

Surface Mount

Power Splitter/Combiner

2 Way-90° 50Ω 315 to 395 MHz

HPQ-04+
HPQ-04



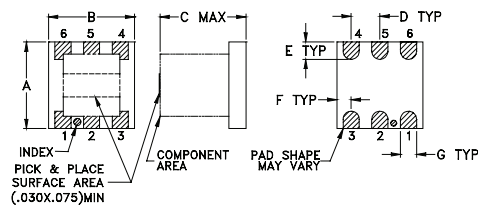
Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W max.
Permanent damage may occur if any of these limits are exceeded.	

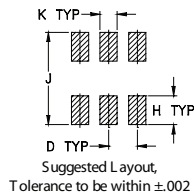
Pin Connections

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

Outline Drawing



PCB Land Pattern

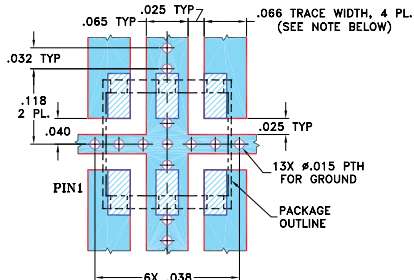


Outline Dimensions (inch)

A	B	C	D	E	F
.200	.200	.200	.075	.050	.025
5.08	5.08	5.08	1.91	1.27	0.64
G	H	J	K	wt	
.026	.070	.220	.035	grams	
0.66	1.78	5.59	0.89	0.15	

Demo Board MCL P/N: TB-43

Suggested PCB Layout (PL-114)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; 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.
3. DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
4. DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Features

- excellent amplitude and phase unbalance
- good insertion loss, 0.2 dB typ.
- good isolation, 24 dB typ.
- aqueous washable
- small size

Applications

- UHF
- image rejection mixers
- balanced amplifiers
- I&Q modulators

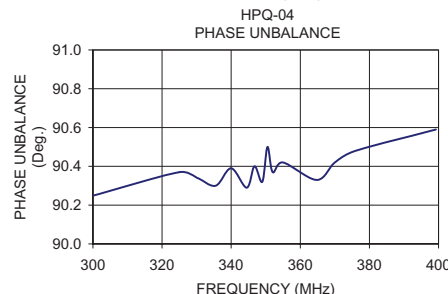
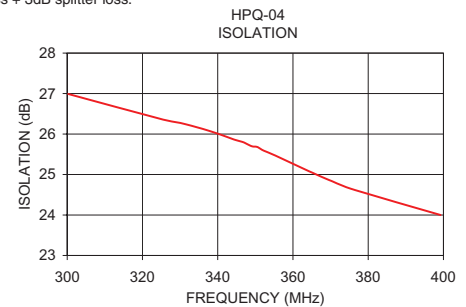
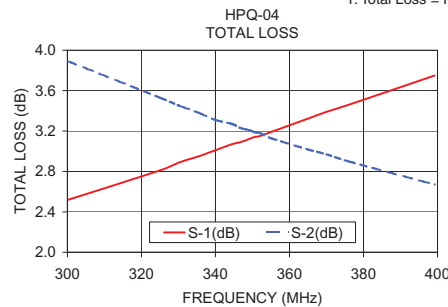
Electrical Specifications

FREQ. RANGE (MHz)	ISOLATION (dB)	INSERTION LOSS (dB) Avg. of Coupled Outputs ABOVE 3 dB	PHASE UNBALANCE (Degrees)	AMPLITUDE UNBALANCE (dB)	VSWR (:1)
f_L - f_U	Typ. Min.	Typ. Max.	Typ. Max.	Typ. Max.	S-Port Typ. Output Typ.
315-395	24 18	0.20 0.45	0.7 3.0	1.0 1.6	1.17 1.15
332-367	27 19	0.17 0.40	0.5 3.0	0.5 1.0	1.17 1.15

