

High IP3 Frequency Mixer

SYM-24DH+

Level 17 (LO Power +17 dBm) 1400 to 2400 MHz

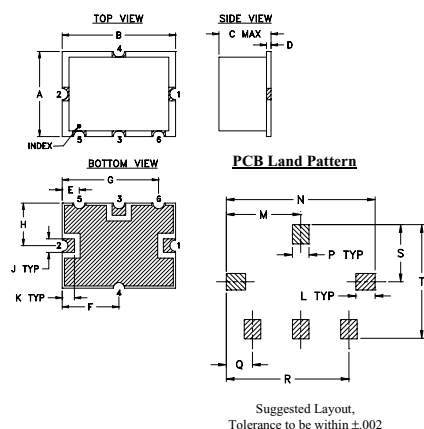
Maximum Ratings

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

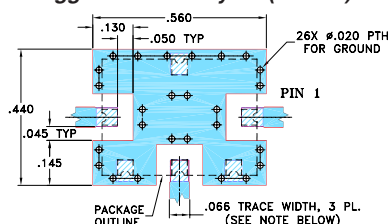
Outline Drawing



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:

- 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.
- 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.
- 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

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.
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Features

- low conversion loss, 7.0 dB typ.
- high IP3, 29 dBm typ.
- good L-R isolation, 32 dB typ.; & L-I isolation, 36 dB typ.

Applications

- base stations
- cellular
- communications
- DCS
- PCS



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

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

Electrical Specifications

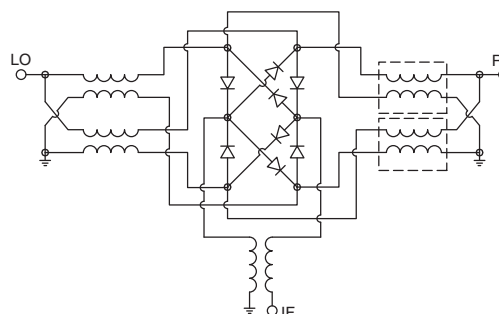
FREQUENCY (MHz)		CONVERSION LOSS (dB)		LO-RF ISOLATION (dB)		LO-IF ISOLATION (dB)		IP3 at center band (dBm)	
LO/RF f_L - f_U	IF	Mid-Band m		Total Range Max.	Typ.	Min.	Typ.		Min.
		$\overline{X}$	σ						
1400-2400	10-250	7.0	.20	9.3	32	22	36	23	29

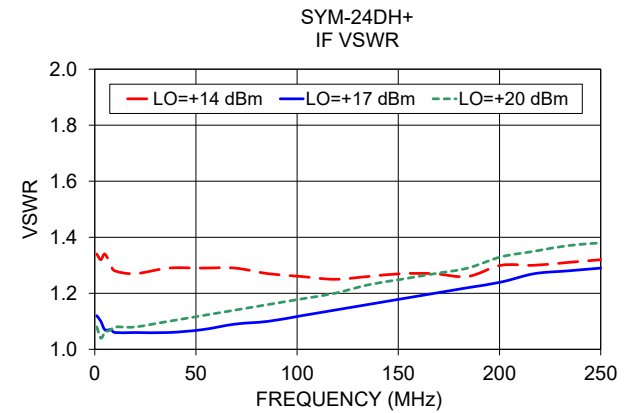
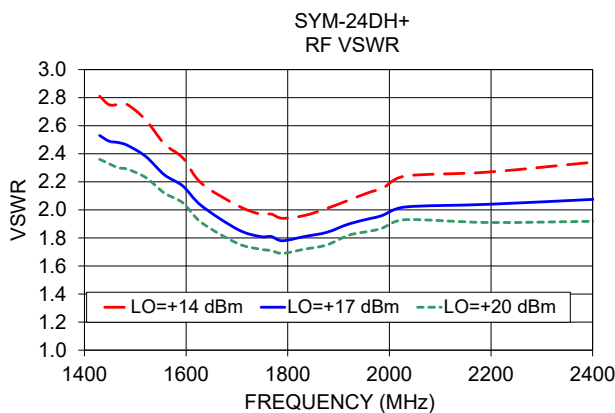
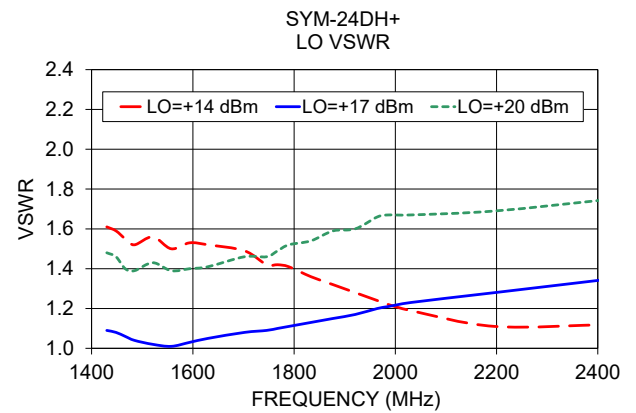
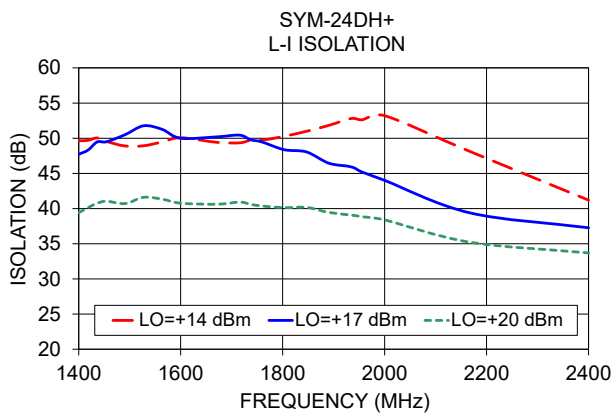
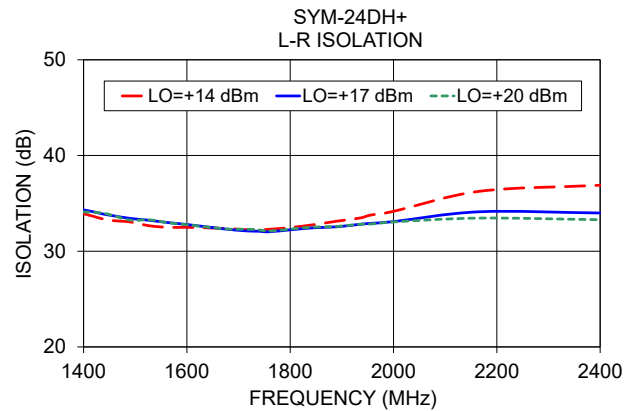
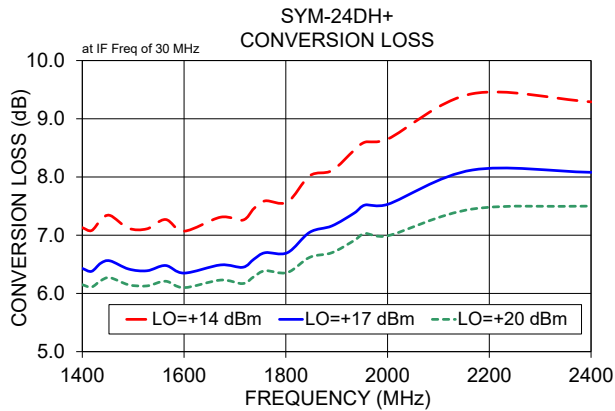
1 dB COMP.: +14 dBm typ.

