LTCC SURFACE MOUNT

Power Splitter/Combiner

QCU-55+

50Ω (2 Way-90°) 45 to 55 MHz

THE BIG DEAL

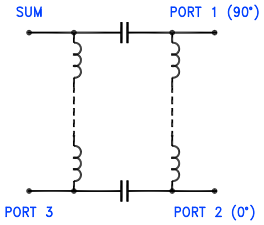
- Insertion Loss, Typ. 1.5 dB
- Pass Band Return Loss, Typ. 14 dB
- Small Size, 1812 Case Style
- Power Handling: 6.25 W

Generic photo used for illustration purposes only

APPLICATIONS

- Military Applications
- I&Q Modulators
- Image Reject Mixers

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

Mini-Circuits' QCU-55+ is a miniature low temperature co-fired ceramic (LTCC) 2-way 90° power splitter with a 45-55 MHz passband that supports a variety of applications. This model provides 1.5 dB typical average insertion loss above the theoretical 3dB loss over a mainline, due to its rugged monolithic construction. Housed in an 1812 ceramic form factor, it is ideal for dense signal chain PCB layouts where it complements MMIC size and performance. The LTCC fabrication process assures minimal RF performance variation while delivering a product that is well suited for environmental extremes of high humidity and temperature.

KEY FEATURES

Features	Advantages
LTCC Construction	The use of LTCC technology allows for repeatable performance in a rugged ceramic package, well suited for tough environments such as high humidity and temperature extremes. See Mini-Circuits Environmental Rating ENV06T10 for more information.
Small Size, 1812 (4.5mm x 3.2mm)	1812 package allows for space to be saved in dense circuit board layouts, while also minimizing the effects of parasitics.
High Power Handling, 6.25 W	Handles up to 6.25 Watts in an 1812 package.

REV. OR
ECO-022839
QCU-55+
EDU4881
URJ
240824

Power Splitter/Combiner

QCU-55+

50Ω (2 Way-90°) 45 to 55 MHz

ELECTRICAL SPECIFICATIONS[1,2] AT +25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Units
Frequency Range		45		55	MHz
Insertion Loss (Avg. of coupled outputs above 3 dB)	45 - 55	—	1.5	2.2	dB
Isolation	45 - 55	10	15	—	dB
Phase Unbalance (±) (Relative to 90°)	45 - 55	—	10	15	Degree
Amplitude Unbalance (±)	45 - 55	—	0.9	1.5	dB
Return Loss (Port S)	45 - 55	10	14	—	dB
Return Loss (Port 1 to Port 2)	45 - 55 45 - 55	10 10	14 15	— —	dB

1. Tested on Evaluation Board P/N TB-QCU-55+ with port extension option in the network analyzer.
2. This component should not be used as a DC-block. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.

ABSOLUTE MAXIMUM RATINGS[3]

Parameter		Ratings
Operating Temperature		-55°C to +125°C
Storage Temperature		-55°C to +125°C
Input Power	as splitter[4]	6.25 W
	as combiner per port	—

3. Permanent damage may occur if any of these limits are exceeded.
4. At +25°C. Derate linearly to 2.7 W at +125°C

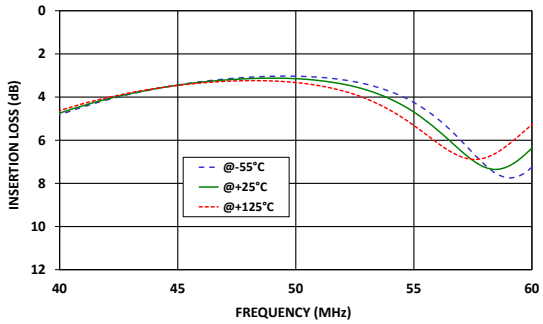
Power Splitter/Combiner

QCU-55+

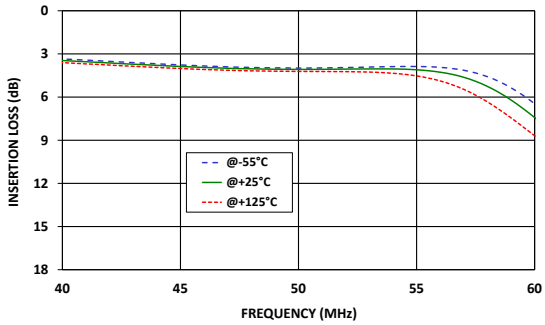
50Ω (2 Way-90°) 45 to 55 MHz

TYPICAL PERFORMANCE GRAPHS

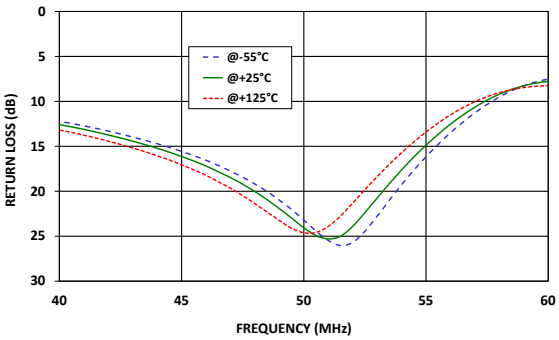
QCU-55+
INSERTION LOSS (S, 1)



