Surface Mount

Frequency Mixer

TUF-5LHSM+

Level 10 (LO Power +10dBm) 20 to 1500 MHz

Generic photo used for illustration purposes only

CASE STYLE: NNN150

+RoHS Compliant

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

Maximum Ratings

Operating Temperature	-55°C to 100°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	4
RF	1
IF	2
GROUND	3
CASE GROUND	3

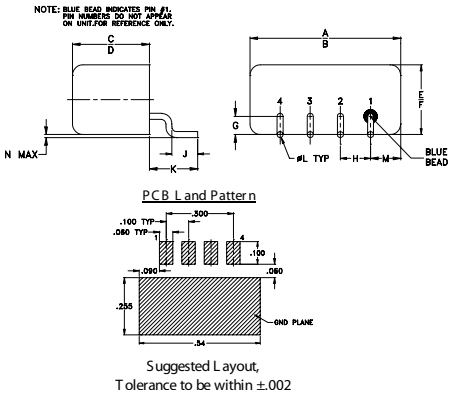
Features

- low conversion loss, 6.9 dB typ.
- high L-R isolation, 42 dB typ.
- rugged welded construction

Applications

- cellular
- satellite distribution
- GSM/ISM

Outline Drawing

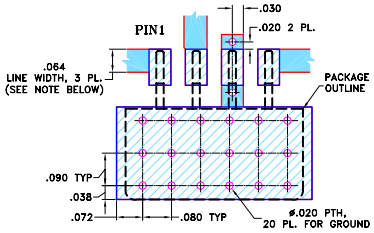


Outline Dimensions (inch / mm)

A	B	C	D	E	F	G
.50	.48	.255	.240	.23	.21	.06
12.70	12.19	6.48	6.10	5.84	5.33	1.52

H	J	K	L	M	N	wt
.100	.09	.16	.020	.09	.005	grams
2.54	2.29	4.06	0.51	2.29	0.13	1.9

Demo Board MCL PIN: TB-201
Suggested PCB Layout (PL-081)



NOTES: 1.TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 0.002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2.BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Electrical Specifications

FREQUENCY (MHz)		CONVERSION LOSS (dB)				LO-RF ISOLATION (dB)						LO-IF ISOLATION (dB)						IP3 @ CENTER BAND (dBm)
LO/RF	IF	Mid-Band m			Total Range	L		M		U		L		M		U		
f_L-f_U		$\overline{X}$	σ	Max.	Max.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.
20-1500	DC-1000	6.9	0.27	8.5	9.0	53	40	42	30	38	25	40	25	30	18	22	8	14

1 dB COMP.: +5 dBm typ.

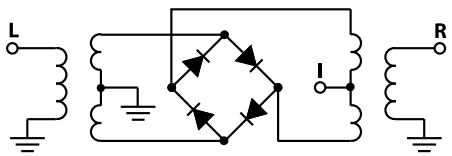
L = low range [f_L to 10 f_L] M = mid range [10 f_L to f_U/2] U = upper range [f_U/2 to f_U]

m= mid band [2f_L to f_U/2]

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 +10dBm	LO +10dBm	LO +10dBm	LO +10dBm	LO +10dBm
20.00	50.00	5.60	62.84	53.91	1.43	2.57
50.00	80.00	5.38	57.81	46.30	1.32	2.51
100.00	70.00	5.25	52.60	40.86	1.31	2.50
158.75	128.75	5.20	49.11	38.29	1.34	2.38
200.00	170.00	5.25	47.45	36.98	1.48	2.28
297.50	267.50	5.37	44.43	34.13	1.59	2.36
436.25	406.25	5.54	42.14	31.89	1.91	2.34
500.00	470.00	5.74	41.47	30.68	2.36	2.36
575.00	545.00	5.89	40.90	30.02	2.49	2.36
713.75	683.75	6.61	40.16	28.61	2.97	2.45
750.00	720.00	6.80	39.71	28.48	3.40	2.46
760.00	730.00	6.83	39.62	28.42	3.53	2.48
852.50	822.50	7.07	39.30	28.00	3.80	2.56
991.25	961.25	6.99	38.97	26.26	3.86	2.67
1000.00	970.00	7.07	38.98	26.16	3.95	2.70
1130.00	1100.00	7.19	35.93	24.11	3.91	2.73
1222.50	1192.50	7.02	38.98	22.14	3.77	2.73
1361.25	1331.25	6.88	39.21	19.23	3.65	2.77
1453.75	1423.75	6.78	38.09	16.51	3.54	2.78
1500.00	1470.00	6.66	37.95	16.08	3.47	2.77

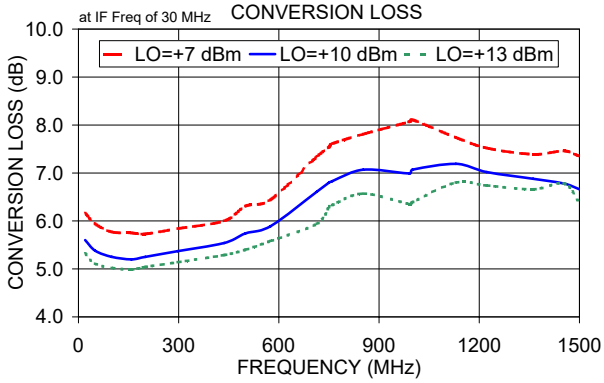
Electrical Schematic



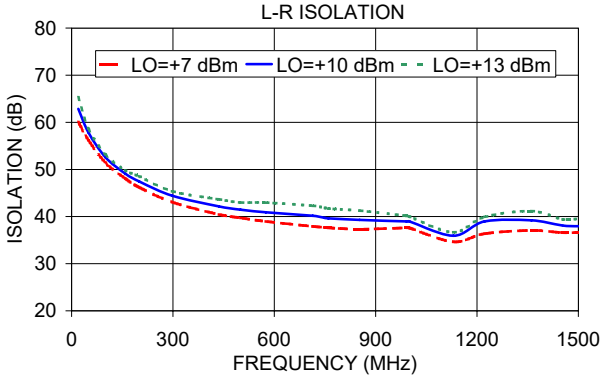
Notes

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

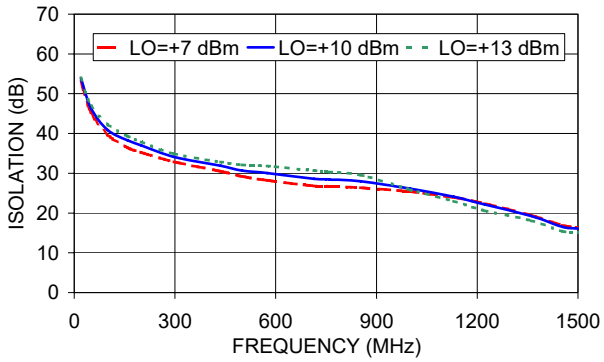
TUF-5LHSM
at IF Freq of 30 MHz CONVERSION LOSS