Typical Performance Data

Frequency (MHz)		Conversion Loss (dB)	Isolation L-R (dB)	Isolation L-I (dB)	VSWR RF Port (:1)	VSWR LO Port (:1)
RF	LO	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm
1400.00	1430.00	6.43	34.31	47.72	2.53	1.09
1418.18	1448.18	6.38	34.13	48.31	2.49	1.08
1436.36	1466.36	6.52	33.90	49.48	2.48	1.06
1454.55	1484.55	6.56	33.73	49.50	2.46	1.04
1490.91	1520.91	6.42	33.42	50.50	2.38	1.02
1527.27	1557.27	6.39	33.23	51.77	2.25	1.01
1563.64	1593.64	6.48	32.99	51.26	2.17	1.03
1600.00	1630.00	6.35	32.79	50.00	2.03	1.05
1671.88	1701.88	6.49	32.33	50.20	1.86	1.08
1715.63	1745.63	6.45	32.12	50.44	1.81	1.09
1737.50	1767.50	6.59	32.09	49.78	1.81	1.10
1759.38	1789.38	6.70	32.03	49.47	1.78	1.11
1803.13	1833.13	6.70	32.25	48.37	1.81	1.13
1846.88	1876.88	7.05	32.45	48.05	1.84	1.15
1890.63	1920.63	7.16	32.55	46.45	1.90	1.17
1934.38	1964.38	7.38	32.81	45.93	1.94	1.20
1956.25	1986.25	7.52	32.91	45.18	1.96	1.21
2000.00	2030.00	7.53	33.09	44.01	2.02	1.23
2166.67	2196.67	8.12	34.12	39.40	2.04	1.28
2400.00	2430.00	8.08	33.99	37.27	2.08	1.35

Electrical Schematic





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Frequency Mixer

SYM-24DH+

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	5.88	5.43	5.25
110.4	140.4	6.42	5.89	5.66
210.7	240.7	6.47	6.01	5.72
310.9	340.9	6.87	6.28	5.89
411.2	441.2	6.94	6.25	5.88
511.5	541.5	7.17	6.35	5.97
611.8	641.8	7.28	6.41	6.04
712.1	742.1	7.17	6.39	6.06
792.3	822.3	7.22	6.55	6.22
892.6	922.6	7.20	6.64	6.35
972.8	1002.8	7.17	6.64	6.41
1073.1	1103.1	7.18	6.68	6.45
1153.3	1183.3	7.23	6.72	6.48
1253.6	1283.6	7.26	6.69	6.47
1333.8	1363.8	7.33	6.71	6.50
1434.1	1464.1	7.47	6.78	6.54
1514.3	1544.3	7.51	6.82	6.59
1614.6	1644.6	7.59	6.91	6.67
1694.8	1724.8	7.72	6.99	6.75
1795.1	1825.1	8.12	7.27	6.99
1875.3	1905.3	8.51	7.59	7.20
1975.6	2005.6	9.07	7.96	7.49
2055.8	2085.8	9.44	8.27	7.68
2156.1	2186.1	9.64	8.42	7.79
2236.3	2266.3	9.68	8.50	7.88
2336.6	2366.6	9.46	8.40	7.85
2416.8	2446.8	9.20	8.20	7.74
2517.1	2547.1	8.99	8.13	7.69
2597.3	2627.3	8.76	7.98	7.59
2697.6	2727.6	8.58	7.80	7.44
2777.8	2807.8	8.43	7.71	7.36
2878.1	2908.1	8.51	7.69	7.38
2958.3	2988.3	8.59	7.75	7.42
3058.6	3088.6	8.83	8.01	7.54
3138.8	3168.8	9.20	8.18	7.72
3239.1	3269.1	9.73	8.56	8.01
3319.3	3349.3	10.43	9.04	8.34
3419.6	3449.6	11.47	9.57	8.70
3499.8	3529.8	12.60	10.03	9.11
3600.1	3630.1	14.67	10.75	9.54