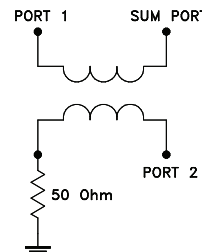
Typical Performance Data

Frequency (MHz)	Total Loss ¹ (dB)	Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
	S-1 S-2						
300.25	2.52 3.89	1.38	26.99	90.25	1.13	1.11	1.13
325.00	2.81 3.53	0.71	26.37	90.37	1.13	1.11	1.14
330.25	2.89 3.45	0.55	26.27	90.34	1.13	1.11	1.14
335.50	2.95 3.38	0.43	26.14	90.30	1.13	1.11	1.14
340.00	3.01 3.31	0.30	26.01	90.39	1.13	1.11	1.14
344.50	3.07 3.27	0.21	25.86	90.29	1.14	1.11	1.14
346.75	3.09 3.23	0.14	25.80	90.40	1.14	1.11	1.14
349.00	3.12 3.21	0.09	25.70	90.32	1.14	1.11	1.14
350.50	3.14 3.19	0.05	25.68	90.50	1.14	1.12	1.14
352.00	3.15 3.18	0.03	25.60	90.37	1.14	1.12	1.14
355.00	3.19 3.13	0.06	25.48	90.42	1.14	1.12	1.14
364.75	3.32 3.02	0.30	25.06	90.33	1.14	1.12	1.15
370.00	3.39 2.97	0.42	24.85	90.42	1.14	1.12	1.15
376.00	3.46 2.90	0.55	24.63	90.48	1.14	1.12	1.15
399.25	3.75 2.67	1.08	24.00	90.59	1.15	1.13	1.15

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



electrical schematic



For detailed performance specs & shopping online see web site

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Notes: 1. Performance and quality attributes and conditions not expressly stated in this specification sheet are intended to be excluded and do not form a part of this specification sheet. 2. Electrical specifications and performance data contained herein are based on Mini-Circuits' applicable established test performance criteria and measurement instructions. 3. The parts covered by this specification sheet 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.

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2 Way-90° Power Splitter/Combiner

HPQ-04+

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) 1-2	VSWR (:1)		
	S-1	S-2				S	1	2
150	0.82	8.35	7.54	0.67	33.33	1.02	1.02	1.02
200	1.31	6.35	5.04	0.66	32.26	1.03	1.03	1.03
250	1.87	4.97	3.10	0.64	31.88	1.05	1.05	1.05
260	1.99	4.75	2.77	0.63	31.84	1.05	1.05	1.05
270	2.11	4.54	2.43	0.61	31.76	1.05	1.05	1.05
280	2.22	4.35	2.12	0.59	31.72	1.05	1.05	1.06
290	2.34	4.16	1.82	0.59	31.65	1.06	1.06	1.06
300	2.46	3.98	1.51	0.58	31.55	1.06	1.06	1.06
310	2.60	3.82	1.22	0.58	31.44	1.06	1.06	1.07
315	2.66	3.75	1.09	0.58	31.36	1.06	1.06	1.07
320	2.72	3.67	0.95	0.57	31.30	1.06	1.06	1.07
332	2.86	3.49	0.63	0.56	31.09	1.07	1.07	1.07
340	2.96	3.38	0.42	0.56	30.97	1.07	1.07	1.07
350	3.08	3.26	0.17	0.58	30.76	1.07	1.07	1.08
360	3.21	3.13	0.08	0.55	30.53	1.07	1.08	1.08
367	3.29	3.05	0.25	0.56	30.36	1.07	1.08	1.08
380	3.46	2.91	0.55	0.55	30.01	1.08	1.08	1.09
390	3.58	2.80	0.78	0.55	29.75	1.08	1.08	1.09
395	3.64	2.75	0.89	0.54	29.59	1.08	1.08	1.09
400	3.70	2.70	1.00	0.55	29.46	1.08	1.08	1.09
410	3.83	2.61	1.22	0.54	29.15	1.08	1.09	1.09
420	3.95	2.52	1.44	0.54	28.81	1.09	1.09	1.10
430	4.08	2.44	1.64	0.52	28.48	1.09	1.09	1.10
440	4.20	2.36	1.84	0.52	28.13	1.09	1.09	1.10
450	4.32	2.29	2.04	0.52	27.80	1.09	1.09	1.11
500	4.93	1.96	2.97	0.52	26.11	1.10	1.10	1.12
550	5.52	1.71	3.81	0.47	24.54	1.10	1.11	1.13
600	6.09	1.51	4.58	0.43	23.12	1.11	1.12	1.14
650	6.64	1.35	5.29	0.40	21.84	1.11	1.13	1.14
700	7.17	1.23	5.94	0.39	20.69	1.12	1.13	1.15
750	7.67	1.12	6.55	0.28	19.65	1.12	1.14	1.16
800	8.15	1.05	7.10	0.20	18.73	1.12	1.15	1.17
850	8.61	0.99	7.62	0.07	17.88	1.13	1.15	1.17
900	9.04	0.95	8.09	0.14	17.10	1.13	1.16	1.18
950	9.44	0.92	8.52	0.40	16.38	1.14	1.17	1.19
1000	9.81	0.90	8.91	0.76	15.70	1.15	1.18	1.20

