

Surface Mount Frequency Mixer

Level 7 (LO Power +7 dBm) 2 to 1000 MHz

SYM-2+
SYM-2



CASE STYLE: TTT166

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	50mW
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

- low conversion loss, 5.4 dB typ.
- excellent L-R & L-I isolation, 50 dB typ.
- IF response to DC

Applications

- VHF TV
- cellular
- GSM/ISM

+RoHS Compliant

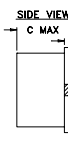
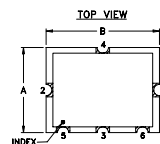
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications



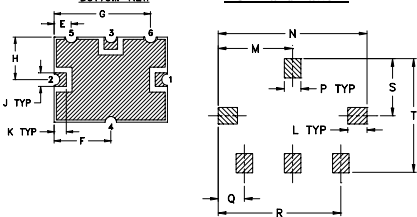
Available Tape and Reel at no extra cost

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

Outline Drawing



PCB Land Pattern

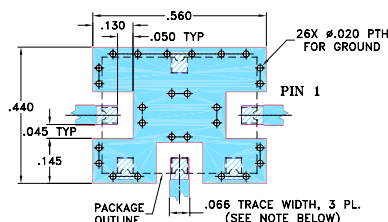


Suggested Layout,
Tolerance to be within ±.002

Outline Dimensions (inch)

A	B	C	D	E	F	G	H	J	
.38	.50	.15	.020	.075	.250	.425	.187	.050	
9.65	12.70	3.81	0.51	1.91	6.35	10.80	4.75	1.27	
K	L	M	N	P	Q	R	S	T	wt.
.050	.070	.270	.540	.060	.095	.445	.208	.415	grams
1.27	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.

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



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Electrical Specifications

FREQUENCY (MHz)		CONVERSION LOSS (dB)				LO-RF ISOLATION (dB)						LO-IF ISOLATION (dB)						IP3 at center band (dBm)
LO/RF	IF	Mid-Band		Total Range	Max.	L		M		U		L		M		U		
		$\overline{X}$	σ			Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	
f_L - f_U																		
2-1000	DC-1000	5.4	.10	7.2	9.5	70	45	50	30	40	25	63	40	48	24	37	20	17

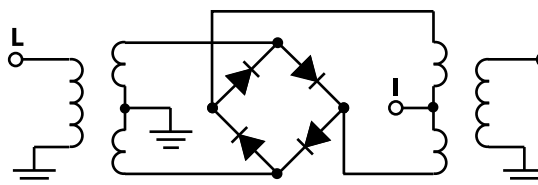
1 dB COMP.: +1 dBm typ.

L = low range [f_L to $10 f_L$]
M = mid band [$2 f_L$ to $f_U/2$]
U = upper range [$f_U/2$ to f_U]

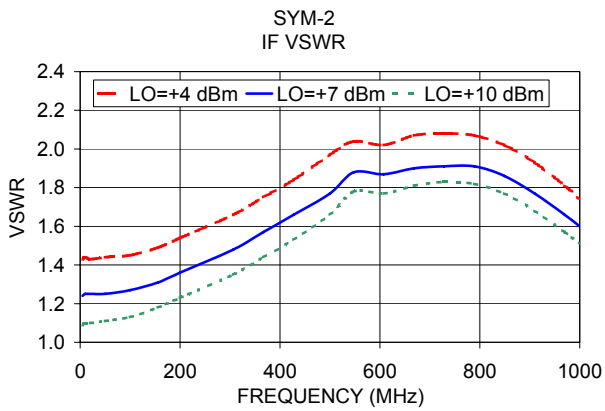
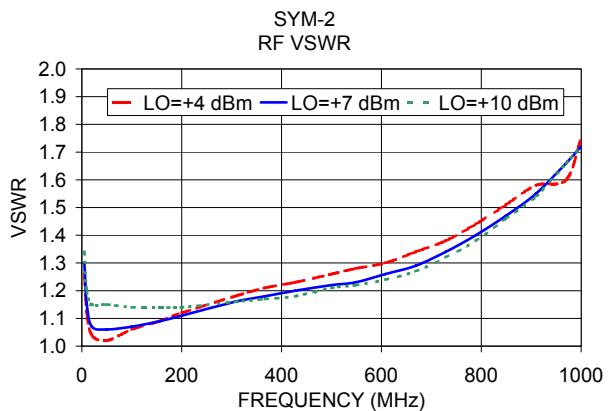
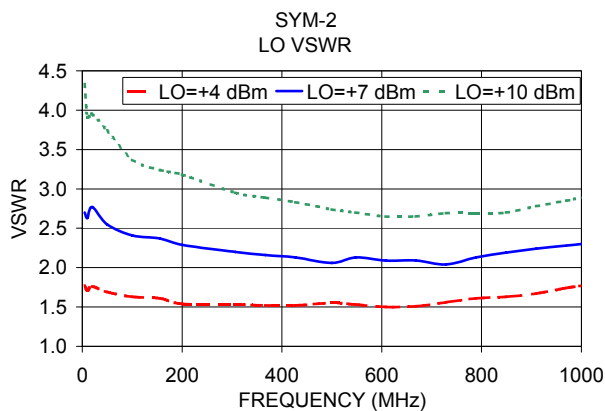
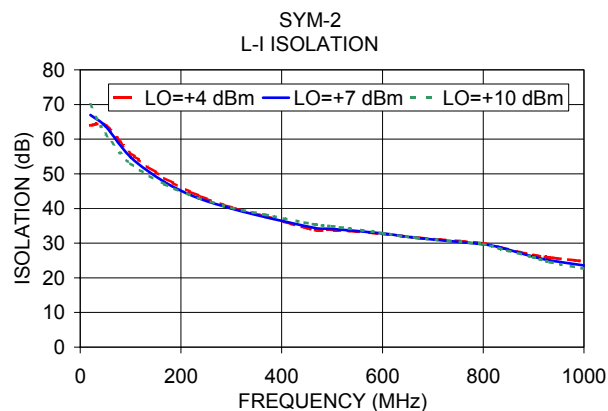
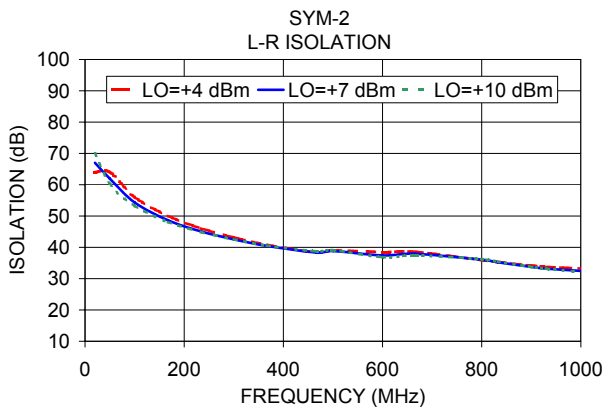
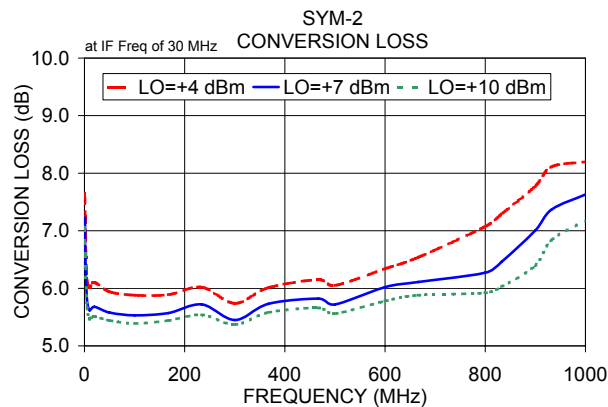
Typical Performance Data

