

Frequency Mixer

TUF-3HSM+

Level 17 (LO Power +17 dBm) 0.15 to 400 MHz

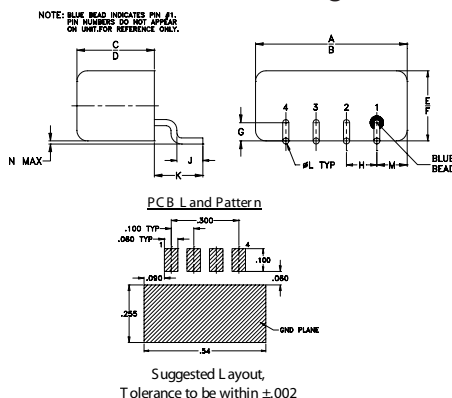
Maximum Ratings

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

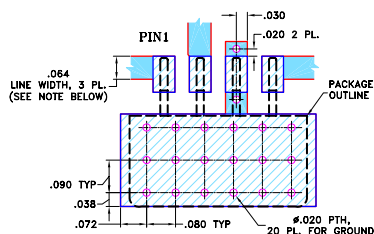
Outline Drawing



Outline Dimensions (inch mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	wt
.50	.48	.255	.240	.23	.21	.06	.100	.09	.16	.020	.09	.005	grams
12.70	12.19	6.48	6.10	5.84	5.33	1.52	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)



Features

- low conversion loss, 5.0 dB typ.
- good IP3, 22 dBm typ.
- excellent L-R isolation, 50 dB typ.; L-I, 45 dB typ.
- rugged welded construction

Applications

- HF/VHF
- defense & federal communications



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

Electrical Specifications

FREQUENCY (MHz)		CONVERSION LOSS (dB)				LO-RF ISOLATION (dB)						LO-IF ISOLATION (dB)						IP3 @ CENTER BAND (dBm)
LO/RF	IF	Mid-Band		Total Range Max.		L		M		U		L		M		U		
		$\bar{X}$	σ			Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	
0.15-400	DC-400	5.00	0.33	7.0	8.0	60	50	50	35	40	30	60	40	45	25	35	20	22

1 dB COMP.: +14 dBm typ.

$E = [IP3 \text{ (dBm)} - LO \text{ Power (dBm)}] / 10$

L = low range [f_L to $10 f_L$]

M = mid range [$10 f_L$ to $f_U/2$]

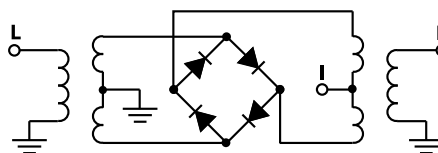
U = upper range [$f_U/2$ to f_U]

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

Typical Performance Data

Frequency (MHz)		Conversion Loss (dB)	VSWR RF Port (:1)	Frequency (MHz)	Isolation L-R (dB)	Isolation L-I (dB)	VSWR LO Port (:1)
RF	LO						
		LO +17dBm	LO +17dBm		LO +17dBm	LO +17dBm	LO +17dBm
0.15	30.15	5.73	1.50	10.00	82.56	73.10	1.50
0.30	30.30	5.50	1.42	20.00	77.94	72.84	1.49
0.50	30.50	5.40	1.41	40.00	73.33	71.28	1.46
0.75	30.75	5.32	1.41	50.00	71.91	69.09	1.49
1.00	31.00	5.29	1.41	68.00	70.74	64.21	1.48
2.80	32.80	5.15	1.42	86.00	70.55	58.19	1.45
10.00	40.00	5.07	1.36	104.00	68.91	54.46	1.47
20.00	50.00	5.01	1.35	122.00	69.27	51.05	1.48
38.00	68.00	4.98	1.35	140.00	65.14	48.62	1.50
56.00	86.00	4.96	1.29	176.00	69.38	45.57	1.52
110.00	140.00	5.08	1.26	212.00	58.50	42.60	1.55
128.00	158.00	5.07	1.25	230.00	54.52	41.38	1.56
164.00	194.00	5.10	1.19	255.00	55.28	41.47	1.61
200.00	230.00	5.24	1.16	280.00	56.41	41.92	1.60
250.00	280.00	5.41	1.11	305.00	51.98	40.69	1.64
300.00	330.00	5.43	1.00	330.00	48.01	38.86	1.66
325.00	355.00	5.40	1.05	355.00	49.07	36.77	1.65
350.00	380.00	5.46	1.08	380.00	53.89	34.86	1.74
375.00	405.00	5.63	1.15	405.00	51.11	33.11	1.90
400.00	430.00	6.10	1.28	430.00	47.28	33.20	1.89