¹Total Loss = Insertion Loss + 3dB Splitter Loss

REV. X2

HPQ-04+

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2 Way-90° Power Splitter/Combiner

HPQ-04+

Typical Performance Data

TEST CONDITIONS: INPUT POWER = 0dBm @Temperature = -40°C

FREQ. (MHz)	TOTAL LOSS ¹ (dB)		AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB) 1-2	VSWR (:1)		
	S-1	S-2				S	1	2
150	0.73	8.48	7.75	0.74	36.88	1.03	1.04	1.03
200	1.20	6.45	5.25	0.84	34.69	1.05	1.05	1.05
250	1.73	5.04	3.31	0.97	33.34	1.06	1.07	1.06
260	1.85	4.81	2.96	1.01	33.03	1.06	1.07	1.06
270	1.96	4.60	2.63	1.01	32.66	1.07	1.07	1.06
280	2.08	4.39	2.31	1.03	32.27	1.07	1.07	1.07
290	2.19	4.20	2.01	1.06	31.89	1.07	1.08	1.07
300	2.31	4.02	1.71	1.09	31.51	1.07	1.08	1.07
310	2.44	3.85	1.42	1.11	31.16	1.07	1.08	1.08
315	2.50	3.78	1.28	1.14	30.98	1.08	1.08	1.08
320	2.55	3.70	1.15	1.14	30.85	1.08	1.08	1.08
332	2.70	3.52	0.82	1.16	30.47	1.08	1.08	1.08
340	2.79	3.40	0.61	1.18	30.24	1.08	1.08	1.08
350	2.91	3.27	0.36	1.22	29.89	1.08	1.09	1.09
360	3.03	3.14	0.11	1.23	29.54	1.08	1.09	1.09
367	3.11	3.06	0.06	1.26	29.29	1.08	1.09	1.09
380	3.27	2.91	0.37	1.29	28.81	1.09	1.09	1.09
390	3.39	2.80	0.59	1.31	28.45	1.09	1.09	1.10
395	3.45	2.75	0.71	1.34	28.26	1.09	1.10	1.10
400	3.51	2.70	0.82	1.36	28.08	1.09	1.10	1.10
410	3.64	2.60	1.03	1.40	27.74	1.09	1.10	1.10
420	3.75	2.51	1.25	1.42	27.41	1.09	1.10	1.11
430	3.88	2.42	1.46	1.43	27.09	1.10	1.10	1.11
440	3.99	2.34	1.65	1.45	26.78	1.10	1.10	1.11
450	4.12	2.27	1.85	1.48	26.45	1.10	1.10	1.11
500	4.71	1.92	2.79	1.63	24.90	1.10	1.11	1.13
550	5.29	1.66	3.63	1.73	23.42	1.11	1.12	1.13
600	5.85	1.45	4.40	1.84	22.21	1.12	1.13	1.14
650	6.38	1.28	5.10	1.95	21.16	1.12	1.13	1.15
700	6.90	1.14	5.76	2.08	20.12	1.12	1.14	1.16
750	7.39	1.03	6.36	2.15	19.23	1.12	1.14	1.17
800	7.86	0.94	6.92	2.22	18.37	1.12	1.15	1.17
850	8.31	0.87	7.43	2.25	17.53	1.13	1.15	1.18
900	8.73	0.82	7.91	2.23	16.80	1.14	1.16	1.18
950	9.13	0.79	8.34	2.11	16.10	1.15	1.17	1.19
1000	9.50	0.76	8.74	1.95	15.50	1.16	1.17	1.20

