MMIC DIE

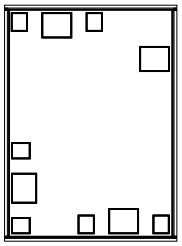
Directional Coupler

EDC14-553-D+

50Ω 14dB 22 to 55 GHz

THE BIG DEAL

- Wide Bandwidth, 22 to 55 GHz
- Coupling Flatness ±1.0 dB typ. over 22 to 55 GHz
- Nominal Coupling 13.5 dB typ. over 22 to 55 GHz
- Low Insertion Loss 0.8dB typ.
- DC Passing



+RoHS Compliant
The +Suffix identifies RoHS Compliance.
See our website for methodologies and qualifications

SEE ORDERING INFORMATION ON THE LAST PAGE

APPLICATIONS

- 5G MIMO and Back Haul Radio Systems
- Satellite Communications
- Test and Measurement Equipment
- Radar, EW, and ECM Defense Systems

PRODUCT OVERVIEW

Mini-Circuits' EDC14-553-D+ is a directional coupler die designed for wide bandwidth operation from 22 to 55 GHz with a nominal coupling of 13.5 dB over the entire frequency band. It also provides excellent coupling flatness over a broad bandwidth and good return loss. Manufactured using GaAs MMIC technology, it has excellent repeatability and excellent reliability.

KEY FEATURES

Features	Advantages
Wide Bandwidth, 22 to 55 GHz	A single directional coupler can be used in many applications, saving component count. Also ideal for applications such as 5G, military and instrumentation.
Unpackaged die	Enables user to integrate it directly into hybrids.
Coupling flatness	Coupling flatness yields higher accuracy

Directional Coupler

EDC14-553-D+

50Ω 14dB 22 to 55 GHz

ELECTRICAL SPECIFICATIONS AT 25°C[1]

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Frequency Range		22		55	GHz
Mainline Loss	22 - 30		0.7		dB
	30 - 40		0.8		
	40 - 50		0.9		
	50 - 55		1.0		
Nominal Coupling	22 - 30		13.9		dB
	30 - 40		12.7		
	40 - 50		12.8		
	50 - 55		14.4		
Coupling Flatness (±)	22 - 55		1.0		dB
Directivity	22 - 30		11		dB
	30 - 40		9		
	40 - 50		8		
	50 - 55		7		
Return Loss - Input / Output	22 - 30		14		dB
	30 - 40		15		
	40 - 50		15		
	50 - 55		13		
Return Loss – Coupled Port	22 - 30		18		dB
	30 - 40		17		
	40 - 50		20		
	50 - 55		25		

1. Characterization data obtained by mounting Die to substrate and RF probing directly to pads.

MAXIMUM RATINGS

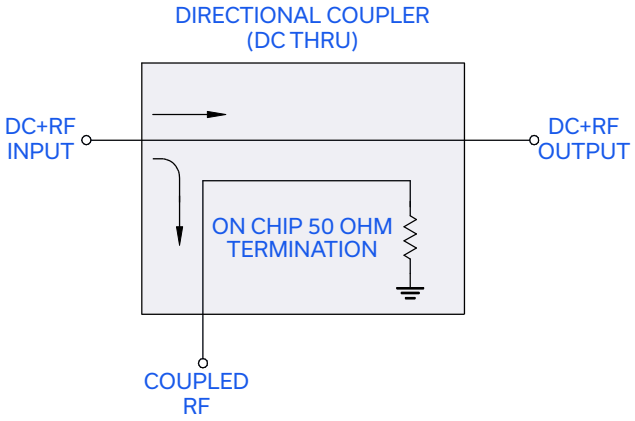
Parameter	Ratings
Operating Temperature	-40°C to 85°C
Power input: • Input to Output port • Input to Coupled port • Output to Coupled port	+32 dBm
Power input: • Coupled to Output port	+29 dBm
DC Current: • Input to Output port • Coupled port	500 mA 127 mA

