



MMIC SURFACE MOUNT

Balun

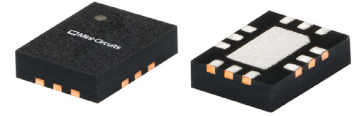
MTX2-4143+

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

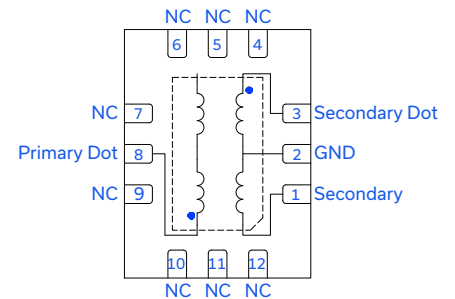


Generic photo used for illustration purposes only

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"> • Typ. 1.4 dB (above 3.0 dB theoretical) 	Enables excellent signal power transmission from input to output.
Excellent Common Mode Rejection <ul style="list-style-type: none"> • 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.

**ELECTRICAL SPECIFICATIONS¹ AT +25°C, Z₀ = 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		

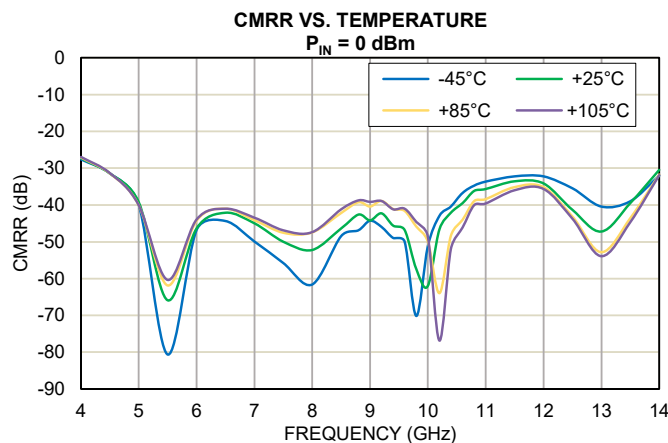
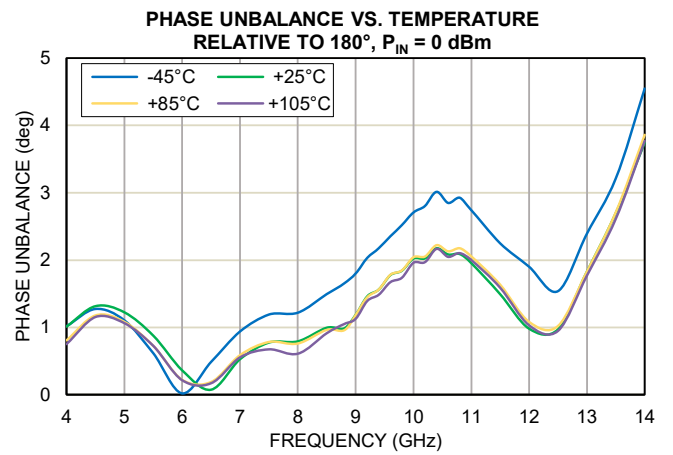
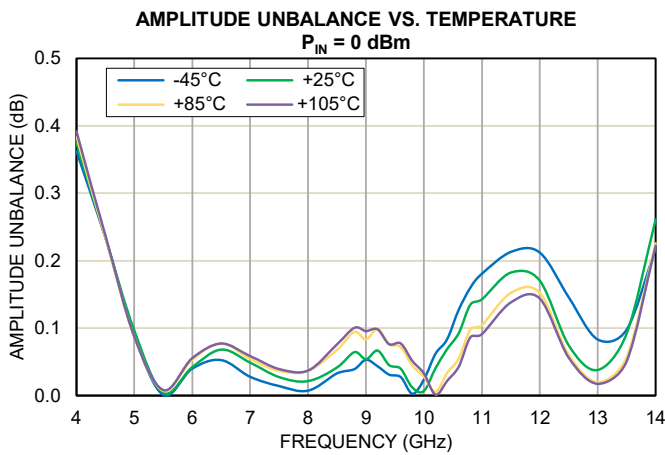
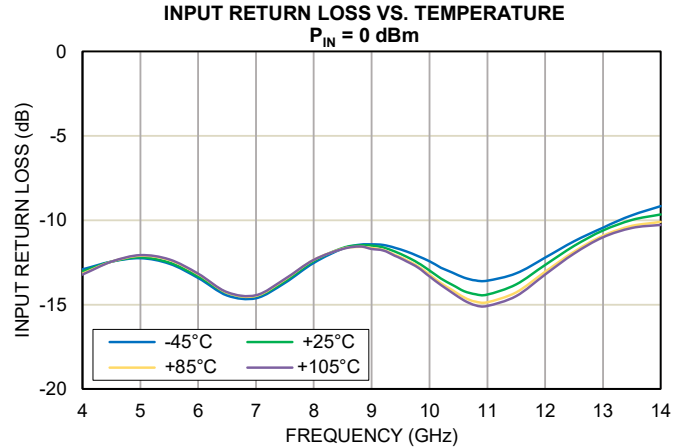
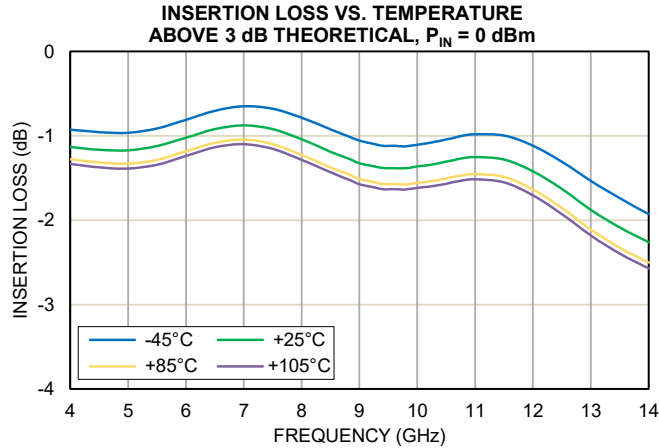
1. Tested on Mini-Circuits Evaluation Board TB-MTX2-4143C+. See Figure 2. Board loss de-embedded.