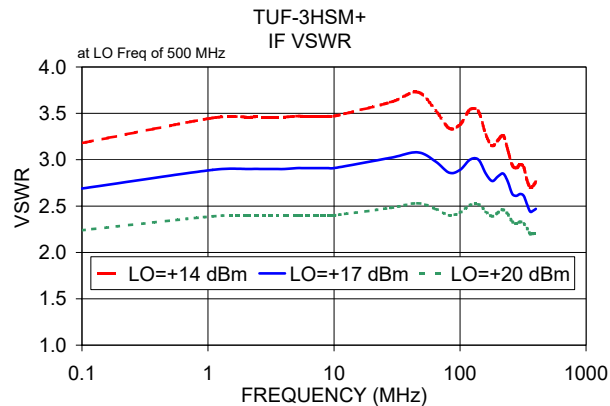
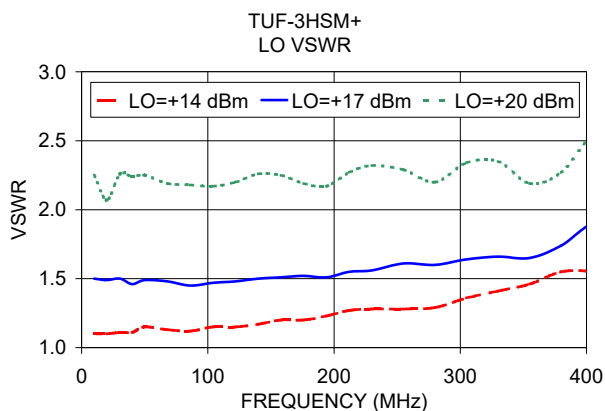
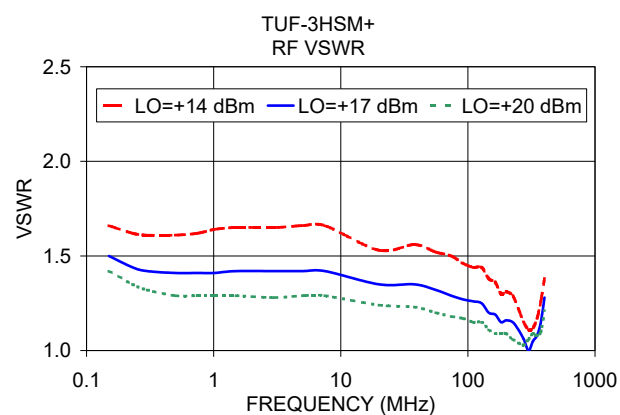
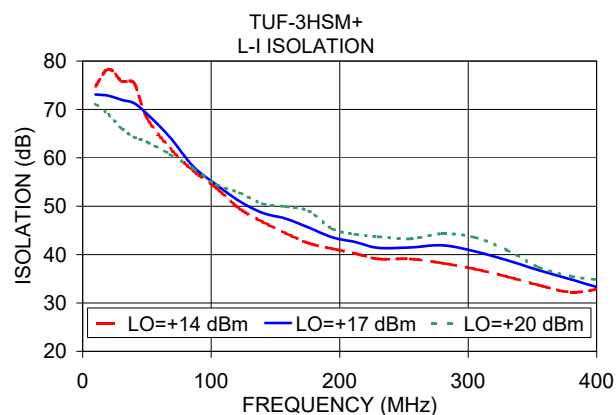
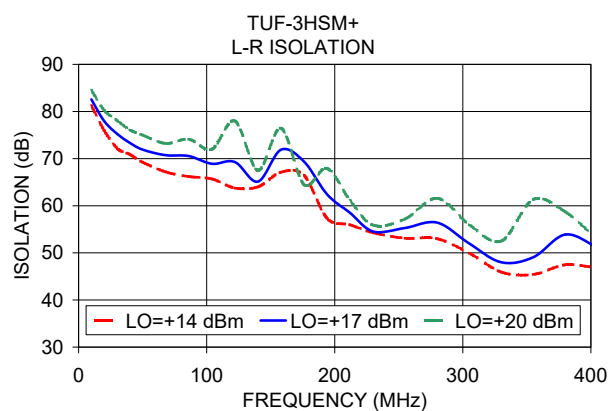
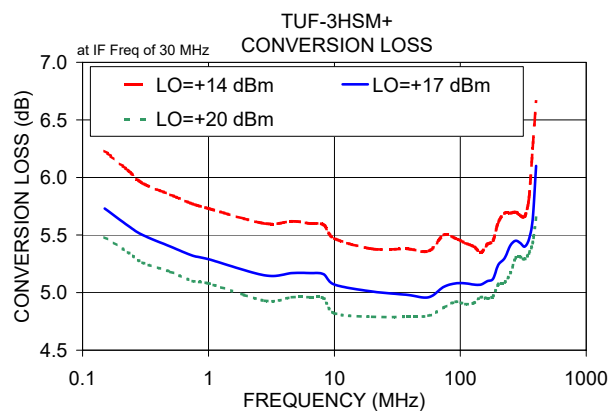
Electrical Schematic



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-Circuits' applicable established test performance criteria and measurement instructions.
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Frequency Mixer

TUF-3HSM+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	CONVERSION LOSS IF FIXED @IF(OUT)=30MHz (dB)		
		@LO (dBm)		
		+14	+17	+20
0.1	30.1	5.71	5.43	5.26
5.0	35.0	5.24	4.99	4.92
10.0	40.0	5.17	4.91	4.78
30.6	60.6	5.65	5.18	4.95
51.1	81.1	5.56	5.17	4.99
71.6	101.6	5.51	5.15	4.98
92.1	122.1	5.61	5.19	5.01
112.5	142.5	5.52	5.17	5.01
133.0	163.0	5.53	5.20	5.06
153.5	183.5	5.61	5.28	5.11
174.0	204.0	5.55	5.26	5.12
194.5	224.5	5.57	5.21	5.08
215.0	245.0	5.70	5.33	5.13
256.0	286.0	5.89	5.62	5.42
276.4	306.4	5.83	5.59	5.43
296.9	326.9	5.78	5.53	5.38
317.4	347.4	5.83	5.54	5.38
337.9	367.9	5.91	5.52	5.37
358.4	388.4	6.15	5.63	5.44
378.9	408.9	6.38	5.89	5.59
399.4	429.4	6.43	6.09	5.80
419.9	449.9	6.63	6.33	6.10
440.3	470.3	6.92	6.60	6.36
460.8	490.8	7.31	6.95	6.67
481.3	511.3	7.85	7.42	6.99
501.8	531.8	8.52	7.94	7.27
522.3	552.3	9.14	8.28	7.22
542.8	572.8	9.47	8.20	6.83
563.3	593.3	9.52	7.90	6.48
583.8	613.8	9.27	7.43	6.48
604.2	634.2	8.98	7.20	6.54
624.7	654.7	8.67	7.28	6.75
645.2	675.2	8.64	7.46	7.00
665.7	695.7	8.59	7.66	7.27
686.2	716.2	8.69	7.89	7.52
706.7	736.7	8.82	8.19	7.82
727.2	757.2	9.07	8.45	8.09
768.1	798.1	9.37	8.80	8.51
829.6	859.6	10.42	9.55	9.37
850.1	880.1	10.72	10.00	9.84