¹Total Loss = Insertion Loss + 3dB Splitter Loss

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2 Way-90° Power Splitter/Combiner

HPQ-04+

Typical Performance Data

TEST CONDITIONS: INPUT POWER = 0dBm @Temperature = +85°C

FREQ. (MHz)	TOTAL LOSS ¹ (dB)		AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB) 1-2	VSWR (:1)		
	S-1	S-2				S	1	2
150	0.85	8.33	7.49	0.89	32.51	1.02	1.02	1.02
200	1.35	6.35	5.00	0.85	31.75	1.03	1.03	1.03
250	1.92	4.99	3.07	0.80	31.61	1.04	1.04	1.05
260	2.04	4.77	2.73	0.79	31.58	1.05	1.05	1.05
270	2.16	4.56	2.40	0.78	31.55	1.05	1.05	1.05
280	2.28	4.37	2.09	0.76	31.55	1.05	1.05	1.06
290	2.40	4.18	1.78	0.76	31.55	1.06	1.05	1.06
300	2.52	4.01	1.49	0.74	31.56	1.06	1.05	1.06
310	2.65	3.85	1.20	0.73	31.55	1.06	1.06	1.06
315	2.71	3.77	1.05	0.73	31.54	1.06	1.06	1.07
320	2.77	3.70	0.93	0.72	31.55	1.06	1.06	1.07
332	2.92	3.52	0.60	0.70	31.46	1.07	1.06	1.07
340	3.02	3.41	0.39	0.70	31.37	1.07	1.07	1.07
350	3.14	3.29	0.14	0.69	31.19	1.07	1.07	1.08
360	3.27	3.16	0.11	0.67	30.99	1.07	1.07	1.08
367	3.36	3.09	0.28	0.68	30.82	1.07	1.07	1.08
380	3.52	2.94	0.59	0.67	30.50	1.08	1.08	1.09
390	3.65	2.84	0.81	0.65	30.23	1.08	1.08	1.09
395	3.70	2.79	0.92	0.66	30.08	1.08	1.08	1.09
400	3.77	2.74	1.03	0.67	29.95	1.08	1.08	1.09
410	3.90	2.65	1.25	0.64	29.65	1.08	1.08	1.09
420	4.02	2.56	1.47	0.63	29.31	1.09	1.09	1.10
430	4.15	2.48	1.67	0.61	28.99	1.09	1.09	1.10
440	4.27	2.40	1.87	0.62	28.65	1.09	1.09	1.10
450	4.39	2.33	2.06	0.62	28.31	1.09	1.09	1.10
500	5.00	2.00	3.00	0.60	26.49	1.10	1.10	1.12
550	5.60	1.76	3.84	0.56	24.82	1.10	1.11	1.13
600	6.17	1.56	4.60	0.50	23.33	1.11	1.12	1.14
650	6.72	1.41	5.31	0.45	21.98	1.11	1.13	1.14
700	7.25	1.29	5.96	0.42	20.80	1.11	1.14	1.15
750	7.76	1.19	6.57	0.32	19.73	1.12	1.14	1.16
800	8.23	1.12	7.11	0.19	18.77	1.12	1.15	1.17
850	8.70	1.07	7.63	0.04	17.91	1.12	1.16	1.17
900	9.13	1.03	8.10	0.20	17.11	1.13	1.17	1.18
950	9.53	1.00	8.53	0.47	16.39	1.14	1.18	1.19
1000	9.91	0.99	8.92	0.84	15.71	1.14	1.19	1.20

¹Total Loss = Insertion Loss + 3dB Splitter Loss

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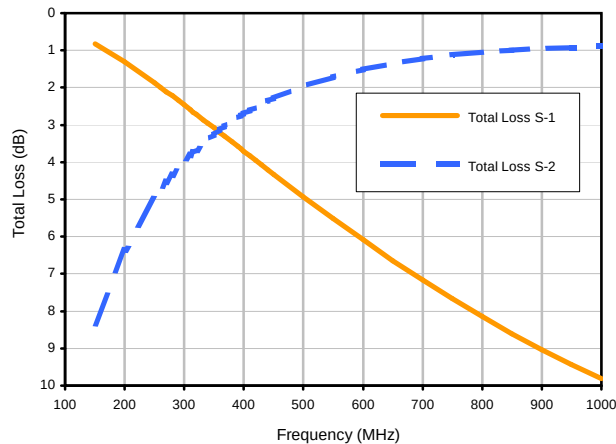