Frequency (MHz)		Conversion Loss (dB)	Isolation L-R (dB)	Isolation L-I (dB)	VSWR RF Port (:1)	VSWR LO Port (:1)
RF	LO	LO +7dBm	LO +7dBm	LO +7dBm	LO +7dBm	LO +7dBm
1.00	31.00	7.23	>67.00	>67.00	1.30	2.70
2.00	32.00	6.50	>67.00	>67.00	1.15	2.63
5.00	35.00	5.80	>67.00	>67.00	1.07	2.77
10.00	40.00	5.62	>67.00	>67.00	1.06	2.55
20.00	50.00	5.68	>67.00	>67.00	1.07	2.41
50.00	80.00	5.58	61.94	63.74	1.09	2.37
100.00	70.00	5.53	54.33	54.76	1.11	2.29
167.34	137.34	5.57	48.65	47.61	1.16	2.20
233.87	203.87	5.72	45.10	43.03	1.18	2.16
300.40	270.40	5.45	42.56	40.00	1.20	2.13
366.94	336.94	5.73	40.45	37.57	1.22	2.06
466.74	436.74	5.82	38.33	34.32	1.23	2.13
500.00	470.00	5.72	38.80	34.10	1.26	2.09
599.81	569.81	6.02	37.43	32.81	1.29	2.09
666.34	636.34	6.11	37.94	31.57	1.34	2.04
799.41	769.41	6.27	36.06	29.67	1.40	2.13
832.68	802.68	6.46	35.22	28.79	1.47	2.19
899.21	869.21	7.00	33.77	26.14	1.55	2.24
932.48	902.48	7.37	33.17	25.03	1.66	2.28
1000.00	969.00	7.63	32.49	23.59	1.72	2.30