RF (IN) (MHz)	LO (MHz)	IP3 INPUT (dBm)		
		@LO (dBm)		
		+14	+17	+20
10.1	40.1	29.35	31.52	31.15
30.6	60.6	27.76	29.93	28.56
51.1	81.1	30.49	27.55	27.71
71.6	101.6	28.00	26.25	29.63
92.1	122.1	24.25	25.69	32.79
112.5	142.5	28.00	32.52	28.86
133.0	163.0	23.07	28.48	26.16
153.5	183.5	25.72	29.72	28.98
174.0	204.0	29.80	25.81	24.59
194.5	224.5	31.04	24.15	23.06
215.0	245.0	24.52	23.15	23.02
235.5	265.5	23.66	21.59	21.99
256.0	286.0	25.94	23.53	22.48
276.4	306.4	29.14	27.61	26.68
296.9	326.9	30.11	28.87	26.78
317.4	347.4	30.10	24.59	23.34
337.9	367.9	21.84	21.96	22.31
358.4	388.4	18.94	22.12	22.18
378.9	408.9	15.23	16.74	20.48
399.4	429.4	14.46	14.09	17.09
419.9	449.9	13.96	12.94	13.44
440.3	470.3	13.54	12.79	12.66
460.8	490.8	13.13	12.74	12.82
481.3	511.3	12.71	12.82	13.54
501.8	531.8	12.38	13.04	14.59
522.3	552.3	12.77	14.10	16.62
542.8	572.8	13.27	14.88	19.27
563.3	593.3	13.66	16.12	23.77
583.8	613.8	14.51	19.45	26.26
604.2	634.2	15.87	23.91	29.02
624.7	654.7	19.00	26.81	28.99
645.2	675.2	22.73	27.01	27.54
665.7	695.7	24.76	26.90	25.50
686.2	716.2	23.51	25.56	25.23
706.7	736.7	24.92	24.89	26.02
727.2	757.2	24.47	24.56	25.60
768.1	798.1	23.49	24.88	26.82
788.6	818.6	24.15	26.97	28.98
829.6	859.6	21.98	27.73	32.45
850.1	880.1	21.40	24.66	30.00

RF (IN) (MHz)	LO (MHz)	COMPRESSION @RF IN=+14dBm (dB)		
		@LO (dBm)		
		+14	+17	+20
10.1	40.1	1.41	0.94	0.68
30.6	60.6	1.14	0.80	0.59
51.1	81.1	1.16	0.79	0.57
71.6	101.6	1.23	0.79	0.55
92.1	122.1	1.18	0.74	0.51
112.5	142.5	1.14	0.68	0.47
133.0	163.0	1.08	0.66	0.47
153.5	183.5	1.09	0.64	0.46
174.0	204.0	1.05	0.60	0.43
194.5	224.5	1.10	0.70	0.52
215.0	245.0	0.98	0.68	0.52
235.5	265.5	0.92	0.55	0.45
256.0	286.0	1.05	0.56	0.45
276.4	306.4	1.24	0.71	0.55
296.9	326.9	1.44	0.85	0.63
317.4	347.4	1.62	1.03	0.71
337.9	367.9	1.78	1.29	0.82
358.4	388.4	1.76	1.44	0.94
378.9	408.9	1.89	1.53	1.11
399.4	429.4	2.13	1.67	1.28
419.9	449.9	2.34	1.91	1.45
440.3	470.3	2.32	1.94	1.55
460.8	490.8	2.14	1.73	1.39
481.3	511.3	1.69	1.32	1.04
501.8	531.8	1.19	0.90	0.75
522.3	552.3	0.63	0.54	0.70
542.8	572.8	0.32	0.51	0.96
563.3	593.3	0.32	0.77	1.20
583.8	613.8	0.59	1.16	1.21
604.2	634.2	1.03	1.43	1.23
624.7	654.7	1.34	1.40	1.11
645.2	675.2	1.56	1.31	1.00
665.7	695.7	1.60	1.21	0.93
686.2	716.2	1.65	1.13	0.91
706.7	736.7	1.44	1.03	0.88
727.2	757.2	1.43	0.95	0.82
768.1	798.1	1.20	0.74	0.63
788.6	818.6	1.20	0.66	0.52
829.6	859.6	1.09	0.56	0.38
850.1	880.1	0.98	0.51	0.31

Frequency Mixer

TUF-3HSM+

Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=200.1MHz (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)=400.1MHz (dB)
		@LO (dBm)			@LO (dBm)			@LO (dBm)
		+17			+17			+17
190.0	10.1	5.46	10.0	20.1	5.01	390.0	10.1	6.13
185.4	14.7	5.48	19.7	29.8	4.96	380.3	19.8	6.06
180.8	19.3	5.42	29.5	39.6	4.86	370.5	29.6	5.99
176.2	23.9	5.34	39.2	49.3	4.92	360.8	39.3	5.92
171.5	28.6	5.36	49.0	59.1	4.97	351.0	49.1	5.87
166.9	33.2	5.30	58.7	68.8	4.90	341.3	58.8	5.80
162.3	37.8	5.29	68.5	78.6	4.99	331.5	68.6	5.74
157.7	42.4	5.30	78.2	88.3	5.04	321.8	78.3	5.79
153.1	47.0	5.34	87.9	98.0	5.02	312.1	88.0	5.72
148.5	51.6	5.27	97.7	107.8	5.03	302.3	97.8	5.62
143.8	56.3	5.21	107.4	117.5	5.08	292.6	107.5	5.65
139.2	60.9	5.24	117.2	127.3	5.08	282.8	117.3	5.64
134.6	65.5	5.19	126.9	137.0	5.11	273.1	127.0	5.62
130.0	70.1	5.18	136.7	146.8	5.10	263.3	136.8	5.60
125.4	74.7	5.25	146.4	156.5	5.17	253.6	146.5	5.64
120.8	79.3	5.20	156.2	166.3	5.22	243.8	156.3	5.63
116.2	83.9	5.18	165.9	176.0	5.19	234.1	166.0	5.62
111.5	88.6	5.18	175.6	185.7	5.23	224.4	175.7	5.69
106.9	93.2	5.15	185.4	195.5	5.29	214.6	185.5	5.72
102.3	97.8	5.08	195.1	205.2	5.20	204.9	195.2	5.72
97.7	102.4	5.10	204.9	215.0	5.23	195.1	205.0	5.77
93.1	107.0	5.15	214.6	224.7	5.22	185.4	214.7	5.84
88.5	111.6	5.14	224.4	234.5	5.19	175.6	224.5	5.84
83.8	116.3	5.14	234.1	244.2	5.27	165.9	234.2	5.84
79.2	120.9	5.14	243.8	253.9	5.33	156.2	243.9	5.91
74.6	125.5	5.10	253.6	263.7	5.45	146.4	253.7	5.89
70.0	130.1	5.09	263.3	273.4	5.48	136.7	263.4	5.82
65.4	134.7	5.10	273.1	283.2	5.46	126.9	273.2	5.81
60.8	139.3	5.13	282.8	292.9	5.51	117.2	282.9	5.79
56.2	143.9	5.15	292.6	302.7	5.51	107.4	292.7	5.72
51.5	148.6	5.17	302.3	312.4	5.50	97.7	302.4	5.72
46.9	153.2	5.18	312.1	322.2	5.60	87.9	312.2	5.74
42.3	157.8	5.16	321.8	331.9	5.60	78.2	321.9	5.74
37.7	162.4	5.15	331.5	341.6	5.54	68.5	331.6	5.74
33.1	167.0	5.16	341.3	351.4	5.51	58.7	341.4	5.76
28.5	171.6	5.17	351.0	361.1	5.50	49.0	351.1	5.81
23.8	176.3	5.20	360.8	370.9	5.48	39.2	360.9	5.82
19.2	180.9	5.21	370.5	380.6	5.45	29.5	370.6	5.83
14.6	185.5	5.27	380.3	390.4	5.48	19.7	380.4	5.89
10.0	190.1	5.30	390.0	400.1	5.49	10.0	390.1	5.97