2. Average of S₂₁ & S₃₁, above the 3 dB theoretical loss.

3. Relative to 180°.



TYPICAL PERFORMANCE GRAPHS



**ABSOLUTE MAXIMUM RATINGS⁴**

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

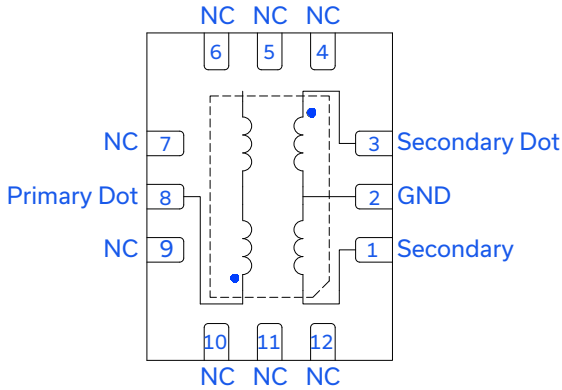


Figure 1. MTX2-4143+ Functional Diagram

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

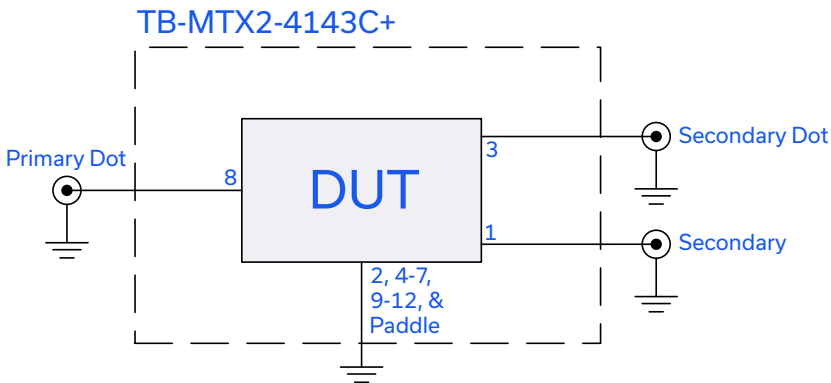


Figure 2. MTX2-4143+ Evaluation Board.

