High IP3

Frequency Mixer

SYM-14H+

Level 17 (LO Power +17 dBm) 100 to 1370 MHz

Generic photo used for illustration purposes only

CASE STYLE: TTT167

+RoHS Compliant

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

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	10, 20, 50, 100, 200
13"	500

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	200mW
IF Current	40mA

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

Pin Connections

LO	2
RF	1
IF	3
GROUND	4,5,6

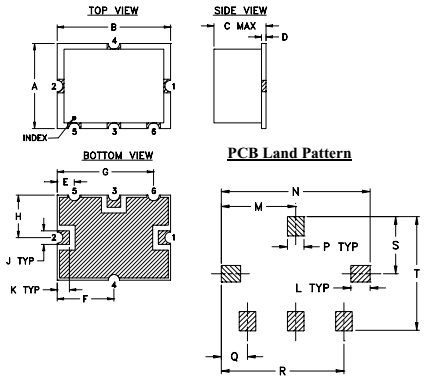
Features

- wide bandwidth, 100 to 1370 MHz
- low conversion loss, 6.5 dB typ.
- high IP3, 30 dBm typ.
- excellent match LO VSWR, 1.25:1 typ.; RF VSWR, 1.6:1 typ.
- good L-R isolation, 36 dB typ.

Applications

- cellular
- UHF TV
- ISM

Outline Drawing



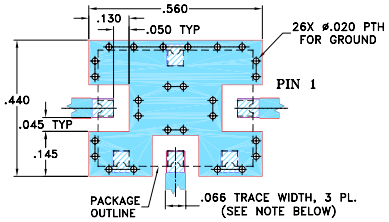
Suggested Layout,
Tolerance to be within ±.002

Outline Dimensions (inch / mm)

A	B	C	D	E	F	G	H	J	K
.38	.50	.23	.020	.075	.250	.425	.187	.050	.050
9.65	12.70	5.84	0.51	1.91	6.35	10.80	4.75	1.27	1.27

L	M	N	P	Q	R	S	T	wt.
.070	.270	.540	.060	.095	.445	.208	.415	grams
1.78	6.86	13.72	1.52	2.41	11.30	5.28	10.54	0.8

Demo Board MCL P/N: TB-12
Suggested PCB Layout (PL-079)



NOTE:

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. THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES TO EXPOSE METAL UNDER THE ENTIRE UNIT GROUND PAD FOR IMPROVED GROUNDING, IT IS RECOMMENDED A SOLDER MASK DAM BE APPLIED AROUND EACH GROUND PAD TO ENSURE FILLET AND CONNECTION AT GROUND PADS.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER), SEE NOTE 2.

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Electrical Specifications

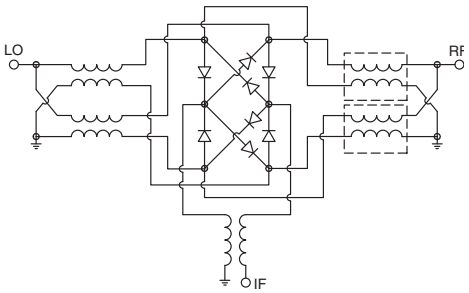
FREQUENCY (MHz) LO/RF f_L-f_U	IF	CONVERSION LOSS (dB) Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO-RF ISOLATION (dB) Typ.	Min.	LO-IF ISOLATION (dB) Typ.	Min.	IP3 at center band (dBm) Typ.
100-1370	10-1000	6.5	.20	7.4	8.9	36	28	30	24	30

1 dB COMP.: +14 dBm typ.
m=mid band ($2f_L$ to $f_U/2$)

Typical Performance Data

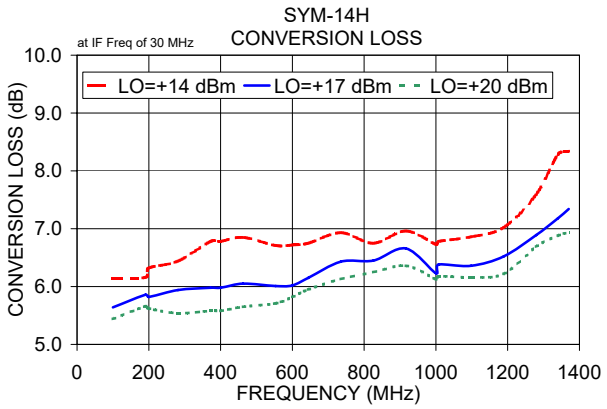
Frequency (MHz) RF	LO	Conversion Loss (dB) LO +17dBm	Isolation L-R (dB) LO +17dBm	Isolation L-I (dB) LO +17dBm	VSWR RF Port (:1) LO +17dBm	VSWR LO Port (:1) LO +17dBm
100.00	130.00	5.64	40.30	44.40	1.21	1.64
190.71	220.71	5.86	38.80	40.50	1.33	1.63
200.00	230.00	5.82	38.70	39.70	1.32	1.66
281.42	311.42	5.94	37.70	36.90	1.39	1.62
372.14	402.14	5.98	37.30	34.70	1.51	1.52
400.00	430.00	5.98	36.80	33.90	1.51	1.53
462.85	492.85	6.05	36.50	33.60	1.59	1.44
553.57	583.57	6.01	36.20	31.50	1.76	1.34
600.00	630.00	6.02	36.50	31.30	1.85	1.29
644.28	674.28	6.15	36.20	29.80	1.89	1.28
735.00	765.00	6.43	36.60	29.60	1.96	1.23
825.71	855.71	6.45	36.00	29.70	1.99	1.18
916.42	946.42	6.66	36.00	30.50	2.08	1.12
1000.00	1030.00	6.23	36.50	30.60	2.06	1.09
1007.14	1037.14	6.38	36.60	30.70	2.03	1.08
1097.85	1127.85	6.36	40.50	31.20	2.06	1.07
1188.57	1218.57	6.52	43.10	32.50	1.94	1.08
1279.28	1309.28	6.89	41.80	34.80	2.06	1.12
1340.00	1370.00	7.18	42.30	38.20	2.06	1.18
1370.00	1400.00	7.34	42.10	39.80	2.10	1.18