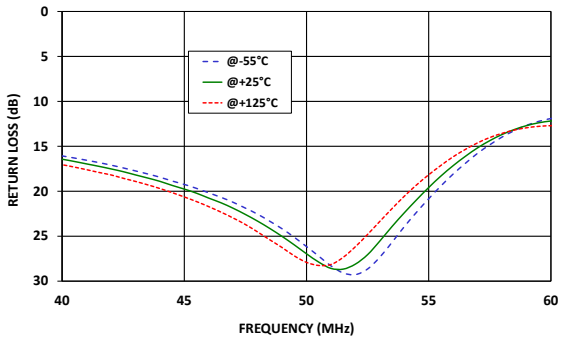
QCU-55+
INSERTION LOSS (S, 2)



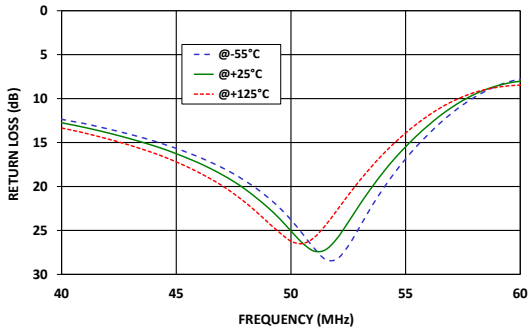
QCU-55+
RETURN LOSS (Output 1)



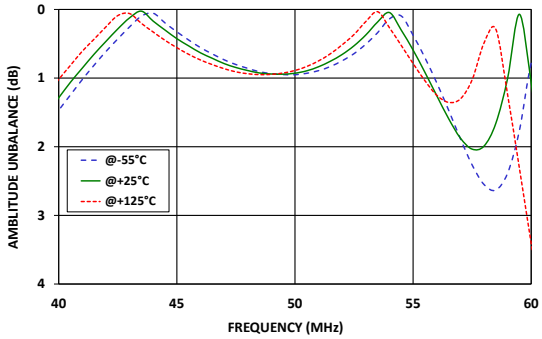
QCU-55+
RETURN LOSS (Output 2)



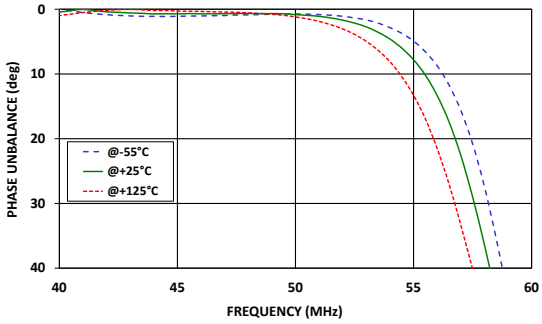
QCU-55+
RETURN LOSS (SUM PORT)



QCU-55+
AMPLITUDE UNBALANCE



QCU-55+
PHASE UNBALANCE



Power Splitter/Combiner QCU-55+

50Ω (2 Way-90°) 45 to 55 MHz

FUNCTIONAL DIAGRAM

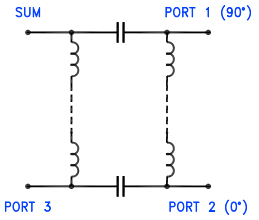
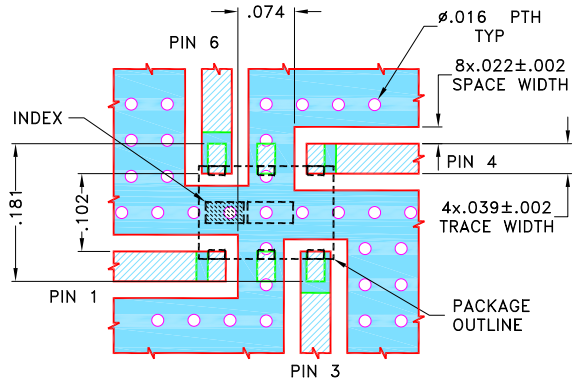


Figure 1. QCU-55+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
Sum Port	6	Connects to RF Input Port
Port 1 (90°)	4	Connects to RF Output 1 Port
Port 2 (0°)	3	Connects to RF Output 2 Port
Port 3	1	50 Ohms Term External
Ground	2,5	Connects to Ground

SUGGESTED PCB LAYOUT (PL-779)

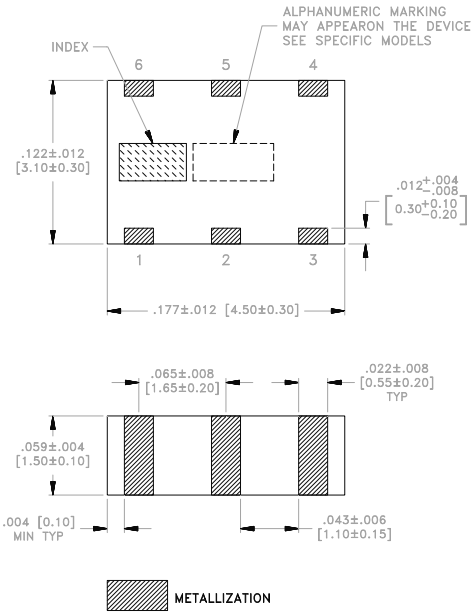


NOTES:
1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (RO4350B) WITH DIELECTRIC THICKNESS .020±.0015; COPPER: 1/2 Oz. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)
DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

Figure 2. Suggested PCB Layout PL-779

CASE STYLE DRAWING



Weight: .070 grams.
Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3Pl. ± .005

PRODUCT MARKING*: S102

*Marking may contain other features or characters for internal lot control.