Electrical Schematic



Performance Charts



Notes

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Frequency Mixer

SYM-2+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	CONVERSION LOSS IF FIXED @IF(OUT)=30MHz (dB)			RF (IN) (MHz)	LO (MHz)	IP3 INPUT (dBm)			RF (IN) (MHz)	LO (MHz)	COMPRESSION @RF IN=+1dBm (dB)		
		@LO (dBm)					@LO (dBm)					@LO (dBm)		
+4	+7	+10	+4	+7	+10	+4	+7	+10	+4	+7	+10			
1.0	31.0	7.65	7.23	7.05	10.1	40.1	16.41	19.47	22.74	10.1	40.1	1.24	0.92	0.70
2.0	32.0	6.99	6.50	6.38	50.4	80.4	16.87	17.73	20.73	50.4	80.4	1.19	0.80	0.65
5.0	35.0	6.14	5.80	5.68	90.7	120.7	15.39	18.95	21.85	90.7	120.7	1.24	0.84	0.64
10.0	40.0	6.01	5.62	5.47	131.0	161.0	17.07	16.83	21.99	131.0	161.0	1.17	0.83	0.62
50.4	80.4	5.75	5.43	5.17	171.4	201.4	16.38	20.99	26.37	171.4	201.4	1.13	0.80	0.59
90.7	120.7	5.74	5.41	5.22	211.7	241.7	20.44	21.62	21.41	211.7	241.7	1.13	0.78	0.57
131.0	161.0	5.76	5.44	5.24	252.0	282.0	26.10	22.47	23.05	252.0	282.0	1.09	0.78	0.56
171.4	201.4	5.78	5.45	5.26	292.3	322.3	22.36	17.90	19.44	292.3	322.3	1.07	0.81	0.60
252.0	282.0	5.79	5.48	5.35	332.6	362.6	24.08	19.66	20.00	332.6	362.6	1.08	0.75	0.61
292.3	322.3	5.79	5.49	5.32	372.9	402.9	19.74	19.16	19.37	372.9	402.9	1.04	0.73	0.57
332.6	362.6	5.81	5.56	5.38	413.2	443.2	14.74	19.01	26.12	413.2	443.2	1.09	0.76	0.59
372.9	402.9	5.84	5.58	5.42	453.5	483.5	14.68	15.03	15.83	453.5	483.5	1.06	0.72	0.58
413.2	443.2	5.81	5.53	5.40	493.9	523.9	18.17	26.17	22.26	493.9	523.9	0.96	0.67	0.53
453.5	483.5	5.88	5.59	5.41	514.0	544.0	17.59	19.51	17.26	514.0	544.0	0.99	0.69	0.51
493.9	523.9	5.90	5.65	5.47	554.3	584.3	16.75	23.04	18.19	554.3	584.3	0.96	0.69	0.51
514.0	544.0	6.00	5.70	5.50	574.5	604.5	16.91	20.30	19.16	574.5	604.5	1.01	0.70	0.54
554.3	584.3	6.05	5.76	5.56	614.8	644.8	18.97	17.57	19.48	614.8	644.8	1.04	0.72	0.57
574.5	604.5	6.06	5.80	5.60	634.9	664.9	17.52	19.24	18.50	634.9	664.9	1.07	0.75	0.56
614.8	644.8	6.16	5.87	5.70	675.3	705.3	17.80	20.61	17.59	675.3	705.3	1.07	0.73	0.53
675.3	705.3	6.27	6.00	5.88	695.4	725.4	15.10	17.80	18.48	695.4	725.4	1.08	0.75	0.50
695.4	725.4	6.32	6.06	5.94	735.7	765.7	10.54	16.90	24.37	735.7	765.7	1.14	0.76	0.52
735.7	765.7	6.44	6.20	6.05	755.9	785.9	8.68	12.27	18.15	755.9	785.9	1.20	0.81	0.57
755.9	785.9	6.43	6.25	6.12	796.2	826.2	6.52	8.57	11.95	796.2	826.2	1.25	0.86	0.64
796.2	826.2	6.53	6.35	6.18	816.4	846.4	5.85	7.24	9.24	816.4	846.4	1.36	0.95	0.73
816.4	846.4	6.57	6.36	6.21	856.7	886.7	6.01	6.98	8.07	856.7	886.7	1.37	0.98	0.74
856.7	886.7	6.73	6.49	6.35	876.8	906.8	6.43	7.21	8.53	876.8	906.8	1.40	1.00	0.76
876.8	906.8	6.85	6.56	6.39	917.1	947.1	7.05	8.76	10.44	917.1	947.1	1.51	1.07	0.84
917.1	947.1	7.01	6.73	6.53	937.3	967.3	7.56	9.33	11.68	937.3	967.3	1.59	1.15	0.88
937.3	967.3	7.06	6.73	6.56	977.6	1007.6	8.70	12.40	14.93	977.6	1007.6	1.55	1.13	0.87
977.6	1007.6	7.28	6.86	6.59	997.8	1027.8	9.33	13.35	17.41	997.8	1027.8	1.58	1.18	0.85
997.8	1027.8	7.36	6.88	6.60	1038.1	1068.1	9.74	16.02	21.85	1038.1	1068.1	1.54	1.20	0.89
1038.1	1068.1	7.67	7.05	6.76	1058.2	1088.2	9.38	18.22	20.74	1058.2	1088.2	1.53	1.19	0.85
1058.2	1088.2	7.83	7.14	6.77	1098.5	1128.5	8.64	18.82	19.27	1098.5	1128.5	1.37	1.20	0.90
1098.5	1128.5	8.29	7.46	6.99	1118.7	1148.7	8.30	21.33	16.03	1118.7	1148.7	1.27	1.16	0.93
1159.0	1189.0	9.13	8.03	7.40	1159.0	1189.0	7.85	17.79	14.73	1159.0	1189.0	1.03	1.07	0.87
1179.2	1209.2	9.44	8.28	7.60	1179.2	1209.2	8.19	14.86	15.17	1179.2	1209.2	0.92	1.03	0.92
1219.5	1249.5	9.96	8.78	7.93	1219.5	1249.5	7.95	13.47	14.76	1219.5	1249.5	0.69	0.91	0.90
1239.6	1269.6	10.28	9.08	8.17	1239.6	1269.6	7.58	11.08	15.20	1239.6	1269.6	0.61	0.84	0.92
1279.9	1309.9	10.97	9.77	8.82	1279.9	1309.9	7.29	9.65	12.19	1279.9	1309.9	0.38	0.72	0.88
1300.1	1330.1	11.29	10.13	9.14	1300.1	1330.1	7.11	9.00	11.53	1300.1	1330.1	0.30	0.55	0.84