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

Directional Coupler EDC14-553-D+

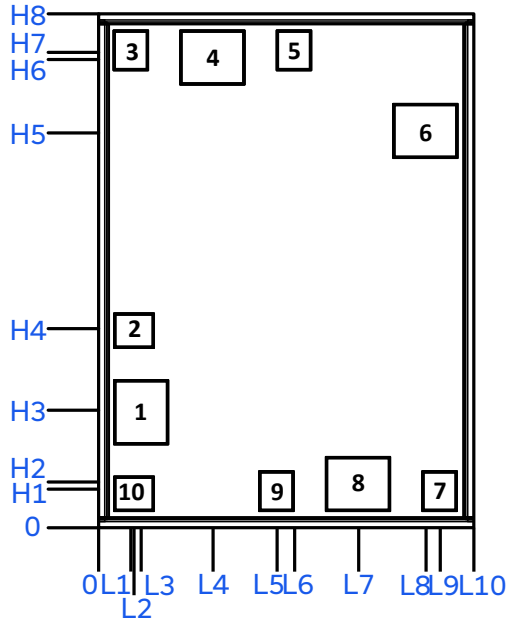
50Ω 14dB 22 to 55 GHz

SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



Function	Pad Number	Description
DC + RF IN	1	RF Input Pad and DC (Pass Thru) Pad
GROUND	2,3,5,6, 7,9,10	The bond pads are connected to backside through vias and do not require wire-bond connections to ground
DC + RF OUT	4	RF Output Pad and DC Pad
COUPLED RF	8	RF Couple Pad

BONDING PAD POSITION



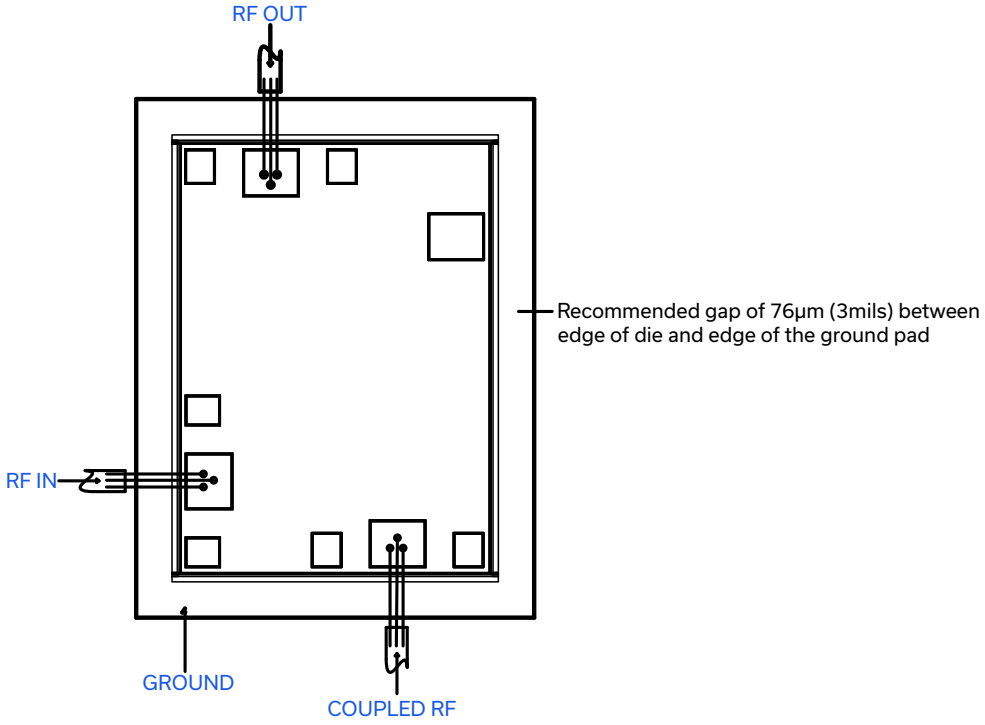
DIMENSION IN µm, TYP.

L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
79.0	87.0	104.0	279.0	436.0	479.0	636.0	801.0	836.0	920

H1	H2	H3	H4	H5	H6	H7	H8
90.0	107.0	283.0	483.0	937.0	1153.0	1170.0	1260.0

Thickness	Die Size	Pad Size 1	Pad Size 2 & 10	Pad Size 3,5,7,9	Pad Size 4,6,8
100	920 x 1260	125 x 150	90 x 77	77 x 90	150 x 125