RF (IN) (MHz)	LO (MHz)	IP3 INPUT (dBm)		
		@LO (dBm)		
		+14	+17	+20
10.1	40.1	31.09	30.16	28.33
110.4	140.4	23.99	23.88	24.16
210.7	240.7	21.37	23.12	24.87
310.9	340.9	21.43	22.98	24.93
411.2	441.2	22.16	24.44	26.34
511.5	541.5	22.99	26.59	28.36
611.8	641.8	23.51	26.68	29.76
712.1	742.1	27.25	32.58	34.76
792.3	822.3	30.13	35.48	31.91
892.6	922.6	32.59	41.75	30.85
972.8	1002.8	41.36	31.50	29.83
1073.1	1103.1	31.43	28.49	26.89
1153.3	1183.3	31.87	26.55	27.00
1253.6	1283.6	38.63	28.11	26.97
1333.8	1363.8	28.82	35.92	28.06
1434.1	1464.1	30.12	31.69	31.24
1514.3	1544.3	29.37	31.32	33.92
1614.6	1644.6	26.54	30.57	37.07
1694.8	1724.8	23.84	29.60	34.55
1795.1	1825.1	22.46	27.80	32.51
1875.3	1905.3	21.72	26.64	33.97
1975.6	2005.6	21.90	26.58	34.02
2055.8	2085.8	22.22	28.51	32.67
2156.1	2186.1	25.24	30.94	29.41
2236.3	2266.3	27.45	27.33	26.31
2336.6	2366.6	27.06	26.24	25.97
2416.8	2446.8	26.73	25.23	25.12
2517.1	2547.1	25.23	24.01	24.10
2597.3	2627.3	23.73	23.76	23.43
2697.6	2727.6	22.82	22.94	22.76
2777.8	2807.8	22.19	22.40	22.21
2878.1	2908.1	21.28	22.03	22.34
2958.3	2988.3	20.72	21.72	22.56
3058.6	3088.6	20.26	21.28	22.29
3138.8	3168.8	20.05	21.21	22.31
3239.1	3269.1	19.48	21.05	21.99
3319.3	3349.3	19.21	21.05	22.19
3419.6	3449.6	19.21	21.19	22.29
3499.8	3529.8	20.18	20.99	22.28
3600.1	3630.1	15.97	19.67	22.20

RF (IN) (MHz)	LO (MHz)	COMPRESSION @RF IN=+14dBm (dB)		
		@LO (dBm)		
		+14	+17	+20
10.1	40.1	1.17	0.68	0.41
110.4	140.4	0.92	0.59	0.39
210.7	240.7	1.08	0.69	0.48
310.9	340.9	0.96	0.68	0.53
411.2	441.2	1.02	0.79	0.63
511.5	541.5	1.12	0.98	0.76
611.8	641.8	1.09	0.90	0.69
712.1	742.1	1.17	0.90	0.65
792.3	822.3	1.11	0.80	0.57
892.6	922.6	0.95	0.63	0.45
972.8	1002.8	0.87	0.52	0.36
1073.1	1103.1	0.74	0.40	0.28
1153.3	1183.3	0.59	0.29	0.21
1253.6	1283.6	0.56	0.27	0.19
1333.8	1363.8	0.61	0.26	0.17
1434.1	1464.1	0.55	0.27	0.16
1514.3	1544.3	0.58	0.30	0.17
1614.6	1644.6	0.70	0.31	0.18
1694.8	1724.8	0.66	0.31	0.18
1795.1	1825.1	0.57	0.29	0.19
1875.3	1905.3	0.40	0.26	0.18
1975.6	2005.6	0.30	0.24	0.21
2055.8	2085.8	0.16	0.18	0.19
2156.1	2186.1	0.14	0.21	0.21
2236.3	2266.3	0.16	0.24	0.26
2336.6	2366.6	0.35	0.36	0.35
2416.8	2446.8	0.45	0.44	0.40
2517.1	2547.1	0.70	0.50	0.47
2597.3	2627.3	0.85	0.61	0.51
2697.6	2727.6	1.13	0.75	0.60
2777.8	2807.8	1.32	0.83	0.64
2878.1	2908.1	1.57	0.88	0.66
2958.3	2988.3	1.70	0.92	0.67
3058.6	3088.6	1.78	0.98	0.62
3138.8	3168.8	1.87	1.01	0.62
3239.1	3269.1	2.08	1.21	0.60
3319.3	3349.3	1.96	1.28	0.67
3419.6	3449.6	1.72	1.38	0.72
3499.8	3529.8	1.23	1.48	0.79
3600.1	3630.1	0.19	1.56	0.85