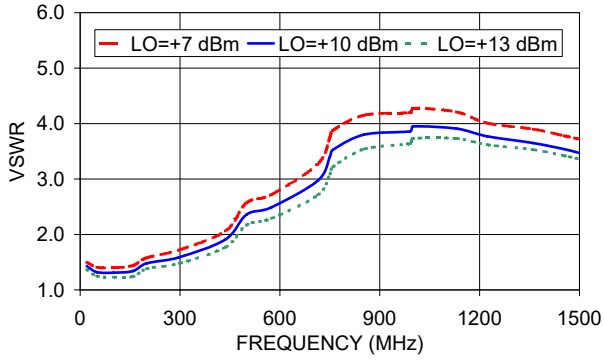
TUF-5LHSM
L-R ISOLATION



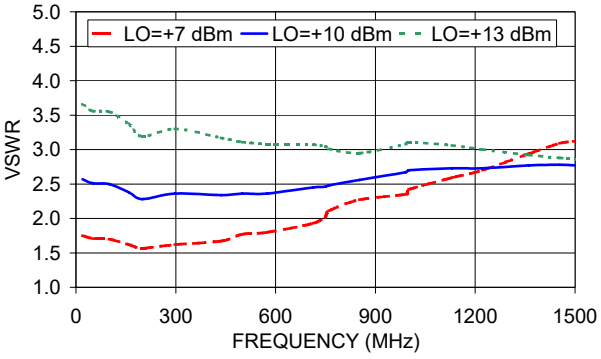
TUF-5LHSM
L-I ISOLATION



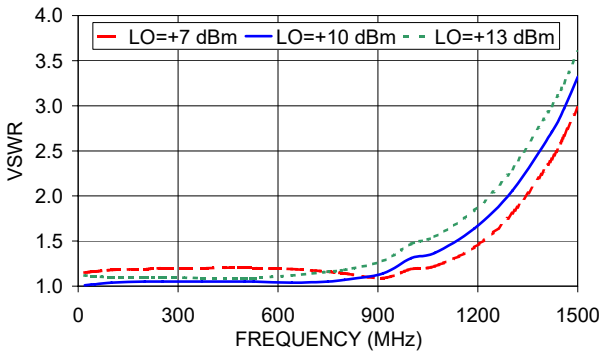
TUF-5LHSM
RF VSWR



TUF-5LHSM
LO VSWR



TUF-5LHSM
IF VSWR



Frequency Mixer TUF-5LHSM+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	CONVERSION LOSS IF FIXED @IF(OUT)=30MHz (dB) @LO (dBm)		
		+7	+10	+13
10.1	40.1	6.53	6.09	5.88
90.9	120.9	5.97	5.61	5.44
171.8	201.8	5.98	5.61	5.45
252.6	282.6	5.98	5.65	5.49
333.5	363.5	6.06	5.75	5.55
414.3	444.3	6.14	5.82	5.62
495.1	525.1	6.29	5.90	5.63
576.0	606.0	6.43	6.04	5.81
656.8	686.8	6.72	6.13	5.74
737.7	767.7	7.22	6.61	6.16
818.5	848.5	7.69	7.04	6.59
899.3	929.3	7.84	6.95	6.40
980.2	1010.2	7.82	6.78	6.32
1061.0	1091.0	7.94	6.99	6.43
1141.8	1171.8	7.72	7.12	6.56
1202.5	1232.5	7.54	6.99	6.57
1283.3	1313.3	7.34	6.91	6.51
1343.9	1373.9	7.24	6.80	6.49
1424.8	1454.8	7.22	6.80	6.53
1485.4	1515.4	7.20	6.77	6.42
1566.3	1596.3	7.18	6.50	6.08
1626.9	1656.9	6.93	6.24	5.96
1707.7	1737.7	6.71	6.14	5.97
1768.4	1798.4	6.70	6.21	6.02
1849.2	1879.2	6.80	6.33	6.11
1909.8	1939.8	7.04	6.46	6.24
1990.7	2020.7	7.47	6.63	6.30
2051.3	2081.3	7.75	6.75	6.38
2132.1	2162.1	8.17	6.76	6.34
2192.8	2222.8	9.09	7.09	6.37
2273.6	2303.6	9.84	7.53	6.52
2334.2	2364.2	9.77	7.63	6.56
2415.1	2445.1	10.13	7.85	6.74
2475.7	2505.7	10.81	8.26	7.09
2556.5	2586.5	11.28	8.44	7.21
2617.2	2647.2	11.36	8.53	7.36
2698.0	2728.0	12.34	9.24	7.63
2758.6	2788.6	12.84	9.75	7.92
2839.5	2869.5	13.08	10.01	8.20
2900.1	2930.1	14.48	10.69	8.45

RF (IN) (MHz)	LO (MHz)	IP3 INPUT (dBm) @LO (dBm)		
		+7	+10	+13
10.1	40.1	16.87	18.73	21.05
90.9	120.9	18.15	21.01	17.27
171.8	201.8	16.22	14.62	15.91
252.6	282.6	12.46	14.25	17.11
333.5	363.5	12.51	14.39	16.56
414.3	444.3	12.47	14.12	16.58
495.1	525.1	11.73	15.25	21.60
576.0	606.0	12.16	13.94	15.52
656.8	686.8	11.54	17.55	25.27
737.7	767.7	10.11	12.18	16.23
818.5	848.5	11.08	13.29	15.17
899.3	929.3	10.88	13.00	16.22
980.2	1010.2	11.45	13.78	15.43
1061.0	1091.0	10.52	11.85	13.32
1141.8	1171.8	10.74	10.47	11.14
1202.5	1232.5	11.08	10.91	10.54
1283.3	1313.3	11.59	10.56	10.15
1343.9	1373.9	11.45	10.05	9.27
1424.8	1454.8	10.79	9.70	9.29
1485.4	1515.4	10.34	10.89	14.16
1566.3	1596.3	11.30	15.47	15.69
1626.9	1656.9	13.83	14.04	15.41
1707.7	1737.7	11.74	15.56	18.85
1768.4	1798.4	12.81	17.65	19.34
1849.2	1879.2	14.66	19.11	20.78
1909.8	1939.8	14.71	20.60	22.18
1990.7	2020.7	13.19	18.70	24.39
2051.3	2081.3	12.97	16.85	19.92
2132.1	2162.1	13.73	14.36	17.75
2192.8	2222.8	11.44	11.99	16.53
2273.6	2303.6	9.75	12.45	13.89
2334.2	2364.2	10.86	15.12	14.18
2415.1	2445.1	10.44	14.45	15.97
2475.7	2505.7	9.03	13.19	14.39
2556.5	2586.5	8.96	12.18	13.95
2617.2	2647.2	10.21	11.56	13.06
2698.0	2728.0	7.67	12.39	13.25
2758.6	2788.6	5.44	11.05	13.85
2839.5	2869.5	3.41	8.66	12.86
2900.1	2930.1	1.92	6.77	12.16

