Surface Mount

Power Splitter/Combiner

2 Way-90° 50Ω 1900 to 2400 MHz

QBA-24+
QBA-24

Generic photo used for illustration purposes only

CASE STYLE: SM33

+RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Maximum Ratings

Operating Temperature	-55°C to 100°C
Storage Temperature	-55°C to 100°C

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

Pin Connections

SUM PORT	1
PORT 1 (+90°)	10
PORT 2 (0°)	6
GROUND	2,3,4,7,8,9
50 OHM TERM EXTERNAL	5

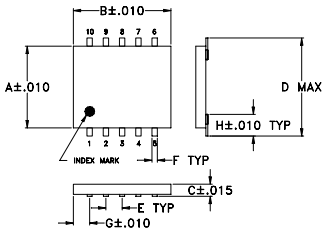
Features

- insertion loss, 0.55 dB typ.
- high power capability, 20W
- good isolation, 21 dB typ.
- ceramic body, good for heat dissipation
- solder plated leads for excellent solderability
- aqueous washable
- protected by U.S. Patent 5,534,830

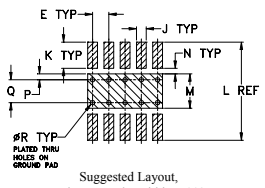
Applications

- DECT
- PHS
- satellite communications

Outline Drawing



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

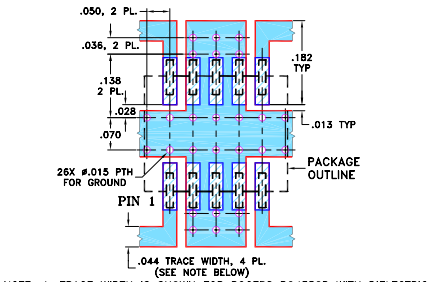
ADJACENT GROUND PINS SHALL BE CONNECTED TO EACH OTHER AND TO GROUND PAD

Outline Dimensions (inch / mm)

A	B	C	D	E	F	G	H
.250	.300	.050	.310	.050	.015	.050	.066
6.35	7.62	1.27	7.87	1.27	0.38	1.27	1.68

J	K	L	M	N	P	Q	R	wt
.030	.095	.330	.100	.020	.015	.070	.014	grams
0.76	2.41	8.38	2.54	0.51	0.38	1.78	0.36	0.2

Demo Board MCL P/N: TB-115+
Suggested PCB Layout (PL-004)



NOTE: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020 ± .0015; COPPER: 1/2 OZ. EACH SIDE. 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

Electrical Specifications

FREQ. RANGE (MHz)	ISOLATION (dB)		INSERTION LOSS[1] (dB) Avg. of Coupled Outputs ABOVE 3 dB			PHASE UNBALANCE (Degrees)	AMPLITUDE UNBALANCE (dB)	INPUT POWER[2] (W)
			f_L	f_U				
f_L-f_U	Typ.	Min.	$\overline{X}$	$\overline{X}$	σ	Max.	Max.	below 25°C
1900-2400	21	17	0.54	0.71	0.02	6.0	0.8	20

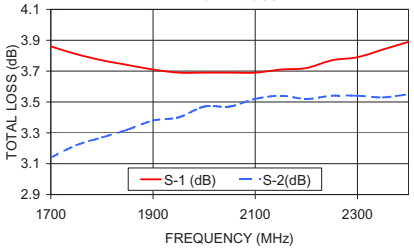
1. Includes test fixture losses.
2. Derate linearly to 4W at 100°C
Thermal compound may be applied to decrease body temperature. See application note AN-10-007

Typical Performance Data

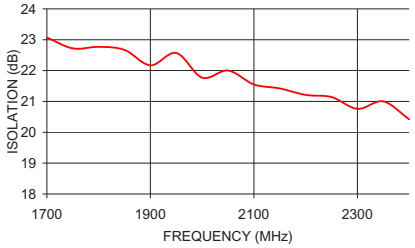
Frequency (MHz)	Total Loss[1] (dB)		Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
	S-1	S-2						
1700.00	3.86	3.14	0.72	23.07	87.86	1.19	1.24	1.20
1750.00	3.81	3.22	0.59	22.72	87.93	1.19	1.24	1.21
1800.00	3.77	3.27	0.50	22.77	87.90	1.19	1.24	1.21
1850.00	3.74	3.32	0.43	22.67	87.88	1.19	1.23	1.21
1900.00	3.71	3.38	0.32	22.17	87.77	1.19	1.23	1.21
1950.00	3.69	3.40	0.29	22.57	87.76	1.19	1.23	1.22
2000.00	3.69	3.47	0.22	21.77	87.70	1.19	1.22	1.22
2050.00	3.69	3.47	0.23	22.00	87.53	1.20	1.22	1.22
2100.00	3.69	3.52	0.17	21.55	87.48	1.19	1.22	1.21
2150.00	3.71	3.54	0.18	21.42	87.34	1.19	1.21	1.21
2200.00	3.72	3.52	0.20	21.21	87.47	1.19	1.21	1.21
2250.00	3.77	3.54	0.22	21.14	87.29	1.19	1.21	1.20
2300.00	3.79	3.54	0.24	20.76	87.39	1.19	1.20	1.20
2350.00	3.84	3.53	0.31	21.00	87.06	1.18	1.19	1.20
2400.00	3.89	3.55	0.34	20.42	87.13	1.19	1.20	1.20

