

# Surface Mount Power Splitter/Combiner

## JSPQ-350+ JSPQ-350

2 Way-90° 50Ω 150 to 350 MHz



Generic photo used for illustration purposes only

CASE STYLE: BK276

**+RoHS Compliant**

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

### Maximum Ratings

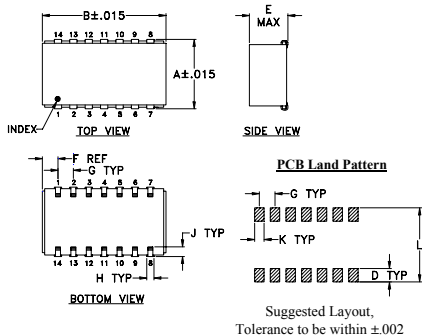
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W max.

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

### Pin Connections

SUM PORT	1
PORT 1 (0°)	3
PORT 2 (+90°)	12
GROUND	5,7,8,10
50 OHM TERM. EXTERNAL	14
NOT USED	2,4,6,9,11,13

### Outline Drawing



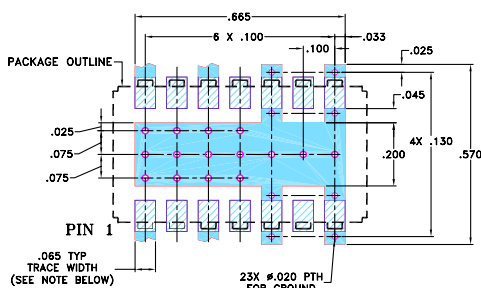
### Outline Dimensions (inch/mm)

A	B	C	D	E	F	G
.450	.803	--	.100	.250	.102	.100
11.43	20.40	--	2.54	6.35	2.59	2.54

H	J	K	L	wt
.047	.065	.065	.470	grams
1.19	1.65	1.65	11.94	3.0

### Demo Board MCL P/N: TB-59 Suggested PCB Layout (PL-061)



- 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.
- 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

### 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-Circuit's 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-Circuit's website at [www.minicircuits.com/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)

### Features

- wideband, 150 to 350 MHz
- low insertion loss, 0.5 dB typ.
- good isolation, 20 dB typ.
- aqueous washable

### Applications

- VHF-TV
- IF signal processing
- modulators

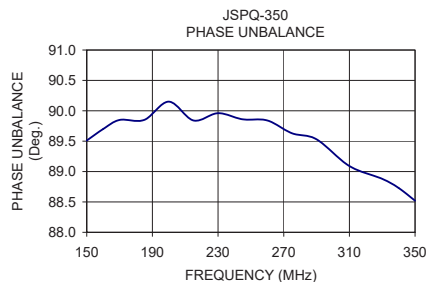
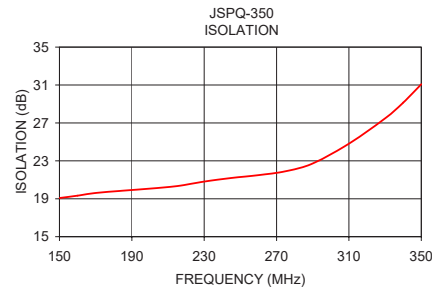
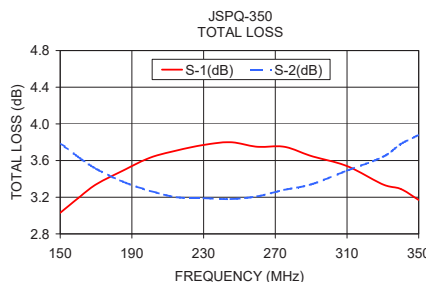
### Electrical Specifications

FREQ. RANGE (MHz)	ISOLATION (dB)		INSERTION LOSS (dB) Avg. of Coupled Outputs ABOVE 3 dB		PHASE UNBALANCE (Degrees)	AMPLITUDE UNBALANCE (dB)
	Typ.	Min.	Typ.	Max.	Max.	Max.
$f_L$ - $f_U$						
150-350	20	13	0.5	1.0	5	1.5

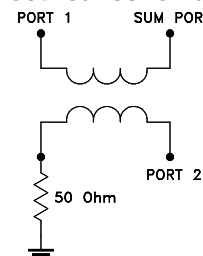
### Typical Performance Data

Frequency (MHz)	Total Loss <sup>1</sup> (dB)		Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
	S-1	S-2						
150.00	3.03	3.79	0.76	19.08	89.51	1.22	1.19	1.19
160.00	3.19	3.64	0.45	19.33	89.70	1.24	1.20	1.20
170.00	3.34	3.51	0.17	19.61	89.85	1.24	1.20	1.21
185.00	3.49	3.37	0.12	19.85	89.85	1.24	1.21	1.22
200.00	3.63	3.27	0.36	20.07	90.15	1.26	1.22	1.22
215.00	3.71	3.20	0.50	20.34	89.84	1.24	1.23	1.23
230.00	3.77	3.19	0.58	20.81	89.96	1.27	1.24	1.23
245.00	3.80	3.18	0.61	21.19	89.86	1.25	1.25	1.23
260.00	3.75	3.21	0.54	21.49	89.84	1.26	1.25	1.22
275.00	3.75	3.28	0.47	21.90	89.63	1.24	1.25	1.22
290.00	3.65	3.34	0.31	22.73	89.53	1.24	1.24	1.22
310.00	3.54	3.49	0.05	24.81	89.09	1.22	1.22	1.20
330.00	3.34	3.64	0.30	27.48	88.88	1.20	1.21	1.18
340.00	3.29	3.78	0.49	29.15	88.73	1.19	1.19	1.17
350.00	3.17	3.88	0.72	31.08	88.52	1.16	1.18	1.17