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QCU-55+

50Ω (2 Way-90°) 45 to 55 MHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD. CLICK HERE

Performance Data & Graphs	Data Graphs S-Parameter (S4P Files) Data Set (.zip file) De-embedded to device pads
Case Style	NM1812C-6 Lead Finish: Nickel-Tin
RoHS Status	Compliant
Tape and Reel	F77
Suggested Layout for PCB Design	PL-779
Evaluation Board	TB-QCU-55+ Gerber File
Environmental Rating	ENV06T10

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-Circuits' 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

2 Way-90° Power Splitter/Combiner QCU-55+

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS[1] (dB)						RETURN LOSS (dB)					
	(S, 1)			(S, 2)			OUTPUT 1			OUTPUT 2		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
40.0	4.82	4.74	4.63	3.35	3.46	3.61	12.22	12.59	13.19	16.07	16.44	17.05
40.5	4.63	4.56	4.46	3.39	3.50	3.65	12.46	12.84	13.46	16.30	16.69	17.31
41.0	4.45	4.40	4.30	3.43	3.54	3.69	12.73	13.11	13.76	16.55	16.96	17.60
41.5	4.28	4.24	4.16	3.47	3.59	3.73	13.01	13.42	14.08	16.81	17.22	17.90
42.0	4.13	4.09	4.03	3.52	3.63	3.78	13.31	13.74	14.43	17.09	17.51	18.18
42.5	3.99	3.96	3.91	3.56	3.67	3.82	13.63	14.07	14.79	17.40	17.82	18.56
43.0	3.86	3.84	3.80	3.61	3.72	3.86	13.97	14.43	15.19	17.74	18.18	18.90
43.5	3.74	3.73	3.70	3.64	3.75	3.90	14.33	14.81	15.59	18.07	18.53	19.28
44.0	3.63	3.62	3.61	3.69	3.79	3.94	14.71	15.22	16.05	18.44	18.90	19.69
44.5	3.53	3.53	3.53	3.73	3.83	3.98	15.11	15.65	16.52	18.86	19.35	20.15
45.0	3.44	3.45	3.46	3.77	3.87	4.01	15.57	16.14	17.06	19.24	19.76	20.63
45.5	3.36	3.37	3.40	3.80	3.91	4.05	16.04	16.64	17.63	19.68	20.22	21.15
46.0	3.28	3.31	3.35	3.84	3.94	4.08	16.55	17.19	18.23	20.18	20.76	21.71
46.5	3.22	3.26	3.30	3.87	3.97	4.11	17.13	17.83	18.94	20.68	21.28	22.32
47.0	3.17	3.21	3.27	3.90	4.00	4.13	17.77	18.48	19.67	21.23	21.89	22.98
47.5	3.12	3.17	3.25	3.92	4.02	4.16	18.44	19.22	20.49	21.88	22.58	23.70
48.0	3.08	3.15	3.24	3.94	4.04	4.18	19.20	20.04	21.38	22.55	23.33	24.53
48.5	3.05	3.13	3.24	3.96	4.05	4.19	20.04	20.94	22.32	23.34	24.14	25.41
49.0	3.04	3.12	3.25	3.97	4.06	4.20	20.99	21.94	23.25	24.17	25.02	26.26
49.5	3.03	3.13	3.28	3.98	4.07	4.21	22.03	22.98	24.12	25.12	25.97	27.19
50.0	3.03	3.15	3.33	3.98	4.08	4.22	23.20	24.07	24.61	26.15	26.96	27.91
50.5	3.05	3.18	3.39	3.98	4.08	4.22	24.43	24.93	24.58	27.22	27.88	28.26
51.0	3.08	3.24	3.47	3.97	4.07	4.22	25.47	25.30	23.91	28.30	28.58	28.15
51.5	3.13	3.31	3.58	3.96	4.06	4.23	26.04	25.01	22.77	29.08	28.66	27.35
52.0	3.20	3.40	3.72	3.95	4.06	4.23	25.68	23.90	21.31	29.27	28.10	26.17
52.5	3.29	3.52	3.88	3.93	4.05	4.25	24.45	22.37	19.82	28.65	27.05	24.80
53.0	3.41	3.67	4.08	3.91	4.04	4.26	22.77	20.76	18.37	27.33	25.54	23.35
53.5	3.56	3.86	4.33	3.90	4.04	4.29	21.01	19.15	17.00	25.67	23.92	21.93
54.0	3.74	4.09	4.61	3.88	4.05	4.35	19.28	17.63	15.71	23.94	22.40	20.56
54.5	3.97	4.36	4.94	3.87	4.06	4.42	17.65	16.19	14.51	22.34	20.96	19.30
55.0	4.25	4.69	5.32	3.87	4.10	4.53	16.17	14.88	13.41	20.83	19.58	18.16
55.5	4.59	5.08	5.72	3.89	4.17	4.68	14.77	13.66	12.41	19.41	18.30	17.12
56.0	5.00	5.53	6.13	3.93	4.27	4.88	13.49	12.53	11.50	18.08	17.15	16.16
56.5	5.48	6.00	6.49	4.01	4.42	5.14	12.34	11.54	10.71	16.89	16.11	15.34
57.0	6.02	6.50	6.77	4.14	4.63	5.46	11.27	10.65	10.04	15.78	15.17	14.62
57.5	6.59	6.94	6.89	4.32	4.90	5.86	10.34	9.87	9.48	14.83	14.37	14.02
58.0	7.13	7.25	6.82	4.58	5.26	6.33	9.52	9.21	9.03	13.97	13.69	13.56
58.5	7.55	7.35	6.58	4.92	5.69	6.87	8.83	8.68	8.69	13.26	13.14	13.20
59.0	7.74	7.21	6.20	5.36	6.20	7.44	8.27	8.27	8.46	12.67	12.70	12.94
59.5	7.64	6.86	5.75	5.87	6.79	8.06	7.83	7.97	8.32	12.23	12.38	12.78
60.0	7.25	6.36	5.27	6.47	7.42	8.68	7.53	7.78	8.26	11.91	12.18	12.70