Frequency Mixer

SYM-24DH+

Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=1900.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=1400.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=2400.1MHz (dB)
		@LO (dBm)			@LO (dBm)			@LO (dBm)
		+17			+17			+17
250.0	1650.1	7.65	10.0	1410.1	6.83	250.0	2150.1	8.34
237.4	1662.7	7.67	16.2	1416.3	6.78	243.8	2156.3	8.35
224.7	1675.4	7.63	22.3	1422.4	6.75	237.7	2162.4	8.30
212.1	1688.0	7.63	28.5	1428.6	6.73	231.5	2168.6	8.29
199.5	1700.6	7.63	34.6	1434.7	6.74	225.4	2174.7	8.29
186.8	1713.3	7.61	40.8	1440.9	6.73	219.2	2180.9	8.31
174.2	1725.9	7.63	46.9	1447.0	6.73	213.1	2187.0	8.29
161.6	1738.5	7.62	53.1	1453.2	6.71	206.9	2193.2	8.28
148.9	1751.2	7.60	59.2	1459.3	6.70	200.8	2199.3	8.26
136.3	1763.8	7.64	65.4	1465.5	6.70	194.6	2205.5	8.25
123.7	1776.4	7.59	71.5	1471.6	6.74	188.5	2211.6	8.27
111.1	1789.0	7.59	77.7	1477.8	6.76	182.3	2217.8	8.27
98.4	1801.7	7.60	83.8	1483.9	6.75	176.2	2223.9	8.27
85.8	1814.3	7.58	90.0	1490.1	6.73	170.0	2230.1	8.27
73.2	1826.9	7.60	96.2	1496.3	6.72	163.8	2236.3	8.25
60.5	1839.6	7.60	102.3	1502.4	6.70	157.7	2242.4	8.26
47.9	1852.2	7.58	108.5	1508.6	6.71	151.5	2248.6	8.28
35.3	1864.8	7.61	114.6	1514.7	6.70	145.4	2254.7	8.28
22.6	1877.5	7.62	120.8	1520.9	6.68	139.2	2260.9	8.27
10.0	1890.1	7.70	126.9	1527.0	6.66	133.1	2267.0	8.24
10.0	1910.1	7.72	133.1	1533.2	6.66	126.9	2273.2	8.24
22.6	1922.7	7.64	139.2	1539.3	6.69	120.8	2279.3	8.23
35.3	1935.4	7.70	145.4	1545.5	6.71	114.6	2285.5	8.22
47.9	1948.0	7.73	151.5	1551.6	6.71	108.5	2291.6	8.22
60.5	1960.6	7.77	157.7	1557.8	6.69	102.3	2297.8	8.21
73.2	1973.3	7.78	163.8	1563.9	6.68	96.2	2303.9	8.21
85.8	1985.9	7.78	170.0	1570.1	6.69	90.0	2310.1	8.21
98.4	1998.5	7.84	176.2	1576.3	6.69	83.8	2316.3	8.19
111.1	2011.2	7.87	182.3	1582.4	6.69	77.7	2322.4	8.21
123.7	2023.8	7.92	188.5	1588.6	6.67	71.5	2328.6	8.21
136.3	2036.4	7.95	194.6	1594.7	6.66	65.4	2334.7	8.21
148.9	2049.0	7.97	200.8	1600.9	6.66	59.2	2340.9	8.21
161.6	2061.7	8.02	206.9	1607.0	6.66	53.1	2347.0	8.20
174.2	2074.3	8.07	213.1	1613.2	6.66	46.9	2353.2	8.22
186.8	2086.9	8.08	219.2	1619.3	6.65	40.8	2359.3	8.23
199.5	2099.6	8.14	225.4	1625.5	6.64	34.6	2365.5	8.19
212.1	2112.2	8.19	231.5	1631.6	6.62	28.5	2371.6	8.22
224.7	2124.8	8.22	237.7	1637.8	6.62	22.3	2377.8	8.19
237.4	2137.5	8.30	243.8	1643.9	6.62	16.2	2383.9	8.21
250.0	2150.1	8.34	250.0	1650.1	6.63	10.0	2390.1	8.26

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100818
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Frequency Mixer

SYM-24DH+

Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)		
	@LO (dBm)			@LO (dBm)		
	+14	+17	+20	+14	+17	+20
10.1	37.18	39.83	42.49	42.74	45.29	49.16
110.4	37.62	40.25	42.23	42.65	45.58	47.05
210.7	37.99	39.46	39.69	44.07	45.47	44.18
310.9	38.11	38.01	37.87	45.24	44.07	41.73
411.2	38.46	37.74	37.12	47.85	42.61	39.95
511.5	38.94	38.03	36.90	47.42	40.97	38.38
611.8	40.54	38.73	36.79	46.73	40.16	37.30
712.1	42.24	39.35	36.74	44.22	39.00	36.31
792.3	42.89	38.85	36.39	43.34	38.36	35.85
892.6	42.62	38.10	35.78	43.46	37.76	35.18
972.8	42.41	37.77	35.52	43.29	37.71	35.00
1073.1	44.22	38.63	35.92	44.61	38.53	35.49
1153.3	44.41	39.54	36.30	43.72	39.61	36.10
1253.6	41.89	38.97	36.13	42.23	40.18	36.46
1333.8	40.58	37.85	35.60	41.27	40.49	36.68
1434.1	39.51	37.09	34.75	41.42	41.42	37.17
1514.3	38.78	36.95	34.46	41.96	42.38	37.51
1614.6	38.41	37.34	34.98	42.75	43.26	38.13
1694.8	38.31	37.61	35.65	43.68	42.97	38.12
1795.1	37.78	37.50	36.14	42.57	42.26	37.86
1875.3	38.22	38.58	37.29	41.97	41.42	37.59
1975.6	38.59	40.30	39.22	41.26	39.67	36.17
2055.8	38.26	40.52	40.33	40.12	37.69	34.90
2156.1	37.02	39.21	40.04	38.55	35.61	33.49
2236.3	35.73	37.77	39.10	37.00	34.29	32.24
2336.6	34.08	35.90	37.46	34.93	32.94	31.09
2416.8	32.80	34.27	35.93	33.43	31.52	30.26
2517.1	31.65	32.99	34.48	32.09	30.56	29.42
2597.3	30.15	31.65	33.24	30.63	29.93	28.78
2697.6	28.40	30.08	32.01	28.41	28.49	28.07
2777.8	27.50	29.24	31.30	27.05	27.30	27.29
2878.1	26.39	28.04	30.19	25.82	26.10	26.62
2958.3	25.64	27.21	29.38	25.02	25.25	26.02
3058.6	25.07	26.68	28.71	24.16	24.62	25.22
3138.8	24.68	26.24	28.19	23.59	24.13	24.79
3239.1	24.29	25.78	27.61	23.03	23.69	24.38
3319.3	24.16	25.62	27.40	22.76	23.47	24.23
3419.6	24.07	25.44	27.14	22.52	23.27	24.12
3499.8	24.01	25.25	26.87	22.43	23.19	24.10
3600.1	24.10	25.01	26.48	22.28	22.93	23.88