ASSEMBLY DIAGRAM



Note : bond wires should be as short as possible

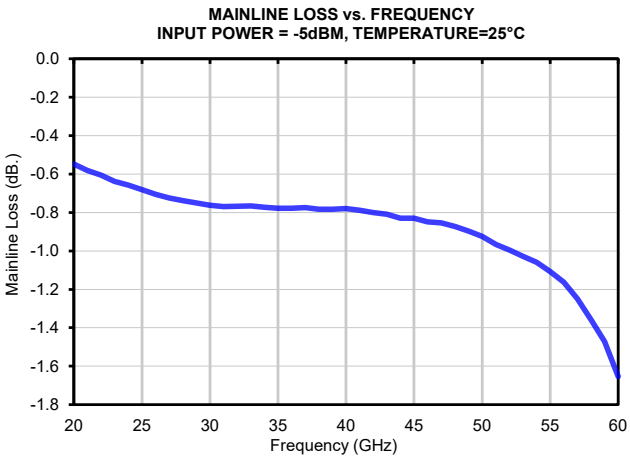
ASSEMBLY PROCEDURE

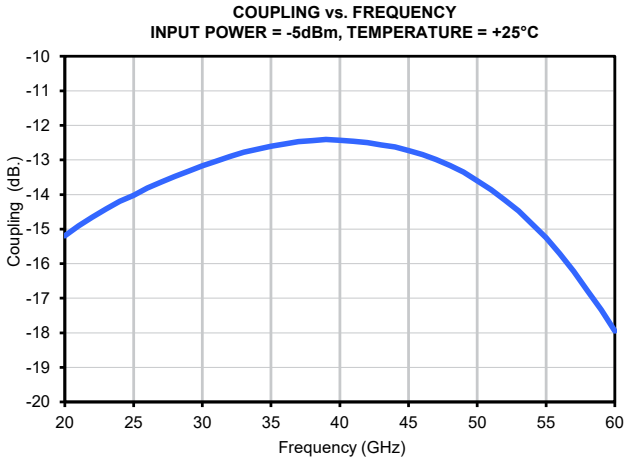
1. Storage
   Die should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC PHEMT coupler die are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be open in clean room conditions at an appropriately grounded anti-static workstation.
3. Die Handling and Attachment
   Devices need careful handling using correctly designed collets, it is recommended to handle the chip along the edges with a custom design collet. The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are Ablestik 84-1 LMISR4 or equivalents. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the die gold bond pads. Thermo-sonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1mil diameter. Bonds must be made from the bond pads on the die to the packaged or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