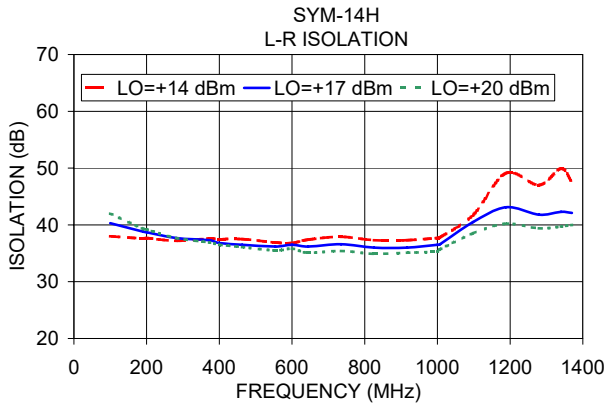
Electrical Schematic

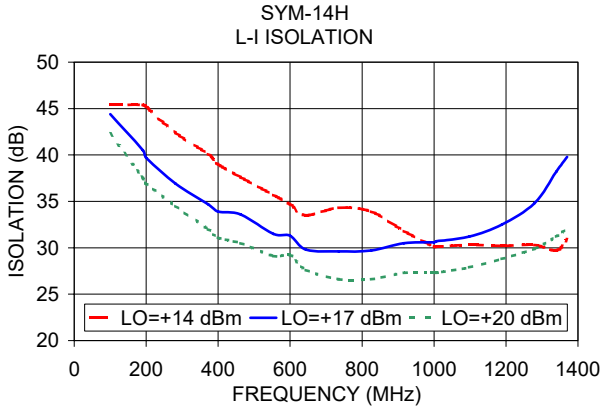


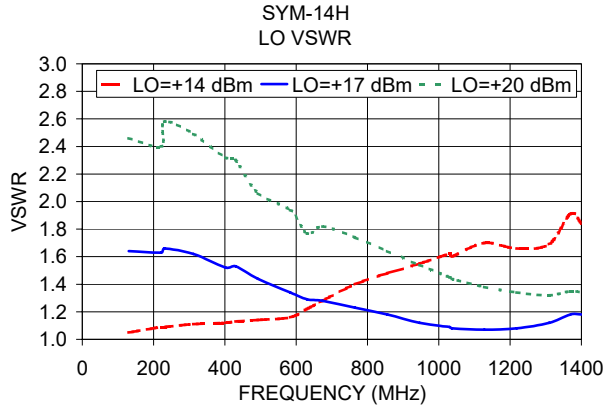
Notes

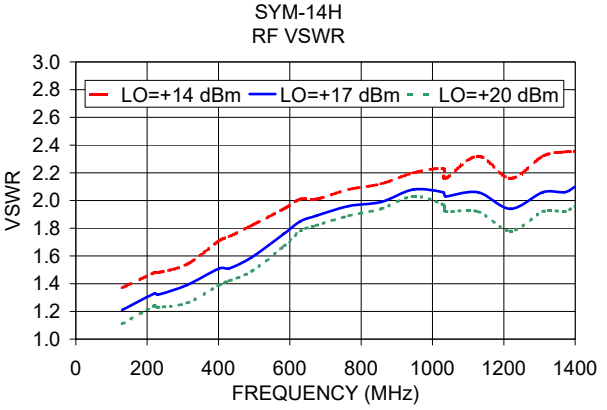
A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's 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

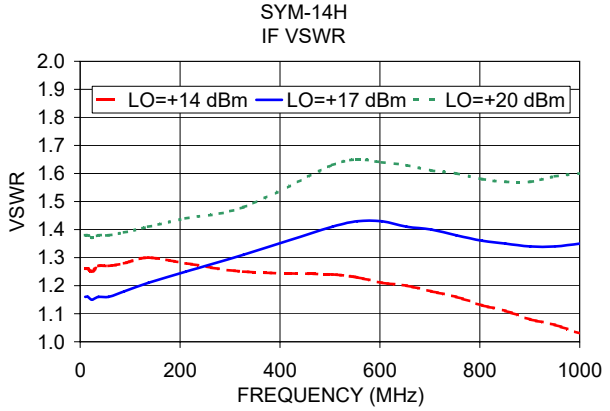












Notes

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

Frequency Mixer SYM-14H+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	CONVERSION LOSS IF FIXED @IF(OUT)=30MHz (dB) @LO (dBm)		
		+14	+17	+20
10.1	40.1	5.80	5.34	5.06
70.8	100.8	5.84	5.39	5.20
131.5	161.5	5.98	5.51	5.30
192.1	222.1	6.17	5.66	5.40
252.8	282.8	6.26	5.74	5.42
313.5	343.5	6.46	5.80	5.44
374.2	404.2	6.70	5.90	5.51
434.8	464.8	6.68	5.85	5.54
515.7	545.7	6.71	5.90	5.61
576.4	606.4	6.57	5.93	5.68
657.3	687.3	6.62	6.05	5.84
718.0	748.0	6.65	6.20	6.02
798.9	828.9	6.89	6.38	6.18
859.6	889.6	6.86	6.41	6.22
940.5	970.5	7.08	6.49	6.26
1001.2	1031.2	7.07	6.54	6.33
1082.1	1112.1	7.53	6.73	6.50
1142.7	1172.7	7.64	6.89	6.65
1223.6	1253.6	8.13	7.15	6.86
1284.3	1314.3	8.56	7.43	7.03
1365.2	1395.2	9.25	7.91	7.36
1425.9	1455.9	9.78	8.27	7.64
1506.8	1536.8	10.28	8.65	7.90
1567.5	1597.5	10.75	8.89	8.13
1648.4	1678.4	10.87	9.14	8.42
1709.0	1739.0	11.23	9.30	8.53
1789.9	1819.9	10.82	9.26	8.54
1850.6	1880.6	10.74	9.20	8.48
1931.5	1961.5	10.03	8.83	8.24
1992.2	2022.2	9.94	8.75	8.18
2073.1	2103.1	9.56	8.63	8.18
2133.8	2163.8	9.59	8.72	8.28
2214.7	2244.7	9.58	8.74	8.25
2275.4	2305.4	9.58	8.68	8.17
2356.3	2386.3	9.64	8.65	8.12
2416.9	2446.9	9.84	8.82	8.22
2497.8	2527.8	10.49	9.19	8.53
2558.5	2588.5	10.91	9.49	8.73
2639.4	2669.4	11.83	10.01	9.12
2700.1	2730.1	12.42	10.45	9.44

RF (IN) (MHz)	LO (MHz)	IP3 INPUT (dBm) @LO (dBm)		
		+14	+17	+20
10.1	40.1	29.82	31.82	29.22
70.8	100.8	24.30	25.10	25.28
131.5	161.5	24.05	24.88	29.14
192.1	222.1	24.35	28.95	30.70
252.8	282.8	25.86	27.85	27.58
313.5	343.5	24.60	31.05	28.67
374.2	404.2	23.64	28.16	27.14
434.8	464.8	24.61	26.17	29.22
515.7	545.7	29.38	25.62	32.11
576.4	606.4	26.32	30.92	31.91
657.3	687.3	25.74	31.49	33.16
718.0	748.0	27.36	35.36	32.42
798.9	828.9	30.02	30.82	29.89
859.6	889.6	29.93	30.14	28.15
940.5	970.5	26.87	32.36	27.64
1001.2	1031.2	33.61	28.45	28.40
1082.1	1112.1	24.68	29.51	28.38
1142.7	1172.7	24.82	32.19	29.48
1223.6	1253.6	21.55	27.84	29.86
1284.3	1314.3	21.77	26.22	32.22
1365.2	1395.2	21.57	26.74	32.11
1425.9	1455.9	22.03	27.64	34.82
1506.8	1536.8	22.90	30.90	34.57
1567.5	1597.5	23.59	37.87	32.05
1648.4	1678.4	26.80	30.67	34.18
1709.0	1739.0	26.94	29.55	30.78
1789.9	1819.9	27.17	27.73	27.24
1850.6	1880.6	28.83	25.61	26.42
1931.5	1961.5	24.09	25.42	25.93
1992.2	2022.2	21.87	24.63	26.32
2073.1	2103.1	20.34	23.80	24.88
2133.8	2163.8	20.75	23.77	25.18
2214.7	2244.7	20.56	22.68	23.60
2275.4	2305.4	20.00	21.76	22.48
2356.3	2386.3	18.41	20.99	21.92
2416.9	2446.9	17.66	21.04	21.56
2497.8	2527.8	16.84	20.27	21.23
2558.5	2588.5	17.28	20.23	20.58
2639.4	2669.4	19.43	19.66	20.78
2700.1	2730.1	25.05	19.89	20.92