RF (IN) (MHz)	LO (MHz)	COMPRESSION @RF IN=+5dBm (dB) @LO (dBm)		
		+7	+10	+13
10.1	40.1	0.92	0.71	0.55
90.9	120.9	1.28	1.06	0.79
171.8	201.8	1.35	1.04	0.78
252.6	282.6	1.38	0.98	0.74
333.5	363.5	1.35	0.99	0.78
414.3	444.3	1.33	1.04	0.81
495.1	525.1	1.41	1.14	0.93
576.0	606.0	1.71	1.32	1.09
656.8	686.8	1.78	1.59	1.36
737.7	767.7	1.59	1.39	1.32
818.5	848.5	1.35	1.23	1.15
899.3	929.3	1.31	1.34	1.30
980.2	1010.2	1.45	1.55	1.37
1061.0	1091.0	1.16	1.32	1.26
1141.8	1171.8	1.13	1.13	1.12
1202.5	1232.5	1.23	1.13	1.06
1283.3	1313.3	1.23	1.09	1.02
1343.9	1373.9	1.24	1.05	0.98
1424.8	1454.8	1.23	0.99	0.90
1485.4	1515.4	1.31	1.04	0.91
1566.3	1596.3	1.33	1.13	0.86
1626.9	1656.9	1.54	1.15	0.74
1707.7	1737.7	1.70	0.95	0.61
1768.4	1798.4	1.75	0.90	0.61
1849.2	1879.2	1.71	0.90	0.62
1909.8	1939.8	1.80	1.00	0.70
1990.7	2020.7	1.91	1.18	0.85
2051.3	2081.3	1.92	1.30	0.95
2132.1	2162.1	1.68	1.46	1.07
2192.8	2222.8	1.37	1.52	1.21
2273.6	2303.6	1.13	1.45	1.32
2334.2	2364.2	1.20	1.33	1.28
2415.1	2445.1	1.33	1.31	1.23
2475.7	2505.7	1.33	1.47	1.20
2556.5	2586.5	1.20	1.57	1.24
2617.2	2647.2	1.27	1.56	1.24
2698.0	2728.0	1.13	1.60	1.39
2758.6	2788.6	0.77	1.45	1.46
2839.5	2869.5	0.38	1.25	1.54
2900.1	2930.1	-0.43	0.88	1.52

Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=750.1MHz (dB) @LO (dBm) +10
710.0	40.1	6.11
692.1	58.0	6.13
674.1	76.0	6.20
656.2	93.9	6.19
638.2	111.9	6.21
620.3	129.8	6.20
602.3	147.8	6.26
584.4	165.7	6.26
566.4	183.7	6.35
548.5	201.6	6.36
530.5	219.6	6.37
512.6	237.5	6.32
494.6	255.5	6.39
476.7	273.4	6.37
458.7	291.4	6.43
440.8	309.3	6.46
422.8	327.3	6.39
404.9	345.2	6.36
386.9	363.2	6.34
369.0	381.1	6.31
351.0	399.1	6.41
333.1	417.0	6.42
315.1	435.0	6.43
297.2	452.9	6.41
279.2	470.9	6.41
261.3	488.8	6.45
243.3	506.8	6.40
225.4	524.7	6.46
207.4	542.7	6.47
189.5	560.6	6.49
171.5	578.6	6.48
153.6	596.5	6.52
135.6	614.5	6.45
117.7	632.4	6.46
99.7	650.4	6.38
81.8	668.3	6.41
63.8	686.3	6.37
45.9	704.2	6.46
27.9	722.2	6.49
10.0	740.1	6.59

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=20.1MHz (dB) @LO (dBm) +10
10.0	30.1	6.00
30.2	50.3	5.99
50.4	70.5	6.05
70.6	90.7	6.11
90.8	110.9	6.04
111.0	131.1	6.01
131.2	151.3	6.04
151.4	171.5	6.08
171.6	191.7	6.04
191.8	211.9	6.00
212.0	232.1	6.00
232.2	252.3	5.99
252.4	272.5	6.03
272.7	292.8	6.02
292.9	313.0	6.01
313.1	333.2	6.00
333.3	353.4	6.00
353.5	373.6	6.05
373.7	393.8	6.02
393.9	414.0	6.03
434.3	454.4	6.04
454.5	474.6	6.07
494.9	515.0	6.06
515.1	535.2	6.01
555.5	575.6	6.11
575.7	595.8	6.07
616.1	636.2	6.08
636.3	656.4	6.14
676.7	696.8	6.17
696.9	717.0	6.21
737.3	757.4	6.40
757.6	777.7	6.35
798.0	818.1	6.46
818.2	838.3	6.46
858.6	878.7	6.54
878.8	898.9	6.59
919.2	939.3	6.58
939.4	959.5	6.65
979.8	999.9	6.77
1000.0	1020.1	6.82

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=1500.1MHz (dB) @LO (dBm) +10
1000.0	500.1	7.76
979.8	520.3	7.76
959.6	540.5	7.68
939.4	560.7	7.75
919.2	580.9	7.65
899.0	601.1	7.64
878.8	621.3	7.61
858.6	641.5	7.58
838.4	661.7	7.56
818.2	681.9	7.44
798.0	702.1	7.52
777.8	722.3	7.51
757.6	742.5	7.58
737.3	762.8	7.39
717.1	783.0	7.47
696.9	803.2	7.47
676.7	823.4	7.38
656.5	843.6	7.39
636.3	863.8	7.34
616.1	884.0	7.28
575.7	924.4	7.08
555.5	944.6	7.03
515.1	985.0	6.79
494.9	1005.2	6.72
454.5	1045.6	6.66
434.3	1065.8	6.57
393.9	1106.2	6.54
373.7	1126.4	6.56
333.3	1166.8	6.54
313.1	1187.0	6.62
272.7	1227.4	6.72
252.4	1247.7	6.74
212.0	1288.1	6.81
191.8	1308.3	6.81
151.4	1348.7	6.80
131.2	1368.9	6.79
90.8	1409.3	6.80
70.6	1429.5	6.85
30.2	1469.9	6.82
10.0	1490.1	7.03

Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB) @LO (dBm)			LO-IF ISOLATION (dB) @LO (dBm)		
	+7	+10	+13	+7	+10	+13
10.1	66.48	65.32	64.64	56.15	59.28	58.27
90.9	56.08	56.42	56.76	40.10	41.45	42.69
171.8	50.94	51.49	52.07	35.33	37.07	38.39
252.6	47.83	48.74	49.41	33.24	34.73	35.68
333.5	45.81	46.85	47.61	31.37	32.66	33.61
414.3	44.19	45.17	45.87	29.89	31.18	32.21
495.1	43.25	44.32	45.13	28.42	29.91	31.16
576.0	42.54	44.01	45.28	26.90	28.54	30.11
656.8	41.08	42.44	43.59	25.84	27.67	29.24
737.7	40.18	41.81	43.12	24.58	26.39	28.28
818.5	39.52	41.38	42.96	23.95	25.51	27.05
899.3	39.34	41.44	43.30	23.46	24.79	25.99
980.2	38.45	40.29	41.77	22.58	23.50	24.11
1061.0	37.40	38.59	39.65	21.66	22.30	22.59
1141.8	36.81	37.71	38.25	20.70	20.97	20.91
1202.5	36.41	37.09	37.62	20.10	20.21	19.98
1283.3	35.83	36.50	36.82	19.31	19.22	18.81
1343.9	35.44	36.06	36.38	18.80	18.54	17.99
1424.8	34.91	35.40	35.84	18.11	17.84	17.28
1485.4	34.45	34.79	35.03	17.47	17.02	16.33
1566.3	33.64	33.88	34.20	16.14	15.43	14.50
1626.9	33.01	33.47	34.09	15.15	14.33	13.75
1707.7	32.71	33.60	34.34	14.04	13.45	12.85
1768.4	32.88	33.33	34.03	13.38	12.78	12.41
1849.2	32.85	33.29	33.71	12.51	12.23	11.93
1909.8	32.98	33.23	33.55	12.02	11.78	11.55
1990.7	32.89	33.09	33.37	11.44	11.26	11.09
2051.3	32.65	33.01	33.29	10.94	11.02	10.85
2132.1	32.52	32.71	32.98	10.60	10.63	10.73
2192.8	32.51	33.64	34.10	10.31	10.48	10.60
2273.6	32.81	34.60	35.68	10.08	10.20	10.40
2334.2	32.54	34.36	36.32	9.89	10.14	10.41
2415.1	32.75	34.23	36.25	9.75	10.00	10.28
2475.7	33.24	35.17	37.06	9.62	10.02	10.34
2556.5	33.66	36.27	38.69	9.63	10.09	10.51
2617.2	33.73	36.72	40.38	9.53	9.97	10.58
2698.0	34.50	38.17	42.69	9.52	10.05	10.72
2758.6	35.24	39.75	46.59	9.72	10.24	10.86
2839.5	35.79	40.53	49.40	9.83	10.43	11.13
2900.1	36.70	41.00	47.61	9.87	10.50	11.22

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB) @LO (dBm)		
		+7	+10	+13
10.1	40.1	51.97	57.02	46.63
90.9	120.9	48.39	45.32	44.97
171.8	201.8	42.30	41.64	40.83
252.6	282.6	39.43	38.42	38.15
333.5	363.5	37.19	36.26	35.55
414.3	444.3	34.78	34.16	33.79
495.1	525.1	32.51	31.91	31.80
576.0	606.0	30.99	30.54	30.20
656.8	686.8	29.93	29.25	28.78
737.7	767.7	28.17	27.77	27.26
818.5	848.5	27.19	26.94	26.68
899.3	929.3	27.29	26.88	26.45
980.2	1010.2	28.81	28.23	28.04
1061.0	1091.0	30.47	30.30	30.01
1141.8	1171.8	30.41	30.70	30.78
1202.5	1232.5	29.21	29.57	29.90
1283.3	1313.3	27.18	27.38	27.80
1343.9	1373.9	26.17	26.39	26.67
1424.8	1454.8	24.43	24.90	25.16
1485.4	1515.4	23.63	24.03	24.33
1566.3	1596.3	22.93	23.34	23.49
1626.9	1656.9	22.67	22.97	23.11
1707.7	1737.7	22.30	22.80	23.05
1768.4	1798.4	22.02	22.46	22.83
1849.2	1879.2	21.42	21.87	22.23
1909.8	1939.8	20.86	21.35	21.71
1990.7	2020.7	20.15	20.67	21.06
2051.3	2081.3	19.80	20.42	20.83
2132.1	2162.1	19.45	20.24	20.68
2192.8	2222.8	19.06	20.06	20.64
2273.6	2303.6	19.05	20.07	20.93
2334.2	2364.2	19.39	20.29	21.13
2415.1	2445.1	19.79	20.79	21.52
2475.7	2505.7	19.98	21.20	22.00
2556.5	2586.5	20.69	22.09	23.03
2617.2	2647.2	21.27	22.84	23.82
2698.0	2728.0	21.79	23.37	24.85
2758.6	2788.6	22.41	23.74	25.30
2839.5	2869.5	23.61	24.69	26.11
2900.1	2930.1	24.86	25.72	26.54

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1) @LO (dBm)		
		+7	+10	+13
10.1	40.1	1.89	1.85	1.83
90.9	120.9	1.17	1.07	1.05
171.8	201.8	1.19	1.09	1.07
252.6	282.6	1.26	1.19	1.16
333.5	363.5	1.34	1.28	1.25
414.3	444.3	1.42	1.36	1.32
495.1	525.1	1.54	1.46	1.41
576.0	606.0	1.72	1.64	1.59
656.8	686.8	2.01	1.87	1.77
737.7	767.7	2.41	2.27	2.14
818.5	848.5	2.81	2.65	2.52
899.3	929.3	3.16	2.91	2.73
980.2	1010.2	3.47	3.15	2.98
1061.0	1091.0	3.67	3.37	3.15
1141.8	1171.8	3.53	3.31	3.10
1202.5	1232.5	3.36	3.18	3.00
1283.3	1313.3	3.22	3.06	2.88
1343.9	1373.9	3.18	2.99	2.81
1424.8	1454.8	3.08	2.85	2.61
1485.4	1515.4	2.94	2.66	2.41
1566.3	1596.3	2.65	2.30	2.09
1626.9	1656.9	2.38	2.07	1.93
1707.7	1737.7	2.20	1.96	1.84
1768.4	1798.4	2.17	1.95	1.83
1849.2	1879.2	2.14	1.93	1.81
1909.8	1939.8	2.15	1.94	1.80
1990.7	2020.7	2.21	1.97	1.84
2051.3	2081.3	2.29	2.02	1.88
2132.1	2162.1	2.40	2.06	1.89
2192.8	2222.8	2.51	2.06	1.85
2273.6	2303.6	2.45	2.00	1.74
2334.2	2364.2	2.26	1.90	1.66
2415.1	2445.1	2.20	1.86	1.66
2475.7	2505.7	2.28	1.91	1.71
2556.5	2586.5	2.26	1.85	1.67
2617.2	2647.2	2.12	1.74	1.58
2698.0	2728.0	2.03	1.66	1.49
2758.6	2788.6	2.02	1.67	1.50
2839.5	2869.5	2.09	1.74	1.56
2900.1	2930.1	2.30	1.88	1.60