1. Total Loss = Insertion Loss + 3dB splitter loss.

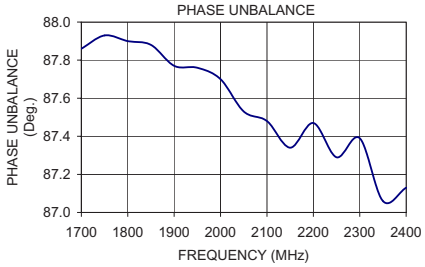
QBA-24
TOTAL LOSS



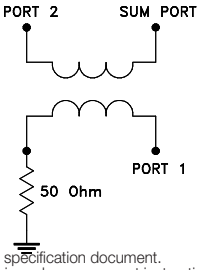
QBA-24
ISOLATION



QBA-24
PHASE UNBALANCE



electrical schematic



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/MCLStore/terms.jsp

2 Way-90° Power Splitter/Combiner QBA-24

Typical Performance Data

TEST CONDITIONS: INPUT POWER = 0dBm @Temperature = +25°C

FREQ. (MHz)	TOTAL LOSS[1] (dB)			AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB)	VSWR (:1)		
	S-1	S-2	AVG.			1-2	S	1	2
1000	5.62	1.75	3.68	3.87	1.09	22.01	1.10	1.31	1.08
1050	5.38	1.86	3.62	3.52	0.96	22.22	1.11	1.30	1.08
1100	5.17	1.96	3.56	3.20	0.84	22.46	1.11	1.30	1.09
1150	4.98	2.06	3.52	2.91	0.73	22.70	1.12	1.29	1.10
1200	4.79	2.17	3.48	2.62	0.63	23.01	1.13	1.28	1.10
1250	4.63	2.27	3.45	2.36	0.53	23.27	1.14	1.27	1.11
1300	4.49	2.36	3.42	2.12	0.44	23.57	1.15	1.26	1.12
1350	4.35	2.46	3.40	1.89	0.38	23.88	1.16	1.25	1.12
1400	4.23	2.56	3.39	1.67	0.28	24.11	1.17	1.24	1.13
1450	4.12	2.64	3.38	1.48	0.23	24.31	1.18	1.23	1.14
1500	4.02	2.73	3.38	1.29	0.15	24.42	1.19	1.21	1.15
1550	3.93	2.81	3.37	1.12	0.11	24.43	1.20	1.20	1.16
1600	3.85	2.89	3.37	0.97	0.05	24.33	1.21	1.19	1.17
1650	3.79	2.96	3.38	0.82	0.00	24.11	1.22	1.19	1.18
1700	3.73	3.03	3.38	0.70	0.05	23.78	1.23	1.18	1.19
1750	3.68	3.10	3.39	0.58	0.09	23.39	1.24	1.18	1.20
1800	3.63	3.16	3.40	0.47	0.13	22.92	1.25	1.18	1.21
1850	3.60	3.21	3.40	0.39	0.18	22.40	1.26	1.18	1.22
1900	3.57	3.27	3.42	0.30	0.26	21.89	1.28	1.18	1.23
1925	3.56	3.29	3.43	0.27	0.28	21.62	1.28	1.19	1.23
1950	3.55	3.32	3.43	0.23	0.32	21.34	1.29	1.19	1.24
1975	3.54	3.34	3.44	0.20	0.33	21.10	1.29	1.20	1.24
2000	3.54	3.36	3.45	0.18	0.33	20.86	1.30	1.20	1.25
2025	3.54	3.38	3.46	0.16	0.36	20.61	1.30	1.21	1.25
2050	3.53	3.40	3.47	0.13	0.40	20.36	1.31	1.21	1.25
2075	3.53	3.41	3.47	0.12	0.45	20.12	1.31	1.22	1.26
2100	3.53	3.43	3.48	0.10	0.50	19.87	1.32	1.23	1.26
2125	3.53	3.45	3.49	0.08	0.52	19.68	1.32	1.23	1.26
2150	3.53	3.45	3.49	0.08	0.53	19.43	1.33	1.24	1.27
2175	3.54	3.47	3.50	0.07	0.59	19.23	1.33	1.25	1.27
2200	3.54	3.48	3.51	0.06	0.59	19.02	1.34	1.26	1.27
2300	3.58	3.52	3.55	0.06	0.72	18.21	1.35	1.30	1.29
2400	3.65	3.52	3.59	0.13	0.85	17.47	1.37	1.34	1.30
2500	3.75	3.51	3.63	0.24	0.97	16.81	1.38	1.38	1.31
2600	3.86	3.48	3.67	0.39	1.12	16.23	1.39	1.42	1.31
2700	4.03	3.41	3.72	0.62	1.24	15.71	1.40	1.47	1.32
2800	4.22	3.31	3.77	0.91	1.41	15.20	1.40	1.52	1.32
2900	4.45	3.19	3.82	1.26	1.74	14.72	1.40	1.58	1.32
3000	4.76	3.05	3.91	1.71	2.02	14.18	1.39	1.65	1.32