REV. X2
TUF-3HSM+
100818
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Frequency Mixer

TUF-3HSM+

Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)		
	@LO (dBm)			@LO (dBm)		
	+14	+17	+20	+14	+17	+20
0.1	64.78	66.42	66.35	68.59	66.28	63.03
5.0	60.18	61.64	63.09	64.99	64.07	62.71
10.0	59.08	60.33	61.40	61.56	61.62	60.74
30.6	71.60	74.47	77.21	60.61	56.39	54.07
51.1	69.13	73.22	78.25	57.25	52.88	50.58
71.6	67.99	72.62	77.65	53.85	50.40	47.96
92.1	68.20	76.87	77.22	51.78	48.75	46.56
112.5	69.20	76.84	76.17	49.54	46.71	44.72
133.0	67.22	74.79	65.19	45.80	44.19	42.83
153.5	71.99	77.06	68.10	44.93	43.62	41.91
174.0	74.28	69.16	65.89	42.23	42.31	41.41
194.5	90.00	60.27	56.07	39.48	39.83	39.83
215.0	68.35	62.08	56.68	38.49	38.79	38.51
256.0	59.64	63.30	63.48	35.60	35.36	35.47
276.4	57.49	64.15	66.74	35.35	36.09	35.75
296.9	55.73	59.70	57.44	33.98	35.20	35.49
317.4	51.74	54.74	54.42	32.89	34.51	35.30
337.9	46.20	46.88	47.18	32.09	34.56	36.04
358.4	45.67	46.29	48.30	30.55	32.64	34.19
378.9	44.00	43.91	46.02	29.03	31.36	33.26
399.4	46.22	43.90	47.26	27.97	29.46	31.37
419.9	51.68	47.25	48.32	28.85	28.48	29.71
440.3	51.96	48.19	47.66	28.47	28.22	28.50
460.8	56.15	51.92	49.84	28.56	28.47	28.32
481.3	58.49	51.66	47.42	28.32	28.70	28.87
501.8	51.33	49.16	46.75	27.84	28.25	28.40
522.3	48.59	46.52	43.75	28.00	28.68	28.69
542.8	44.79	43.81	42.12	27.62	28.45	28.58
563.3	43.06	42.32	40.82	27.64	28.42	28.45
583.8	40.59	40.05	40.28	27.89	28.45	28.58
604.2	40.24	40.37	40.98	28.07	28.19	28.45
624.7	38.47	37.92	37.82	28.40	27.53	28.00
645.2	37.89	37.53	37.88	28.45	26.98	27.44
665.7	36.50	35.38	34.97	27.78	26.11	26.50
686.2	35.71	35.01	35.43	26.88	25.51	25.95
706.7	34.73	33.70	33.09	26.04	25.06	25.09
727.2	34.31	33.55	33.27	26.52	25.24	24.88
768.1	34.23	32.56	31.66	28.93	25.94	24.56
829.6	32.20	30.66	28.99	25.41	24.26	22.38
850.1	29.75	29.36	27.68	23.02	23.64	21.98

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB)		
		@LO (dBm)		
		+14	+17	+20
10.1	40.1	40.80	41.23	41.18
30.6	60.6	32.31	32.48	32.83
51.1	81.1	28.31	28.70	28.90
71.6	101.6	25.80	26.19	26.57
92.1	122.1	24.33	24.83	25.15
112.5	142.5	23.04	23.55	24.02
133.0	163.0	22.40	22.73	22.93
153.5	183.5	21.97	22.75	23.21
174.0	204.0	21.35	22.15	22.72
194.5	224.5	21.12	21.95	22.61
215.0	245.0	21.14	21.69	22.33
235.5	265.5	21.96	22.24	22.55
256.0	286.0	23.12	23.48	23.59
276.4	306.4	23.35	23.99	24.28
296.9	326.9	23.18	24.18	25.32
317.4	347.4	21.98	23.11	24.46
337.9	367.9	20.17	20.95	21.72
358.4	388.4	18.70	19.17	19.42
378.9	408.9	17.62	17.66	17.50
399.4	429.4	16.83	16.62	16.25
419.9	449.9	16.34	16.08	15.61
440.3	470.3	15.58	15.31	14.95
460.8	490.8	15.37	15.01	14.71
481.3	511.3	15.20	14.96	14.80
501.8	531.8	15.33	15.11	14.90
522.3	552.3	16.10	15.85	15.53
542.8	572.8	16.53	16.17	15.64
563.3	593.3	16.83	16.21	15.52
583.8	613.8	16.52	15.77	15.12
604.2	634.2	15.82	14.94	14.39
624.7	654.7	14.88	14.17	13.81
645.2	675.2	14.02	13.43	13.14
665.7	695.7	13.10	12.75	12.50
686.2	716.2	12.48	12.13	11.89
706.7	736.7	11.76	11.46	11.22
727.2	757.2	11.15	10.78	10.59
768.1	798.1	10.08	9.56	9.22
788.6	818.6	9.48	8.90	8.60
829.6	859.6	8.58	7.89	7.44
850.1	880.1	8.04	7.40	6.93