REV. X2

SYM-2+

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Frequency Mixer

SYM-2+

Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=500.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=10.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=1000.1MHz (dB)
		@LO (dBm)			@LO (dBm)			@LO (dBm)
		+7			+7			+7
490.0	10.1	5.89	10.0	20.1	5.24	990.0	10.1	8.02
477.7	22.4	5.86	30.0	40.1	5.17	970.0	30.1	8.06
465.4	34.7	5.82	50.0	60.1	5.21	950.0	50.1	8.03
453.1	47.0	5.81	70.0	80.1	5.27	930.0	70.1	8.04
440.8	59.3	5.86	90.0	100.1	5.27	910.0	90.1	8.02
428.5	71.6	5.81	110.0	120.1	5.27	890.0	110.1	7.96
416.2	83.9	5.81	130.0	140.1	5.26	870.0	130.1	7.83
403.8	96.3	5.75	150.0	160.1	5.30	850.0	150.1	7.80
391.5	108.6	5.70	170.0	180.1	5.33	830.0	170.1	7.80
379.2	120.9	5.69	190.0	200.1	5.32	810.0	190.1	7.73
366.9	133.2	5.68	210.0	220.1	5.31	790.0	210.1	7.71
354.6	145.5	5.65	230.0	240.1	5.30	770.0	230.1	7.65
342.3	157.8	5.65	250.0	260.1	5.37	750.0	250.1	7.60
330.0	170.1	5.64	270.0	280.1	5.36	730.0	270.1	7.61
317.7	182.4	5.64	290.0	300.1	5.36	710.0	290.1	7.59
305.4	194.7	5.63	310.0	320.1	5.38	690.0	310.1	7.57
293.1	207.0	5.61	330.0	340.1	5.39	670.0	330.1	7.54
280.8	219.3	5.59	350.0	360.1	5.41	650.0	350.1	7.55
268.5	231.6	5.62	370.0	380.1	5.45	630.0	370.1	7.58
256.2	243.9	5.61	390.0	400.1	5.45	610.0	390.1	7.61
243.8	256.3	5.62	430.0	440.1	5.47	570.0	430.1	7.53
231.5	268.6	5.61	450.0	460.1	5.45	550.0	450.1	7.54
219.2	280.9	5.59	490.0	500.1	5.41	510.0	490.1	7.49
206.9	293.2	5.61	510.0	520.1	5.41	490.0	510.1	7.47
194.6	305.5	5.62	550.0	560.1	5.46	450.0	550.1	7.46
182.3	317.8	5.62	570.0	580.1	5.50	430.0	570.1	7.48
170.0	330.1	5.62	610.0	620.1	5.59	390.0	610.1	7.36
157.7	342.4	5.62	630.0	640.1	5.64	370.0	630.1	7.33
145.4	354.7	5.62	670.0	680.1	5.68	330.0	670.1	7.23
133.1	367.0	5.62	690.0	700.1	5.69	310.0	690.1	7.19
120.8	379.3	5.60	730.0	740.1	5.72	270.0	730.1	7.13
108.5	391.6	5.58	750.0	760.1	5.69	250.0	750.1	7.17
96.2	403.9	5.58	790.0	800.1	5.72	210.0	790.1	7.16
83.8	416.3	5.57	810.0	820.1	5.72	190.0	810.1	7.19
71.5	428.6	5.58	850.0	860.1	5.75	150.0	850.1	7.32
59.2	440.9	5.60	870.0	880.1	5.77	130.0	870.1	7.30
46.9	453.2	5.59	910.0	920.1	5.80	90.0	910.1	7.19
34.6	465.5	5.61	930.0	940.1	5.79	70.0	930.1	7.15
22.3	477.8	5.63	970.0	980.1	5.80	30.0	970.1	7.05
10.0	490.1	5.66	990.0	1000.1	5.78	10.0	990.1	7.04