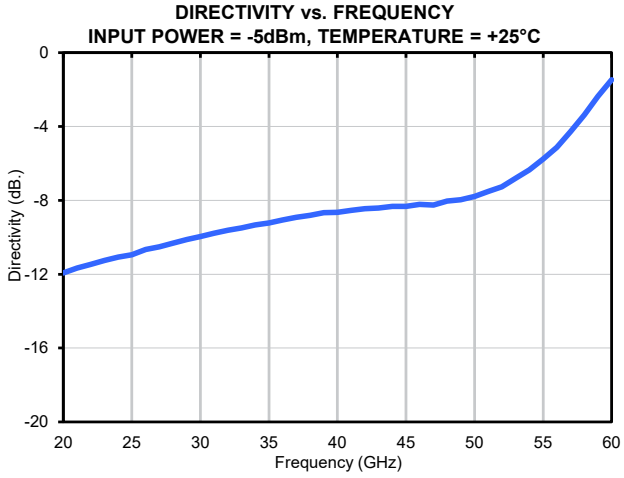
Directional Coupler

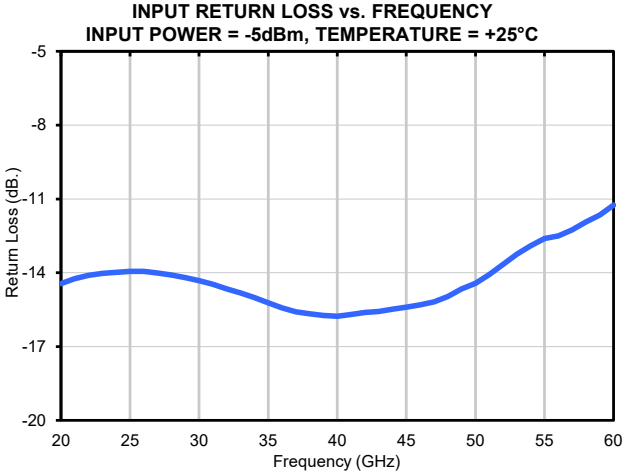
EDC14-553-D+

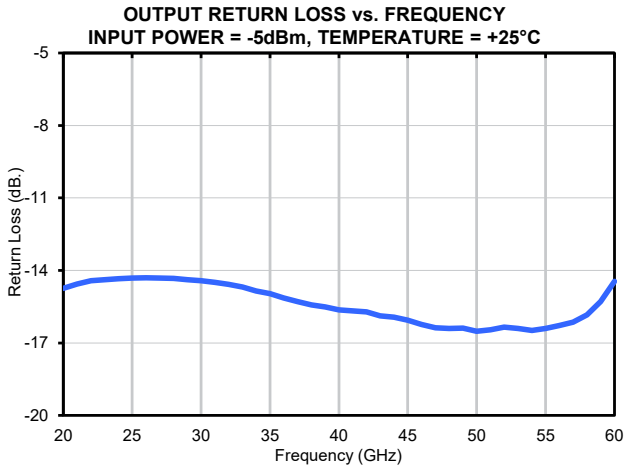
50Ω 14dB 22 to 55 GHz

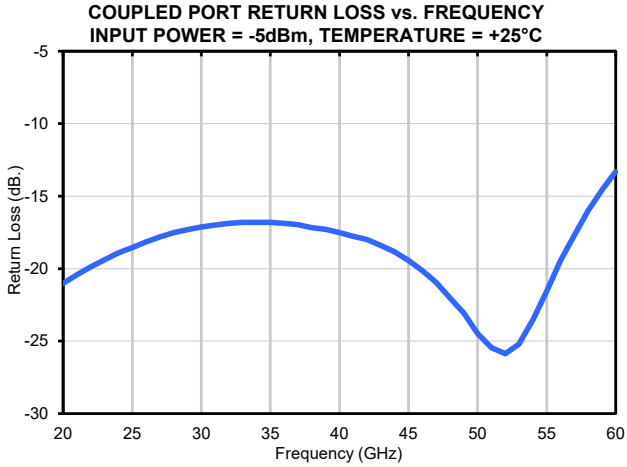












ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD.

Performance Data	Data Table Swept Graphs S-Parameter (S2P Files) Data Set with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package Gel – Pak: 5, 10, 50, 100, 200 Medium†, Partial wafer: KGD*<1320 Full Wafer †Available upon request contact sales representative Refer to AN-60-067	Model No. EDC14-553-DG+ EDC14-553-DP+ EDC14-553-DF+
Die Marking	JR1B	
Environmental Ratings	ENV80	

*Known Good Die ('KGD') means that the die in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such die fall within a predefined range. While DC testing is not definitive, it does provide a higher degree of confidence that die are capable of meeting typical RF electrical performance specified by Mini-Circuits.

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 there in. 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

D. Mini-Circuits does not warrant the accuracy or completeness of the information, text, graphics and other items contained within this document and same are provided as an accommodation and on an As is basis, with all faults.

E. Purchasers of this part are solely responsible for proper storing, handling, assembly and processing of Known Good Die (including, without limitation, proper ESD preventative measures, die preparation, die attach, wire bonding and related assembly and test activities), and Mini-Circuits assumes no responsibility therefor or for environmental effects on Known Good Die.

F. Mini-Circuits and the Mini-Circuits logo are registered trademarks of Scientific Components Corporation d/b/a Mini-Circuits. All other third-party trademarks are the property of their respective owners. A reference to any third-party trademark does not constitute or imply any endorsement, affiliation, sponsorship, or recommendation by any such third-party of Mini-Circuits or its products.