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



### electrical schematic



# 2 Way-90° Power Splitter/Combiner

# JSPQ-350+

## Typical Performance Data

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

FREQ. (MHz)	TOTAL LOSS <sup>1</sup> (dB)		AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB) 1-2	VSWR (:1)		
	S-1	S-2				S	1	2
50	0.77	9.20	8.43	1.70	18.62	1.18	1.17	1.19
60	1.01	8.01	7.01	1.77	17.88	1.19	1.19	1.21
70	1.24	7.09	5.84	1.79	17.49	1.21	1.20	1.23
80	1.49	6.34	4.85	1.68	17.34	1.21	1.21	1.23
90	1.72	5.75	4.03	1.54	17.40	1.21	1.21	1.24
100	1.94	5.26	3.32	1.36	17.61	1.21	1.20	1.23
110	2.16	4.85	2.69	1.16	17.98	1.20	1.20	1.23
120	2.35	4.51	2.15	0.92	18.44	1.20	1.19	1.22
130	2.54	4.22	1.68	0.68	19.01	1.19	1.18	1.21
140	2.71	3.98	1.27	0.46	19.67	1.18	1.18	1.21
150	2.86	3.78	0.92	0.24	20.40	1.17	1.17	1.20
160	3.01	3.61	0.61	0.03	21.21	1.16	1.17	1.19
170	3.13	3.47	0.34	0.16	22.02	1.15	1.16	1.18
180	3.24	3.36	0.12	0.33	22.88	1.14	1.16	1.18
190	3.34	3.28	0.07	0.45	23.72	1.14	1.16	1.17
200	3.41	3.20	0.21	0.58	24.48	1.14	1.16	1.17
210	3.48	3.15	0.33	0.70	25.15	1.13	1.17	1.17
220	3.53	3.11	0.42	0.79	25.64	1.13	1.17	1.17
230	3.57	3.09	0.48	0.82	25.97	1.13	1.17	1.17
240	3.59	3.08	0.51	0.88	26.16	1.13	1.18	1.17
250	3.60	3.09	0.51	0.89	26.22	1.13	1.18	1.17
260	3.60	3.11	0.49	0.89	26.22	1.14	1.19	1.17
270	3.58	3.14	0.44	0.91	26.19	1.14	1.19	1.16
280	3.55	3.17	0.38	0.88	26.20	1.14	1.19	1.16
290	3.51	3.22	0.29	0.86	26.28	1.14	1.20	1.16
300	3.46	3.28	0.19	0.82	26.47	1.14	1.20	1.16
310	3.41	3.35	0.06	0.78	26.81	1.14	1.20	1.15
320	3.35	3.43	0.08	0.72	27.30	1.14	1.19	1.15
330	3.27	3.51	0.23	0.66	27.98	1.14	1.19	1.14
340	3.19	3.60	0.41	0.59	28.96	1.13	1.18	1.13
350	3.10	3.70	0.60	0.53	30.35	1.12	1.18	1.12
360	3.01	3.81	0.80	0.46	32.31	1.12	1.17	1.12
370	2.92	3.94	1.02	0.35	35.13	1.10	1.15	1.11
380	2.82	4.08	1.26	0.24	39.55	1.09	1.14	1.11
390	2.72	4.22	1.51	0.17	42.05	1.07	1.12	1.12
400	2.62	4.39	1.77	0.11	36.71	1.05	1.10	1.13
425	2.37	4.87	2.50	0.04	27.29	1.02	1.08	1.22
450	2.13	5.47	3.34	0.04	22.19	1.11	1.13	1.37
475	1.96	6.26	4.30	0.63	18.78	1.25	1.26	1.59
500	1.88	7.25	5.37	2.11	16.36	1.46	1.47	1.92
525	1.94	8.47	6.53	5.07	14.67	1.75	1.77	2.37