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Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)		
	@LO (dBm)			@LO (dBm)		
	+4	+7	+10	+4	+7	+10
1.0	64.00	67.00	70.00	64.00	67.00	70.00
2.0	64.00	67.00	70.00	64.00	67.00	70.00
5.0	64.00	67.00	70.00	64.00	67.00	70.00
10.0	64.00	67.00	70.00	64.00	67.00	70.00
50.4	67.97	71.34	73.65	54.17	52.62	51.87
90.7	62.20	65.76	69.53	49.12	47.61	46.66
131.0	58.11	61.43	65.41	45.97	45.02	44.35
171.4	54.66	57.92	61.54	44.10	43.10	42.18
252.0	50.30	53.13	55.70	41.54	40.36	39.41
292.3	48.43	50.88	52.97	40.20	39.15	38.36
332.6	47.09	49.12	50.82	38.91	37.86	37.13
372.9	45.60	47.47	48.81	37.64	36.71	35.96
413.2	44.22	45.94	47.28	36.83	35.75	34.94
453.5	43.02	44.36	45.56	35.56	34.87	34.00
493.9	42.05	43.43	44.55	34.44	33.78	33.35
514.0	41.71	43.08	44.20	33.80	33.13	32.61
554.3	41.19	42.33	43.23	32.81	32.27	31.55
574.5	41.01	41.94	42.73	32.37	31.99	31.44
614.8	40.98	41.80	42.13	31.41	31.18	30.93
675.3	40.33	41.56	42.10	30.30	30.02	29.97
695.4	39.99	41.31	41.83	29.95	29.64	29.49
735.7	39.25	40.37	40.92	29.44	28.82	28.39
755.9	38.93	40.09	40.72	29.36	28.79	28.30
796.2	38.24	39.55	40.30	29.01	28.74	28.05
816.4	37.86	39.23	40.10	28.74	28.70	28.13
856.7	37.45	39.05	40.14	28.23	28.52	28.24
876.8	37.31	39.08	40.29	28.03	28.46	28.33
917.1	36.76	38.72	40.23	27.29	27.77	27.99
937.3	36.67	38.74	40.32	27.18	27.78	27.94
977.6	36.43	38.63	40.38	26.70	27.35	27.68
997.8	36.49	38.74	40.55	26.51	27.21	27.55
1038.1	36.50	38.78	40.58	25.74	26.55	27.12
1058.2	36.75	39.07	40.88	25.63	26.33	26.97
1098.5	36.91	39.26	41.18	25.26	25.57	26.29
1159.0	37.56	39.93	41.89	25.27	25.19	25.55
1179.2	37.74	39.96	41.80	25.36	25.19	25.37
1219.5	38.00	39.87	41.26	25.19	25.21	25.21
1239.6	38.13	39.79	40.90	25.25	25.36	25.30
1279.9	38.33	39.62	40.39	25.21	25.53	25.52
1300.1	38.40	39.55	40.25	25.24	25.72	25.76

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB)		
		@LO (dBm)		
		+4	+7	+10
10.1	40.1	43.50	40.93	44.96
50.4	80.4	31.91	32.13	32.21
90.7	120.7	27.83	27.84	27.88
131.0	161.0	25.13	25.18	25.17
171.4	201.4	23.34	23.48	23.58
211.7	241.7	22.36	22.40	22.49
252.0	282.0	21.76	21.89	22.09
292.3	322.3	21.49	21.50	21.59
332.6	362.6	21.79	21.95	21.96
372.9	402.9	22.09	22.49	22.78
413.2	443.2	22.33	22.88	23.31
453.5	483.5	22.92	23.17	23.41
493.9	523.9	23.95	23.88	23.86
514.0	544.0	24.25	24.11	24.09
554.3	584.3	23.89	24.01	24.19
574.5	604.5	22.80	23.34	23.77
614.8	644.8	19.81	20.52	21.09
634.9	664.9	18.57	19.21	19.79
675.3	705.3	16.54	16.89	17.24
695.4	725.4	15.77	16.05	16.34
735.7	765.7	14.53	14.65	14.81
755.9	785.9	14.05	14.10	14.12
796.2	826.2	13.38	13.23	13.17
816.4	846.4	13.03	12.84	12.74
856.7	886.7	12.49	12.31	12.12
876.8	906.8	12.15	11.97	11.86
917.1	947.1	11.70	11.45	11.29
937.3	967.3	11.50	11.23	11.08
977.6	1007.6	11.19	10.91	10.79
997.8	1027.8	11.06	10.85	10.78
1038.1	1068.1	10.87	10.85	10.77
1058.2	1088.2	10.78	10.74	10.79
1098.5	1128.5	10.58	10.59	10.72
1118.7	1148.7	10.52	10.56	10.69
1159.0	1189.0	10.43	10.53	10.65
1179.2	1209.2	10.33	10.42	10.67
1219.5	1249.5	10.17	10.39	10.59
1239.6	1269.6	10.09	10.33	10.54
1279.9	1309.9	9.88	10.18	10.42
1300.1	1330.1	9.78	10.03	10.30