Frequency Mixer

TUF-3HSM+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1)		
		@LO (dBm)		
		+14	+17	+20
5.0	35.0	1.66	1.40	1.24
10.1	40.1	1.48	1.29	1.19
30.6	60.6	1.53	1.32	1.21
51.1	81.1	1.49	1.31	1.20
71.6	101.6	1.48	1.30	1.19
92.1	122.1	1.49	1.29	1.17
112.5	142.5	1.42	1.24	1.13
133.0	163.0	1.42	1.25	1.14
153.5	183.5	1.42	1.25	1.13
174.0	204.0	1.35	1.19	1.09
194.5	224.5	1.36	1.16	1.07
215.0	245.0	1.37	1.18	1.07
235.5	265.5	1.34	1.20	1.09
256.0	286.0	1.29	1.17	1.09
276.4	306.4	1.25	1.12	1.06
296.9	326.9	1.18	1.06	1.05
317.4	347.4	1.16	1.01	1.10
337.9	367.9	1.16	1.04	1.14
358.4	388.4	1.21	1.07	1.15
378.9	408.9	1.26	1.09	1.13
399.4	429.4	1.29	1.17	1.15
419.9	449.9	1.35	1.26	1.21
440.3	470.3	1.42	1.36	1.30
460.8	490.8	1.55	1.48	1.42
481.3	511.3	1.69	1.61	1.54
501.8	531.8	1.87	1.78	1.66
522.3	552.3	2.04	1.90	1.73
542.8	572.8	2.17	1.96	1.75
563.3	593.3	2.25	2.00	1.80
583.8	613.8	2.27	2.00	1.87
604.2	634.2	2.31	2.06	1.97
624.7	654.7	2.34	2.17	2.09
645.2	675.2	2.39	2.27	2.20
665.7	695.7	2.45	2.36	2.31
686.2	716.2	2.51	2.43	2.38
706.7	736.7	2.55	2.49	2.43
727.2	757.2	2.60	2.53	2.48
768.1	798.1	2.66	2.55	2.48
788.6	818.6	2.70	2.57	2.49
829.6	859.6	2.84	2.62	2.53
850.1	880.1	2.86	2.67	2.57

LO (MHz)	LO VSWR (:1)		
	@LO (dBm)		
	+14	+17	+20
5.0	1.32	1.51	2.55
10.1	1.09	1.44	2.11
30.6	1.10	1.53	2.32
51.1	1.09	1.52	2.28
71.6	1.12	1.48	2.16
92.1	1.11	1.45	2.15
112.5	1.15	1.48	2.17
133.0	1.19	1.53	2.25
153.5	1.15	1.52	2.21
174.0	1.20	1.51	2.15
194.5	1.25	1.53	2.17
215.0	1.24	1.56	2.23
235.5	1.29	1.61	2.26
256.0	1.30	1.63	2.25
276.4	1.29	1.62	2.25
296.9	1.35	1.63	2.26
317.4	1.40	1.68	2.31
337.9	1.44	1.70	2.30
358.4	1.54	1.73	2.28
378.9	1.58	1.80	2.32
399.4	1.56	1.87	2.42
419.9	1.54	1.94	2.53
440.3	1.53	1.94	2.56
460.8	1.55	1.97	2.59
481.3	1.55	1.92	2.53
501.8	1.57	1.93	2.56
522.3	1.58	1.94	2.56
542.8	1.61	1.92	2.52
563.3	1.63	1.89	2.48
583.8	1.65	1.89	2.49
604.2	1.66	1.88	2.52
624.7	1.69	1.89	2.54
645.2	1.73	1.94	2.58
665.7	1.84	1.99	2.60
686.2	1.97	2.10	2.70
706.7	2.14	2.22	2.79
727.2	2.36	2.34	2.86
768.1	2.92	2.62	3.01
788.6	3.15	2.78	3.13
829.6	3.73	3.18	3.42
850.1	4.62	3.46	3.48

IF (OUT) (MHz)	IF VSWR @LO=400.1MHz (:1)		
	@LO (dBm)		
	+14	+17	+20
5.0	1.78	1.56	1.47
10.0	2.72	2.14	1.75
20.0	2.62	2.05	1.67
30.0	2.60	2.06	1.67
40.0	2.41	1.90	1.55
50.0	2.31	1.84	1.50
60.0	2.26	1.80	1.47
70.0	2.27	1.81	1.49
80.0	2.43	1.92	1.58
90.0	2.49	1.98	1.62
100.0	2.58	2.05	1.69
110.0	2.63	2.10	1.73
120.0	2.58	2.05	1.70
130.0	2.51	1.99	1.64
140.0	2.48	1.97	1.63
150.0	2.51	1.99	1.65
160.0	2.56	2.04	1.70
170.0	2.59	2.07	1.74
180.0	2.59	2.09	1.76
190.0	2.61	2.10	1.78
200.0	2.63	2.10	1.78
210.0	2.64	2.10	1.78
220.0	2.67	2.12	1.80
230.0	2.70	2.15	1.83
240.0	2.71	2.18	1.85
250.0	2.70	2.17	1.86
260.0	2.66	2.15	1.85
270.0	2.66	2.14	1.84
280.0	2.73	2.17	1.87
290.0	2.81	2.24	1.91
300.0	2.87	2.29	1.96
310.0	2.88	2.30	1.98
320.0	2.86	2.27	1.96
330.0	2.82	2.24	1.93
340.0	2.82	2.23	1.91
350.0	2.84	2.24	1.91
360.0	2.89	2.27	1.94
370.0	2.96	2.33	1.98
380.0	2.99	2.36	2.01
390.0	2.97	2.35	2.01
400.0	2.91	2.35	2.05

Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	14	35	18	36	20	54	25	41	41	52
1	-	16	+0	25	13	38	24	36	38	48	30	51
2	98	63	54	62	51	76	54	65	48	68	55	62
3	>100	52	53	56	58	61	50	56	49	79	55	71
4	>100	83	79	81	77	80	71	76	71	81	77	79
5	>100	78	77	80	75	83	67	78	65	86	69	82
6	>100	>94	92	92	>94	90	>94	92	89	93	84	>94
7	>100	>94	>94	93	91	>94	90	90	87	91	85	90
8	>100	>94	>94	>94	>94	>94	>94	>94	82	>94	>94	>94
9	>100	>94	>94	>94	>94	>94	>94	>94	>94	87	>94	>94
10	>100	>94	>94	>94	>94	>94	>94	>94	>94	>94	92	>94
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -1.00 dBm.
LO IN: 230.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; -6.18 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	24	44	30	45	33	61	40	60	52	62
1	-	17	+0	28	13	39	22	43	46	56	43	59
2	82	55	47	55	45	63	47	67	45	70	48	69
3	>100	41	37	43	39	44	38	45	52	53	51	58
4	>100	66	70	72	62	77	57	79	58	77	61	73
5	>100	62	52	53	55	53	50	61	47	53	52	71
6	>100	87	71	95	68	78	69	75	65	69	66	88
7	>100	89	75	65	61	61	64	64	60	65	57	68
8	>100	95	83	96	74	93	73	78	70	76	70	71
9	>100	80	82	85	89	73	69	71	70	75	64	67
10	>100	98	89	98	93	97	81	90	77	83	76	80
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; 9.00 dBm.
LO IN: 230.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; 3.72 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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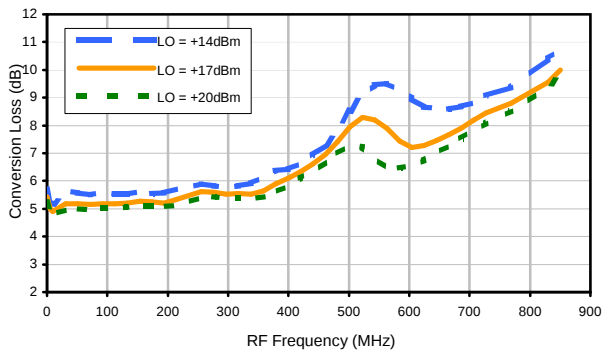


Frequency Mixer

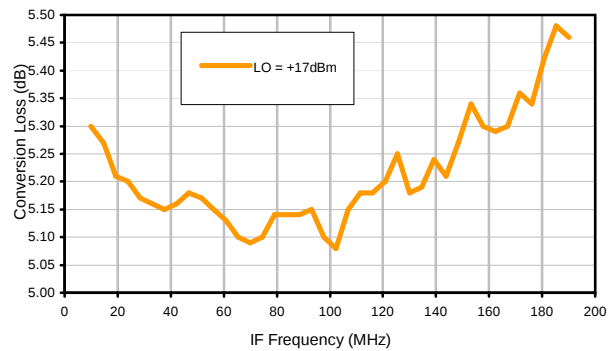
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Typical Performance Curves