1. Total Loss = Insertion Loss + 3dB Splitter Loss

Typical Performance Data

FREQUENCY (MHz)	RETURN LOSS (dB)					
	SUM PORT			ISOLATED PORT		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
40.0	12.36	12.76	13.35	16.27	16.66	17.29
40.5	12.60	13.01	13.62	16.49	16.90	17.55
41.0	12.85	13.28	13.92	16.75	17.16	17.83
41.5	13.14	13.58	14.24	16.99	17.41	18.10
42.0	13.44	13.89	14.58	17.27	17.71	18.40
42.5	13.75	14.22	14.94	17.55	18.00	18.73
43.0	14.08	14.58	15.33	17.87	18.34	19.10
43.5	14.43	14.95	15.74	18.21	18.68	19.48
44.0	14.81	15.35	16.18	18.55	19.08	19.88
44.5	15.23	15.78	16.67	18.94	19.46	20.31
45.0	15.66	16.27	17.21	19.36	19.90	20.79
45.5	16.15	16.80	17.79	19.77	20.34	21.29
46.0	16.67	17.35	18.44	20.30	20.89	21.84
46.5	17.24	17.97	19.14	20.77	21.43	22.49
47.0	17.86	18.66	19.91	21.36	22.01	23.14
47.5	18.56	19.43	20.81	21.96	22.67	23.86
48.0	19.36	20.30	21.79	22.64	23.43	24.70
48.5	20.24	21.31	22.90	23.36	24.22	25.53
49.0	21.26	22.40	24.09	24.20	25.07	26.43
49.5	22.42	23.64	25.24	25.15	26.06	27.33
50.0	23.78	25.06	26.22	26.24	27.09	28.07
50.5	25.36	26.43	26.50	27.30	27.94	28.42
51.0	26.99	27.35	25.83	28.39	28.65	28.19
51.5	28.29	27.21	24.44	29.17	28.71	27.34
52.0	28.27	25.95	22.74	29.36	28.16	26.16
52.5	26.77	24.06	20.98	28.70	26.91	24.71
53.0	24.60	22.06	19.32	27.26	25.36	23.21
53.5	22.35	20.19	17.78	25.67	23.84	21.79
54.0	20.34	18.46	16.36	23.99	22.29	20.44
54.5	18.50	16.89	15.08	22.28	20.80	19.16
55.0	16.87	15.48	13.92	20.71	19.41	18.00
55.5	15.37	14.19	12.85	19.31	18.19	16.97
56.0	14.05	13.03	11.91	17.96	16.99	15.99
56.5	12.79	11.95	11.08	16.74	15.96	15.17
57.0	11.69	11.02	10.37	15.66	15.01	14.45
57.5	10.71	10.21	9.78	14.67	14.21	13.84
58.0	9.85	9.52	9.31	13.81	13.52	13.35
58.5	9.14	8.96	8.95	13.09	12.95	13.00
59.0	8.55	8.54	8.71	12.50	12.51	12.73
59.5	8.09	8.22	8.55	12.04	12.19	12.57
60.0	7.78	8.02	8.47	11.70	11.98	12.46