RF (IN) (MHz)	LO (MHz)	COMPRESSION @RF IN=+14dBm (dB) @LO (dBm)		
		+14	+17	+20
10.1	40.1	1.21	0.79	0.61
70.8	100.8	1.14	0.79	0.63
131.5	161.5	1.13	0.77	0.59
192.1	222.1	1.05	0.72	0.61
252.8	282.8	1.07	0.77	0.65
313.5	343.5	1.05	0.84	0.73
374.2	404.2	1.00	0.85	0.72
434.8	464.8	1.01	0.89	0.70
515.7	545.7	1.23	0.96	0.73
576.4	606.4	1.23	0.81	0.61
657.3	687.3	1.17	0.70	0.51
718.0	748.0	0.94	0.58	0.46
798.9	828.9	0.82	0.41	0.35
859.6	889.6	0.65	0.34	0.31
940.5	970.5	0.64	0.28	0.24
1001.2	1031.2	0.60	0.29	0.27
1082.1	1112.1	0.59	0.32	0.27
1142.7	1172.7	0.53	0.32	0.27
1223.6	1253.6	0.41	0.38	0.33
1284.3	1314.3	0.33	0.36	0.37
1365.2	1395.2	0.20	0.32	0.40
1425.9	1455.9	0.07	0.28	0.37
1506.8	1536.8	-0.05	0.26	0.38
1567.5	1597.5	-0.16	0.23	0.33
1648.4	1678.4	-0.10	0.24	0.29
1709.0	1739.0	-0.10	0.29	0.32
1789.9	1819.9	0.27	0.41	0.42
1850.6	1880.6	0.43	0.51	0.51
1931.5	1961.5	0.94	0.82	0.70
1992.2	2022.2	1.28	1.05	0.89
2073.1	2103.1	1.79	1.33	1.03
2133.8	2163.8	1.96	1.33	1.06
2214.7	2244.7	2.15	1.51	1.20
2275.4	2305.4	2.47	1.77	1.40
2356.3	2386.3	2.86	2.06	1.59
2416.9	2446.9	3.12	2.19	1.64
2497.8	2527.8	3.21	2.25	1.58
2558.5	2588.5	3.09	2.24	1.54
2639.4	2669.4	2.80	2.21	1.43
2700.1	2730.1	2.43	2.21	1.45

Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=685.1MHz (dB) @LO (dBm) +17
485.0	200.1	6.78
472.8	212.3	6.75
460.6	224.5	6.68
448.5	236.6	6.69
436.3	248.8	6.79
424.1	261.0	6.83
411.9	273.2	6.75
399.7	285.4	6.71
387.6	297.5	6.74
375.4	309.7	6.80
363.2	321.9	6.83
351.0	334.1	6.77
338.8	346.3	6.64
326.7	358.4	6.67
314.5	370.6	6.68
302.3	382.8	6.77
290.1	395.0	6.75
277.9	407.2	6.59
265.8	419.3	6.54
253.6	431.5	6.69
241.4	443.7	6.67
229.2	455.9	6.61
217.1	468.0	6.48
204.9	480.2	6.45
192.7	492.4	6.53
180.5	504.6	6.50
168.3	516.8	6.43
156.2	528.9	6.42
144.0	541.1	6.34
131.8	553.3	6.31
119.6	565.5	6.34
107.4	577.7	6.30
95.3	589.8	6.25
83.1	602.0	6.22
70.9	614.2	6.18
58.7	626.4	6.19
46.5	638.6	6.17
34.4	650.7	6.10
22.2	662.9	6.12
10.0	675.1	6.09

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=100.1MHz (dB) @LO (dBm) +17
10.0	110.1	5.40
30.2	130.3	5.47
50.4	150.5	5.48
70.6	170.7	5.55
90.8	190.9	5.48
111.0	211.1	5.57
131.2	231.3	5.56
151.4	251.5	5.52
171.6	271.7	5.54
191.8	291.9	5.60
212.0	312.1	5.58
232.2	332.3	5.53
252.4	352.5	5.58
272.7	372.8	5.49
292.9	393.0	5.50
313.1	413.2	5.54
333.3	433.4	5.46
353.5	453.6	5.41
373.7	473.8	5.47
393.9	494.0	5.38
434.3	534.4	5.36
454.5	554.6	5.31
494.9	595.0	5.33
515.1	615.2	5.35
555.5	655.6	5.36
575.7	675.8	5.38
616.1	716.2	5.42
636.3	736.4	5.42
676.7	776.8	5.48
696.9	797.0	5.51
737.3	837.4	5.57
757.6	857.7	5.61
798.0	898.1	5.63
818.2	918.3	5.63
858.6	958.7	5.63
878.8	978.9	5.65
919.2	1019.3	5.65
939.4	1039.5	5.67
979.8	1079.9	5.69
1000.0	1100.1	5.72

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=1370.1MHz (dB) @LO (dBm) +17
1000.0	370.1	8.84
979.8	390.3	8.78
959.6	410.5	8.84
939.4	430.7	8.83
919.2	450.9	8.61
899.0	471.1	8.67
878.8	491.3	8.64
858.6	511.5	8.41
838.4	531.7	8.46
818.2	551.9	8.32
798.0	572.1	8.28
777.8	592.3	8.30
757.6	612.5	8.20
737.3	632.8	8.15
717.1	653.0	8.11
696.9	673.2	8.07
676.7	693.4	8.02
656.5	713.6	8.00
636.3	733.8	7.95
616.1	754.0	7.86
575.7	794.4	7.85
555.5	814.6	7.82
515.1	855.0	7.76
494.9	875.2	7.77
454.5	915.6	7.76
434.3	935.8	7.72
393.9	976.2	7.79
373.7	996.4	7.78
333.3	1036.8	7.80
313.1	1057.0	7.81
272.7	1097.4	7.87
252.4	1117.7	7.88
212.0	1158.1	7.89
191.8	1178.3	7.88
151.4	1218.7	7.87
131.2	1238.9	7.88
90.8	1279.3	7.92
70.6	1299.5	7.89
30.2	1339.9	7.87
10.0	1360.1	7.80

Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB) @LO (dBm)			LO-IF ISOLATION (dB) @LO (dBm)		
	+14	+17	+20	+14	+17	+20
10.1	37.89	40.47	43.41	45.58	48.89	53.25
70.8	38.13	40.97	43.50	45.34	46.49	45.52
131.5	38.45	41.15	42.41	45.96	43.72	41.30
192.1	39.09	40.54	40.76	47.12	41.42	38.48
252.8	39.54	39.98	39.81	46.40	39.32	36.11
313.5	39.88	39.90	39.25	43.74	37.30	34.21
374.2	40.52	40.01	38.82	40.98	35.35	32.38
434.8	40.93	39.91	38.60	39.18	34.58	31.64
515.7	42.98	40.93	38.83	37.03	32.60	29.86
576.4	44.99	42.10	39.34	35.74	31.89	28.98
657.3	48.67	43.07	39.81	34.39	30.82	28.22
718.0	52.35	44.25	40.22	33.27	30.34	27.27
798.9	54.45	44.69	40.92	32.35	29.98	27.28
859.6	53.66	45.18	40.95	31.34	30.40	27.33
940.5	49.96	44.84	41.35	29.60	30.34	27.64
1001.2	49.23	46.06	41.78	27.53	30.28	27.41
1082.1	48.03	47.14	43.38	27.91	29.93	27.54
1142.7	44.97	49.70	46.47	26.59	30.92	28.32
1223.6	43.92	49.95	53.31	27.78	33.18	29.78
1284.3	41.67	47.01	54.71	26.94	35.71	31.11
1365.2	40.21	44.45	51.13	27.92	40.04	34.31
1425.9	38.77	42.11	47.21	26.22	35.88	40.02
1506.8	38.11	40.95	44.53	25.99	33.26	44.54
1567.5	37.59	40.34	43.61	25.01	30.81	38.32
1648.4	37.89	41.04	44.88	25.19	30.52	35.06
1709.0	38.09	41.84	45.81	25.15	29.73	33.09
1789.9	37.76	41.88	44.46	25.14	29.36	31.62
1850.6	37.38	40.24	42.03	25.39	28.82	30.48
1931.5	36.18	38.54	39.98	25.10	28.07	28.98
1992.2	35.80	38.02	39.57	25.44	27.70	28.20
2073.1	35.97	38.81	40.91	24.89	26.68	27.13
2133.8	38.16	42.46	44.20	24.16	25.82	26.47
2214.7	41.07	44.06	41.89	23.10	24.53	25.18
2275.4	42.90	42.29	39.49	22.73	24.06	24.74
2356.3	43.71	41.12	38.18	21.36	22.90	23.67
2416.9	44.94	39.69	36.86	20.48	22.00	23.05
2497.8	44.78	38.52	35.83	19.65	21.27	22.46
2558.5	43.35	38.02	35.65	19.04	20.73	22.10
2639.4	41.40	38.11	35.79	17.93	20.08	21.52
2700.1	39.32	37.82	36.12	17.36	19.53	21.23

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB) @LO (dBm)		
		+14	+17	+20
10.1	40.1	36.33	36.20	38.74
70.8	100.8	35.90	36.78	37.30
131.5	161.5	36.64	37.08	37.25
192.1	222.1	37.53	38.43	39.08
252.8	282.8	38.74	39.36	39.86
313.5	343.5	40.02	40.22	40.93
374.2	404.2	41.42	41.26	42.06
434.8	464.8	41.59	42.25	43.63
515.7	545.7	41.84	43.09	43.27
576.4	606.4	43.80	44.15	43.26
657.3	687.3	44.59	43.27	42.01
718.0	748.0	43.65	41.83	40.64
798.9	828.9	43.55	41.52	40.60
859.6	889.6	44.45	43.24	41.60
940.5	970.5	48.48	46.32	44.10
1001.2	1031.2	53.99	47.52	44.56
1082.1	1112.1	52.47	48.36	44.49
1142.7	1172.7	48.83	45.21	42.46
1223.6	1253.6	43.74	41.73	39.70
1284.3	1314.3	39.85	38.01	36.56
1365.2	1395.2	35.40	34.10	33.47
1425.9	1455.9	33.73	32.72	32.40
1506.8	1536.8	32.62	32.05	32.07
1567.5	1597.5	32.87	32.34	32.32
1648.4	1678.4	33.56	33.31	32.71
1709.0	1739.0	34.39	33.83	33.15
1789.9	1819.9	34.69	34.09	33.22
1850.6	1880.6	34.62	34.12	33.17
1931.5	1961.5	34.22	33.91	33.31
1992.2	2022.2	34.23	34.33	33.88
2073.1	2103.1	33.94	34.27	33.94
2133.8	2163.8	32.10	32.58	32.93
2214.7	2244.7	30.24	30.43	30.86
2275.4	2305.4	29.43	29.19	29.01
2356.3	2386.3	28.81	28.05	27.46
2416.9	2446.9	28.63	27.49	26.69
2497.8	2527.8	27.87	26.52	25.65
2558.5	2588.5	26.49	25.42	24.69
2639.4	2669.4	24.92	24.29	23.93
2700.1	2730.1	23.84	23.57	23.60

Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1) @LO (dBm)		
		+14	+17	+20
10.1	40.1	1.36	1.20	1.10
70.8	100.8	1.37	1.23	1.14
131.5	161.5	1.42	1.28	1.19
192.1	222.1	1.50	1.36	1.27
252.8	282.8	1.56	1.41	1.32
313.5	343.5	1.67	1.50	1.40
374.2	404.2	1.82	1.62	1.52
434.8	464.8	1.91	1.71	1.62
515.7	545.7	2.05	1.84	1.75
576.4	606.4	2.08	1.92	1.85
657.3	687.3	2.17	2.02	1.95
718.0	748.0	2.23	2.11	2.04
798.9	828.9	2.35	2.20	2.11
859.6	889.6	2.38	2.23	2.14
940.5	970.5	2.52	2.29	2.19
1001.2	1031.2	2.53	2.32	2.21
1082.1	1112.1	2.68	2.37	2.22
1142.7	1172.7	2.68	2.39	2.22
1223.6	1253.6	2.73	2.42	2.24
1284.3	1314.3	2.77	2.45	2.27
1365.2	1395.2	2.84	2.54	2.37
1425.9	1455.9	2.92	2.63	2.46
1506.8	1536.8	3.00	2.75	2.56
1567.5	1597.5	3.02	2.77	2.59
1648.4	1678.4	2.94	2.72	2.59
1709.0	1739.0	2.90	2.68	2.55
1789.9	1819.9	2.80	2.62	2.49
1850.6	1880.6	2.76	2.58	2.43
1931.5	1961.5	2.59	2.43	2.30
1992.2	2022.2	2.48	2.31	2.18
2073.1	2103.1	2.29	2.12	2.03
2133.8	2163.8	2.23	2.09	1.99
2214.7	2244.7	2.22	2.10	1.97
2275.4	2305.4	2.19	2.07	1.92
2356.3	2386.3	2.09	1.95	1.81
2416.9	2446.9	2.00	1.85	1.73
2497.8	2527.8	1.93	1.77	1.65
2558.5	2588.5	1.89	1.73	1.60
2639.4	2669.4	1.89	1.70	1.53
2700.1	2730.1	1.85	1.64	1.48