<sup>1</sup>Total Loss = Insertion Loss + 3dB Splitter Loss



# 2 Way-90° Power Splitter/Combiner

# JSPQ-350+

## Typical Performance Data

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

FREQ. (MHz)	TOTAL LOSS <sup>1</sup> (dB)		AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB) 1-2	VSWR (:1)		
	S-1	S-2				S	1	2
50	0.74	9.20	8.46	1.76	18.61	1.18	1.18	1.19
60	0.98	8.00	7.02	1.85	17.86	1.20	1.19	1.21
70	1.21	7.08	5.86	1.89	17.46	1.21	1.20	1.22
80	1.45	6.33	4.88	1.80	17.31	1.21	1.21	1.23
90	1.68	5.73	4.05	1.67	17.37	1.21	1.21	1.23
100	1.90	5.23	3.33	1.50	17.58	1.21	1.20	1.24
110	2.11	4.82	2.71	1.31	17.94	1.20	1.20	1.24
120	2.31	4.48	2.17	1.09	18.39	1.19	1.19	1.23
130	2.49	4.19	1.70	0.87	18.94	1.19	1.18	1.22
140	2.66	3.95	1.29	0.65	19.58	1.18	1.18	1.21
150	2.81	3.74	0.93	0.48	20.27	1.17	1.17	1.20
160	2.96	3.57	0.62	0.29	21.03	1.16	1.17	1.20
170	3.08	3.43	0.35	0.13	21.79	1.16	1.17	1.19
180	3.19	3.32	0.13	0.01	22.58	1.15	1.17	1.19
190	3.28	3.23	0.05	0.12	23.36	1.15	1.17	1.19
200	3.36	3.15	0.21	0.23	24.07	1.15	1.17	1.18
210	3.43	3.10	0.33	0.33	24.69	1.14	1.17	1.18
220	3.47	3.07	0.41	0.38	25.17	1.14	1.17	1.18
230	3.51	3.04	0.47	0.41	25.53	1.14	1.18	1.18
240	3.53	3.03	0.50	0.42	25.77	1.14	1.18	1.18
250	3.53	3.03	0.50	0.43	25.89	1.14	1.18	1.17
260	3.53	3.05	0.48	0.40	25.96	1.14	1.18	1.17
270	3.51	3.08	0.43	0.40	26.01	1.14	1.19	1.17
280	3.48	3.10	0.38	0.36	26.09	1.14	1.19	1.17
290	3.44	3.14	0.30	0.32	26.24	1.14	1.19	1.17
300	3.39	3.21	0.19	0.28	26.46	1.14	1.19	1.16
310	3.34	3.27	0.06	0.22	26.84	1.14	1.19	1.16
320	3.27	3.34	0.07	0.13	27.36	1.13	1.18	1.15
330	3.19	3.43	0.23	0.06	28.07	1.13	1.18	1.14
340	3.11	3.51	0.40	0.04	29.07	1.12	1.17	1.13
350	3.02	3.61	0.59	0.13	30.49	1.12	1.17	1.12
360	2.93	3.72	0.79	0.22	32.52	1.11	1.16	1.12
370	2.84	3.85	1.01	0.34	35.50	1.10	1.14	1.11
380	2.74	3.98	1.24	0.47	40.70	1.08	1.13	1.11
390	2.64	4.12	1.49	0.57	45.44	1.06	1.12	1.11
400	2.53	4.28	1.75	0.65	37.87	1.04	1.10	1.13
425	2.28	4.75	2.47	0.85	27.59	1.02	1.07	1.22
450	2.04	5.36	3.31	0.83	22.37	1.12	1.13	1.37
475	1.86	6.13	4.27	0.34	18.90	1.25	1.26	1.59
500	1.77	7.10	5.33	1.06	16.45	1.46	1.46	1.92
525	1.81	8.30	6.50	3.90	14.73	1.74	1.76	2.38