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB)		
		@LO (dBm)		
		+14	+17	+20
10.1	40.1	33.46	33.53	34.63
110.4	140.4	34.39	35.22	36.52
210.7	240.7	35.79	36.54	37.10
310.9	340.9	37.56	38.28	39.01
411.2	441.2	39.54	39.91	40.58
511.5	541.5	40.15	41.24	42.62
611.8	641.8	42.57	43.52	43.04
712.1	742.1	46.85	47.06	44.93
792.3	822.3	48.96	46.77	42.72
892.6	922.6	48.79	44.13	41.61
972.8	1002.8	46.87	43.55	40.89
1073.1	1103.1	45.90	43.00	40.92
1153.3	1183.3	46.85	43.66	40.99
1253.6	1283.6	44.00	44.09	41.53
1333.8	1363.8	41.04	43.03	41.19
1434.1	1464.1	39.95	43.21	42.65
1514.3	1544.3	39.57	43.96	44.86
1614.6	1644.6	39.26	42.82	47.04
1694.8	1724.8	37.72	40.34	44.18
1795.1	1825.1	36.18	37.47	39.98
1875.3	1905.3	35.15	35.83	37.85
1975.6	2005.6	34.89	35.30	36.99
2055.8	2085.8	35.27	35.62	37.34
2156.1	2186.1	37.23	37.26	38.62
2236.3	2266.3	38.97	39.14	40.37
2336.6	2366.6	42.06	42.29	42.98
2416.8	2446.8	45.40	44.56	45.33
2517.1	2547.1	43.22	42.53	42.84
2597.3	2627.3	42.75	44.24	45.93
2697.6	2727.6	40.09	41.24	44.40
2777.8	2807.8	38.32	38.72	41.19
2878.1	2908.1	36.25	36.33	37.73
2958.3	2988.3	35.07	34.95	36.26
3058.6	3088.6	33.99	33.56	34.68
3138.8	3168.8	33.27	32.88	33.91
3239.1	3269.1	32.27	31.66	32.79
3319.3	3349.3	31.85	31.06	32.04
3419.6	3449.6	31.69	30.98	32.02
3499.8	3529.8	30.99	30.71	31.93
3600.1	3630.1	29.25	30.07	31.11

Frequency Mixer

SYM-24DH+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1)			LO (MHz)	LO VSWR (:1)			IF (OUT) (MHz)	IF VSWR @LO=2400.1MHz (:1)		
		@LO (dBm)				@LO (dBm)				@LO (dBm)		
		+14	+17	+20		+14	+17	+20		+14	+17	+20
10.1	40.1	1.32	1.16	1.08	10.1	1.03	1.51	2.18	10.0	1.50	1.20	1.18
110.4	140.4	1.40	1.23	1.12	110.4	1.04	1.54	2.25	16.2	1.41	1.07	1.12
210.7	240.7	1.44	1.29	1.21	210.7	1.11	1.52	2.22	22.3	1.34	1.02	1.16
310.9	340.9	1.62	1.45	1.35	310.9	1.12	1.50	2.18	28.5	1.36	1.05	1.14
411.2	441.2	1.76	1.58	1.49	411.2	1.20	1.48	2.12	34.6	1.33	1.06	1.17
511.5	541.5	1.97	1.77	1.66	511.5	1.21	1.42	2.04	40.8	1.33	1.06	1.17
611.8	641.8	2.20	1.98	1.85	611.8	1.27	1.40	1.97	46.9	1.29	1.08	1.21
712.1	742.1	2.34	2.12	2.00	712.1	1.30	1.33	1.88	53.1	1.26	1.09	1.23
792.3	822.3	2.46	2.26	2.14	792.3	1.36	1.31	1.81	59.2	1.26	1.07	1.22
892.6	922.6	2.54	2.37	2.26	892.6	1.43	1.27	1.73	65.4	1.25	1.06	1.21
972.8	1002.8	2.62	2.43	2.33	972.8	1.49	1.25	1.67	71.5	1.24	1.06	1.22
1073.1	1103.1	2.67	2.48	2.38	1073.1	1.57	1.23	1.60	77.7	1.25	1.06	1.21
1153.3	1183.3	2.70	2.48	2.37	1153.3	1.61	1.23	1.56	83.8	1.26	1.06	1.20
1253.6	1283.6	2.73	2.46	2.33	1253.6	1.61	1.19	1.50	90.0	1.28	1.05	1.19
1333.8	1363.8	2.73	2.43	2.28	1333.8	1.61	1.16	1.46	96.2	1.28	1.05	1.19
1434.1	1464.1	2.67	2.39	2.22	1434.1	1.59	1.10	1.42	102.3	1.30	1.07	1.19
1514.3	1544.3	2.59	2.31	2.14	1514.3	1.58	1.04	1.40	108.5	1.30	1.07	1.19
1614.6	1644.6	2.46	2.22	2.08	1614.6	1.57	1.03	1.40	114.6	1.31	1.08	1.20
1694.8	1724.8	2.41	2.18	2.04	1694.8	1.55	1.06	1.42	120.8	1.31	1.09	1.20
1795.1	1825.1	2.51	2.27	2.13	1795.1	1.52	1.08	1.46	126.9	1.31	1.11	1.21
1875.3	1905.3	2.60	2.37	2.22	1875.3	1.47	1.11	1.49	133.1	1.30	1.12	1.23
1975.6	2005.6	2.72	2.50	2.35	1975.6	1.40	1.16	1.56	139.2	1.31	1.12	1.23
2055.8	2085.8	2.78	2.55	2.40	2055.8	1.35	1.20	1.61	145.4	1.30	1.13	1.25
2156.1	2186.1	2.72	2.49	2.35	2156.1	1.28	1.27	1.69	151.5	1.28	1.13	1.26
2236.3	2266.3	2.60	2.40	2.26	2236.3	1.22	1.32	1.76	157.7	1.27	1.13	1.26
2336.6	2366.6	2.43	2.27	2.14	2336.6	1.16	1.39	1.83	163.8	1.27	1.13	1.26
2416.8	2446.8	2.30	2.13	2.03	2416.8	1.14	1.46	1.91	170.0	1.27	1.13	1.26
2517.1	2547.1	2.14	1.99	1.88	2517.1	1.14	1.52	1.96	176.2	1.27	1.12	1.25
2597.3	2627.3	1.99	1.84	1.74	2597.3	1.18	1.58	2.02	182.3	1.28	1.12	1.25
2697.6	2727.6	1.85	1.71	1.61	2697.6	1.26	1.66	2.08	188.5	1.29	1.12	1.24
2777.8	2807.8	1.78	1.64	1.53	2777.8	1.33	1.72	2.12	194.6	1.30	1.13	1.24
2878.1	2908.1	1.70	1.54	1.44	2878.1	1.45	1.81	2.19	200.8	1.31	1.14	1.25
2958.3	2988.3	1.64	1.47	1.38	2958.3	1.54	1.88	2.23	206.9	1.32	1.15	1.26
3058.6	3088.6	1.56	1.42	1.31	3058.6	1.68	1.97	2.29	213.1	1.33	1.16	1.26
3138.8	3168.8	1.54	1.39	1.28	3138.8	1.79	2.04	2.32	219.2	1.33	1.18	1.28
3239.1	3269.1	1.54	1.38	1.26	3239.1	1.94	2.14	2.38	225.4	1.34	1.19	1.28
3319.3	3349.3	1.58	1.39	1.27	3319.3	2.08	2.24	2.44	231.5	1.33	1.19	1.29
3419.6	3449.6	1.62	1.42	1.30	3419.6	2.27	2.35	2.51	237.7	1.34	1.21	1.30
3499.8	3529.8	1.71	1.47	1.34	3499.8	2.42	2.46	2.58	243.8	1.33	1.21	1.31
3600.1	3630.1	1.84	1.51	1.38	3600.1	2.61	2.59	2.67	250.0	1.33	1.22	1.32