Electrical Parameters and Conditions

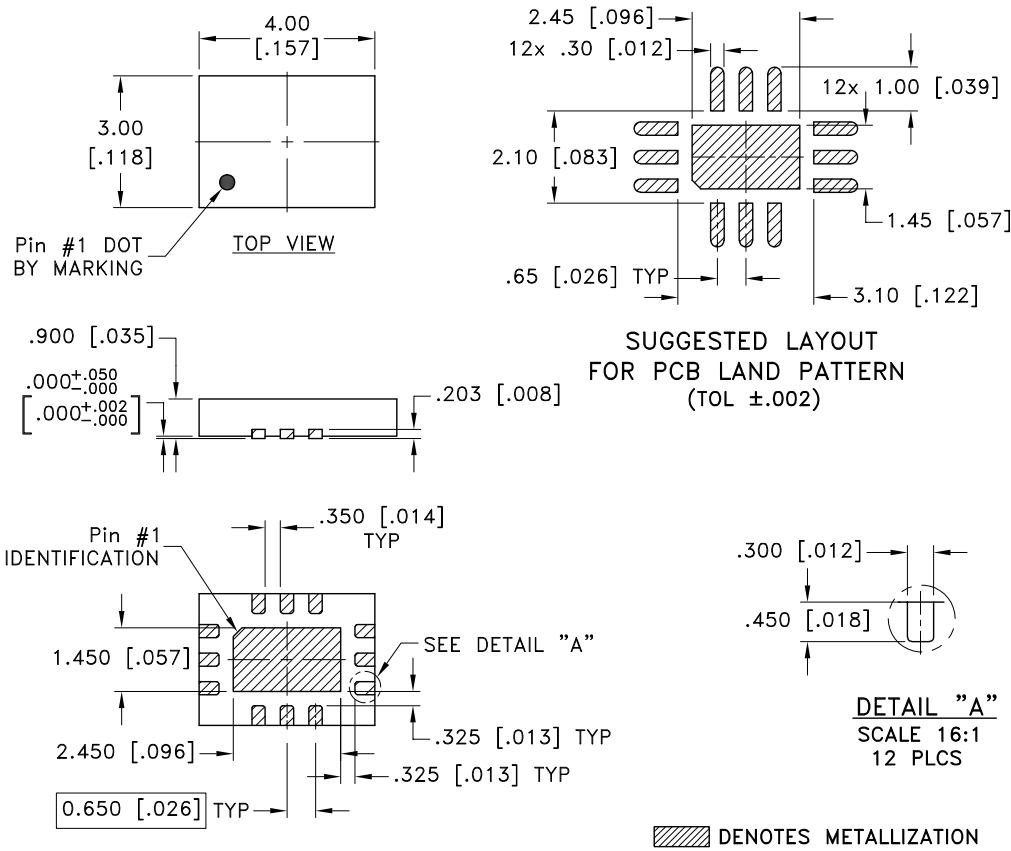
Insertion Loss, Amplitude Unbalance, Phase Unbalance, Common Mode Rejection, and Return Loss measured using N5242A PNA-X microwave network analyzer.

Conditions:

1. $P_{IN} = 0$ dBm

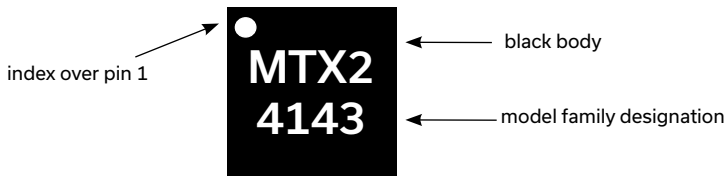


CASE STYLE DRAWING



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](#)