2 Way-90° Power Splitter/Combiner

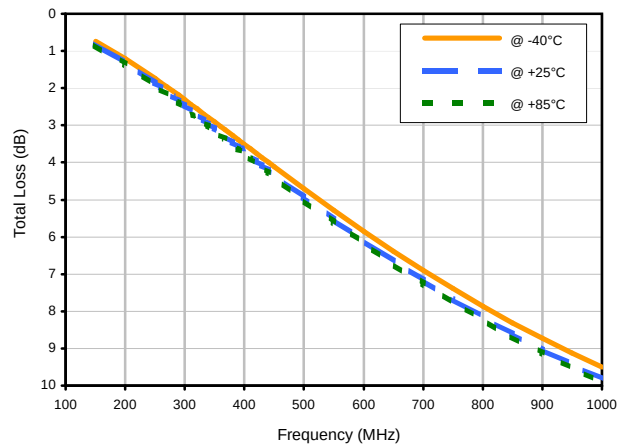
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Typical Performance Curves

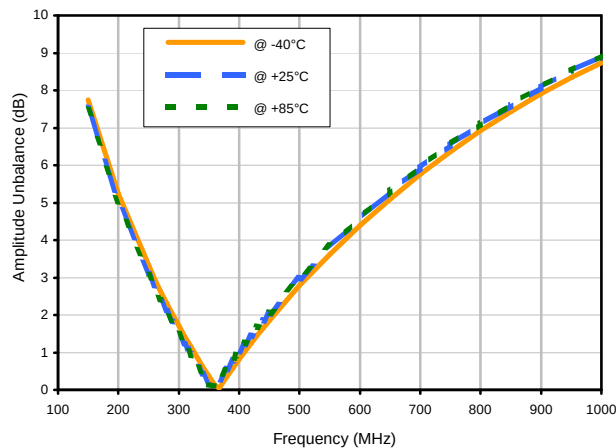
Total Loss



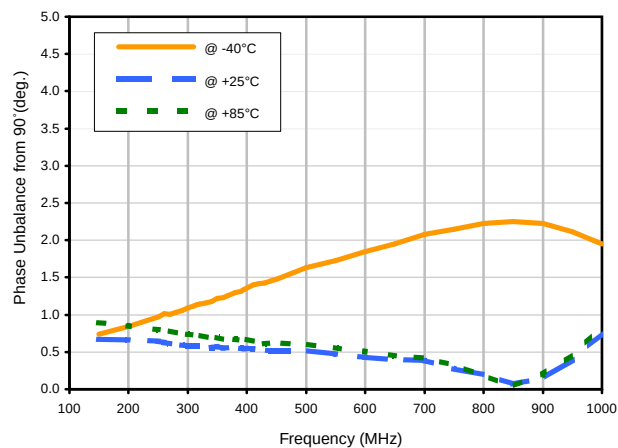
Total Loss S-1 vs. TEMPERATURE



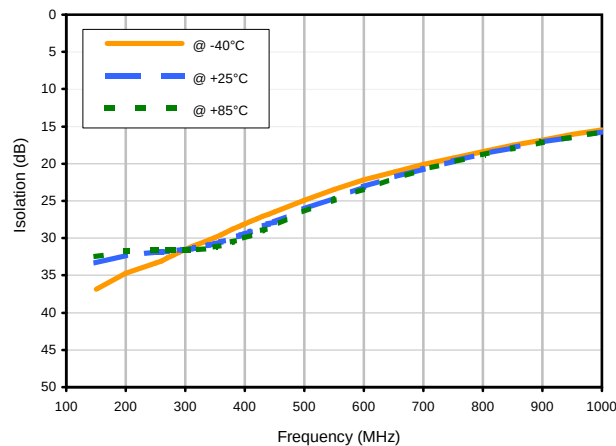
Amplitude Unbalance vs. TEMPERATURE