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Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	13	7	29	29	29	40	28	45	45	75
1	-	31	+0	43	15	45	28	42	56	42	56	70
2	99	52	61	60	60	50	80	61	67	65	61	69
3	>100	84	69	77	58	76	58	91	63	81	80	87
4	>100	>92	>92	89	>92	82	>92	88	>92	>92	>92	>92
5	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
6	>100	>92	>92	>92	>92	>92	>92	92	>92	>92	>92	>92
7	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
8	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
9	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
10	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions:

RF IN: 1900.1 MHz; -1.00 dBm.
LO IN: 1930.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; -8.25 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	23	17	39	38	43	50	43	58	65	79
1	-	31	+0	45	16	45	32	46	69	46	59	64
2	84	44	52	52	48	42	69	54	58	75	60	64
3	>100	63	57	60	41	60	40	69	47	61	67	63
4	>100	68	79	61	69	64	68	61	74	68	76	68
5	>100	84	66	92	63	78	59	75	60	94	65	77
6	>100	93	95	86	93	84	87	91	80	80	83	85
7	>100	96	101	100	91	99	88	87	85	83	82	97
8	>100	>102	>102	>102	>102	98	100	94	94	93	89	90
9	>100	>102	>102	>102	>102	>102	>102	>102	101	>102	>102	>102
10	>100	>102	>102	>102	>102	>102	>102	>102	>102	100	>102	>102
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions:

RF IN: 1900.1 MHz; 9.00 dBm.
LO IN: 1930.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; 1.75 dBm

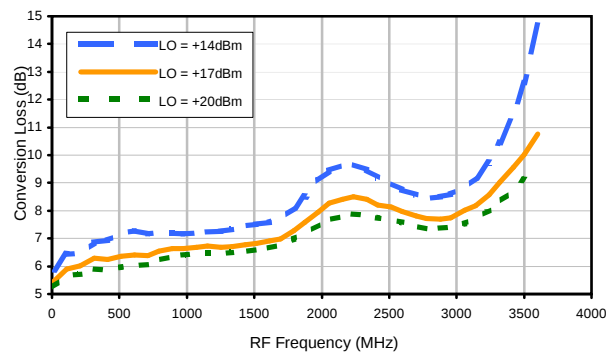
- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT.
2. + entry denotes harmonics are in (dBc) above IF OUTPUT.
3. RF Cal represent the Harmonics level of the RF input signal to the mixer.