Frequency Mixer

SYM-2+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1)			LO (MHz)	LO VSWR (:1)			IF (OUT) (MHz)	IF VSWR @LO=1000.5MHz (:1)		
		@LO (dBm)				@LO (dBm)				@LO (dBm)		
		+4	+7	+10		+4	+7	+10		+4	+7	+10
5.0	35.0	1.26	1.30	1.34	5.0	1.77	2.70	4.33	5.0	1.43	1.24	1.09
10.0	40.0	1.12	1.15	1.20	10.0	1.71	2.63	3.91	10.0	1.44	1.25	1.10
50.4	80.4	1.18	1.09	1.04	50.4	1.85	2.67	3.77	30.2	1.63	1.43	1.30
90.7	120.7	1.19	1.09	1.05	90.7	1.79	2.54	3.54	50.4	1.65	1.44	1.31
131.0	161.0	1.18	1.09	1.07	131.0	1.81	2.60	3.62	70.6	1.62	1.44	1.31
171.4	201.4	1.16	1.10	1.10	171.4	1.78	2.52	3.51	90.8	1.62	1.40	1.28
211.7	241.7	1.16	1.11	1.12	211.7	1.80	2.56	3.54	111.0	1.63	1.42	1.31
252.0	282.0	1.18	1.14	1.16	252.0	1.82	2.58	3.56	131.2	1.67	1.45	1.34
292.3	322.3	1.19	1.17	1.18	292.3	1.81	2.54	3.50	151.4	1.66	1.46	1.35
332.6	362.6	1.21	1.19	1.21	332.6	1.85	2.61	3.57	171.6	1.60	1.41	1.32
372.9	402.9	1.23	1.24	1.26	372.9	1.85	2.58	3.51	191.8	1.62	1.43	1.35
413.2	443.2	1.25	1.26	1.30	413.2	1.89	2.63	3.56	212.0	1.69	1.49	1.41
453.5	483.5	1.27	1.28	1.31	453.5	1.92	2.65	3.56	232.2	1.66	1.47	1.39
493.9	523.9	1.31	1.32	1.35	493.9	1.92	2.64	3.54	252.4	1.63	1.45	1.37
514.0	544.0	1.32	1.33	1.36	514.0	1.94	2.67	3.56	272.7	1.65	1.47	1.40
554.3	584.3	1.38	1.39	1.42	554.3	1.98	2.69	3.56	292.9	1.69	1.50	1.44
574.5	604.5	1.41	1.42	1.45	574.5	1.99	2.69	3.56	313.1	1.68	1.50	1.45
614.8	644.8	1.46	1.48	1.52	614.8	2.03	2.73	3.59	333.3	1.68	1.52	1.47
634.9	664.9	1.49	1.52	1.55	634.9	2.05	2.75	3.60	353.5	1.70	1.55	1.50
675.3	705.3	1.52	1.57	1.61	675.3	2.07	2.74	3.56	373.7	1.70	1.55	1.52
695.4	725.4	1.52	1.58	1.63	695.4	2.09	2.76	3.57	393.9	1.74	1.58	1.56
735.7	765.7	1.51	1.57	1.61	735.7	2.14	2.81	3.61	434.3	1.76	1.61	1.58
755.9	785.9	1.49	1.54	1.58	755.9	2.16	2.82	3.62	454.5	1.72	1.59	1.57
796.2	826.2	1.47	1.50	1.53	796.2	2.19	2.85	3.64	494.9	1.82	1.69	1.69
816.4	846.4	1.45	1.47	1.49	816.4	2.20	2.86	3.65	515.1	1.82	1.69	1.69
856.7	886.7	1.46	1.47	1.48	856.7	2.24	2.88	3.65	555.5	1.81	1.70	1.70
876.8	906.8	1.46	1.46	1.46	876.8	2.26	2.89	3.64	575.7	1.85	1.75	1.75
917.1	947.1	1.51	1.49	1.50	917.1	2.29	2.89	3.63	616.1	1.86	1.74	1.75
937.3	967.3	1.55	1.53	1.54	937.3	2.32	2.91	3.63	636.3	1.85	1.74	1.76
977.6	1007.6	1.68	1.65	1.65	977.6	2.36	2.92	3.62	676.7	1.89	1.81	1.83
997.8	1027.8	1.74	1.71	1.70	997.8	2.37	2.92	3.60	696.9	1.98	1.88	1.89
1038.1	1068.1	1.90	1.86	1.85	1038.1	2.44	2.96	3.64	737.3	1.88	1.79	1.80
1058.2	1088.2	1.98	1.93	1.92	1058.2	2.47	3.00	3.66	757.6	1.92	1.82	1.84
1098.5	1128.5	2.18	2.12	2.07	1098.5	2.52	3.05	3.68	798.0	1.97	1.88	1.88
1118.7	1148.7	2.29	2.20	2.15	1118.7	2.55	3.08	3.71	818.2	1.94	1.84	1.85
1159.0	1189.0	2.48	2.37	2.30	1159.0	2.62	3.16	3.79	858.6	1.94	1.85	1.86
1179.2	1209.2	2.57	2.46	2.37	1179.2	2.63	3.17	3.79	878.8	1.99	1.89	1.88
1219.5	1249.5	2.73	2.61	2.49	1219.5	2.65	3.19	3.80	919.2	2.00	1.87	1.82
1239.6	1269.6	2.80	2.67	2.55	1239.6	2.68	3.22	3.84	939.4	1.92	1.79	1.76
1279.9	1309.9	2.92	2.82	2.68	1279.9	2.72	3.25	3.86	979.8	2.08	1.93	1.87
1300.1	1330.1	2.96	2.86	2.73	1300.1	2.72	3.24	3.85	1000.0	2.20	2.10	2.07

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Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	6	21	17	26	35	34	29	41	30	66
1	-	18	+0	23	11	27	20	40	44	38	47	46
2	>100	58	50	56	51	65	50	56	64	70	67	63
3	>100	>80	74	76	73	72	67	75	77	79	77	70
4	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
5	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
6	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
7	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
8	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
9	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
10	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions: RF IN: 500.1 MHz; -14.00 dBm.
LO IN: 530.01 MHz; +7.00 dBm
IF OUT: 29.91 MHz; -19.71 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	16	33	30	39	55	48	41	59	44	70
1	-	18	+0	24	12	28	21	44	44	45	63	54
2	96	49	42	52	43	60	45	51	57	59	58	71
3	>100	56	52	52	47	49	41	51	45	58	63	51
4	>100	65	70	60	61	59	61	63	54	61	68	72
5	>100	79	67	81	61	69	56	64	56	79	62	80
6	>100	>90	85	86	87	80	73	80	71	75	76	76
7	>100	86	>90	>90	81	85	86	83	79	79	71	>90
8	>100	>90	>90	>90	>90	89	>90	86	87	85	84	87
9	>100	>90	>90	>90	>90	>90	>90	>90	>90	>90	86	>90
10	>100	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions: RF IN: 500.1 MHz; -4.00 dBm.
LO IN: 530.01 MHz; +7.00 dBm
IF OUT: 29.91 MHz; -9.9 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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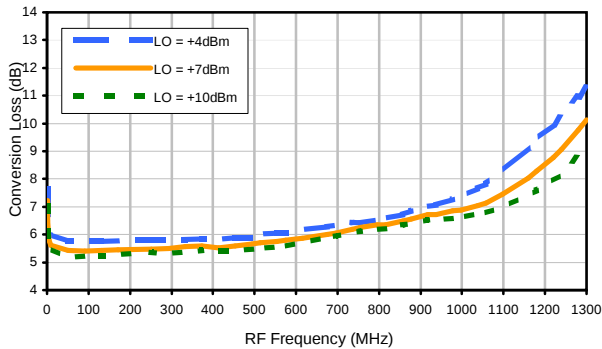