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

- 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

MTX2-4143+

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°

RF Transformer

MTX2-4143+

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°

RF Transformer

MTX2-4143+

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°

RF Transformer

MTX2-4143+

Typical Performance Data

Temperature = +105°C

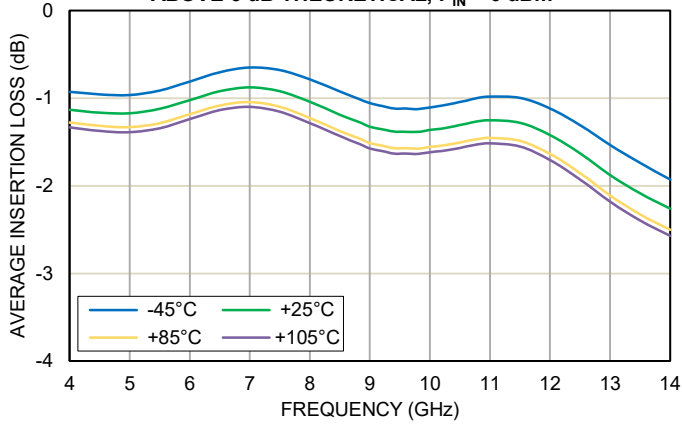
FREQUENCY (GHz)	AVERAGE INSERTION LOSS ⁽¹⁾ (dB)	INPUT RETURN LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE ⁽²⁾ (deg.)	CMRR (dB)
4.0	1.33	13.22	0.39	0.75	26.93
4.5	1.37	12.46	0.24	1.15	31.28
5.0	1.39	12.07	0.09	1.06	39.99
5.5	1.34	12.32	0.01	0.72	60.36
6.0	1.24	13.16	0.06	0.22	43.93
6.5	1.14	14.27	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

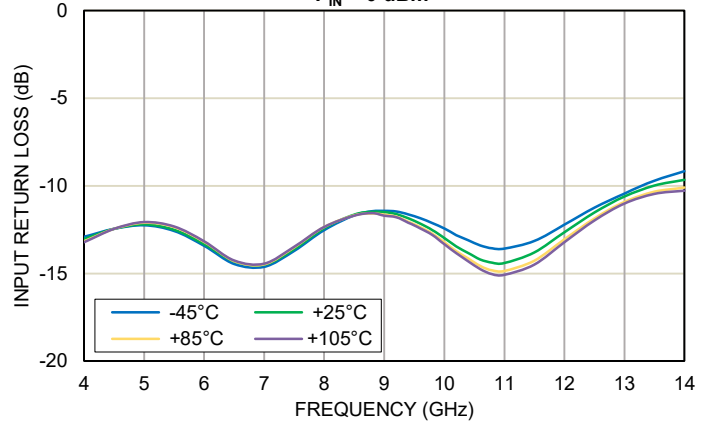
⁽²⁾ Relative to 180°

Typical Performance Data

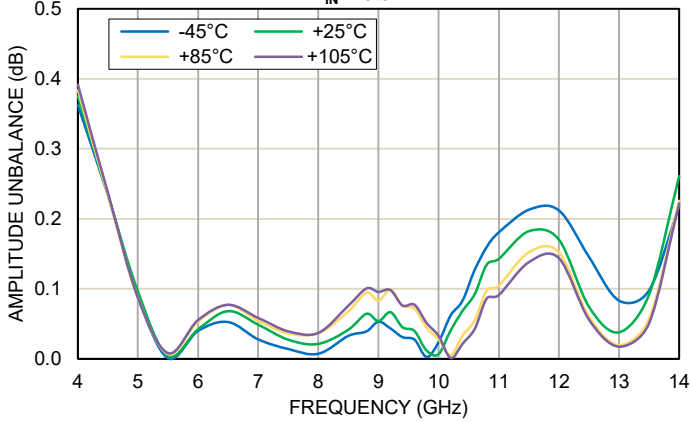
INSERTION LOSS VS. TEMPERATURE
ABOVE 3 dB THEORETICAL, $P_{IN} = 0$ dBm



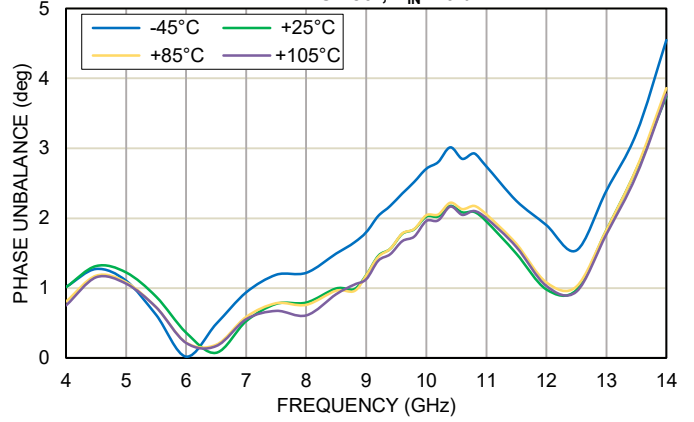
INPUT RETURN LOSS VS. TEMPERATURE
 $P_{IN} = 0$ dBm