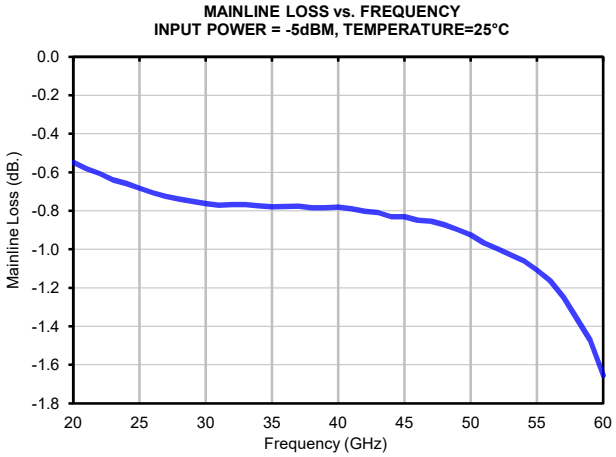
Directional Coupler EDC14-553-D+

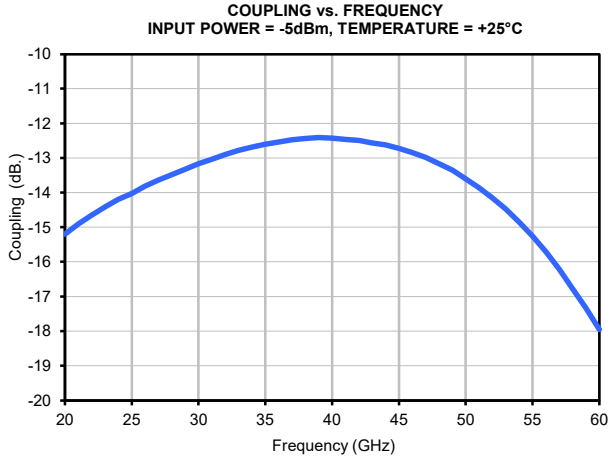
Typical Performance Data

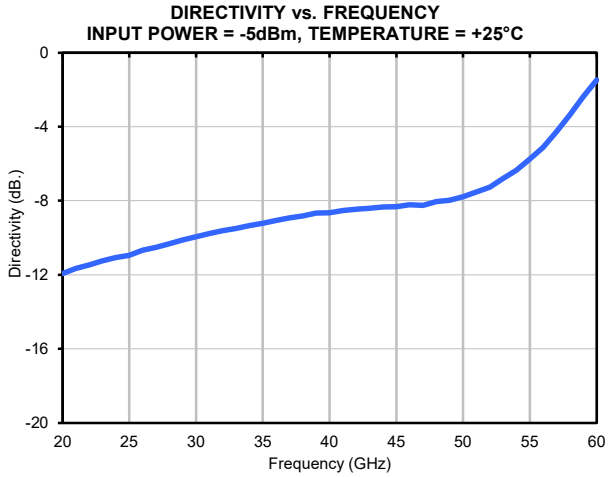
Test Condition: Input power = -5dBm, Temperature= +25°C

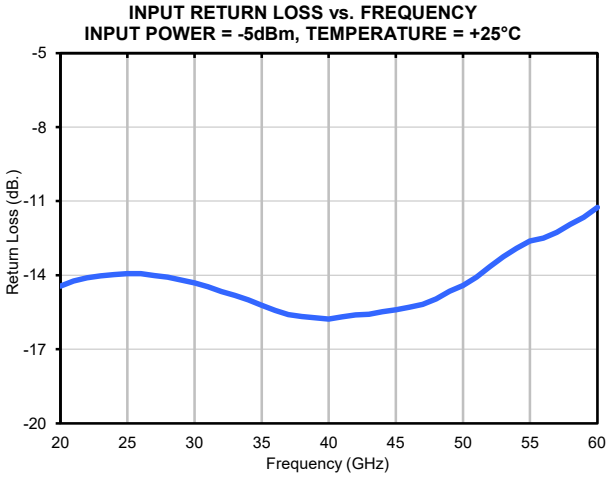
FREQUENCY (GHz)	INSERTION LOSS (dB)	COUPLING (dB)	DIRECTIVITY (dB)	RETURN LOSS (dB)		
				IN	OUT	CPL
20	-0.55	-15.20	-11.93	-14.44	-14.74	-21.02
21	-0.58	-14.91	-11.66	-14.24	-14.56	-20.43
22	-0.61	-14.66	-11.47	-14.10	-14.43	-19.87
23	-0.64	-14.42	-11.25	-14.03	-14.39	-19.39
24	-0.66	-14.20	-11.07	-13.98	-14.34	-18.91
25	-0.68	-14.03	-10.95	-13.94	-14.32	-18.54
26	-0.71	-13.81	-10.67	-13.94	-14.30	-18.15
27	-0.72	-13.64	-10.51	-14.01	-14.32	-17.82
28	-0.74	-13.48	-10.33	-14.09	-14.33	-17.52
29	-0.75	-13.32	-10.12	-14.20	-14.39	-17.31
30	-0.76	-13.17	-9.95	-14.32	-14.43	-17.13
31	-0.77	-13.04	-9.78	-14.47	-14.50	-16.99
32	-0.77	-12.90	-9.62	-14.66	-14.58	-16.87
33	-0.77	-12.78	-9.49	-14.81	-14.69	-16.81
34	-0.77	-12.69	-9.34	-15.00	-14.85	-16.81
35	-0.78	-12.60	-9.22	-15.22	-14.96	-16.82
36	-0.78	-12.54	-9.07	-15.43	-15.15	-16.88
37	-0.77	-12.47	-8.93	-15.59	-15.30	-16.98
38	-0.78	-12.44	-8.82	-15.67	-15.43	-17.17
39	-0.78	-12.41	-8.66	-15.73	-15.51	-17.29
40	-0.78	-12.43	-8.65	-15.77	-15.63	-17.51
41	-0.79	-12.46	-8.54	-15.69	-15.68	-17.76
42	-0.80	-12.50	-8.46	-15.61	-15.72	-18.00
43	-0.81	-12.57	-8.41	-15.58	-15.88	-18.41
44	-0.83	-12.62	-8.33	-15.48	-15.93	-18.83
45	-0.83	-12.73	-8.32	-15.40	-16.06	-19.43
46	-0.85	-12.84	-8.22	-15.31	-16.24	-20.14
47	-0.85	-12.98	-8.25	-15.18	-16.38	-20.94
48	-0.87	-13.16	-8.04	-14.97	-16.40	-22.02
49	-0.90	-13.35	-7.97	-14.65	-16.39	-23.06
50	-0.92	-13.60	-7.78	-14.42	-16.52	-24.47
51	-0.97	-13.86	-7.52	-14.08	-16.46	-25.44
52	-1.00	-14.16	-7.26	-13.66	-16.34	-25.87
53	-1.03	-14.48	-6.80	-13.24	-16.40	-25.21
54	-1.06	-14.85	-6.35	-12.91	-16.48	-23.53
55	-1.11	-15.26	-5.75	-12.61	-16.40	-21.55
56	-1.16	-15.71	-5.13	-12.50	-16.28	-19.45
57	-1.25	-16.22	-4.28	-12.26	-16.14	-17.71
58	-1.36	-16.78	-3.37	-11.94	-15.84	-15.99
59	-1.47	-17.34	-2.37	-11.66	-15.29	-14.58
60	-1.65	-17.95	-1.47	-11.25	-14.46	-13.30