Frequency Mixer

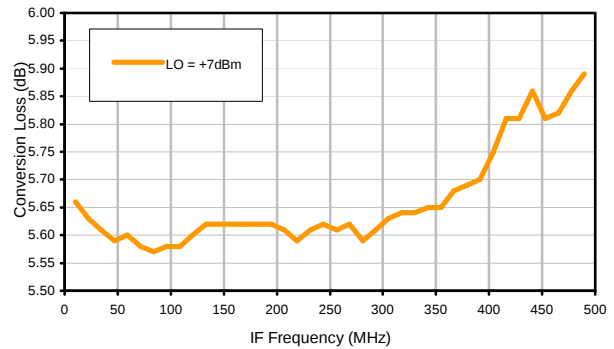
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Typical Performance Curves

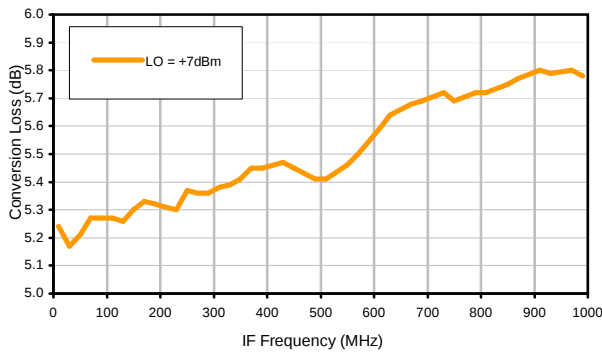
Conversion Loss @ IF=30MHz



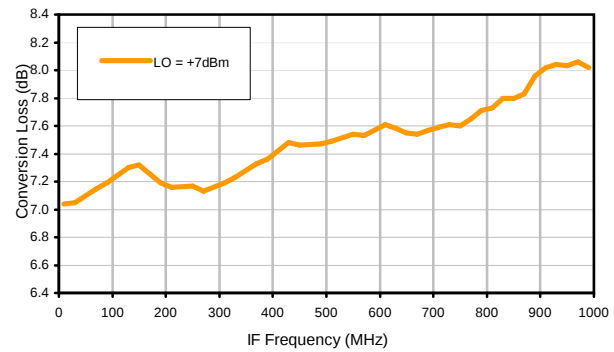
Conversion Loss vs. IF @ RF=500.1MHz



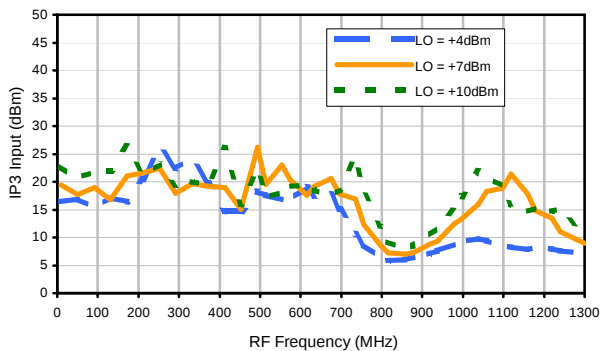
Conversion Loss vs. IF @ RF=10.1MHz



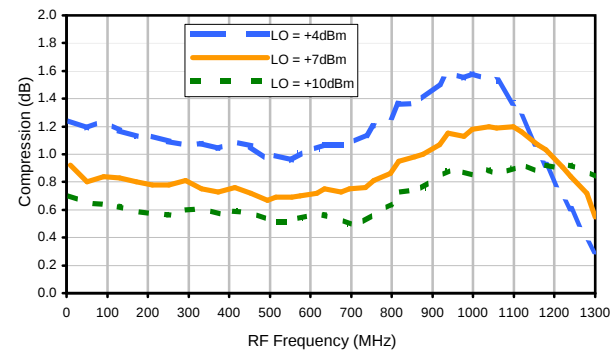
Conversion Loss vs. IF @ RF=1000.1MHz



IP3 Input



Compression @ RF IN=+1dBm



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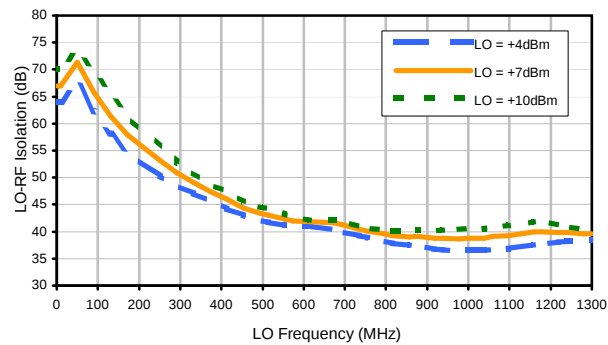