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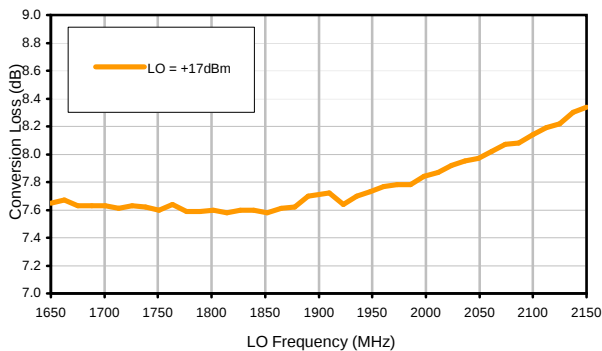


Typical Performance Curves

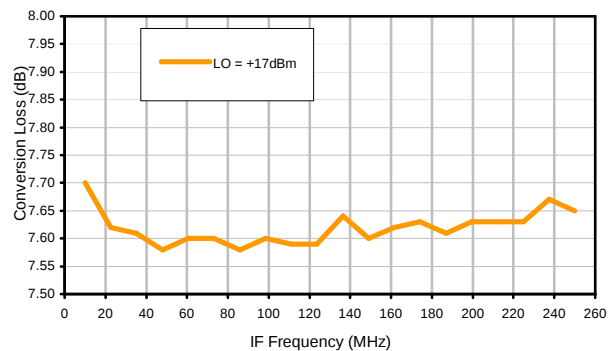
Conversion Loss @ IF=30MHz



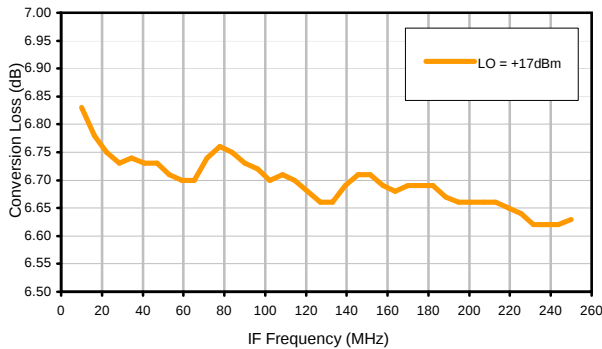
Conversion Loss vs. LO @ RF=1900.1MHz



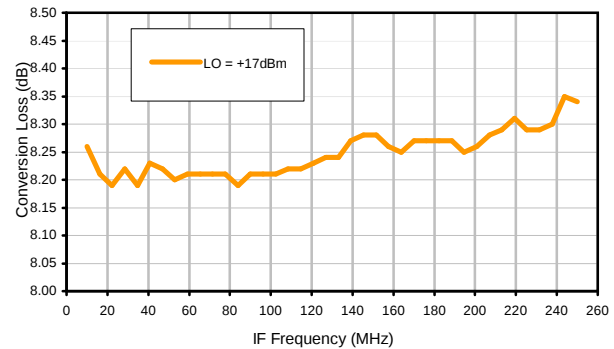
Conversion Loss vs. IF @ RF=1900.1MHz



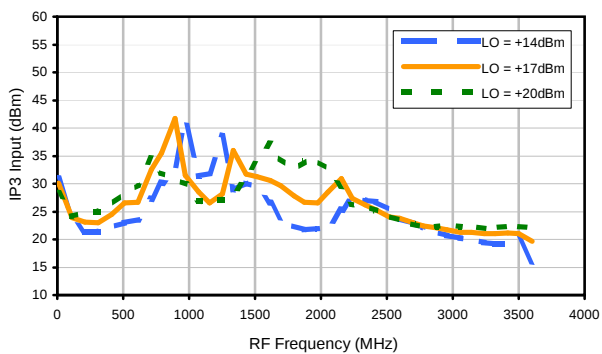
Conversion Loss vs. IF @ RF=1400.1MHz



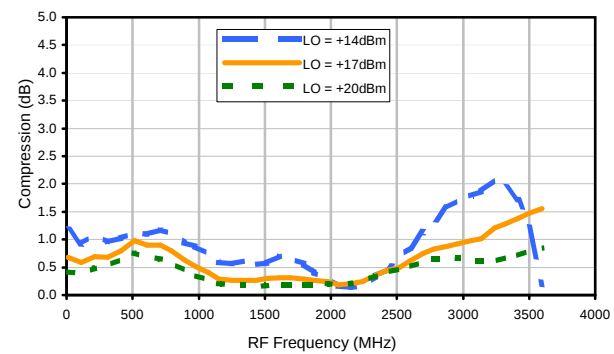
Conversion Loss vs. IF @ RF=2400.1MHz



IP3 Input



Compression @ RF IN=+14dBm

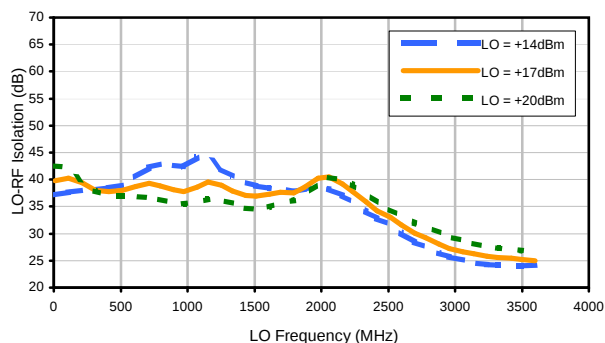


Frequency Mixer

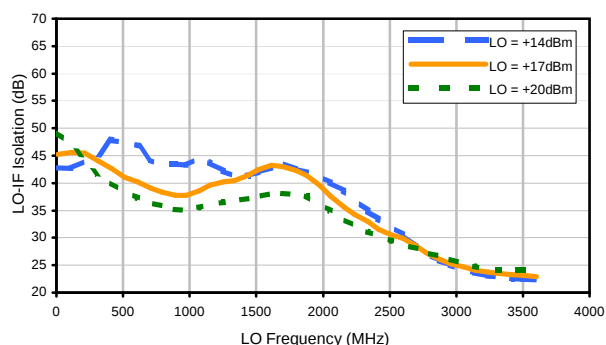
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Typical Performance Curves