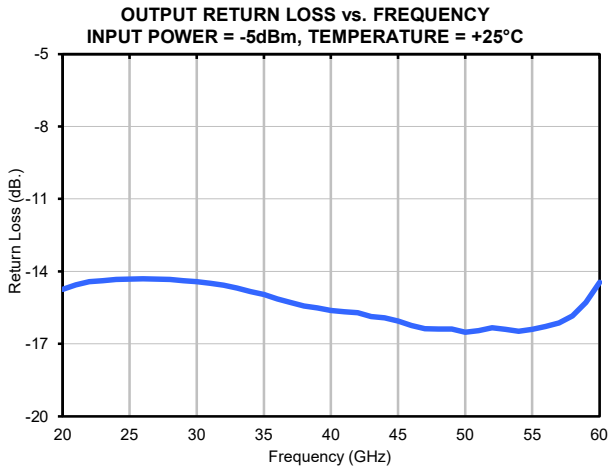
Typical Performance Curves

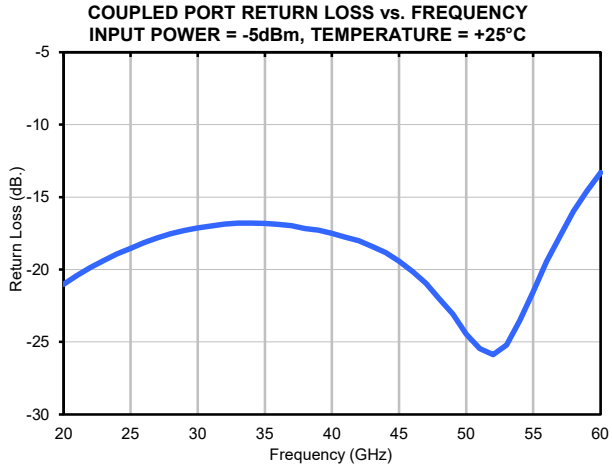












Mini-Circuits

Environmental Specifications ENV80

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 -40° to 105° C or -55° to 105° C Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment	20° to 35° C and 40 to 60% humidity (In Factory Shipped Package)	Individual Model Data Sheet

This document and its contents are the property of Mini-Circuits.