<sup>1</sup>Total Loss = Insertion Loss + 3dB Splitter Loss



# 2 Way-90° Power Splitter/Combiner

# JSPQ-350+

## Typical Performance Data

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

FREQ. (MHz)	TOTAL LOSS <sup>1</sup> (dB)		AMP. UNBAL. (dB)	PHASE UNBAL. From 90° (deg.)	ISOLATION (dB) 1-2	VSWR (:1)		
	S-1	S-2				S	1	2
50	0.78	9.21	8.43	1.69	18.69	1.17	1.17	1.19
60	1.02	8.02	7.00	1.77	17.95	1.19	1.19	1.22
70	1.26	7.10	5.84	1.80	17.56	1.20	1.20	1.23
80	1.50	6.36	4.86	1.70	17.40	1.21	1.21	1.24
90	1.74	5.77	4.03	1.54	17.45	1.21	1.21	1.24
100	1.96	5.28	3.32	1.36	17.66	1.21	1.20	1.23
110	2.18	4.87	2.69	1.18	18.02	1.20	1.20	1.22
120	2.38	4.54	2.16	0.95	18.48	1.19	1.19	1.21
130	2.56	4.26	1.70	0.73	19.04	1.19	1.19	1.21
140	2.73	4.02	1.29	0.47	19.71	1.18	1.18	1.20
150	2.88	3.82	0.94	0.26	20.45	1.17	1.17	1.19
160	3.03	3.65	0.63	0.05	21.27	1.16	1.16	1.19
170	3.15	3.52	0.37	0.15	22.11	1.15	1.16	1.18
180	3.26	3.41	0.15	0.33	22.99	1.14	1.16	1.17
190	3.35	3.33	0.03	0.48	23.86	1.13	1.16	1.17
200	3.43	3.25	0.18	0.61	24.66	1.13	1.16	1.16
210	3.50	3.20	0.30	0.73	25.35	1.13	1.16	1.16
220	3.54	3.17	0.37	0.83	25.87	1.13	1.17	1.16
230	3.58	3.16	0.42	0.87	26.22	1.13	1.17	1.16
240	3.61	3.15	0.46	0.92	26.41	1.13	1.18	1.16
250	3.61	3.16	0.45	0.96	26.47	1.13	1.18	1.16
260	3.61	3.18	0.43	0.95	26.46	1.14	1.19	1.16
270	3.60	3.22	0.38	0.97	26.43	1.14	1.19	1.16
280	3.57	3.25	0.32	0.96	26.44	1.14	1.20	1.16
290	3.53	3.30	0.23	0.93	26.53	1.14	1.20	1.16
300	3.48	3.37	0.12	0.91	26.72	1.15	1.20	1.16
310	3.43	3.44	0.01	0.88	27.09	1.15	1.20	1.15
320	3.37	3.52	0.15	0.82	27.60	1.14	1.20	1.15
330	3.29	3.61	0.31	0.78	28.33	1.14	1.19	1.14
340	3.22	3.70	0.49	0.69	29.37	1.13	1.19	1.13
350	3.13	3.81	0.68	0.64	30.87	1.13	1.18	1.13
360	3.04	3.92	0.89	0.58	33.03	1.12	1.17	1.12
370	2.94	4.06	1.11	0.48	36.27	1.10	1.16	1.12
380	2.85	4.20	1.35	0.37	41.68	1.09	1.14	1.12
390	2.75	4.35	1.60	0.30	42.91	1.07	1.13	1.13
400	2.65	4.52	1.87	0.25	36.19	1.05	1.11	1.15
425	2.40	5.01	2.61	0.10	26.96	1.02	1.08	1.23
450	2.17	5.65	3.47	0.25	22.01	1.12	1.14	1.39
475	2.02	6.46	4.44	0.90	18.69	1.27	1.28	1.61
500	1.95	7.49	5.54	2.51	16.33	1.48	1.50	1.94
525	2.03	8.75	6.72	5.70	14.71	1.78	1.81	2.40