[1] Total Loss = Insertion Loss+ 3dB Splitter Loss

2 Way-90° Power Splitter/Combiner QBA-24

Typical Performance Data

TEST CONDITIONS: INPUT POWER = 0dBm @Temperature = -55°C

FREQ. (MHz)	TOTAL LOSS[1] (dB)			AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB)	VSWR (:1)		
	S-1	S-2	AVG.			1-2	S	1	2
1000	5.46	1.58	3.52	3.88	2.22	21.74	1.11	1.32	1.08
1050	5.22	1.68	3.45	3.54	2.18	21.96	1.12	1.32	1.09
1100	5.00	1.77	3.38	3.24	2.10	22.11	1.12	1.32	1.09
1150	4.81	1.87	3.34	2.94	2.05	22.42	1.12	1.31	1.10
1200	4.61	1.96	3.29	2.65	2.01	22.75	1.13	1.30	1.10
1250	4.44	2.05	3.25	2.39	1.97	23.06	1.13	1.29	1.10
1300	4.29	2.14	3.22	2.15	1.90	23.61	1.14	1.27	1.11
1350	4.15	2.23	3.19	1.92	1.88	23.87	1.15	1.26	1.11
1400	4.02	2.32	3.17	1.70	1.84	24.29	1.16	1.24	1.12
1450	3.90	2.40	3.15	1.50	1.83	24.44	1.17	1.22	1.13
1500	3.79	2.49	3.14	1.31	1.82	24.83	1.17	1.21	1.15
1550	3.70	2.57	3.13	1.13	1.84	24.90	1.18	1.20	1.16
1600	3.61	2.63	3.12	0.98	1.86	24.91	1.19	1.18	1.17
1650	3.54	2.70	3.12	0.83	1.84	24.65	1.21	1.17	1.18
1700	3.47	2.76	3.12	0.71	1.84	24.27	1.22	1.15	1.20
1750	3.41	2.83	3.12	0.58	1.88	23.72	1.23	1.15	1.21
1800	3.37	2.89	3.13	0.48	1.89	23.15	1.25	1.15	1.23
1850	3.33	2.94	3.13	0.39	1.90	22.52	1.26	1.16	1.24
1900	3.30	3.00	3.15	0.30	1.91	21.70	1.29	1.17	1.25
1925	3.29	3.02	3.16	0.27	1.90	21.44	1.29	1.18	1.26
1950	3.28	3.05	3.16	0.23	1.89	21.16	1.30	1.19	1.26
1975	3.28	3.07	3.17	0.20	1.87	20.87	1.31	1.19	1.27
2000	3.27	3.10	3.18	0.17	1.90	20.48	1.33	1.21	1.28
2025	3.26	3.12	3.19	0.14	1.87	20.14	1.33	1.22	1.29
2050	3.27	3.14	3.21	0.12	1.96	19.82	1.33	1.23	1.29
2075	3.26	3.15	3.21	0.11	1.90	19.60	1.34	1.24	1.29
2100	3.26	3.17	3.22	0.09	1.86	19.29	1.36	1.25	1.29
2125	3.26	3.19	3.22	0.07	1.85	19.00	1.37	1.26	1.30
2150	3.26	3.20	3.23	0.06	1.85	18.77	1.37	1.27	1.30
2175	3.26	3.22	3.24	0.04	1.84	18.53	1.38	1.29	1.31
2200	3.26	3.23	3.25	0.03	1.86	18.29	1.39	1.30	1.31
2300	3.30	3.26	3.28	0.04	1.80	17.43	1.42	1.35	1.32
2400	3.36	3.28	3.32	0.08	1.82	16.59	1.45	1.40	1.32
2500	3.43	3.26	3.35	0.16	1.89	16.02	1.45	1.44	1.32
2600	3.50	3.21	3.35	0.29	1.97	15.59	1.44	1.47	1.32
2700	3.63	3.14	3.39	0.50	2.14	15.16	1.44	1.50	1.31
2800	3.79	3.01	3.40	0.78	2.10	14.81	1.43	1.54	1.31
2900	3.97	2.87	3.42	1.10	2.19	14.44	1.41	1.57	1.31
3000	4.23	2.71	3.47	1.52	2.11	14.13	1.39	1.64	1.31