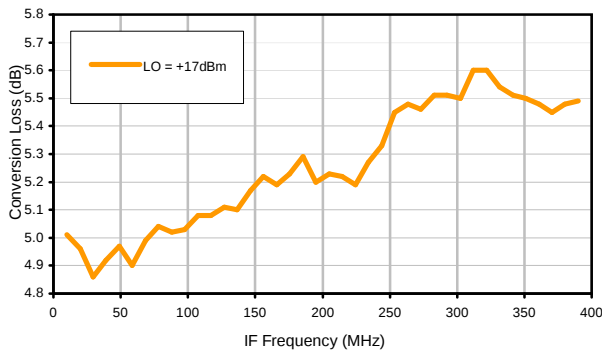
Conversion Loss @ IF=30MHz



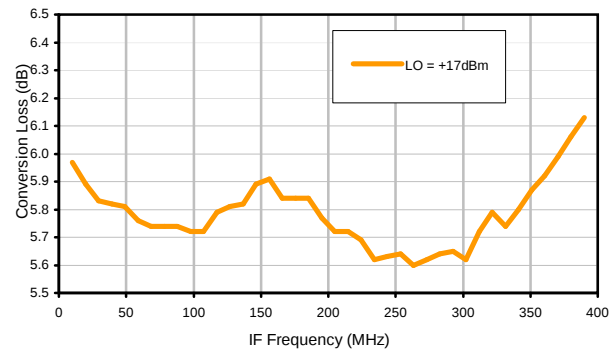
Conversion Loss vs. IF @ RF=200.1MHz



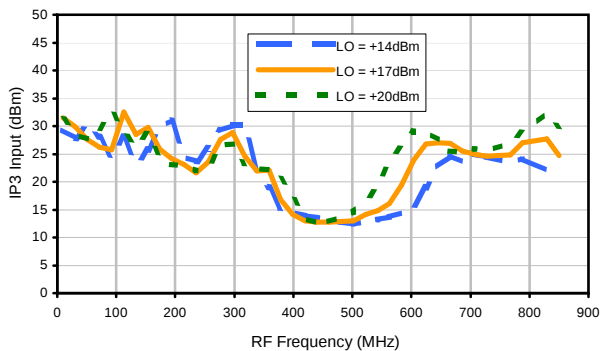
Conversion Loss vs. IF @ RF=10.1MHz



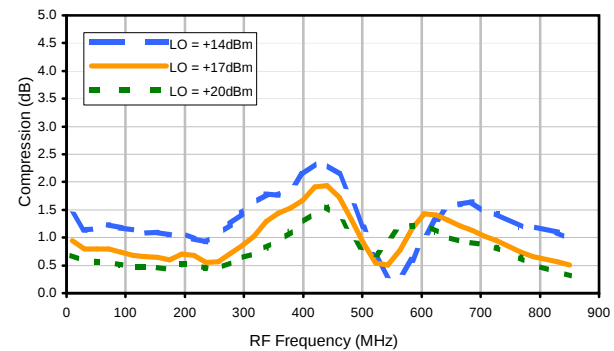
Conversion Loss vs. IF @ RF=400.1MHz



IP3 Input

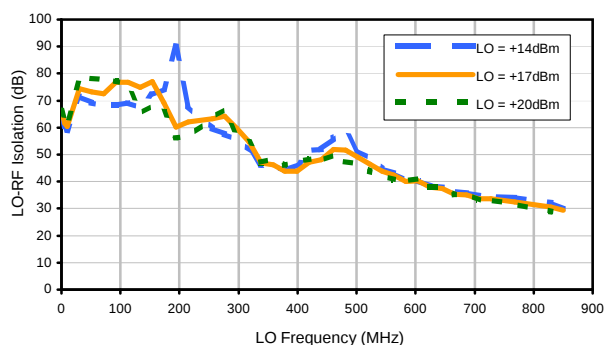


Compression @ RF IN=+14dBm

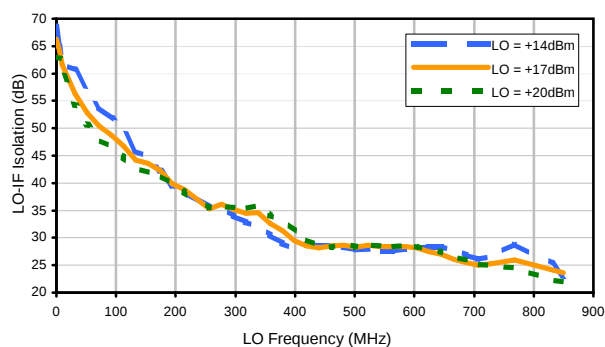


Typical Performance Curves

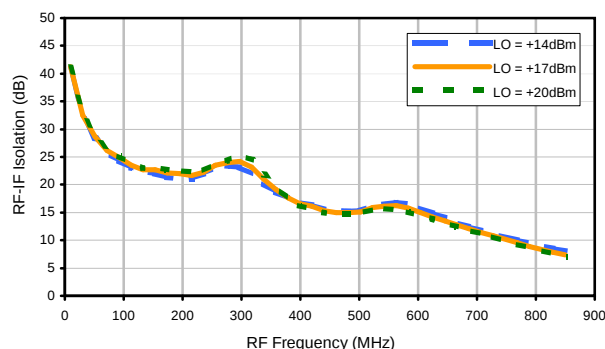
LO-RF Isolation



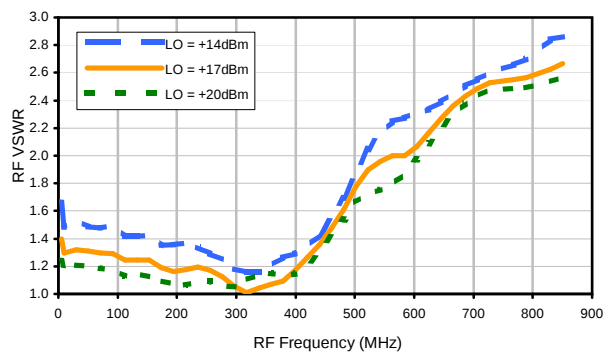
LO-IF Isolation



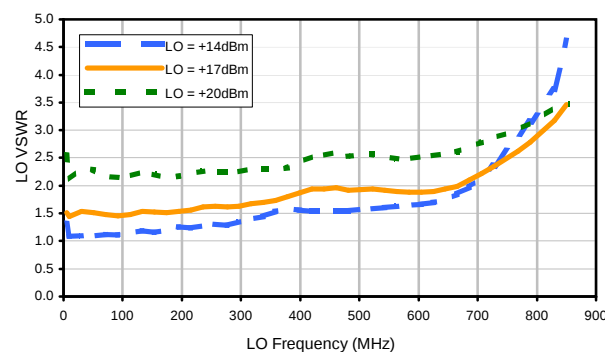
RF-IF Isolation



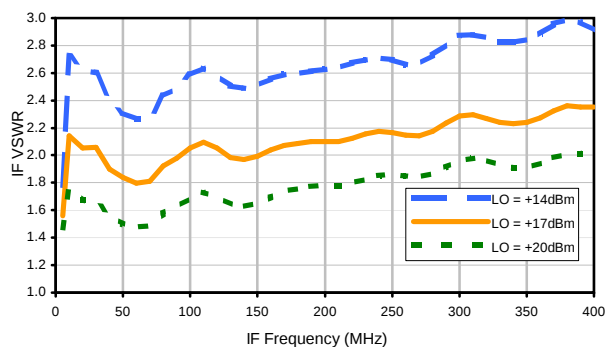
RF VSWR



LO VSWR



IF VSWR



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Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	14	35	18	36	20	54	25	41	41	52
1	-	16	+0	25	13	38	24	36	38	48	30	51
2	98	63	54	62	51	76	54	65	48	68	55	62
3	>100	52	53	56	58	61	50	56	49	79	55	71
4	>100	83	79	81	77	80	71	76	71	81	77	79
5	>100	78	77	80	75	83	67	78	65	86	69	82
6	>100	>94	92	92	>94	90	>94	92	89	93	84	>94
7	>100	>94	>94	93	91	>94	90	90	87	91	85	90
8	>100	>94	>94	>94	>94	>94	>94	>94	82	>94	>94	>94
9	>100	>94	>94	>94	>94	>94	>94	>94	>94	87	>94	>94
10	>100	>94	>94	>94	>94	>94	>94	>94	>94	>94	92	>94
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -1.00 dBm.
LO IN: 230.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; -6.18 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	24	44	30	45	33	61	40	60	52	62