<sup>1</sup>Total Loss = Insertion Loss + 3dB Splitter Loss

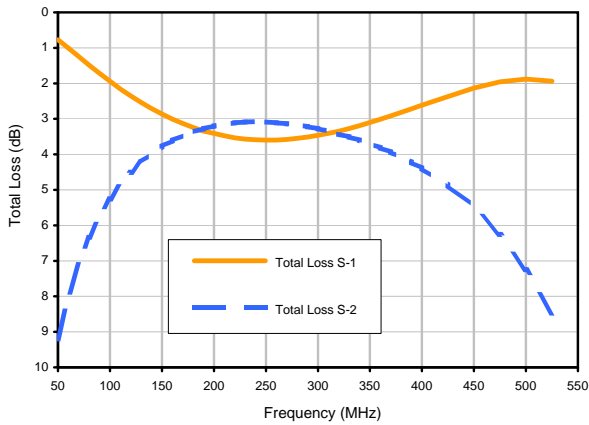


# 2 Way-90° Power Splitter/Combiner

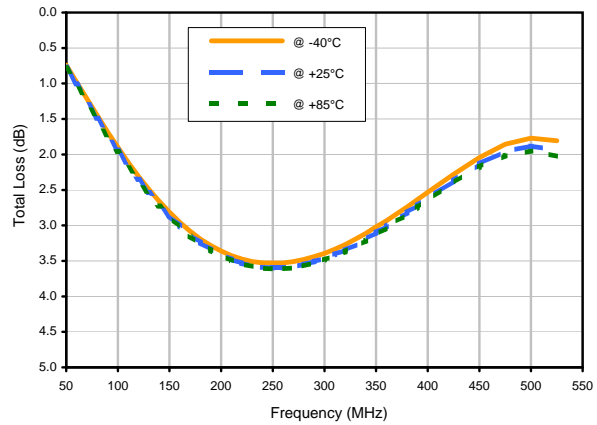
# JSPQ-350+

## Typical Performance Curves

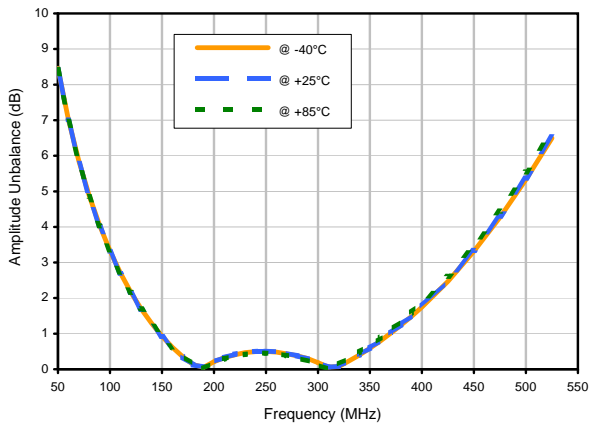
**Total Loss**



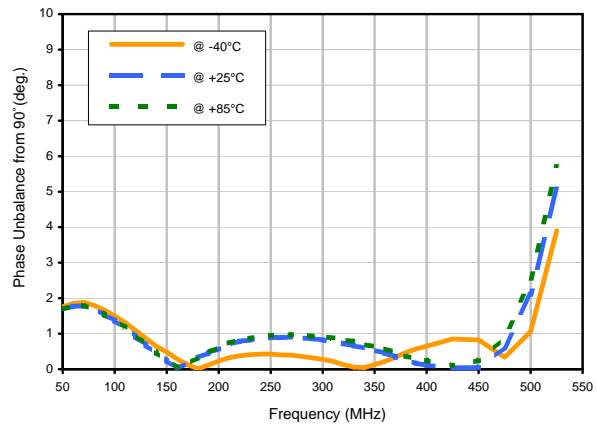
**Total Loss S-1 vs. TEMPERATURE**



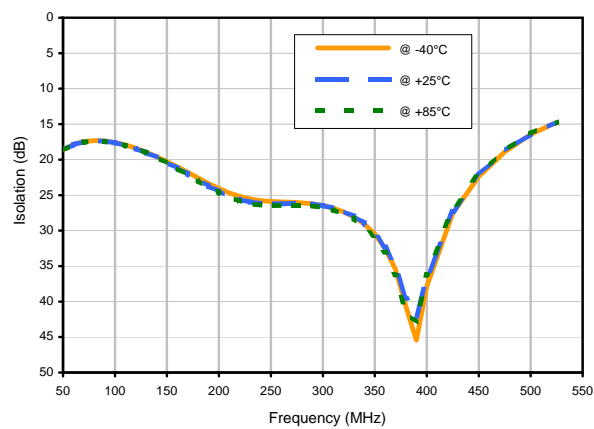
**Amplitude Unbalance vs. TEMPERATURE**



**Phase Unbalance vs. TEMPERATURE**



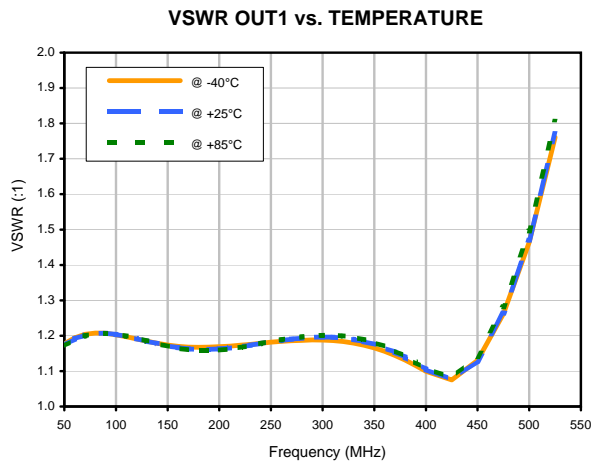
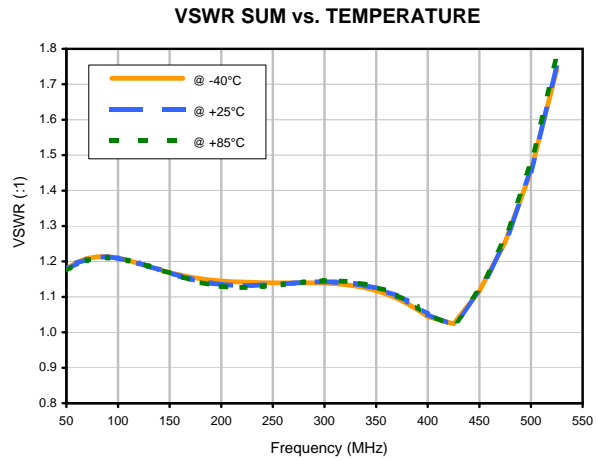
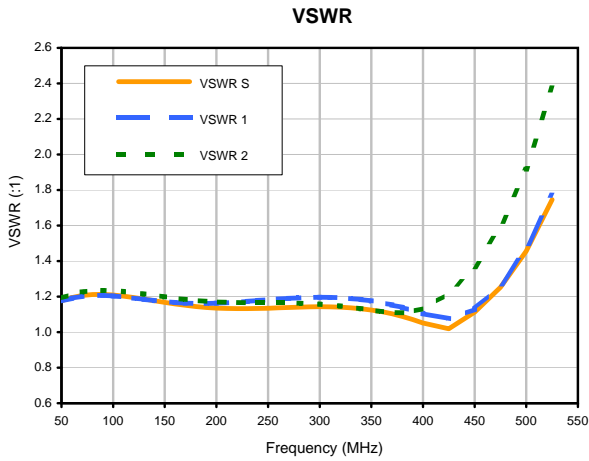
**Isolation 1-2 vs. TEMPERATURE**