[1] Total Loss = Insertion Loss+ 3dB Splitter Loss

2 Way-90° Power Splitter/Combiner QBA-24

Typical Performance Data

TEST CONDITIONS: INPUT POWER = 0dBm @Temperature = +100°C

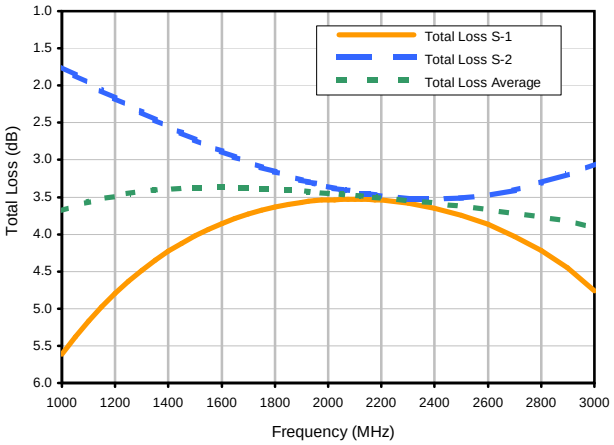
FREQ. (MHz)	TOTAL LOSS[1] (dB)			AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB)	VSWR (:1)		
	S-1	S-2	AVG.			1-2	S	1	2
1000	5.66	1.85	3.75	3.81	0.42	22.41	1.09	1.29	1.09
1050	5.43	1.95	3.69	3.48	0.60	22.58	1.10	1.28	1.10
1100	5.22	2.06	3.64	3.16	0.79	22.77	1.12	1.27	1.10
1150	5.04	2.18	3.61	2.86	0.97	22.90	1.14	1.27	1.12
1200	4.86	2.29	3.58	2.57	1.13	23.07	1.15	1.26	1.12
1250	4.70	2.39	3.55	2.31	1.27	23.21	1.16	1.25	1.13
1300	4.57	2.50	3.54	2.07	1.40	23.32	1.18	1.25	1.14
1350	4.44	2.60	3.52	1.84	1.52	23.42	1.19	1.24	1.15
1400	4.33	2.70	3.51	1.63	1.67	23.52	1.20	1.24	1.16
1450	4.22	2.79	3.51	1.43	1.78	23.58	1.21	1.24	1.17
1500	4.14	2.88	3.51	1.26	1.94	23.56	1.23	1.24	1.18
1550	4.05	2.97	3.51	1.09	2.02	23.43	1.24	1.23	1.18
1600	3.98	3.05	3.51	0.94	2.16	23.31	1.25	1.23	1.19
1650	3.93	3.12	3.53	0.80	2.28	23.11	1.26	1.23	1.19
1700	3.87	3.19	3.53	0.67	2.41	22.87	1.26	1.23	1.19
1750	3.82	3.25	3.53	0.57	2.54	22.62	1.27	1.23	1.20
1800	3.78	3.32	3.55	0.46	2.69	22.31	1.28	1.23	1.20
1850	3.75	3.37	3.56	0.38	2.80	21.93	1.29	1.23	1.20
1900	3.72	3.43	3.57	0.29	2.92	21.63	1.29	1.23	1.21
1925	3.71	3.45	3.58	0.26	2.98	21.49	1.29	1.23	1.21
1950	3.70	3.47	3.58	0.23	3.06	21.32	1.29	1.23	1.21
1975	3.69	3.48	3.59	0.21	3.11	21.17	1.30	1.23	1.21
2000	3.68	3.51	3.60	0.18	3.14	21.03	1.30	1.23	1.21
2025	3.68	3.52	3.60	0.16	3.25	20.87	1.30	1.23	1.21
2050	3.69	3.55	3.62	0.14	3.25	20.70	1.30	1.23	1.21
2075	3.68	3.56	3.62	0.12	3.36	20.55	1.30	1.24	1.21
2100	3.68	3.57	3.63	0.11	3.43	20.37	1.31	1.24	1.22
2125	3.68	3.59	3.63	0.09	3.50	20.22	1.31	1.24	1.22
2150	3.68	3.59	3.63	0.09	3.55	20.09	1.30	1.24	1.22
2175	3.68	3.60	3.64	0.08	3.64	19.97	1.30	1.24	1.22
2200	3.69	3.61	3.65	0.08	3.60	19.78	1.30	1.24	1.22
2300	3.73	3.63	3.68	0.10	3.89	19.13	1.30	1.26	1.23
2400	3.81	3.61	3.71	0.20	4.13	18.52	1.29	1.28	1.25
2500	3.92	3.59	3.75	0.33	4.38	17.85	1.29	1.32	1.26
2600	4.05	3.55	3.80	0.51	4.69	17.19	1.30	1.36	1.28
2700	4.24	3.50	3.87	0.75	5.10	16.54	1.30	1.42	1.30
2800	4.48	3.40	3.94	1.08	5.69	15.87	1.32	1.49	1.32
2900	4.76	3.31	4.03	1.45	6.30	15.16	1.33	1.56	1.33
3000	5.09	3.20	4.14	1.90	7.20	14.48	1.35	1.65	1.34