LO (MHz)	LO VSWR (:1) @LO (dBm)		
	+7	+10	+13
10.1	1.65	2.34	3.19
90.9	1.68	2.42	3.35
171.8	1.68	2.39	3.29
252.6	1.70	2.43	3.34
333.5	1.72	2.44	3.32
414.3	1.73	2.42	3.25
495.1	1.75	2.40	3.17
576.0	1.79	2.41	3.15
656.8	1.88	2.47	3.14
737.7	1.93	2.51	3.18
818.5	1.96	2.50	3.14
899.3	1.98	2.45	3.02
980.2	2.06	2.48	3.01
1061.0	2.16	2.59	3.09
1141.8	2.20	2.64	3.11
1202.5	2.21	2.63	3.10
1283.3	2.25	2.65	3.10
1343.9	2.28	2.66	3.08
1424.8	2.27	2.60	3.00
1485.4	2.28	2.58	2.95
1566.3	2.25	2.50	2.87
1626.9	2.22	2.47	2.85
1707.7	2.30	2.55	2.91
1768.4	2.48	2.69	3.02
1849.2	2.75	2.87	3.16
1909.8	2.94	2.97	3.20
1990.7	3.24	3.15	3.29
2051.3	3.47	3.31	3.46
2132.1	3.76	3.50	3.51
2192.8	4.07	3.68	3.62
2273.6	4.35	3.99	3.86
2334.2	4.60	4.23	4.10
2415.1	4.88	4.45	4.35
2475.7	5.16	4.72	4.55
2556.5	5.46	5.00	4.80
2617.2	5.75	5.36	5.04
2698.0	6.11	5.72	5.39
2758.6	6.39	6.03	5.68
2839.5	6.73	6.32	6.03
2900.1	6.94	6.56	6.24

IF (OUT) (MHz)	IF VSWR @LO=1500.1MHz (:1) @LO (dBm)		
	+7	+10	+13
10.0	1.55	1.33	1.17
30.2	1.45	1.22	1.04
50.4	1.40	1.20	1.08
70.6	1.41	1.21	1.00
90.8	1.43	1.22	1.04
111.0	1.47	1.25	1.04
131.2	1.52	1.30	1.09
151.4	1.47	1.26	1.05
171.6	1.42	1.22	1.03
191.8	1.49	1.27	1.07
212.0	1.53	1.31	1.09
232.2	1.48	1.27	1.07
252.4	1.48	1.27	1.10
272.7	1.51	1.30	1.10
292.9	1.50	1.28	1.07
313.1	1.50	1.29	1.10
333.3	1.55	1.33	1.14
353.5	1.54	1.32	1.12
373.7	1.51	1.29	1.11
393.9	1.55	1.33	1.16
434.3	1.57	1.34	1.15
454.5	1.57	1.35	1.18
494.9	1.64	1.40	1.20
515.1	1.62	1.39	1.20
555.5	1.69	1.45	1.24
575.7	1.68	1.44	1.23
616.1	1.75	1.50	1.29
636.3	1.72	1.47	1.25
676.7	1.81	1.55	1.32
696.9	1.82	1.56	1.33
737.3	1.79	1.54	1.33
757.6	1.84	1.58	1.35
798.0	1.90	1.63	1.41
818.2	1.91	1.65	1.42
858.6	1.88	1.62	1.40
878.8	1.96	1.68	1.45
919.2	1.96	1.70	1.48
939.4	1.92	1.68	1.48
979.8	1.98	1.71	1.49
1000.0	2.02	1.75	1.54

Harmonics Tables

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	10	39	26	46	24	43	38	62	47	79
1	-	21	+0	38	19	44	37	49	49	59	57	69
2	86	74	38	58	38	67	51	70	42	56	55	76
3	>100	49	40	52	36	52	43	53	43	63	55	67
4	>100	83	76	80	50	70	52	71	65	67	64	68
5	>100	65	59	63	53	79	47	83	56	75	56	73
6	>100	77	78	85	79	83	66	79	63	79	78	82
7	>100	82	74	82	72	85	63	71	60	71	69	82
8	>100	>93	>93	>93	83	87	88	91	70	>93	71	88
9	>100	>93	>93	>93	91	92	92	86	80	>93	71	90
10	>100	>93	>93	>93	>93	>93	90	>93	>93	>93	83	>93
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: **RF IN: 750.1 MHz; 0.00 dBm.**
LO IN: 780.01 MHz; +10.00 dBm
IF OUT: 29.91 MHz; -6.67 dBm

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	+1	27	15	34	11	31	24	48	37	67
1	-	22	+0	36	20	37	36	46	47	50	53	60
2	>100	74	44	65	44	67	57	68	47	60	66	73
3	>100	74	55	68	50	69	56	76	56	76	62	80
4	>100	>83	>83	>83	81	>83	76	>83	>83	>83	76	>83
5	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
6	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
7	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
8	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
9	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
10	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

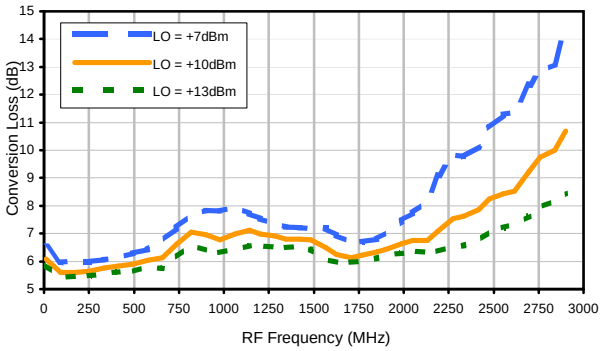
LO HARMONICS ORDER

Test conditions: **RF IN: 750.1 MHz; -10.00 dBm.**
LO IN: 780.01 MHz; +10.00 dBm
IF OUT: 29.91 MHz; -16.9 dBm

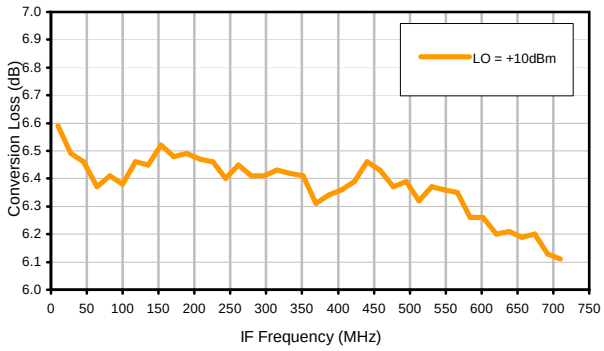
Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT.
2. + entry denotes harmonics are in (dBc) above IF OUTPUT.
3. RF Cal represent the Harmonics level of the RF input signal to the mixer.