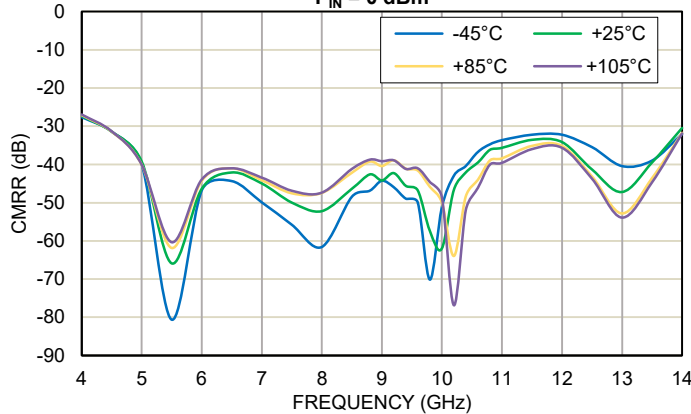
AMPLITUDE UNBALANCE VS. TEMPERATURE
 $P_{IN} = 0$ dBm

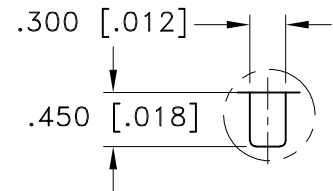
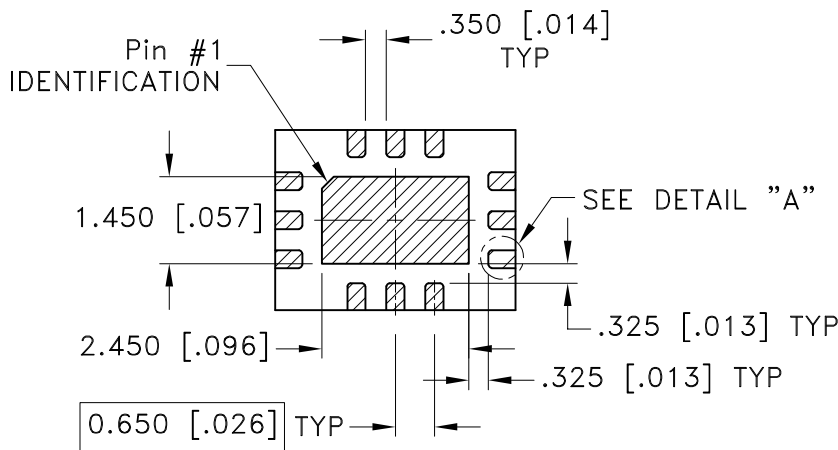
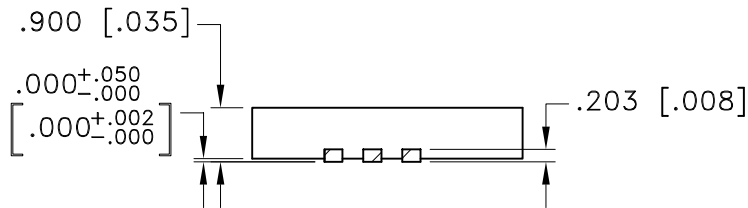
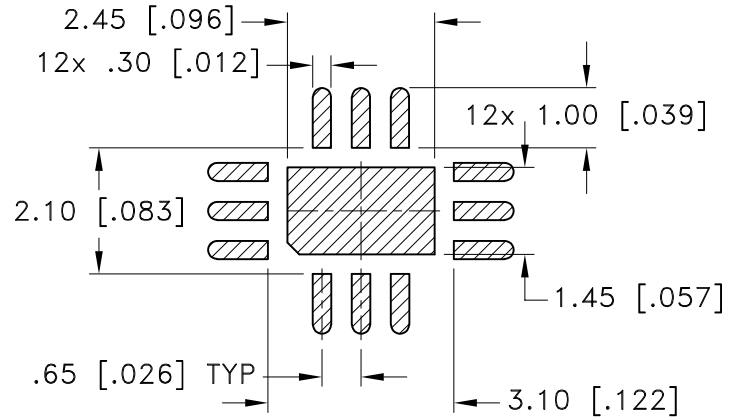
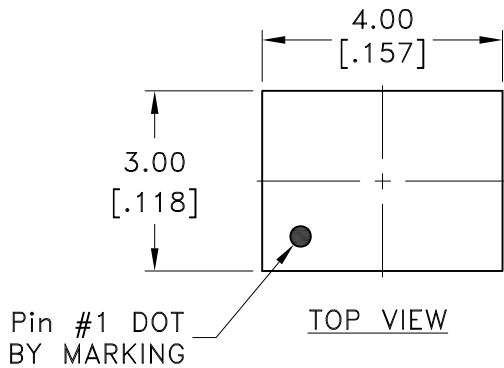