[1] Total Loss = Insertion Loss+ 3dB Splitter Loss

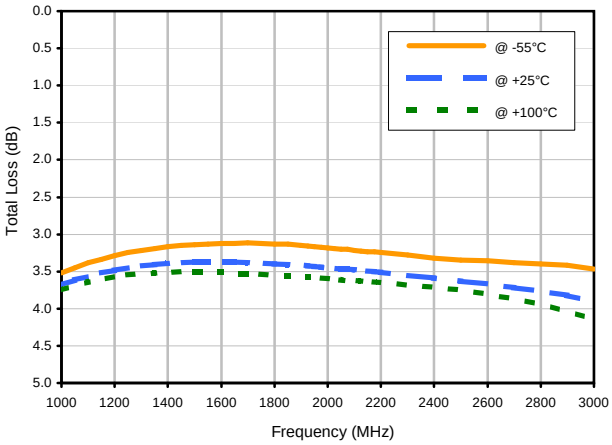
2 Way-90° Power Splitter/Combiner QBA-24

Typical Performance Curves

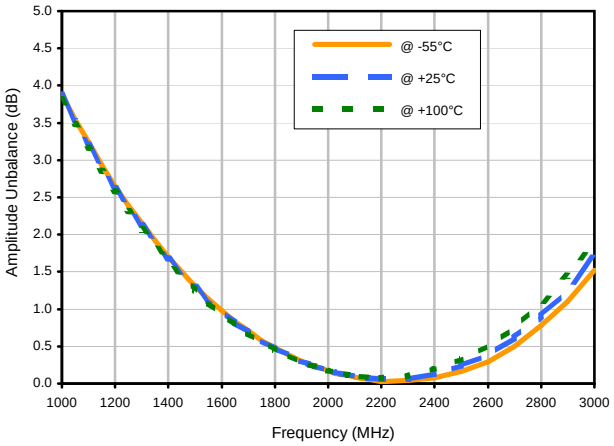
Total Loss



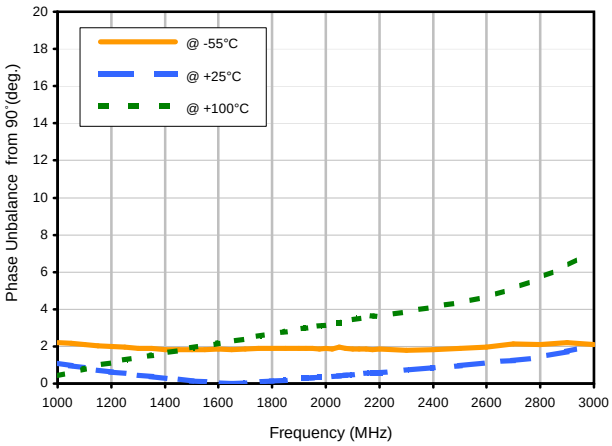
Average Total Loss vs. TEMPERATURE



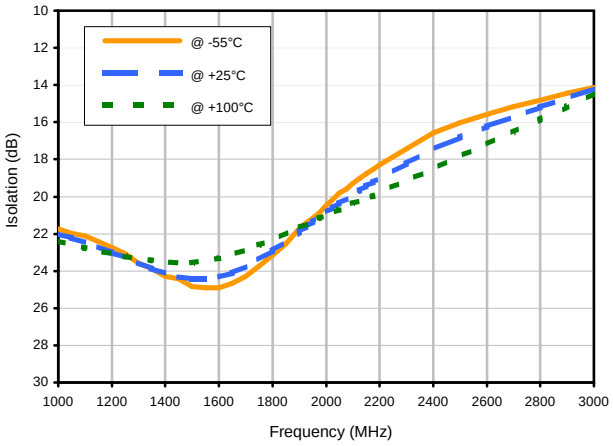
Amplitude Unbalance vs. TEMPERATURE



Phase Unbalance vs. TEMPERATURE



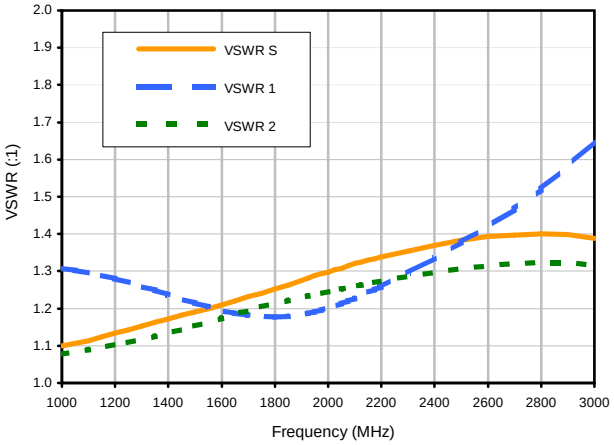
Isolation 1-2 vs. TEMPERATURE



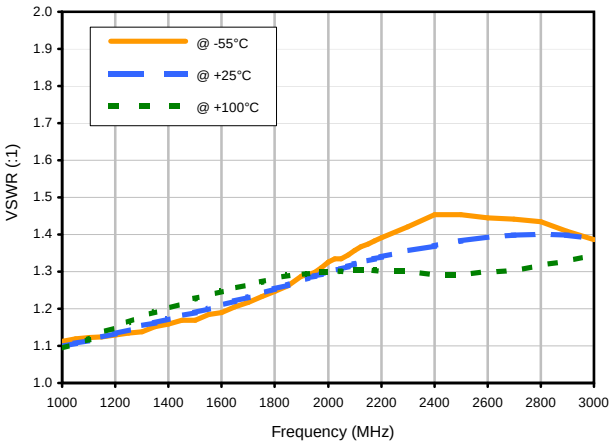
2 Way-90° Power Splitter/Combiner QBA-24