1. Total Loss = Insertion Loss + 3dB Splitter Loss

2 Way-90° Power Splitter/Combiner QCU-55+

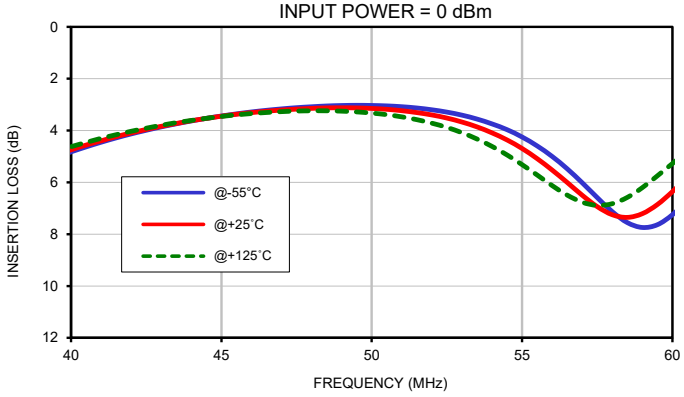
Typical Performance Data

FREQUENCY (MHz)	PHASE UNBALANCE (Degree)			AMPLITUDE UNBALANCE (dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
40.0	0.03	0.47	0.99	1.47	1.29	1.02
40.5	0.27	0.21	0.76	1.24	1.06	0.81
41.0	0.52	0.03	0.52	1.02	0.85	0.61
41.5	0.69	0.22	0.33	0.81	0.65	0.43
42.0	0.86	0.40	0.18	0.61	0.47	0.25
42.5	0.95	0.48	0.07	0.43	0.28	0.09
43.0	1.03	0.58	0.03	0.25	0.12	0.06
43.5	1.10	0.63	0.10	0.10	0.02	0.20
44.0	1.10	0.72	0.19	0.06	0.17	0.33
44.5	1.12	0.70	0.20	0.20	0.30	0.45
45.0	1.09	0.72	0.28	0.33	0.43	0.56
45.5	1.06	0.68	0.32	0.45	0.53	0.65
46.0	1.04	0.71	0.34	0.56	0.63	0.74
46.5	1.00	0.71	0.40	0.65	0.71	0.80
47.0	0.97	0.69	0.44	0.73	0.79	0.86
47.5	0.89	0.68	0.47	0.80	0.85	0.91
48.0	0.87	0.65	0.56	0.86	0.89	0.94
48.5	0.83	0.68	0.65	0.91	0.93	0.95
49.0	0.78	0.67	0.79	0.93	0.94	0.95
49.5	0.75	0.71	0.94	0.95	0.94	0.93
50.0	0.74	0.83	1.20	0.95	0.93	0.89
50.5	0.76	0.95	1.49	0.93	0.89	0.83
51.0	0.83	1.10	1.88	0.89	0.83	0.75
51.5	0.93	1.35	2.41	0.83	0.75	0.65
52.0	1.09	1.69	3.04	0.75	0.66	0.51
52.5	1.35	2.14	3.88	0.64	0.53	0.37
53.0	1.66	2.73	4.97	0.51	0.37	0.18
53.5	2.15	3.56	6.36	0.34	0.18	0.03
54.0	2.85	4.60	8.10	0.14	0.05	0.27
54.5	3.71	6.00	10.41	0.10	0.30	0.52
55.0	4.92	7.80	13.29	0.38	0.59	0.79
55.5	6.58	10.18	16.93	0.70	0.92	1.04
56.0	8.74	13.33	21.51	1.07	1.25	1.25
56.5	11.69	17.37	26.96	1.46	1.59	1.35
57.0	15.61	22.56	33.32	1.88	1.87	1.30
57.5	20.76	28.96	40.12	2.27	2.04	1.02
58.0	27.36	36.36	46.83	2.55	1.99	0.49
58.5	35.40	44.39	52.93	2.63	1.66	0.29
59.0	44.30	52.10	57.78	2.39	1.01	1.24
59.5	53.22	58.77	61.09	1.77	0.07	2.31
60.0	61.02	63.81	63.06	0.78	1.06	3.41

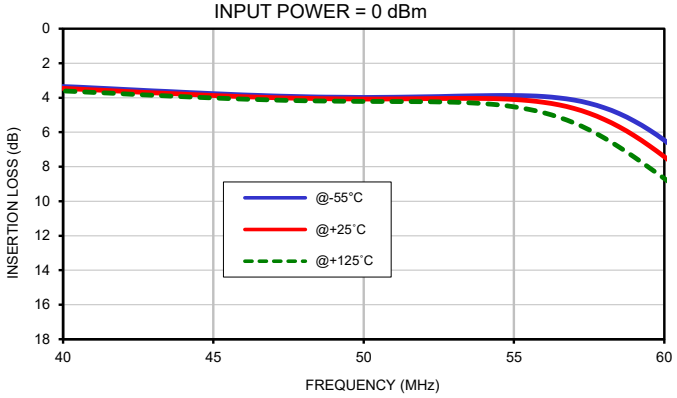
1. Total Loss = Insertion Loss + 3dB Splitter Loss

Typical Performance Curves

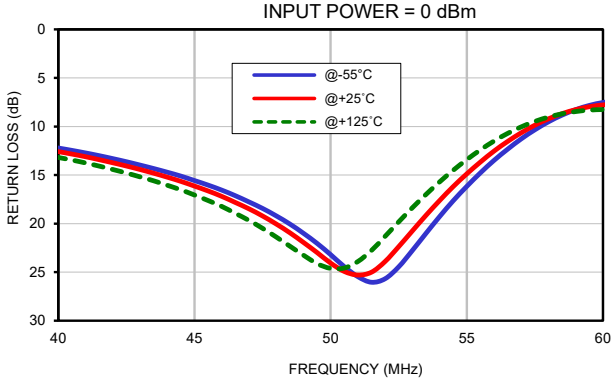
INSERTION LOSS (S, 1) vs. TEMPERATURE
INPUT POWER = 0 dBm



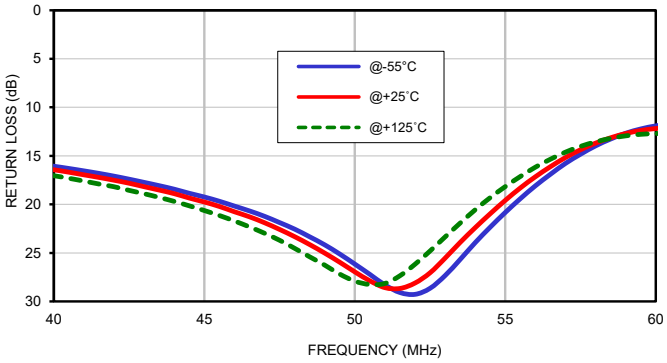
INSERTION LOSS (S, 2) vs. TEMPERATURE
INPUT POWER = 0 dBm



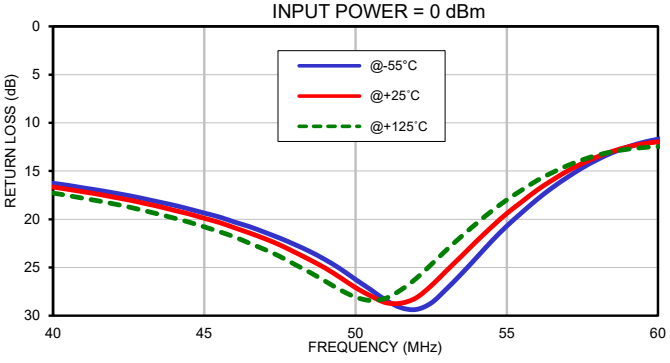
RETURN LOSS (OUTPUT 1) vs. TEMPERATURE
INPUT POWER = 0 dBm