PHASE UNBALANCE VS. TEMPERATURE
RELATIVE TO 180°, $P_{IN} = 0$ dBm



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





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



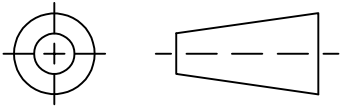
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

RF/IF MICROWAVE COMPONENTS

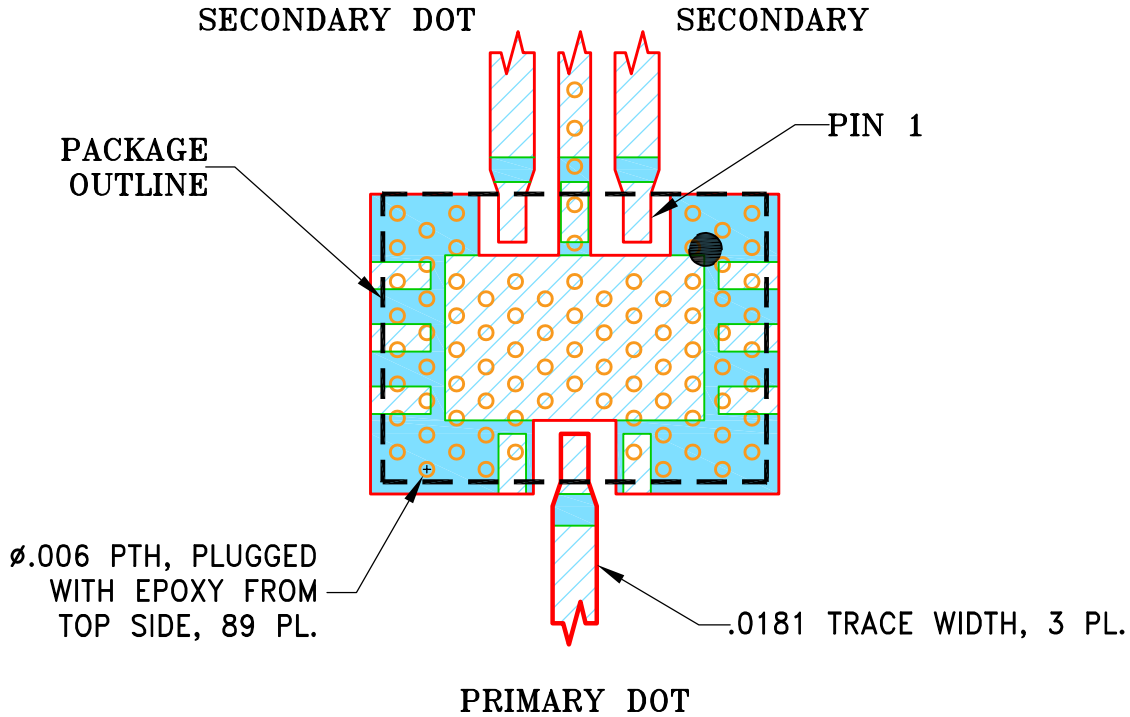
THIRD ANGLE PROJECTION



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

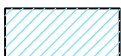


NOTES:

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

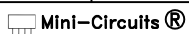
UNLESS OTHERWISE SPECIFIED	INITIALS		DATE
DIMENSIONS ARE IN INCHES	DRAWN	NP	06/15/23
TOLERANCES ON:	CHECKED	IL	06/15/23
2 PL DECIMALS ±	APPROVED	CM	06/15/23
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			