Typical Performance Curves

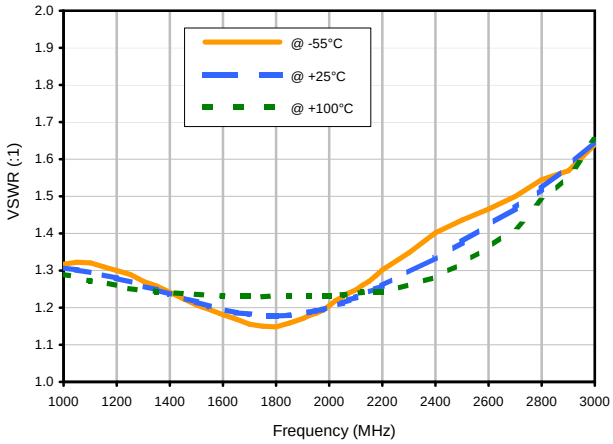
VSWR



VSWR SUM vs. TEMPERATURE



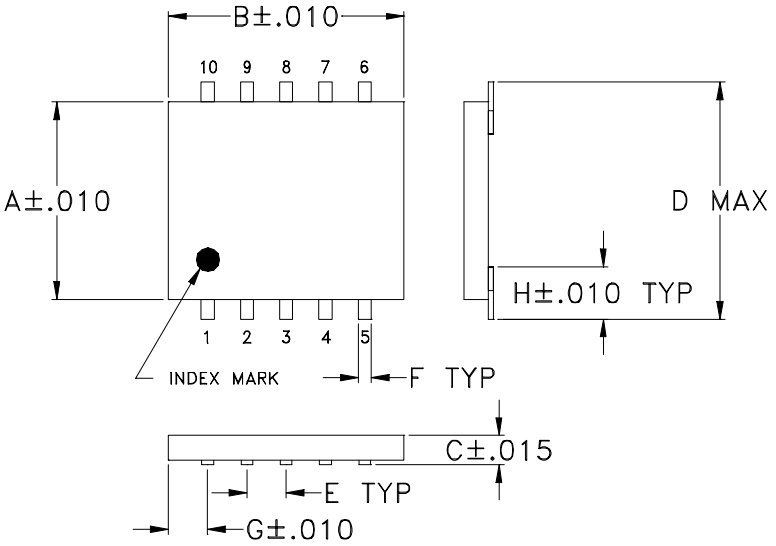
VSWR OUT1 vs. TEMPERATURE



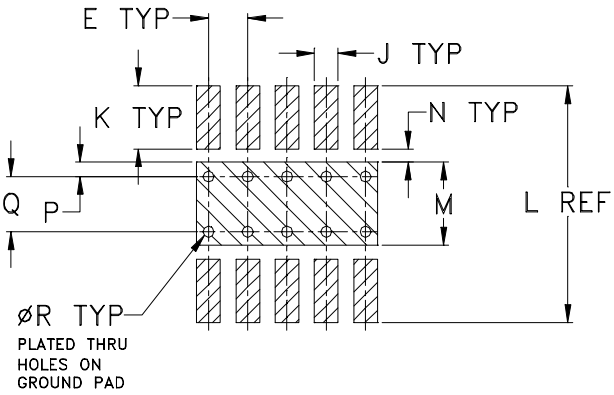
Case Style SM33

SM33

Outline Dimensions



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

ADJACENT GROUND PINS SHALL BE CONNECTED
TO EACH OTHER AND TO GROUND PAD

CASE #	A	B	C	D	E	F	G	H	J	K	L	M	N	P
SM33	.250 (6.35)	.300 (7.62)	.050 (1.27)	.310 (7.87)	.050 (1.27)	.015 (0.38)	.050 (1.27)	.066 (1.68)	.030 (0.76)	.095 (2.41)	.330 (8.38)	.100 (2.54)	.020 (0.51)	.015 (0.38)