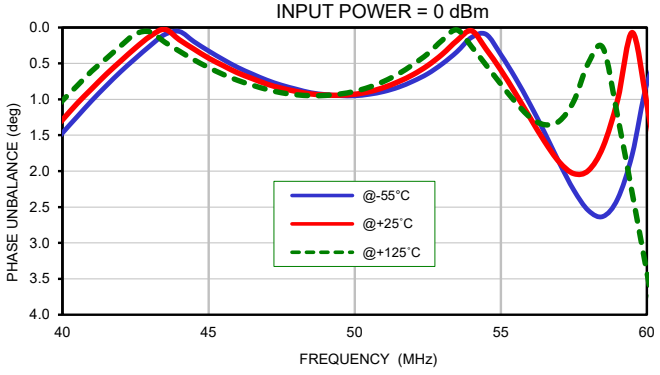
RETURN LOSS (OUTPUT 2) vs. TEMPERATURE
INPUT POWER = 0 dBm



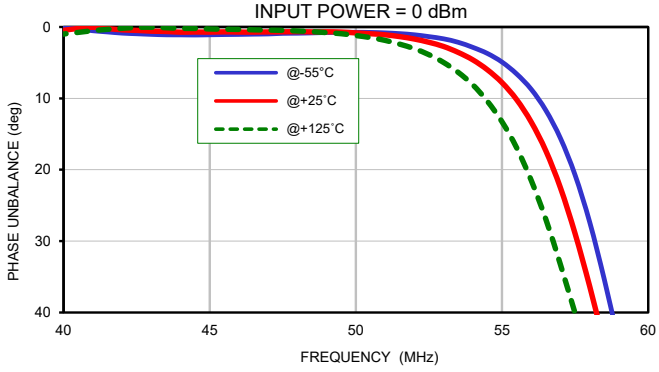
RETURN LOSS (ISOLATED PORT) vs. TEMPERATURE
INPUT POWER = 0 dBm



AMPLITUDE UNBALANCE vs. TEMPERATURE
INPUT POWER = 0 dBm

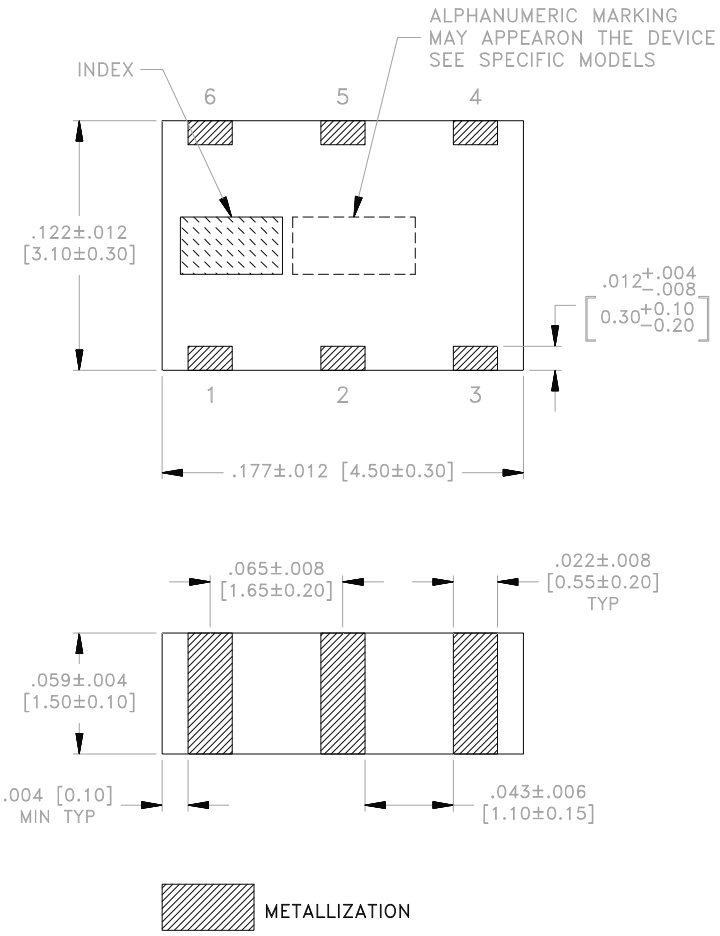


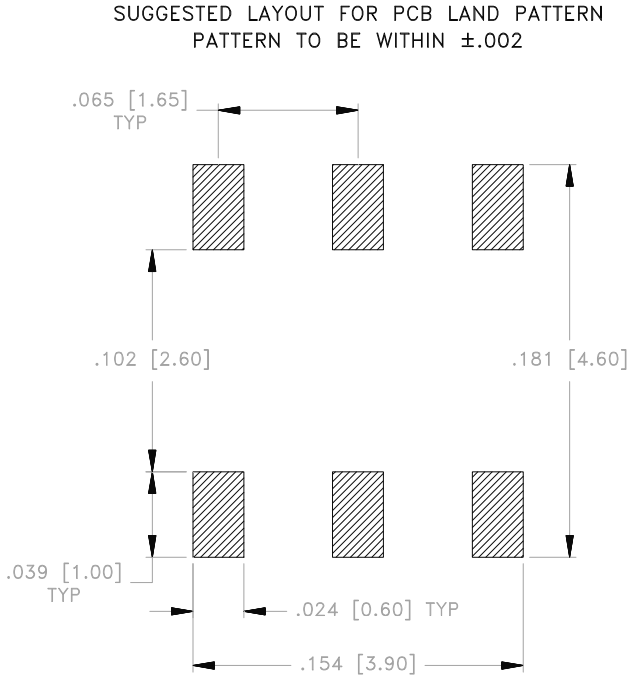
PHASE UNBALANCE vs. TEMPERATURE
INPUT POWER = 0 dBm



Case Style NL

Outline Dimensions NM1812C-6



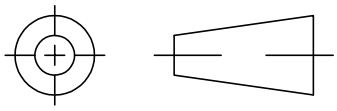


Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3Pl. ± .005

Notes:

1. Open style, Ceramic base.
2. Termination finish: For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.
   For RoHS-5 Case Styles: Tin-lead plate. All models, no (+) suffix.
3. Weight: .070 grams.
4. Pad tolerance is non-cumulative.