Mini-Circuits®

13 Neptune Avenue
Brooklyn NY 11235

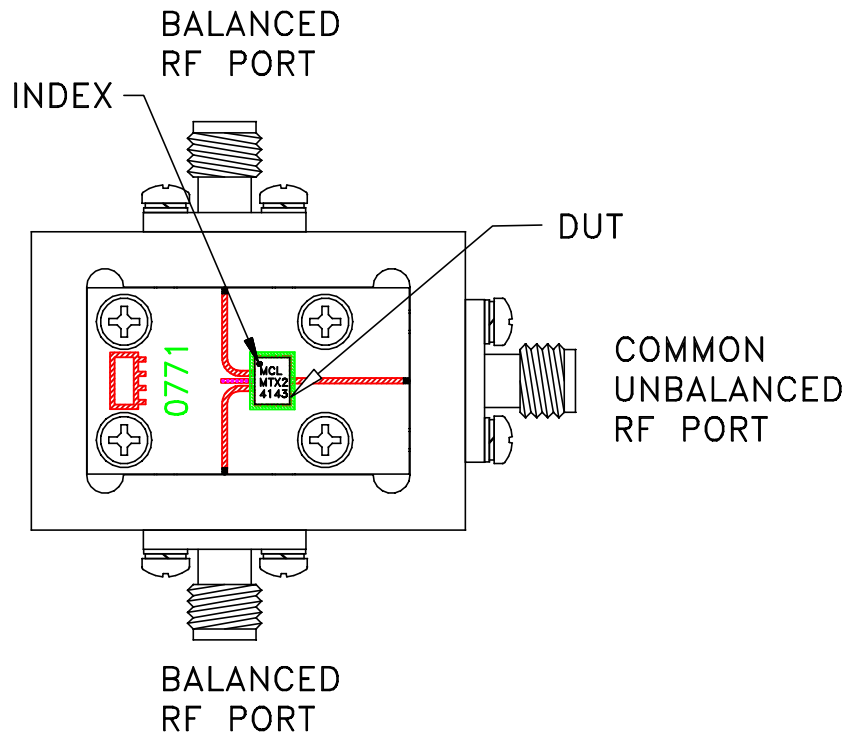
PL, DG3006, TB-MTX2-133/183C+



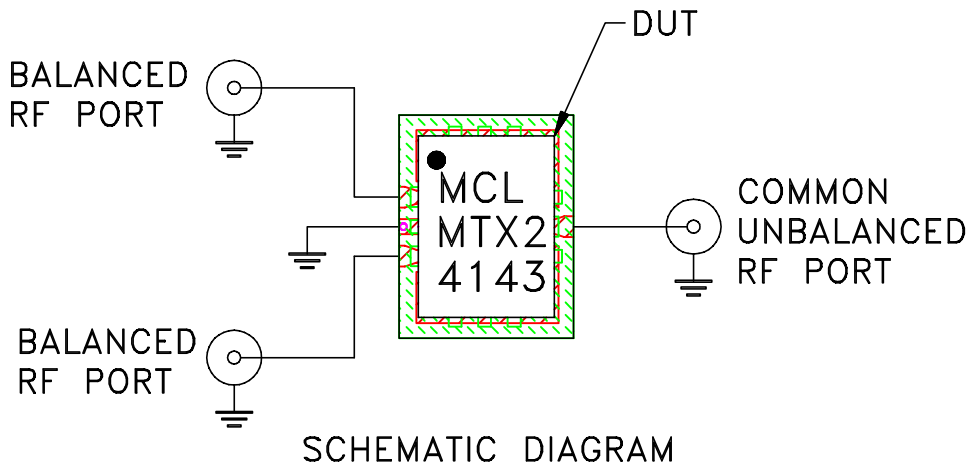
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SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-754	OR
FILE:	98PL754	SCALE: 12:1	SHEET: 1 OF 1

Evaluation Board and Circuit




TB-MTX2-4143C+



Notes:

1. 50 Ohm 2.92mm Female connectors.
2. PCB Material: ROGERS R04003C or equivalent,
Dielectric Constant=3.38±0.05, Thickness=.008 inch.

 **Mini-Circuits®**

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



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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