CASE #	Q	R	WT. GRAM
SM33	.070 (1.78)	.014 (0.36)	0.2

Dimensions are in inches (mm). Tolerances: ± .005

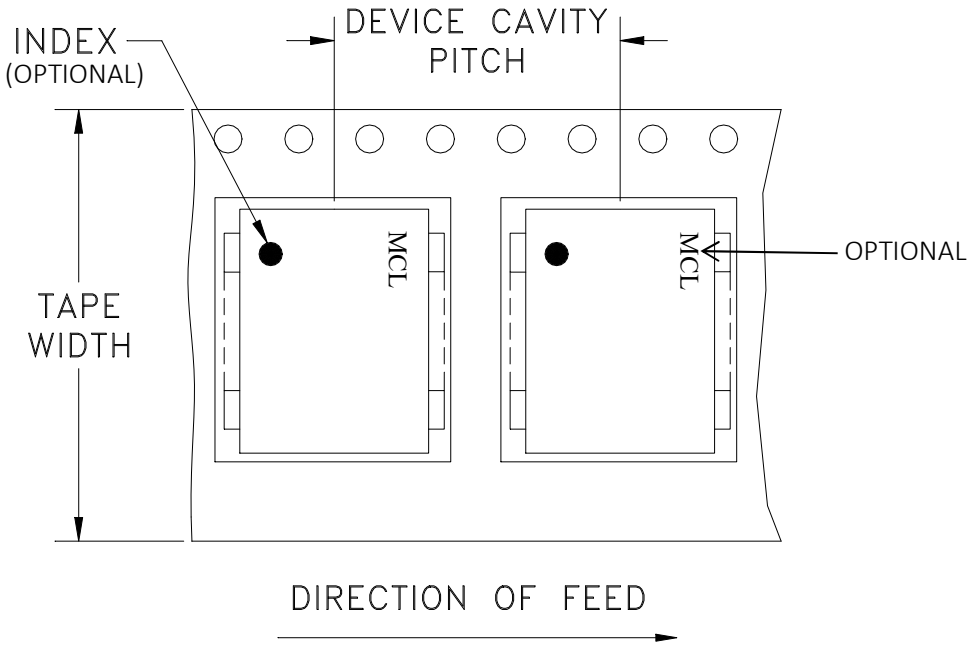
Notes:

1. Case material: Ceramic.
2. Termination finish:
   For RoHS Case Styles: Tin plate.
   For RoHS-5 Case Styles: Tin-Lead plate.

Mini-Circuits®
INTERNET http://www.minicircuits.com
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010
Mini-Circuits ISO 9001 & ISO 14001 Certified

Tape & Reel Packaging TR-F34

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
16	12	7	Small quantity standard (see note)	20
				50
				100
				200
		13	Standard	500
				1000

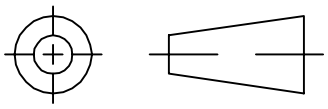
Note: Availability of small reel quantity varies by model.
Refer to pricing and availability on individual model dashboard.

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

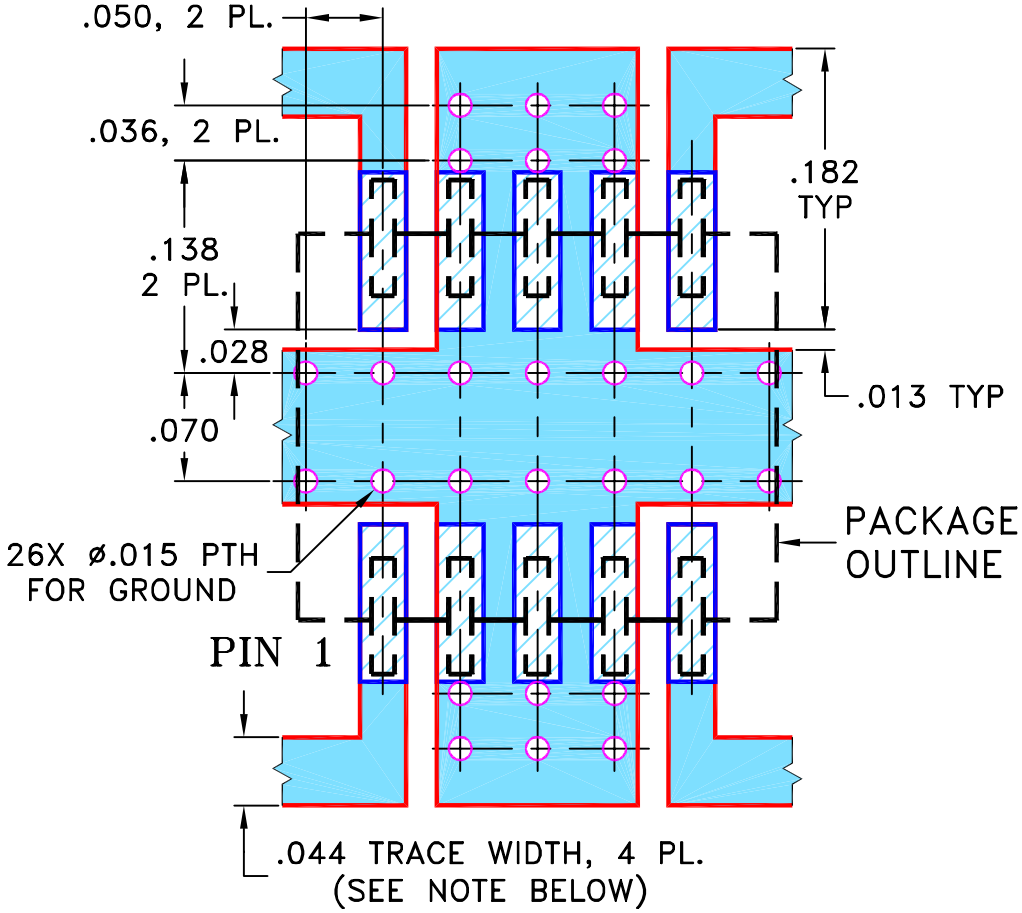
Mini-Circuits®
INTERNET http://www.minicircuits.com
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010
Mini-Circuits ISO 9001 & ISO 14001 Certified