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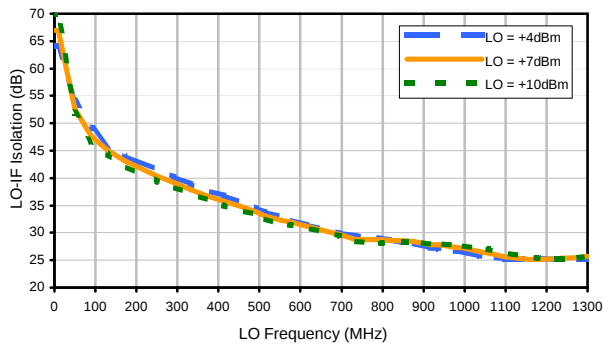


Typical Performance Curves

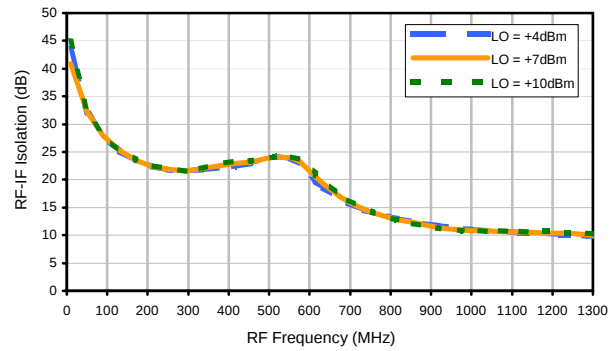
LO-RF Isolation



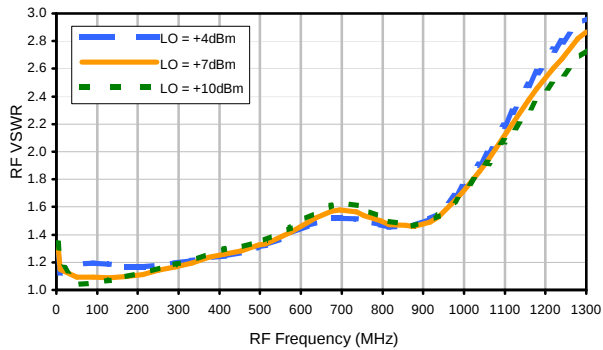
LO-IF Isolation



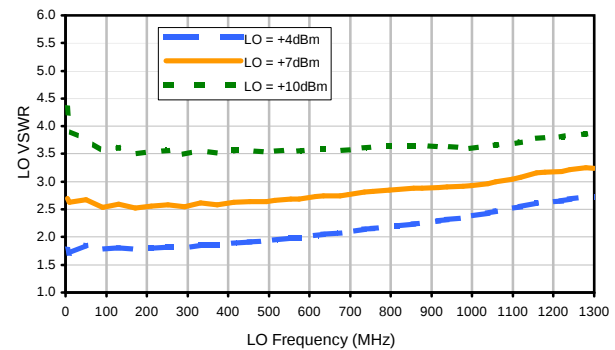
RF-IF Isolation



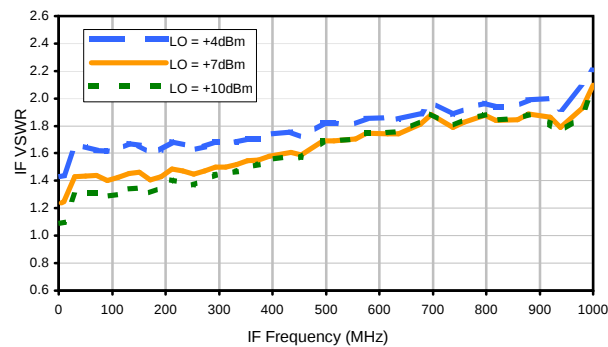
RF VSWR



LO VSWR



IF VSWR



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Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	6	21	17	26	35	34	29	41	30	66
1	-	18	+0	23	11	27	20	40	44	38	47	46
2	>100	58	50	56	51	65	50	56	64	70	67	63
3	>100	>80	74	76	73	72	67	75	77	79	77	70
4	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
5	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
6	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
7	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
8	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
9	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
10	>100	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80	>80
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 500.1 MHz; -14.00 dBm.
LO IN: 530.01 MHz; +7.00 dBm
IF OUT: 29.91 MHz; -19.71 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	16	33	30	39	55	48	41	59	44	70
1	-	18	+0	24	12	28	21	44	44	45	63	54
2	96	49	42	52	43	60	45	51	57	59	58	71
3	>100	56	52	52	47	49	41	51	45	58	63	51
4	>100	65	70	60	61	59	61	63	54	61	68	72
5	>100	79	67	81	61	69	56	64	56	79	62	80
6	>100	>90	85	86	87	80	73	80	71	75	76	76
7	>100	86	>90	>90	81	85	86	83	79	79	71	>90
8	>100	>90	>90	>90	>90	89	>90	86	87	85	84	87
9	>100	>90	>90	>90	>90	>90	>90	>90	>90	>90	86	>90
10	>100	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90	>90
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 500.1 MHz; -4.00 dBm.
LO IN: 530.01 MHz; +7.00 dBm
IF OUT: 29.91 MHz; -9.9 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.

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



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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

DIMENSIONS ARE IN INCHES

TOLERANCES ON:

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

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

INITIALS

DATE

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

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