Phase Unbalance vs. TEMPERATURE



Isolation 1-2 vs. TEMPERATURE



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Patent Pending

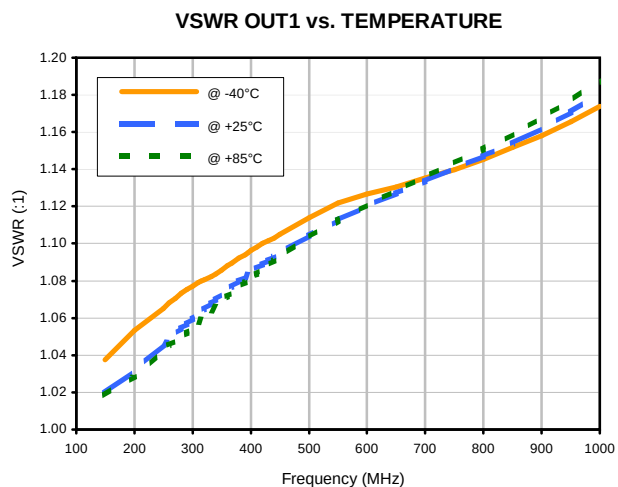
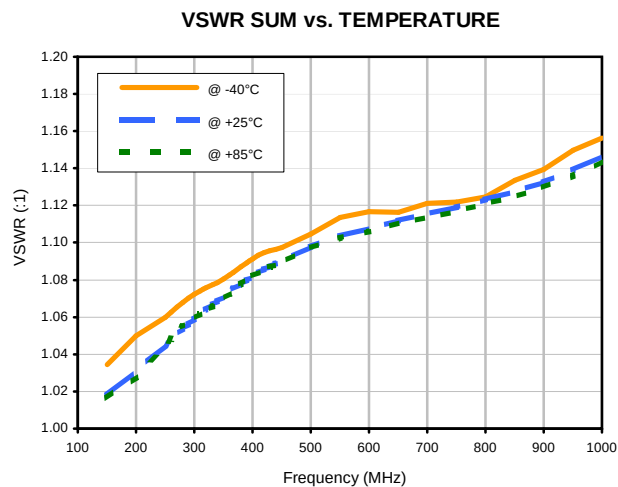
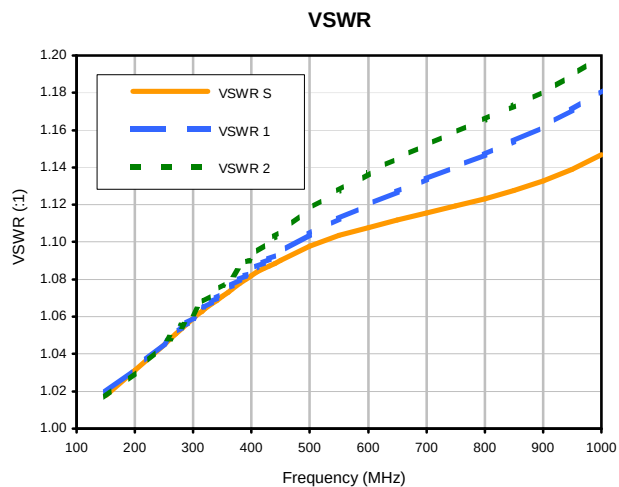
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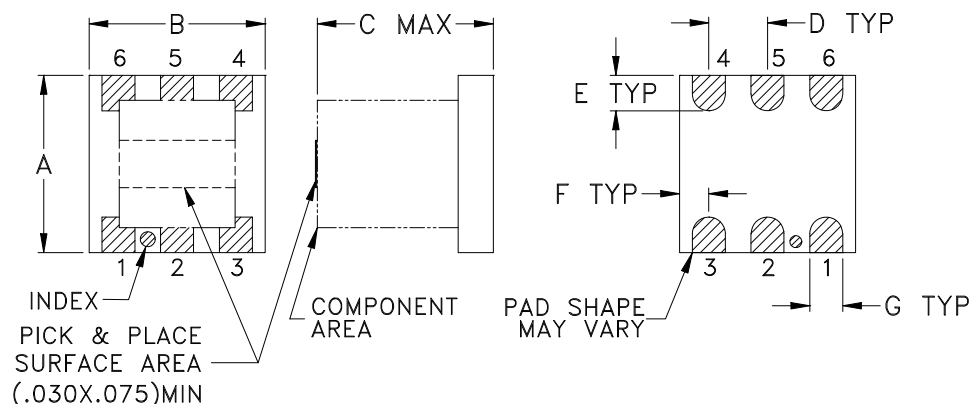
HPQ-04+