THIRD ANGLE PROJECTION



REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
A	M82377	UPDATED DRAWING	07/31/02	AV	DB
B	M101085	UPDATED DRAWING, ADDED DZ944 CASE STYLE & NOTE 2	10/06/05	MMG	HY
C	M102713	UPDATED NOTES	01/10/06	MMG	ABD

SUGGESTED MOUNTING CONFIGURATION FOR SM1L/SM33/DZ944 CASE STYLES, "lf/nl" PIN CONNECTIONS



NOTE: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020 ± .0015; COPPER: 1/2 OZ. EACH SIDE. 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	MMG	04/12/00
TOLERANCES ON:	CHECKED	WP	04/27/00
2 PL DECIMALS ±	APPROVED	DB	04/27/00
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

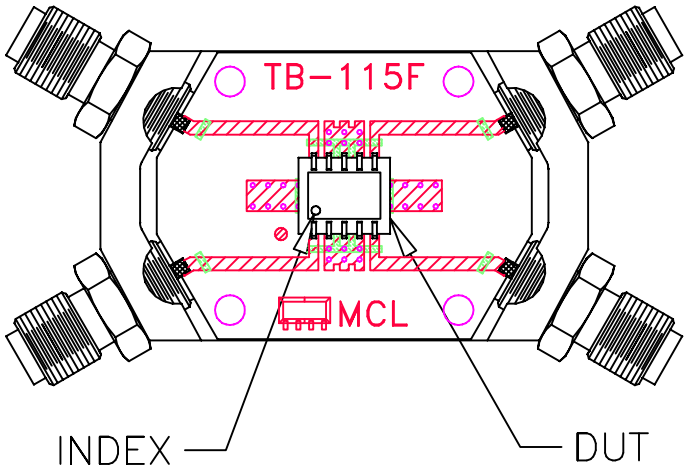
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, lf/nl, SM1L/SM33/DZ944, BDCA/QBA, TB-115

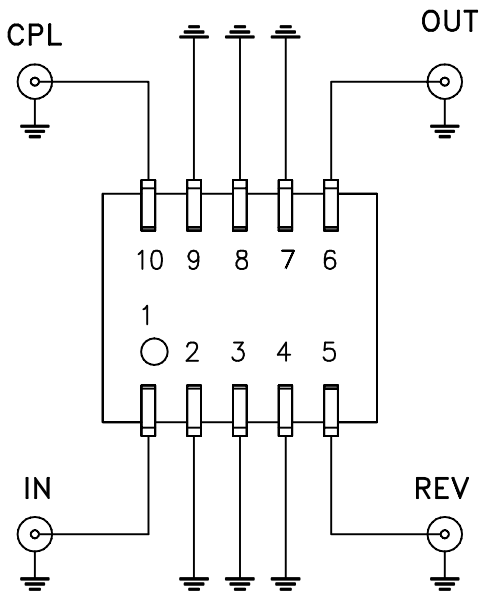
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-004	C

FILE:	SCALE:	SHEET:
98PL004	8:1	1 OF 1

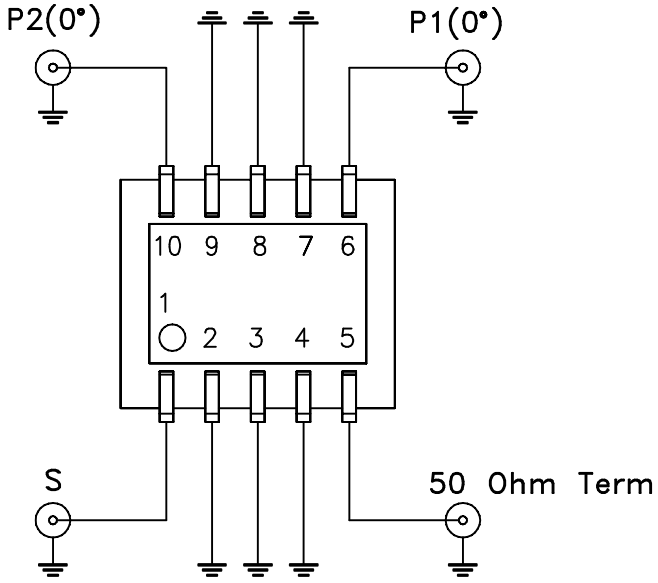
Evaluation Board and Circuit



TB-115+



BDCA MODELS



QBA MODELS

SCHEMATIC DIAGRAM

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers RO4350 or equivalent, Dielectric Constant=3.5, Thickness=.020 inch.

Mini-Circuits®

Mini-Circuits

Environmental Specifications ENV02T2

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 100°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° 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
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutetic Process: 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, 95% Coverage
Vibration (High Frequency)	20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)	MIL-STD-202, Method 204, Condition D
Mechanical Shock	50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes	MIL-STD-202, Method 213, Condition A
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