LO (MHz)	LO VSWR (:1) @LO (dBm)		
	+14	+17	+20
10.1	1.02	1.60	2.35
70.8	1.10	1.61	2.39
131.5	1.13	1.67	2.48
192.1	1.17	1.66	2.37
252.8	1.21	1.57	2.28
313.5	1.24	1.57	2.21
374.2	1.24	1.57	2.23
434.8	1.24	1.47	2.04
515.7	1.32	1.38	1.94
576.4	1.38	1.32	1.82
657.3	1.49	1.32	1.73
718.0	1.65	1.32	1.65
798.9	1.76	1.32	1.55
859.6	1.89	1.32	1.46
940.5	1.92	1.31	1.36
1001.2	2.22	1.34	1.28
1082.1	2.07	1.33	1.17
1142.7	2.40	1.38	1.11
1223.6	2.20	1.35	1.09
1284.3	2.43	1.43	1.17
1365.2	2.25	1.47	1.30
1425.9	2.51	1.58	1.41
1506.8	2.35	1.64	1.57
1567.5	2.46	1.73	1.67
1648.4	2.30	1.77	1.81
1709.0	2.27	1.83	1.88
1789.9	2.22	1.88	2.00
1850.6	2.13	1.92	2.06
1931.5	2.08	1.98	2.13
1992.2	2.02	2.02	2.20
2073.1	1.97	2.03	2.24
2133.8	1.92	2.05	2.27
2214.7	1.88	2.06	2.28
2275.4	1.91	2.13	2.37
2356.3	1.91	2.15	2.36
2416.9	1.94	2.19	2.40
2497.8	1.99	2.22	2.41
2558.5	2.03	2.25	2.43
2639.4	2.05	2.28	2.45
2700.1	2.10	2.31	2.47

IF (OUT) (MHz)	IF VSWR @LO=1370.1MHz (:1) @LO (dBm)		
	+14	+17	+20
10.0	1.15	1.39	1.61
30.2	1.21	1.27	1.56
50.4	1.21	1.24	1.62
70.6	1.24	1.24	1.64
90.8	1.26	1.25	1.58
111.0	1.25	1.24	1.54
131.2	1.24	1.27	1.60
151.4	1.26	1.27	1.62
171.6	1.28	1.25	1.58
191.8	1.26	1.28	1.58
212.0	1.27	1.31	1.59
232.2	1.29	1.30	1.58
252.4	1.28	1.29	1.59
272.7	1.28	1.34	1.63
292.9	1.30	1.35	1.61
313.1	1.30	1.33	1.57
333.3	1.27	1.36	1.62
353.5	1.28	1.38	1.65
373.7	1.28	1.35	1.62
393.9	1.27	1.35	1.61
434.3	1.27	1.38	1.62
454.5	1.25	1.36	1.61
494.9	1.24	1.38	1.63
515.1	1.23	1.34	1.59
555.5	1.21	1.37	1.62
575.7	1.22	1.34	1.58
616.1	1.19	1.33	1.60
636.3	1.20	1.32	1.57
676.7	1.17	1.29	1.54
696.9	1.18	1.29	1.56
737.3	1.16	1.26	1.52
757.6	1.15	1.27	1.50
798.0	1.16	1.22	1.48
818.2	1.14	1.24	1.52
858.6	1.16	1.21	1.44
878.8	1.15	1.22	1.44
919.2	1.17	1.18	1.45
939.4	1.17	1.17	1.43
979.8	1.18	1.16	1.37
1000.0	1.20	1.14	1.36

Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Harmonics Tables

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	6	25	7	39	12	38	23	38	26	49
1	-	36	+0	48	13	45	24	52	44	51	41	59
2	88	58	54	53	49	62	49	77	52	70	52	69
3	>100	91	71	87	78	84	80	83	67	85	78	85
4	>100	>93	88	>93	87	>93	85	>93	88	>93	>93	>93
5	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
6	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
7	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
8	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
9	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
10	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions:
RF IN: 750.1 MHz; -1.00 dBm.
LO IN: 780.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; -7.38 dBm

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	16	36	18	48	24	52	36	54	39	69
1	-	37	+0	49	13	45	25	55	45	54	45	64
2	73	47	45	42	40	50	40	62	43	62	46	60
3	>100	84	45	71	57	75	52	65	51	69	59	65
4	>100	71	77	73	69	73	65	74	58	71	72	71
5	>100	83	63	82	60	83	63	81	60	87	69	90
6	>100	93	83	82	81	85	80	81	75	81	88	80
7	>100	94	92	97	77	97	81	92	77	91	77	>103
8	>100	>103	98	>103	97	>103	95	>103	89	101	90	97
9	>100	>103	>103	>103	>103	102	93	103	95	102	92	101
10	>100	>103	>103	>103	>103	>103	>103	>103	102	>103	102	102
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

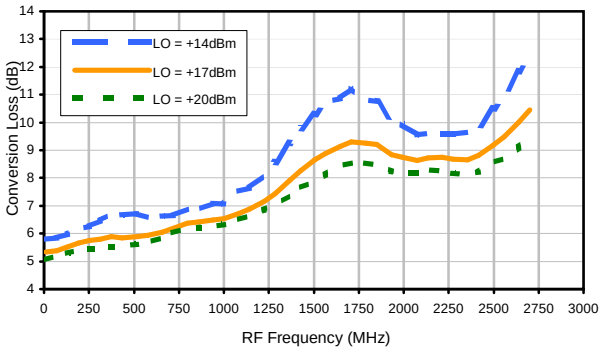
Test conditions:
RF IN: 750.1 MHz; 9.00 dBm.
LO IN: 780.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; 2.54 dBm

Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT.
2. + entry denotes harmonics are in (dBc) above IF OUTPUT.
3. RF Cal represent the Harmonics level of the RF input signal to the mixer.

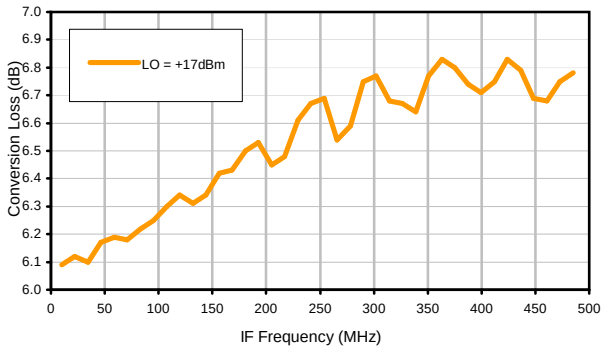
Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Typical Performance Curves