Typical Performance Curves

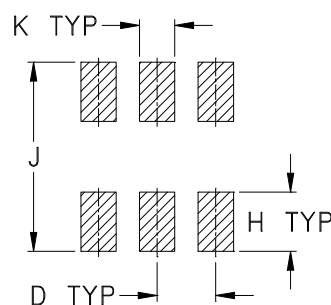


Outline Dimensions

AT577



PCB Land Pattern



Suggested Layout,
Tolerance to be within $\pm .002$

CASE #	A	B	C	D	E	F	G	H	J	K	L	WT. GRAMS
AT577	.200 (5.08)	.200 (5.08)	.200 (5.08)	.075 (1.91)	.050 (1.27)	.025 (0.64)	.026 (0.66)	.070 (1.78)	.220 (5.59)	.035 (0.89)	-- --	.15

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

Notes:

- Open style, ceramic base.
- Termination finish:
For RoHS Case Style: 2-10 μ inch (.05-.25 microns) Gold over 100-300 μ inch (2.54-7.62 microns) Nickel plate.
For RoHS-5 Case Style: Tin-Lead plate



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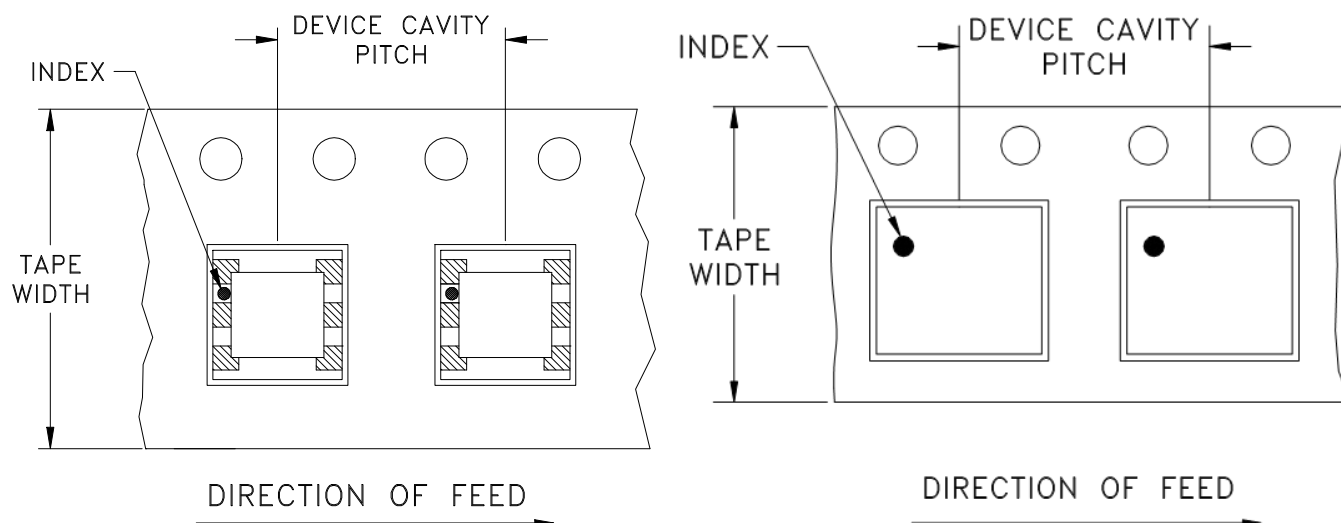


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

RF/IF MICROWAVE COMPONENTS

Tape & Reel Packaging TR-F73

DEVICE ORIENTATION IN T&R



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

Note: Please Consult individual model data sheet to determine device per reel availability.