Typical Performance Curves

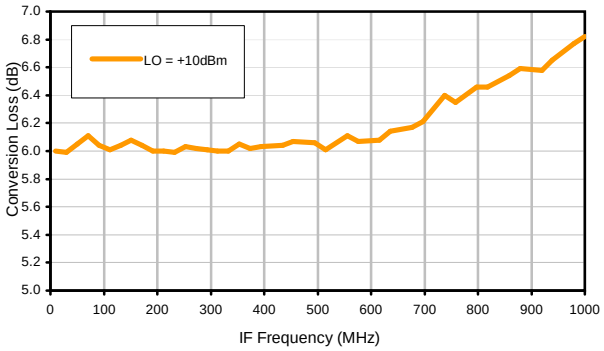
Conversion Loss @ IF=30MHz



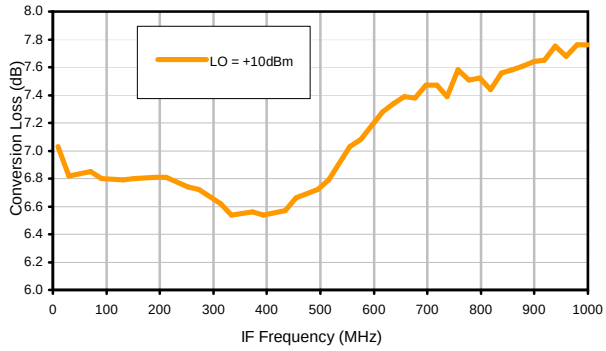
Conversion Loss vs. IF @ RF=750.1MHz



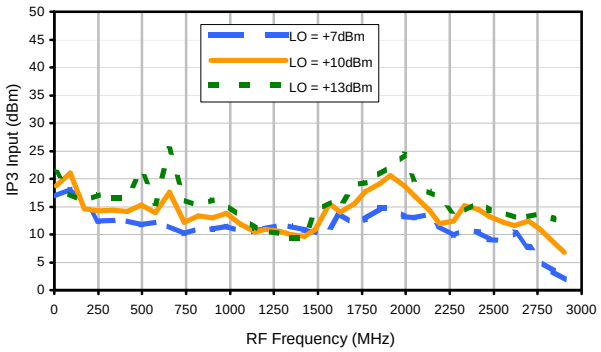
Conversion Loss vs. IF @ RF=20.1MHz



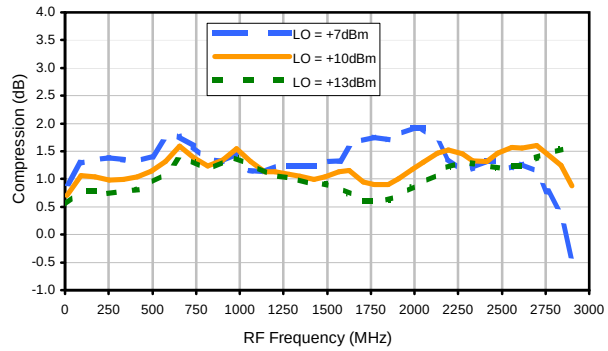
Conversion Loss vs. IF @ RF=1500.1MHz



IP3 Input

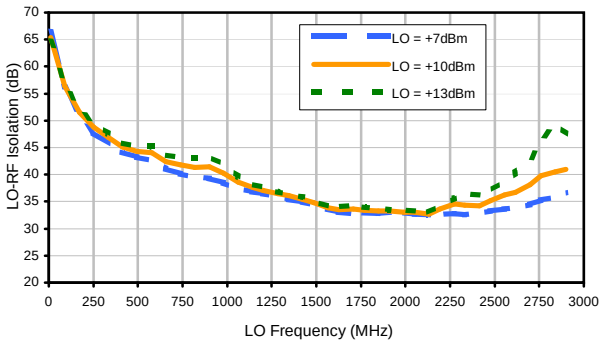


Compression @ RF IN=+5dBm

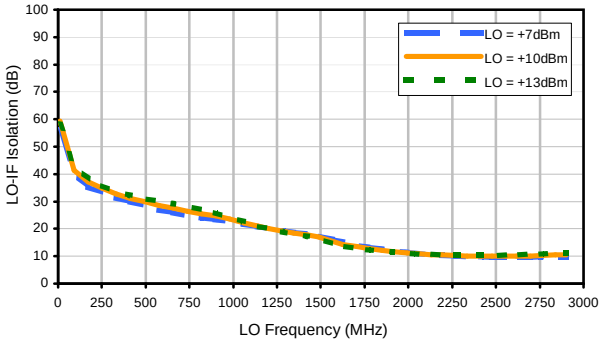


Typical Performance Curves

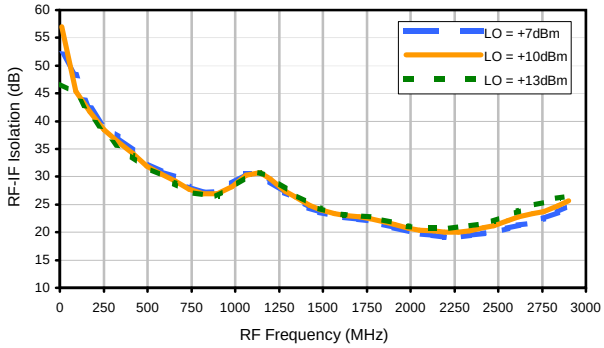
LO-RF Isolation



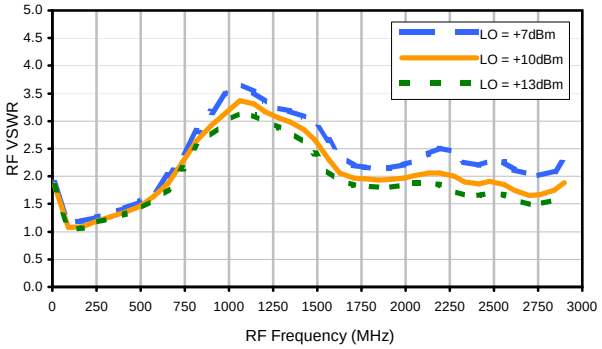
LO-IF Isolation



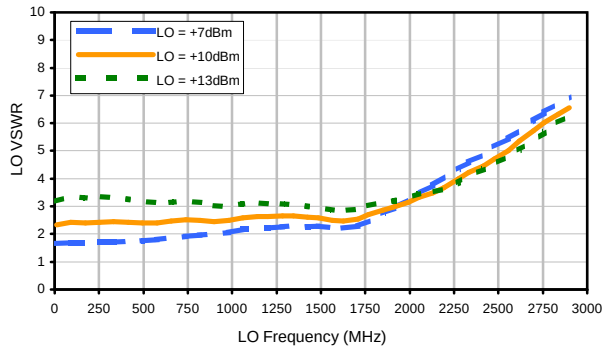
RF-IF Isolation



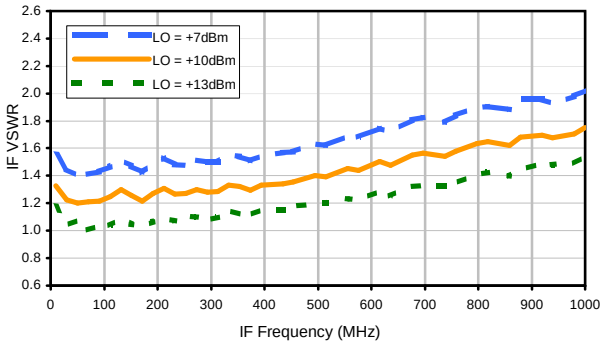
RF VSWR



LO VSWR



IF VSWR



Harmonics Tables

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	10	39	26	46	24	43	38	62	47	79
1	-	21	+0	38	19	44	37	49	49	59	57	69
2	86	74	38	58	38	67	51	70	42	56	55	76
3	>100	49	40	52	36	52	43	53	43	63	55	67
4	>100	83	76	80	50	70	52	71	65	67	64	68
5	>100	65	59	63	53	79	47	83	56	75	56	73
6	>100	77	78	85	79	83	66	79	63	79	78	82
7	>100	82	74	82	72	85	63	71	60	71	69	82
8	>100	>93	>93	>93	83	87	88	91	70	>93	71	88
9	>100	>93	>93	>93	91	92	92	86	80	>93	71	90
10	>100	>93	>93	>93	>93	>93	90	>93	>93	>93	83	>93
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: **RF IN: 750.1 MHz; 0.00 dBm.**
LO IN: 780.01 MHz; +10.00 dBm
IF OUT: 29.91 MHz; -6.67 dBm