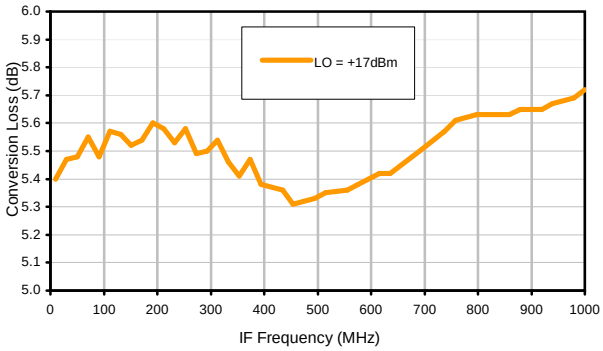
Conversion Loss @ IF=30MHz



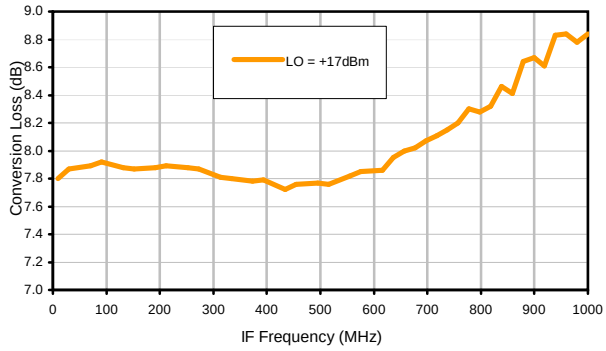
Conversion Loss vs. IF @ RF=685.1MHz



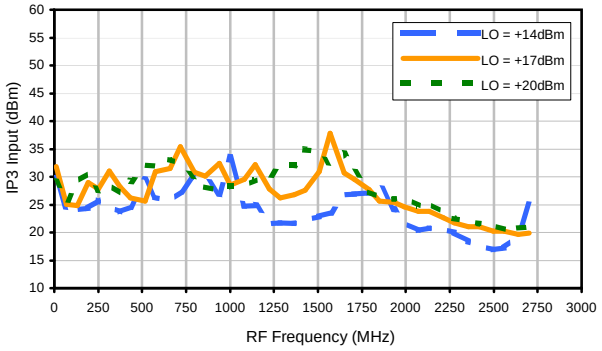
Conversion Loss vs. IF @ RF=100.1MHz



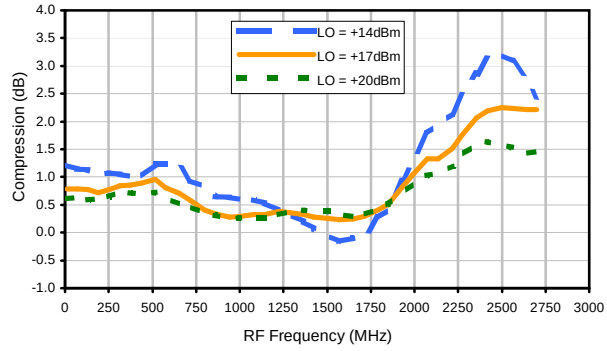
Conversion Loss vs. IF @ RF=1370.1MHz



IP3 Input



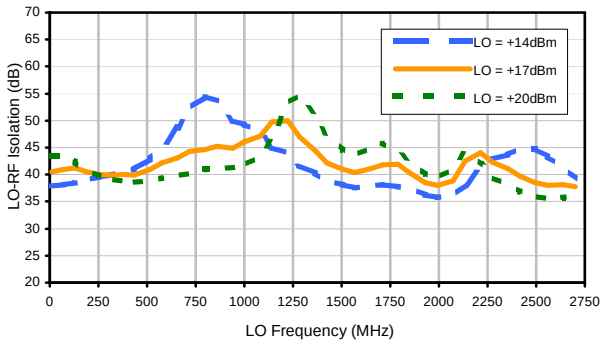
Compression @ RF IN=+14dBm



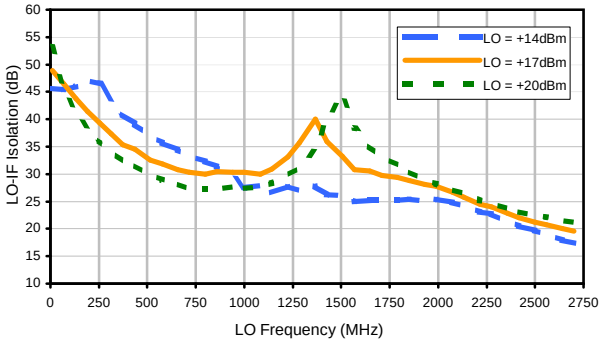
Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Typical Performance Curves

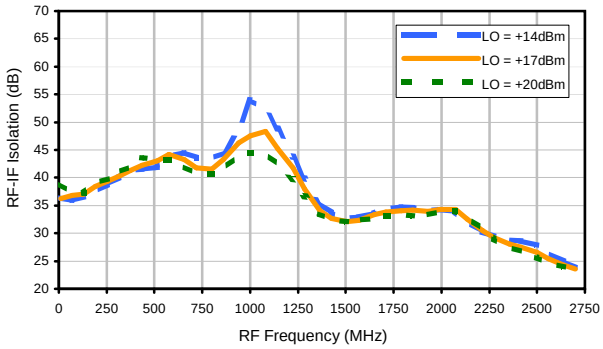
LO-RF Isolation



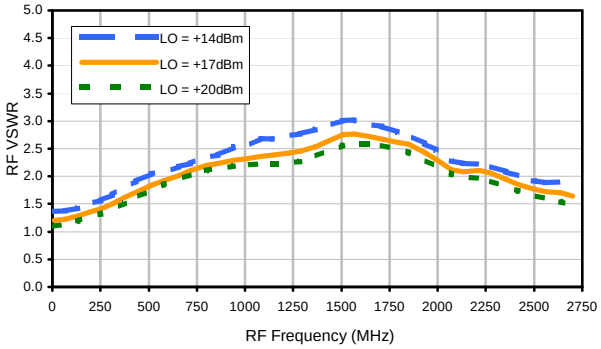
LO-IF Isolation



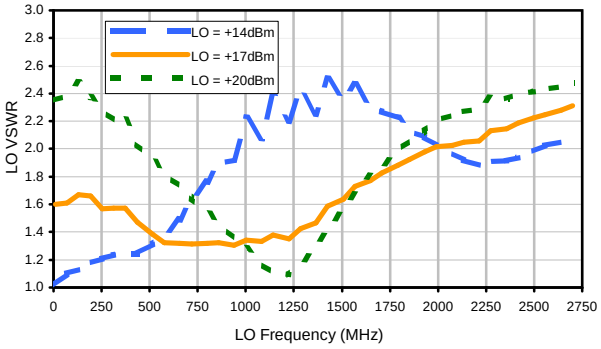
RF-IF Isolation



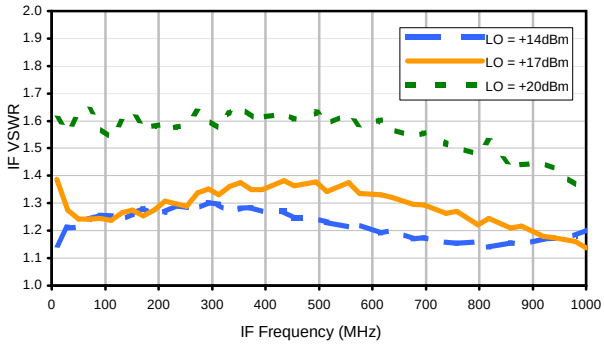
RF VSWR



LO VSWR



IF VSWR



Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Harmonics Tables

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	6	25	7	39	12	38	23	38	26	49
1	-	36	+0	48	13	45	24	52	44	51	41	59
2	88	58	54	53	49	62	49	77	52	70	52	69
3	>100	91	71	87	78	84	80	83	67	85	78	85
4	>100	>93	88	>93	87	>93	85	>93	88	>93	>93	>93
5	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
6	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
7	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
8	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
9	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
10	>100	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93	>93
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions:
RF IN: 750.1 MHz; -1.00 dBm.
LO IN: 780.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; -7.38 dBm

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	16	36	18	48	24	52	36	54	39	69
1	-	37	+0	49	13	45	25	55	45	54	45	64
2	73	47	45	42	40	50	40	62	43	62	46	60
3	>100	84	45	71	57	75	52	65	51	69	59	65
4	>100	71	77	73	69	73	65	74	58	71	72	71
5	>100	83	63	82	60	83	63	81	60	87	69	90
6	>100	93	83	82	81	85	80	81	75	81	88	80
7	>100	94	92	97	77	97	81	92	77	91	77	>103
8	>100	>103	98	>103	97	>103	95	>103	89	101	90	97
9	>100	>103	>103	>103	>103	102	93	103	95	102	92	101
10	>100	>103	>103	>103	>103	>103	>103	>103	102	>103	102	102
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions:
RF IN: 750.1 MHz; 9.00 dBm.
LO IN: 780.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; 2.54 dBm