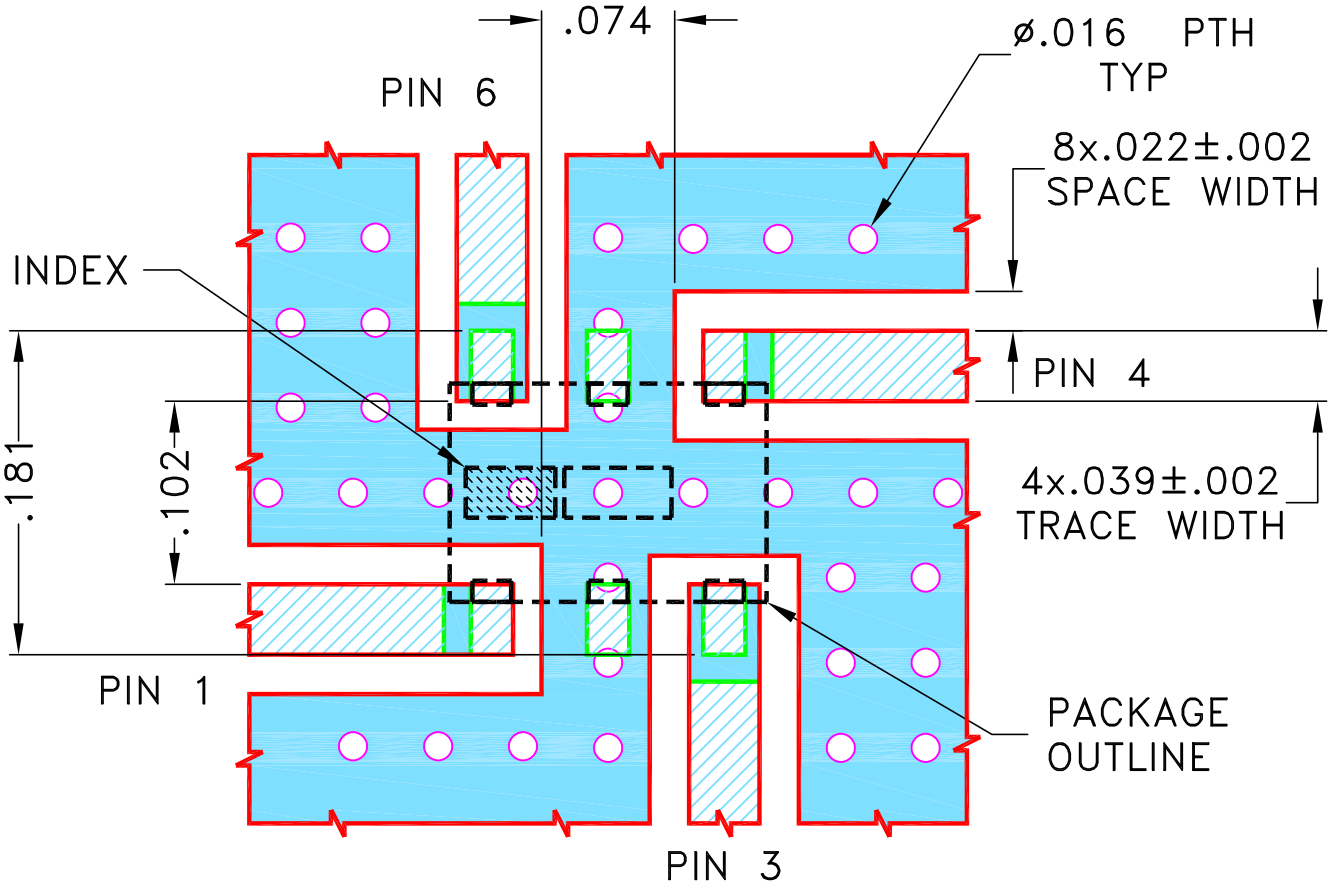
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	NPO-004227	NEW RELEASE	APR 24	AGS	VC

SUGGESTED MOUNTING CONFIGURATION FOR NM1812C-6 CASE STYLE



NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (RO4350B) WITH DIELECTRIC THICKNESS .020±.0015; COPPER: 1/2 Oz. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	AGS	01 APR 24
TOLERANCES ON:	CHECKED	DDR	01 APR 24
2 PL DECIMALS ±	APPROVED	RKS	01 APR 24
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