RF HARMONICS ORDER	(-dBm)	(-dBc)										
0	-	-	+1	27	15	34	11	31	24	48	37	67
1	-	22	+0	36	20	37	36	46	47	50	53	60
2	>100	74	44	65	44	67	57	68	47	60	66	73
3	>100	74	55	68	50	69	56	76	56	76	62	80
4	>100	>83	>83	>83	81	>83	76	>83	>83	>83	76	>83
5	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
6	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
7	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
8	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
9	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
10	>100	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83	>83
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

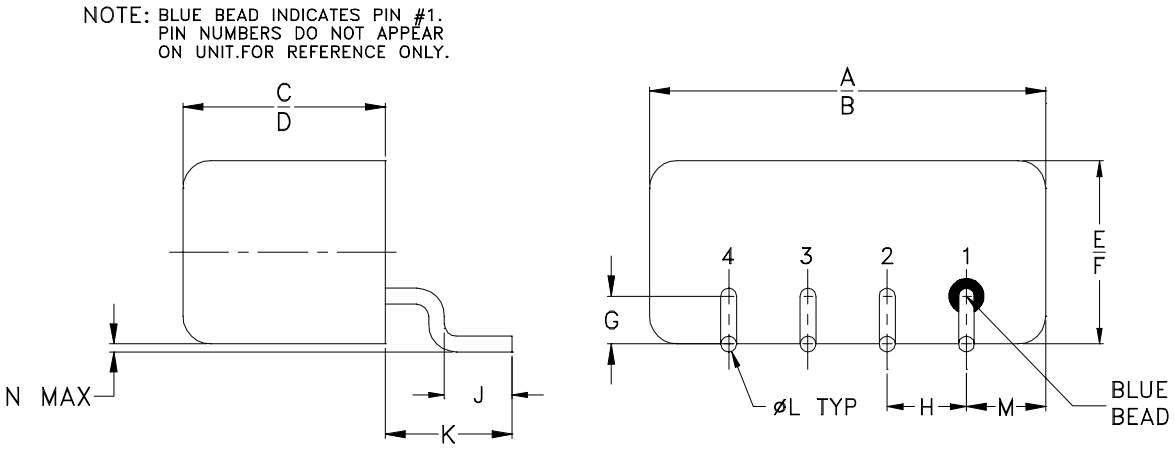
Test conditions: **RF IN: 750.1 MHz; -10.00 dBm.**
LO IN: 780.01 MHz; +10.00 dBm
IF OUT: 29.91 MHz; -16.9 dBm

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.

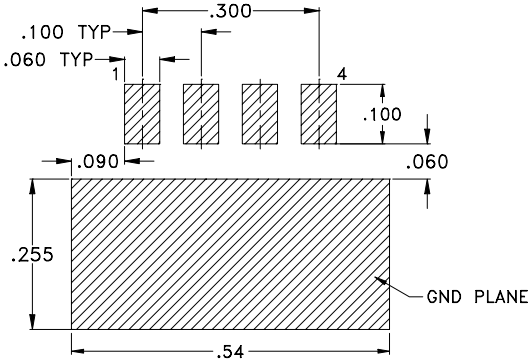
Case Style NNN

Outline Dimensions

NNN150



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE #.	A	B	C	D	E	F	G	H	J	K	L	M	N	WT, GRAM
NNN150	.50 (12.70)	.48 (12.19)	.255 (6.48)	.240 (6.10)	.23 (5.84)	.21 (5.33)	.06 (1.52)	.100 (2.54)	.09 (2.29)	.16 (4.06)	.020 (0.51)	.09 (2.29)	.005 (0.13)	1.9

Dimensions are in inches (mm). Tolerances: 2 Pl. ± .03; 3 Pl. ± .015

Notes:

1. Header material C.R.S. Pin material #52 alloy.
2. Finish: Electro-Tin, hot-oil flowed or electro-Tin-Silver.
3. Cover material: Cupro-Nickel.
4. Pin's meniscus 0.015 inch max.
5. Special Tolerances: Pin diameter ± .005 inch.

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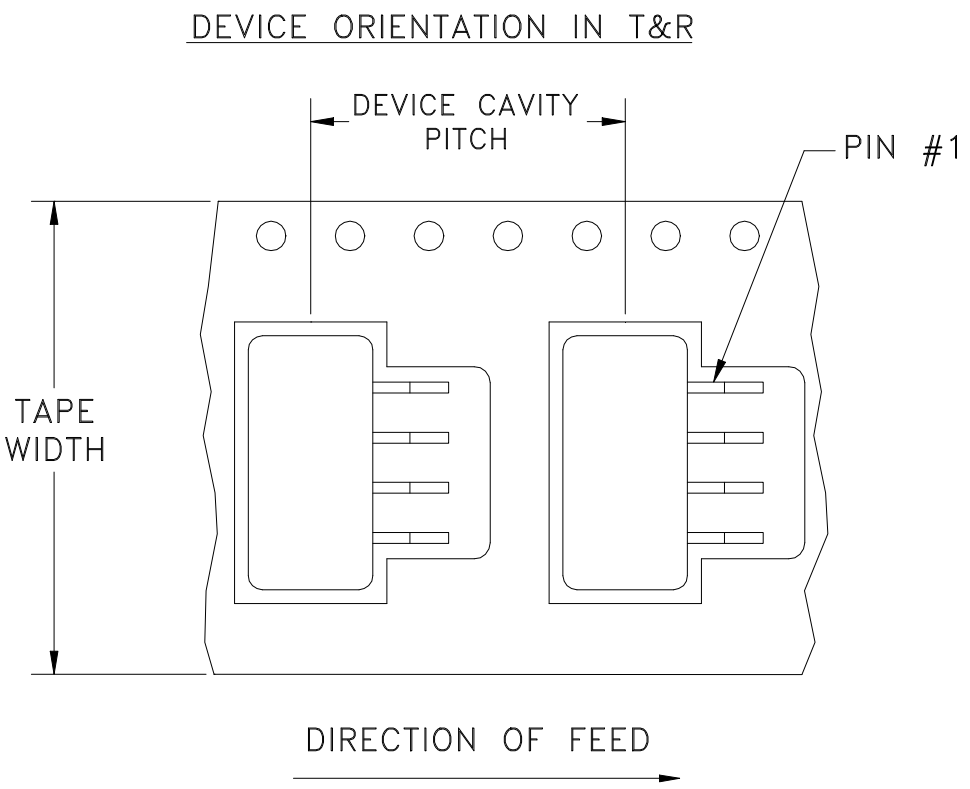
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010
Mini-Circuits ISO 9001 & ISO 14001 Certified