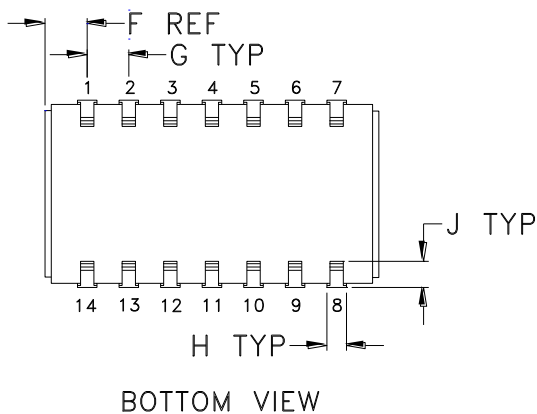
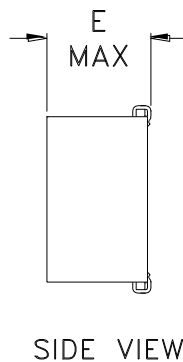
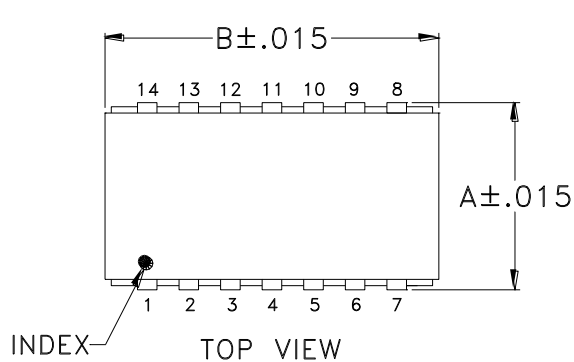
# 2 Way-90° Power Splitter/Combiner

# JSPQ-350+

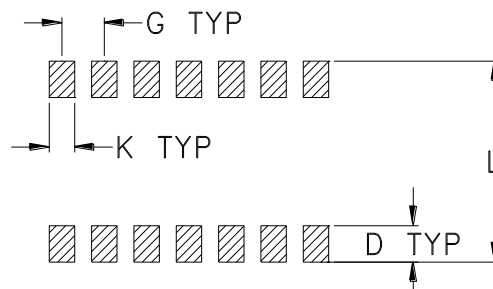
## Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



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

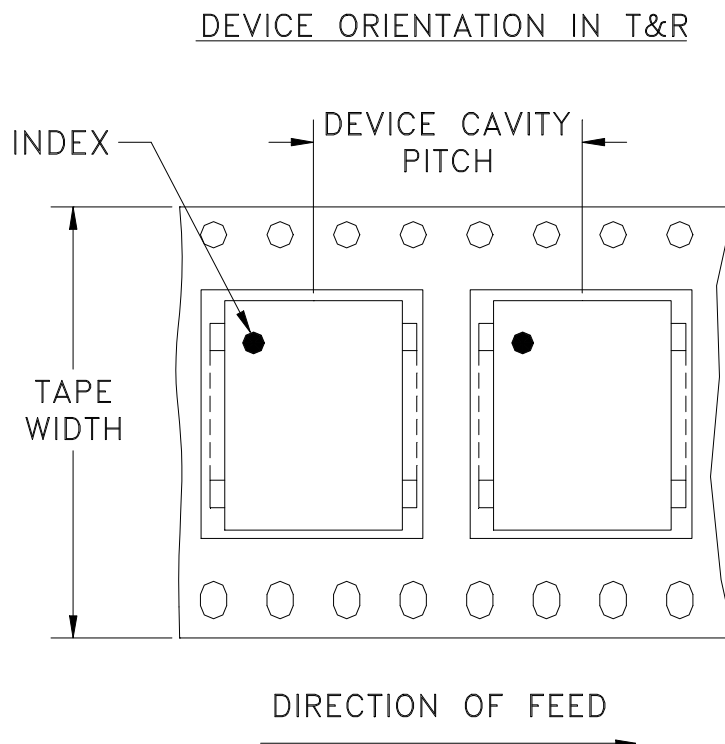
CASE #	A	B	C	D	E	F	G	H	J	K	L	WT. GRAM
BK276	.450 (11.43)	.803 (20.40)	-- --	.100 (2.54)	.250 (6.35)	.102 (2.59)	.100 (2.54)	.047 (1.19)	.065 (1.65)	.065 (1.65)	.470 (11.94)	2.0 MAX.

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

#### Notes:

- Case material: Copper Nickel alloy.
- Base material: Printed wiring laminate.
- 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.