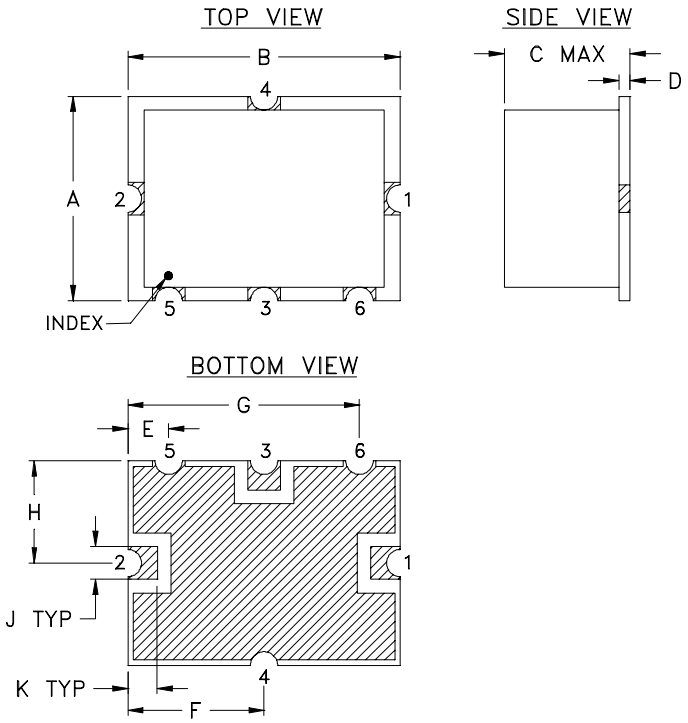
Notes: **1. All Harmonics are in (dBc) relative to IF OUTPUT.**
2. + entry denotes harmonics are in (dBc) above IF OUTPUT.
3. RF Cal represent the Harmonics level of the RF input signal to the mixer.

Mini-Circuits®
IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

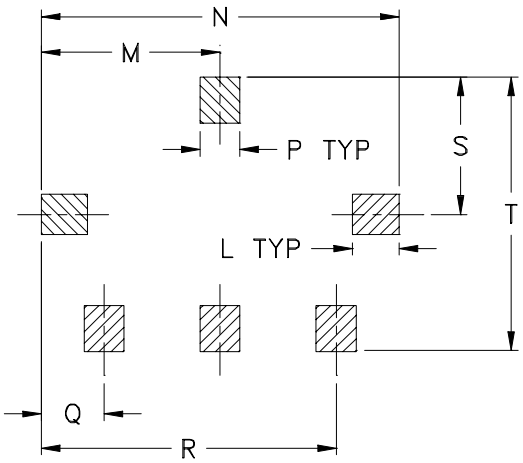
Case Style TTT

Outline Dimensions

TTT166
TTT167



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE #	A	B	C	D	E	F	G	H	J	K	L	M	N
TTT166	.38 (9.65)	.50 (12.70)	.15 (3.81)	.020 (0.51)	.075 (1.91)	.250 (6.35)	.425 (10.80)	.187 (4.75)	.050 (1.27)	.050 (1.27)	.070 (1.78)	.270 (6.86)	.540 (13.72)
TTT167			.23 (5.84)										

CASE #	P	Q	R	S	T	WT. GRAM
TTT166	.060 (1.52)	.095 (2.41)	.445 (11.30)	.208 (5.28)	.415 (10.54)	.8
TTT167						.8

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

Note:

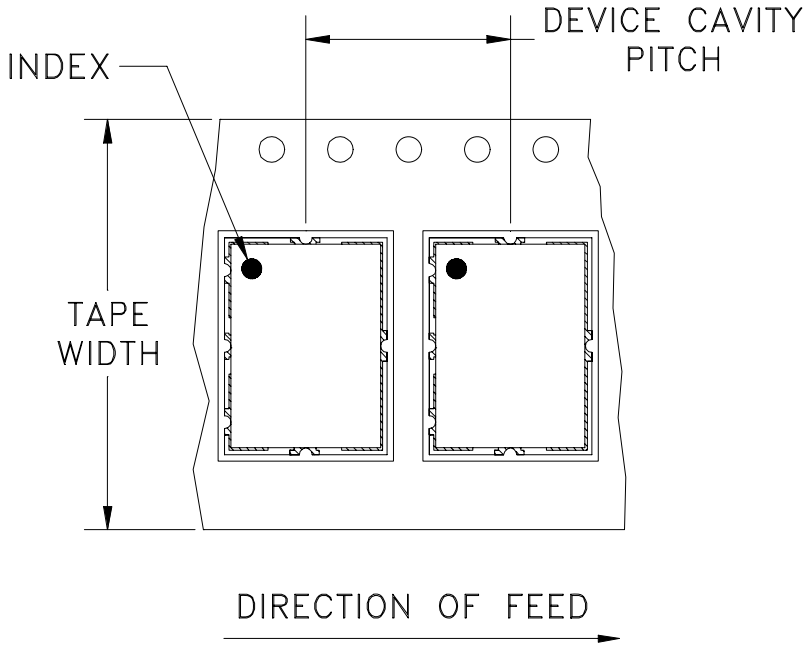
1. Case material: Plastic.
2. Base material: Printed wiring laminate.
3. Termination finish:
   For RoHS Case Styles: 3-5 µ inch (.08-.13 microns) Gold over 120-240 µ inch (3.05-6.10 microns) Nickel plate. All models, (+) suffix.
   For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

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

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

Tape & Reel Packaging TR-F12

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
24	12	7	Small quantity standards (see note)	10
				20
				50
				100
				200
		13	Standard	500

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

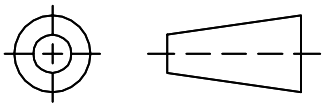
Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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