Tape & Reel Packaging TR-F9



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel
24	16	13	500

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

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

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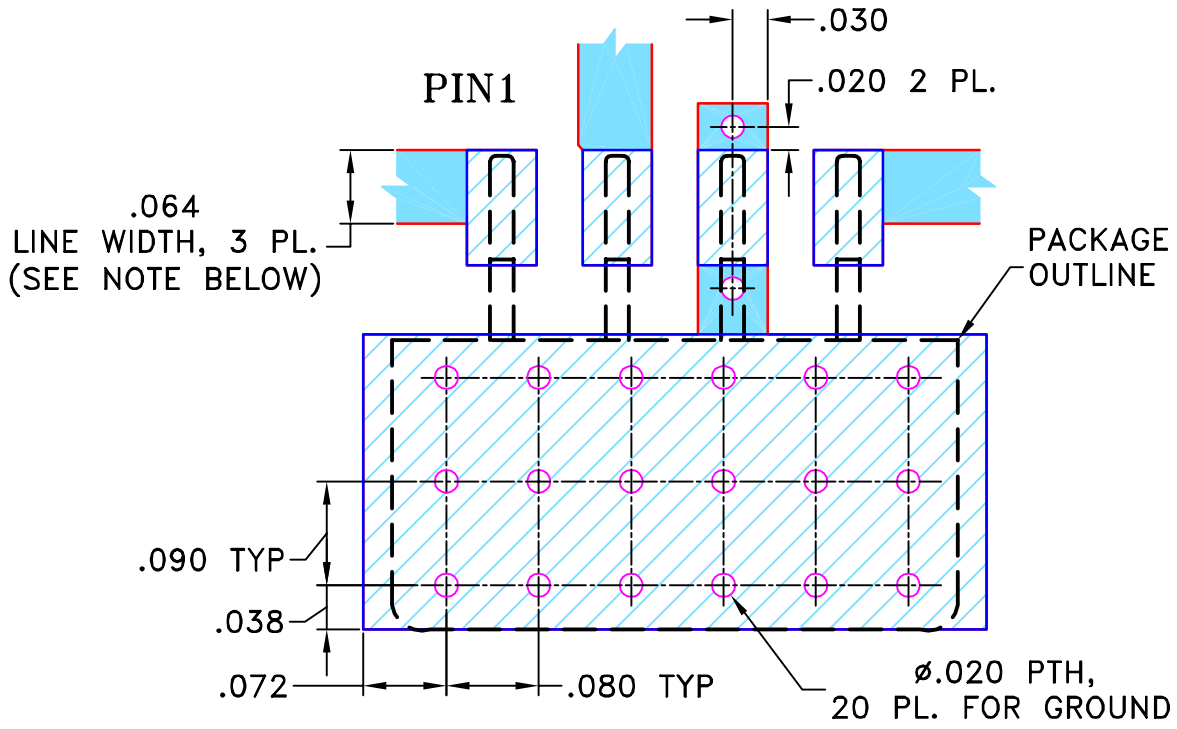
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M86549	NEW RELEASE	04/15/03	GF	DJ
A	M102713	UPDATED NOTES & DISCRIPTION	01/14/06	GF	IL

SUGGESTED MOUNTING CONFIGURATION
FOR NNN150 CASE STYLE, "z"/"cm" PIN CONNECTIONS.



NOTES: 1.TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 0.002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.

2.BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	GF	04/11/03
TOLERANCES ON:	CHECKED	AV	04/15/03
2 PL DECIMALS ±	APPROVED	DJ	04/15/03
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

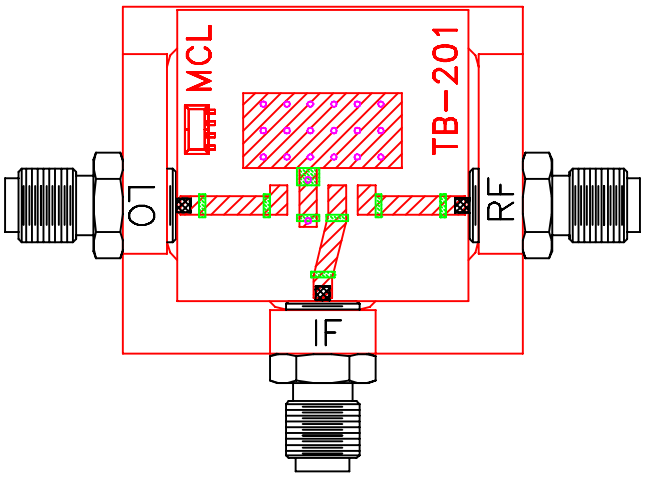
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, z/cm NNN150, TUF/TFAS-SM, TB-201

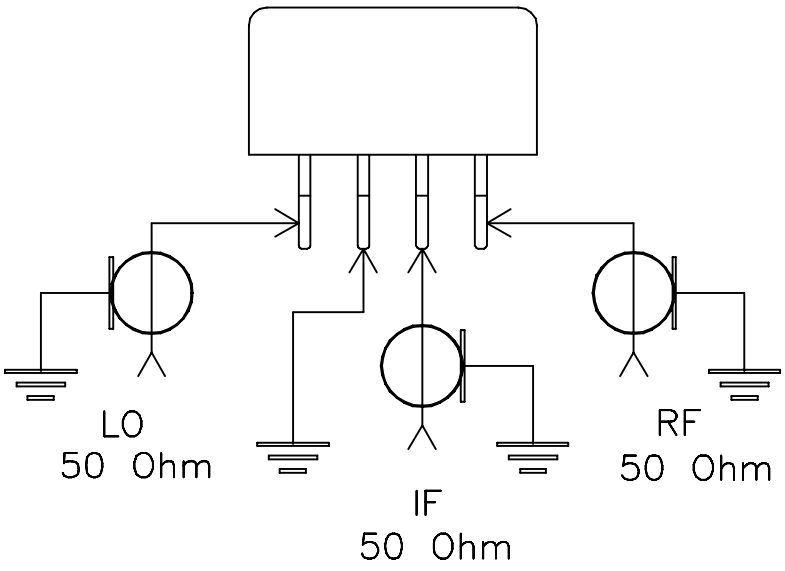
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-081	A

FILE:	SCALE:	SHEET:
98PL081	6:1	1 OF 1

Evaluation Board and Circuit



TB-201



Schematic Diagram

Notes:

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

Mini-Circuits®

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Environmental Specifications ENV30

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	-55° to 100°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
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
Moisture Resistance	10 cycles, 24 hours per cycle	MIL-STD-202, Method 106, Condition A, except 50°C and end point electrical test done within 12 hours
Solderability	10X Magnification	J-STD-002, 95% Coverage
Resistance to Solder Heat	260°C for 10 seconds	MIL-STD-202, Method 210, Condition B
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
Terminal Strength	4 1/2 Pound Pull	MIL-STD-202, Method 211, Condition A

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
Barometric Pressure	100,000 Feet	MIL-STD-202, Method 105, Condition D