# Tape & Reel Packaging TR-F5



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel
32	16	13	500

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](http://www.minicircuits.com/pages/pdfs/tape.pdf)



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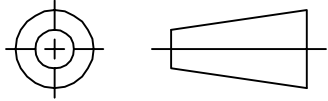
Mini-Circuits ISO 9001 & ISO 14001 Certified

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

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661



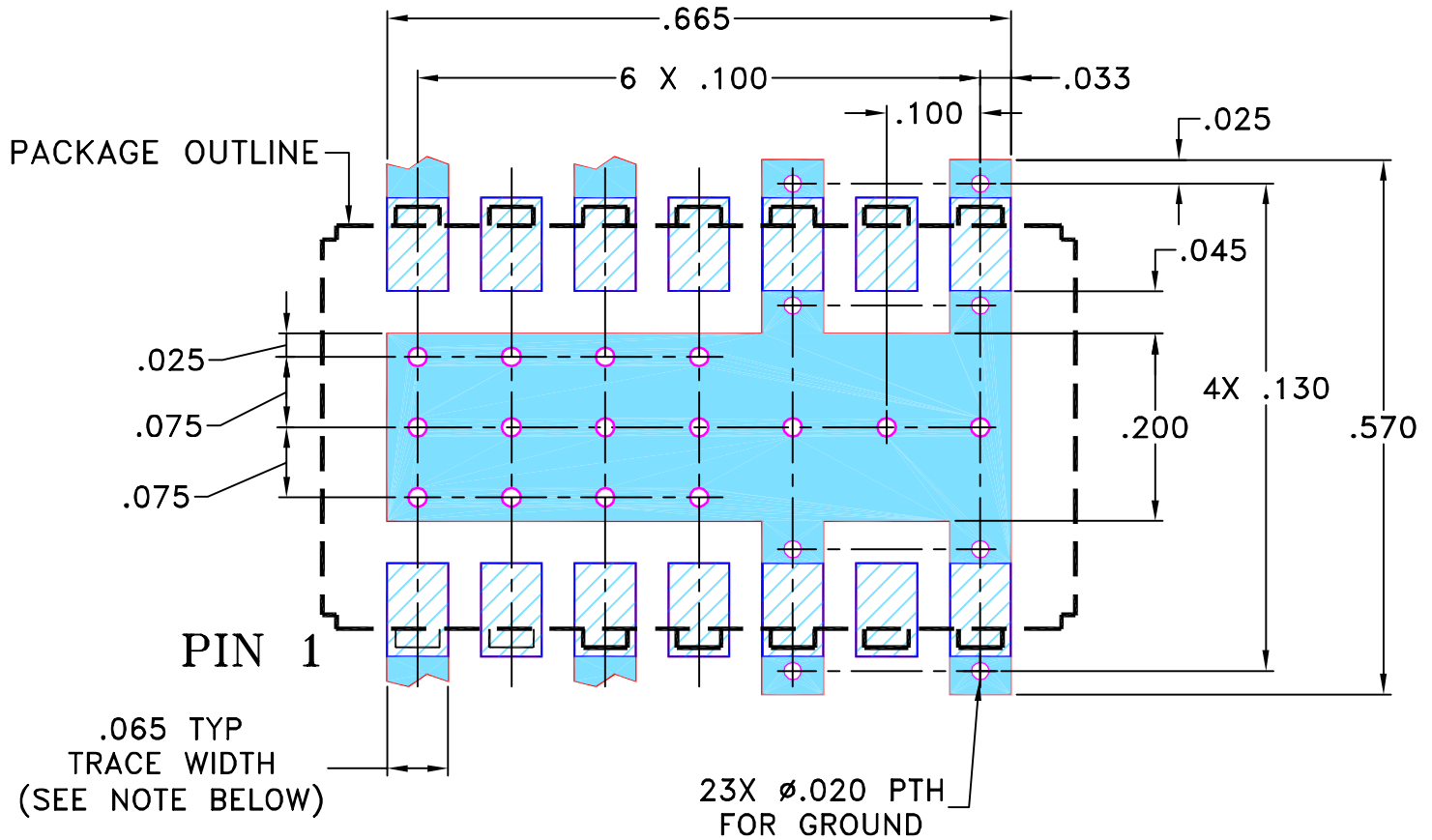
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M82272	NEW RELEASE	08/05/02	MMG	DJ
A	M102713	MODIFIED PATTERN, UPDATED DIM, NOTES, ADDED "...WITH SMOBC"	01/16/06	GT	IL

SUGGESTED MOUNTING CONFIGURATION  
FOR BK276 CASE STYLE, "lu" PIN CONNECTION



NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B 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.