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



INTERNET <http://www.minicircuits.com>

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REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M83147	NEW RELEASE	11/26/02	MMG	HY
A	M102713	ADDED "...WITH SMOBC"	01/17/06	MMG	IL

.065 TYP

.025 TYP

.066 TRACE WIDTH, 4 PL.
(SEE NOTE BELOW)

.032 TYP

.118
2 PL.

.040

.025 TYP

13X Ø.015 PTH
FOR GROUND

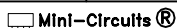
PIN1

PACKAGE
OUTLINE

6X .038

	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 TOLERANCES ON: 2 PL DECIMALS ± 3 PL DECIMALS ± .005 ANGLES ± FRACTIONS ±	DRAWN	MMG	11/19/02
	CHECKED	AV	11/25/02
	APPROVED	HY	11/26/02



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



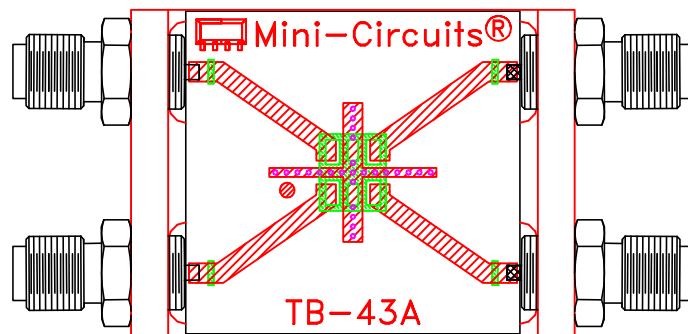
Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

PL, km, AT577, HPQ, TB-43

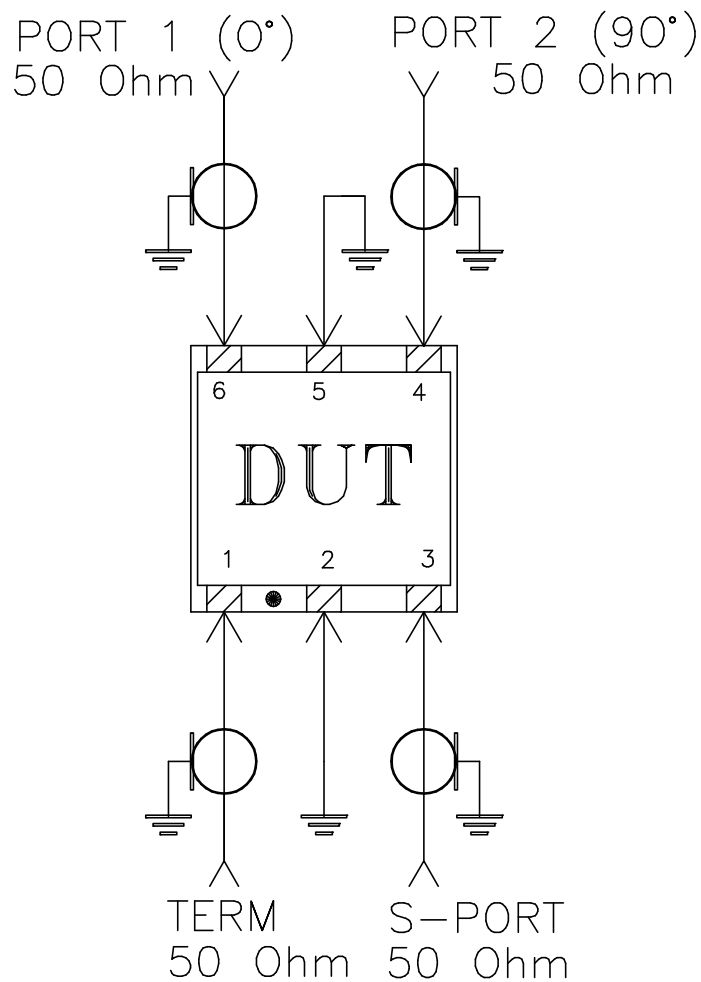
SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-114	REV: A
FILE:	98PL114	SCALE: 10:1	SHEET: 1 OF 1

Evaluation Board and Circuit

For Pin Connection refer to Data Sheet of the DUT



TB-43



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,
Dielectric Constant=3.5, Thickness=.030 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 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