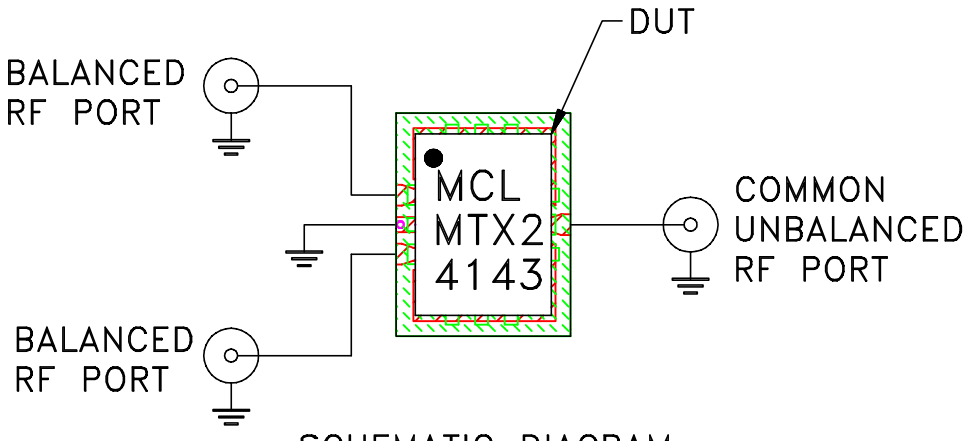
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-754	OR

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

Evaluation Board and Circuit



TB-MTX2-4143C+



SCHEMATIC DIAGRAM

Notes:

1. 50 Ohm 2.92mm Female connectors.
2. PCB Material: ROGERS RO4003C or equivalent, Dielectric Constant=3.38±0.05, Thickness=.008 inch.

Mini-Circuits®

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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 or -55° to 105° C or -40° to 105° C or -40° to 95° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° Ambient Environment	Individual Model Data Sheet
HTOL	1000 hours at 125°C	MIL-STD-883, Method 1005, Condition B
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

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
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