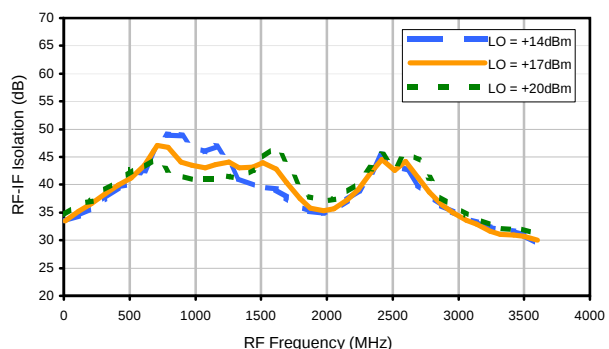
LO-RF Isolation



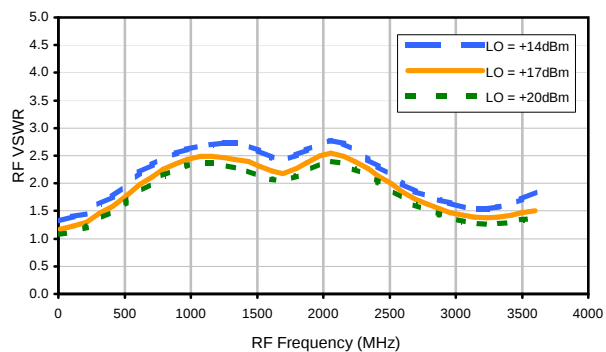
LO-IF Isolation



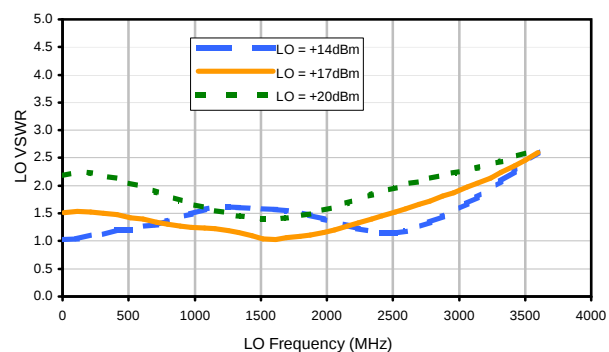
RF-IF Isolation



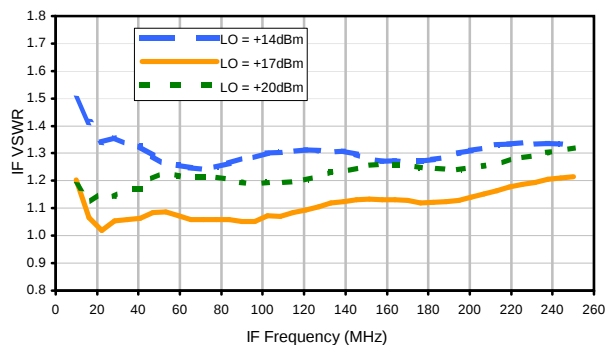
RF VSWR



LO VSWR



IF VSWR



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Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	13	7	29	29	29	40	28	45	45	75
1	-	31	+0	43	15	45	28	42	56	42	56	70
2	99	52	61	60	60	50	80	61	67	65	61	69
3	>100	84	69	77	58	76	58	91	63	81	80	87
4	>100	>92	>92	89	>92	82	>92	88	>92	>92	>92	>92
5	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
6	>100	>92	>92	>92	>92	>92	>92	92	>92	>92	>92	>92
7	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
8	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
9	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
10	>100	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92	>92
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions: RF IN: 1900.1 MHz; -1.00 dBm.
LO IN: 1930.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; -8.25 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	23	17	39	38	43	50	43	58	65	79
1	-	31	+0	45	16	45	32	46	69	46	59	64
2	84	44	52	52	48	42	69	54	58	75	60	64
3	>100	63	57	60	41	60	40	69	47	61	67	63
4	>100	68	79	61	69	64	68	61	74	68	76	68
5	>100	84	66	92	63	78	59	75	60	94	65	77
6	>100	93	95	86	93	84	87	91	80	80	83	85
7	>100	96	101	100	91	99	88	87	85	83	82	97
8	>100	>102	>102	>102	>102	98	100	94	94	93	89	90
9	>100	>102	>102	>102	>102	>102	>102	>102	101	>102	>102	>102
10	>100	>102	>102	>102	>102	>102	>102	>102	>102	100	>102	>102
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions: RF IN: 1900.1 MHz; 9.00 dBm.
LO IN: 1930.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; 1.75 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.

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Outline Dimensions

TTT166
TTT167



PCB Land Pattern



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

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. $\pm .01$; 3 Pl. $\pm .005$

Note:

- Case material: Plastic.
- Base material: Printed wiring laminate.
- 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.

Tape & Reel Packaging TR-F12



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.

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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 R04350B WITH DIELECTRIC THICKNESS .030" $\pm$.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

INITIALS

DATE

DIMENSIONS ARE IN INCHES

TOLERANCES ON:

2 PL DECIMALS $\pm$ 3 PL DECIMALS $\pm$.005ANGLES $\pm$ FRACTIONS $\pm$

DRAWN

GF

03/18/03

CHECKED

IL

04/15/03

APPROVED

DJ

04/15/03



Mini-Circuits®

13 Neptune Avenue
Brooklyn NY 11235

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

SIZE
A

CODE IDENT
15542

DRAWING NO:
98-PL-079

REV:
D

FILE: 98PL079

SCALE: 5:1

SHEET: 1 OF 1

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

Evaluation Board and Circuit

For Pin Connections Refer to Data Sheet of the DUT



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