- 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 07/18/02
	CHECKED	HY 08/01/02
	APPROVED	DJ 08/05/02

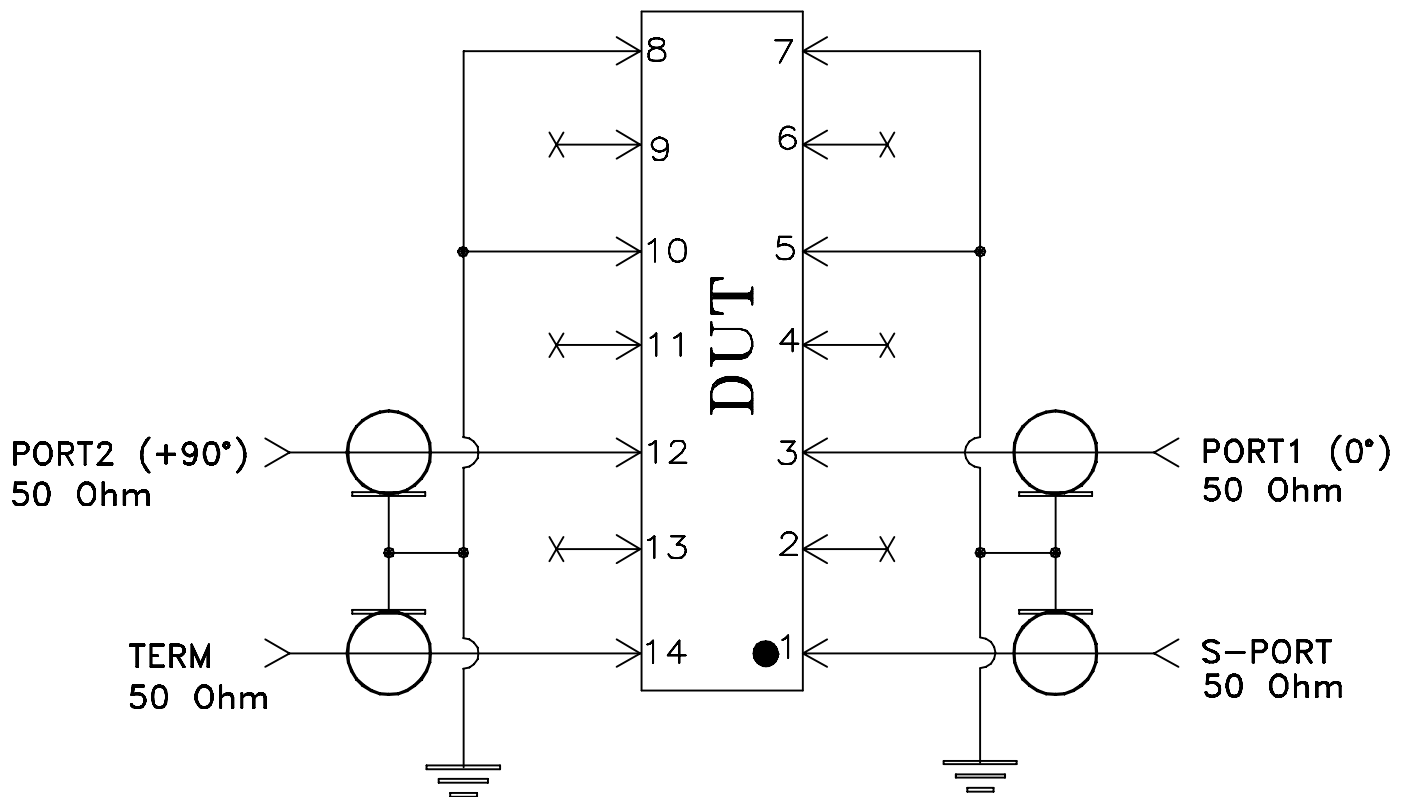
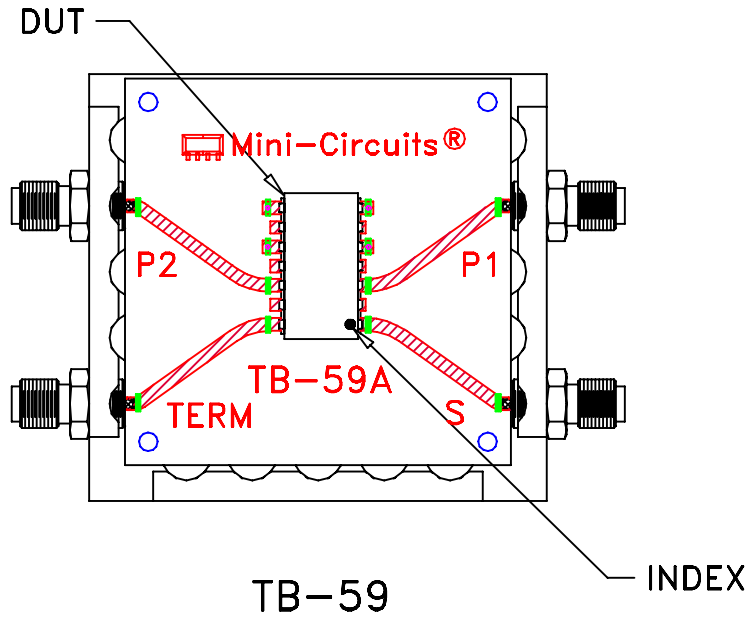
**Mini-Circuits<sup>®</sup>** 13 Neptune Avenue  
 Brooklyn NY 11235

PL, lu, BK276, JSPQ, TB-59

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SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-061	A
FILE:	98PL061	SCALE:	SHEET:
		5:1	1 OF 1


# Evaluation Board and Circuit



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