ASHEETA1.DWG REV:A DATE:01/12/95

Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

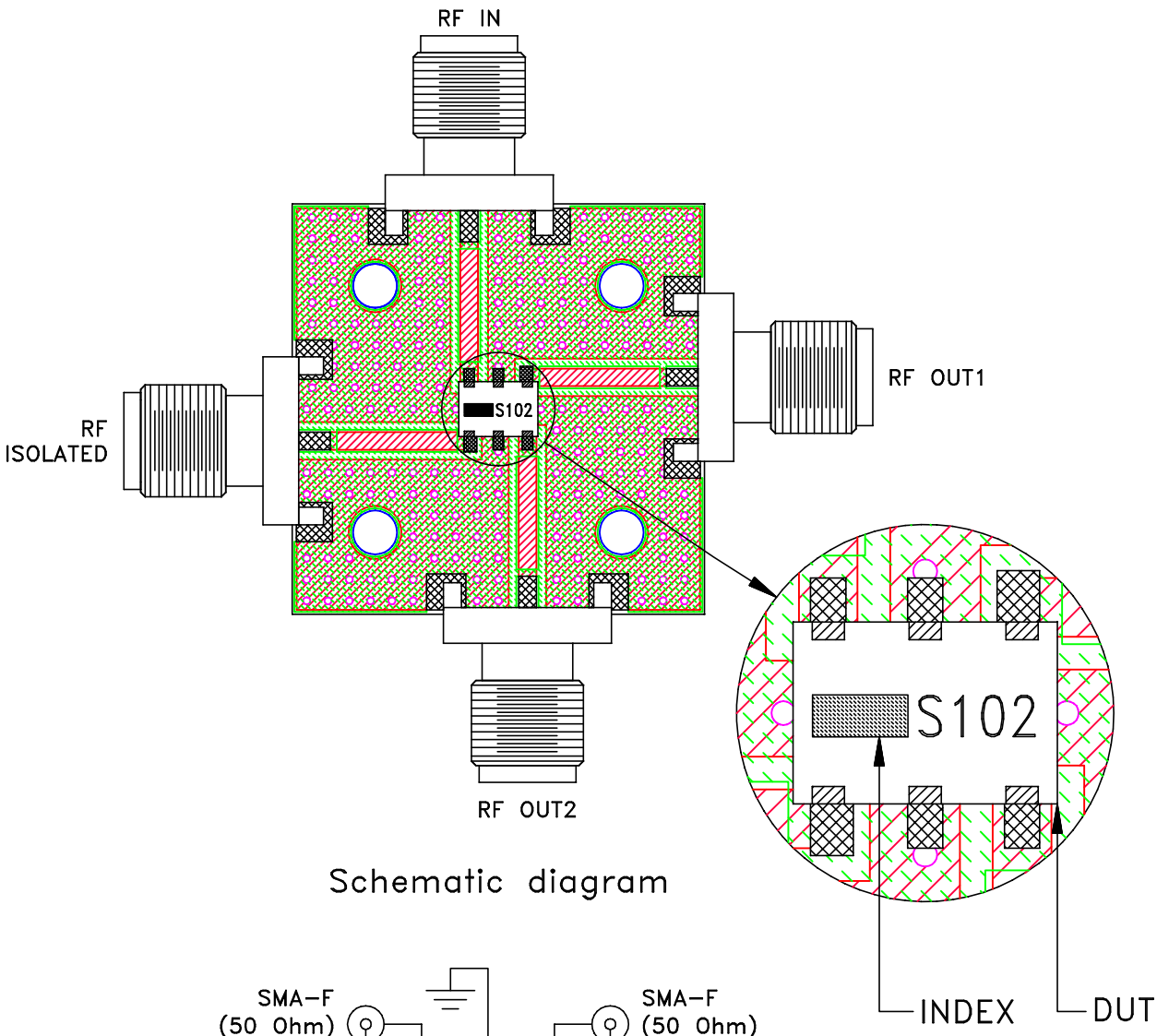
PL, NM1812C-6, TB-1275

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-779	OR

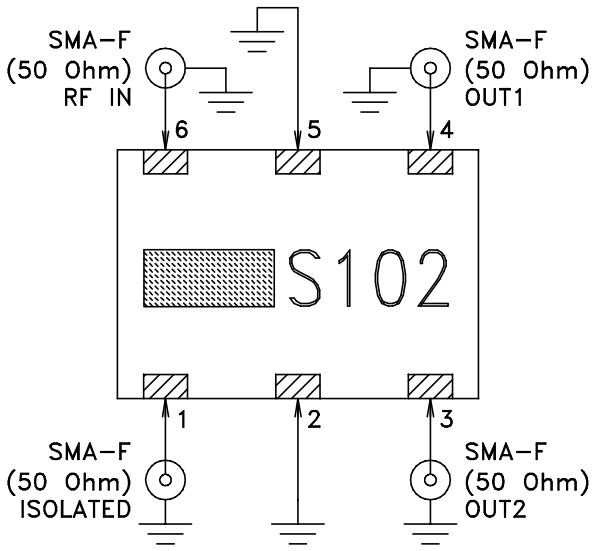
FILE:	SCALE:	SHEET:
98-PL-779	9:1	1 OF 1

Evaluation Board and Circuit

TB-QCU-55+



Schematic diagram



Notes:

1. PCB Material: ROGERS (RO4350B) OR Equivalent, Dielectric Constant=3.48±0.05
Dielectric Thickness: .020±.0015 inch
2. 50 Ohm SMA Female Connectors.

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Environmental Specifications ENV06T10

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	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Solder Reflow Heat	Sn-Pb Eutectic Process 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020C, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, Test B,B1, 95% Coverage
Thermal Shock	-55° to +125°C, 15 min dwell,250 cycles	MIL-STD-202, Method 107
Bend Test	1mm, deflection for 5 seconds Span of bending: 2.75"	--
High Temp Storage	125°C to 1000 Hrs	---