This document and its contents are the property of Mini-Circuits.1

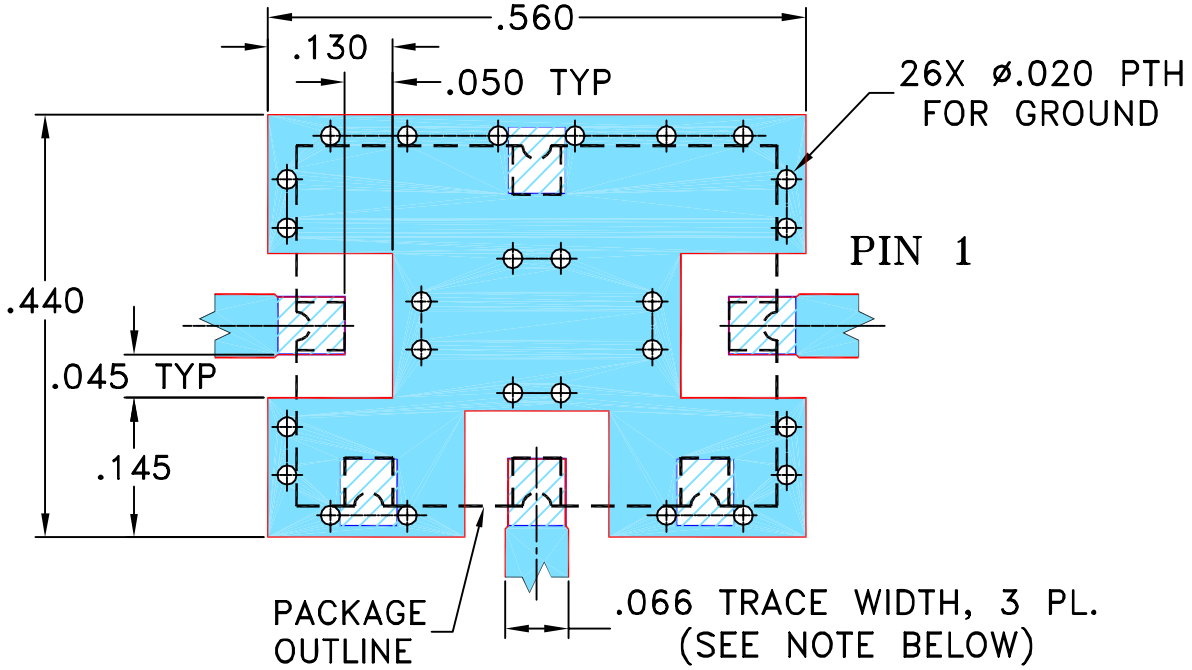
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
A	M86762	ADDED CONNECTIONS "lp & lq"	05/23/03	MMG	WL
B	M94598	ADDED CONNECTION "hk"	10/08/04	MMG	HY
C	M102713	UPDATED NOTES & DESCRIPTION	01/14/06	GF	IL
D	M132989	UPDATED NOTE 2	08/24/11	GF	DJ

SUGGESTED MOUNTING CONFIGURATION FOR TTT166/167 CASE STYLE, "hk"/"lp"/"lq" "x"/"ck"/"ec" PIN CONNECTIONS



NOTE:

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. THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES TO EXPOSE METAL UNDER THE ENTIRE UNIT GROUND PAD FOR IMPROVED GROUNDING, IT IS RECOMMENDED A SOLDER MASK DAM BE APPLIED AROUND EACH GROUND PAD TO ENSURE FILLET AND CONNECTION AT GROUND PADS.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER), SEE NOTE 2.

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PL DECIMALS ±
3 PL DECIMALS ± .005
ANGLES ±
FRACTIONS ±

	INITIALS	DATE
DRAWN	GF	03/18/03
CHECKED	IL	04/15/03
APPROVED	DJ	04/15/03

Mini-Circuits®

Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, hk/lp/lq/x/ck/ec, TTT166/167, SYM/HJK/SYAS/SYPD, TB-12

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-079	D

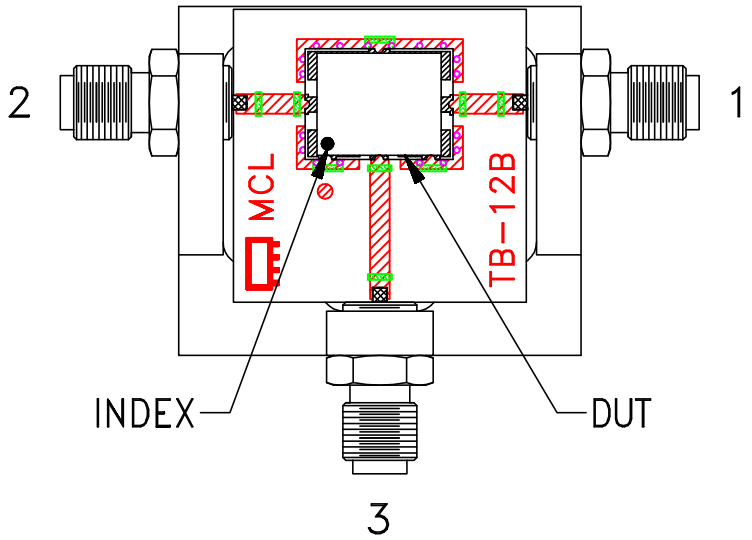
FILE:	SCALE:	SHEET:
98PL079	5:1	1 OF 1

Mini-Circuits®
THIS DOCUMENT AND ITS CONTENTS ARE THE PROPERTY OF MINI-CIRCUITS. EXCEPT FOR USE EXPRESSLY GRANTED, IN WRITING, TO ITS VENDORS, VENDEE AND THE UNITED STATES GOVERNMENT, MINI-CIRCUITS RESERVES ALL PROPRIETARY DESIGN, USE , MANUFACTURING AND REPRODUCTION RIGHTS THERETO. THESE CONTENTS SHALL NOT BE USED, DUPLICATED OR DISCLOSED TO ANY OUTSIDE PARTY, IN WHOLE OR IN PART, WITHOUT WRITTEN PERMISSION OF MINI-CIRCUITS.

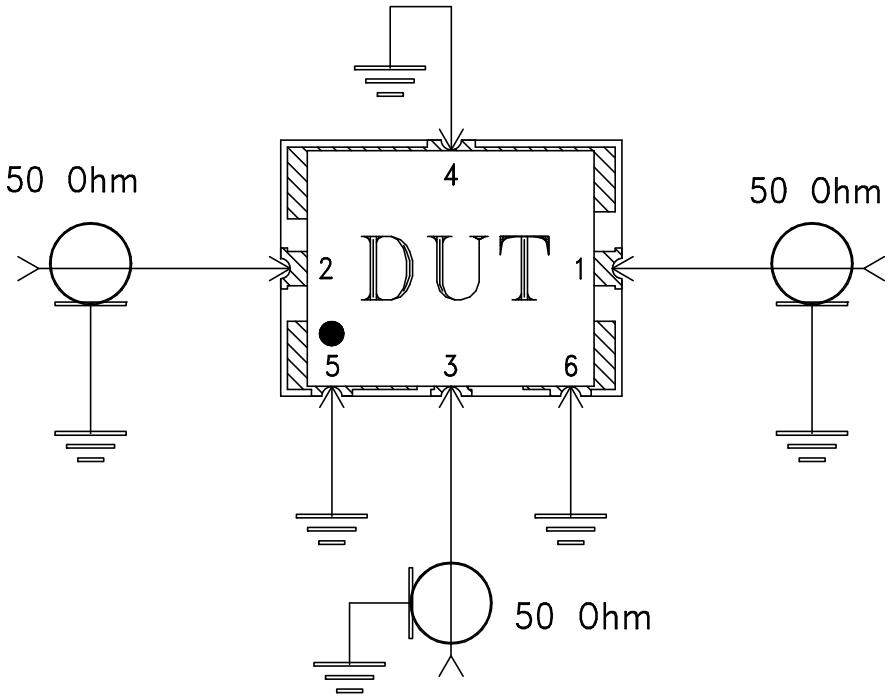
ASHEETA1.DWG REV:A DATE:01/12/95

Evaluation Board and Circuit

For Pin Connections Refer to Data Sheet of the DUT



TB-12



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers RO4350 or equivalent, Dielectric Constant=3.5, Thickness=.030 inch.

Mini-Circuits®

THIS DOCUMENT AND ITS CONTENTS ARE THE PROPERTY OF MINI-CIRCUITS.

Mini-Circuits

Environmental Specifications ENV02T1

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

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