1	-	17	+0	28	13	39	22	43	46	56	43	59
2	82	55	47	55	45	63	47	67	45	70	48	69
3	>100	41	37	43	39	44	38	45	52	53	51	58
4	>100	66	70	72	62	77	57	79	58	77	61	73
5	>100	62	52	53	55	53	50	61	47	53	52	71
6	>100	87	71	95	68	78	69	75	65	69	66	88
7	>100	89	75	65	61	61	64	64	60	65	57	68
8	>100	95	83	96	74	93	73	78	70	76	70	71
9	>100	80	82	85	89	73	69	71	70	75	64	67
10	>100	98	89	98	93	97	81	90	77	83	76	80
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; 9.00 dBm.
LO IN: 230.01 MHz; +17.00 dBm
IF OUT: 29.91 MHz; 3.72 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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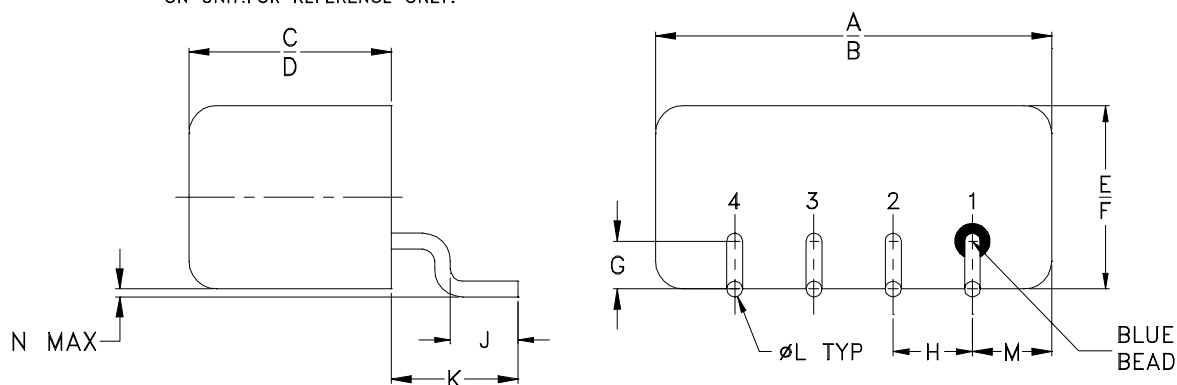
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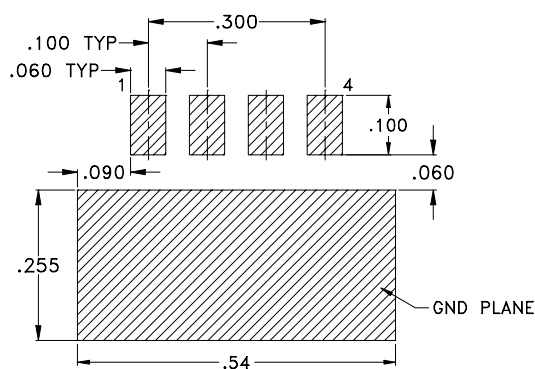
Outline Dimensions

NNN150

NOTE: BLUE BEAD INDICATES PIN #1.
PIN NUMBERS DO NOT APPEAR
ON UNIT.FOR REFERENCE ONLY.



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	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. $\pm .03$; 3 Pl. $\pm .015$

Notes:

- Header material C.R.S. Pin material #52 alloy.
- Finish: Electro-Tin, hot-oil flowed or electro-Tin-Silver.
- Cover material: Cupro-Nickel.
- Pin's meniscus 0.015 inch max.
- Special Tolerances: Pin diameter $\pm .005$ inch.



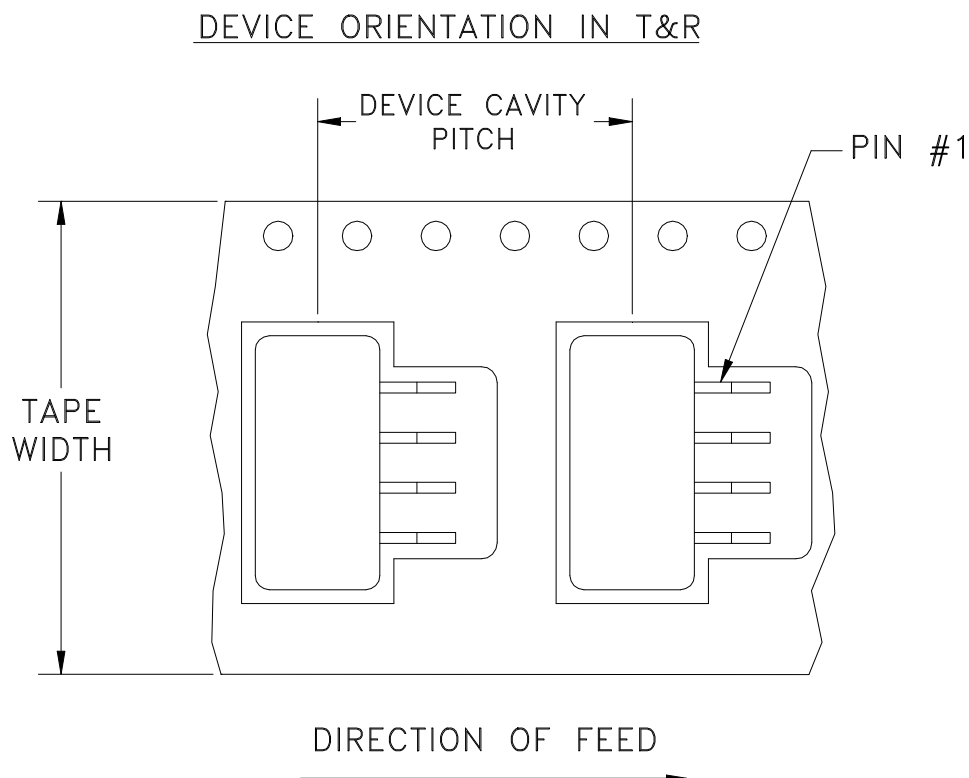
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24	16	13	500

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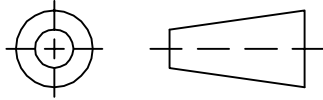
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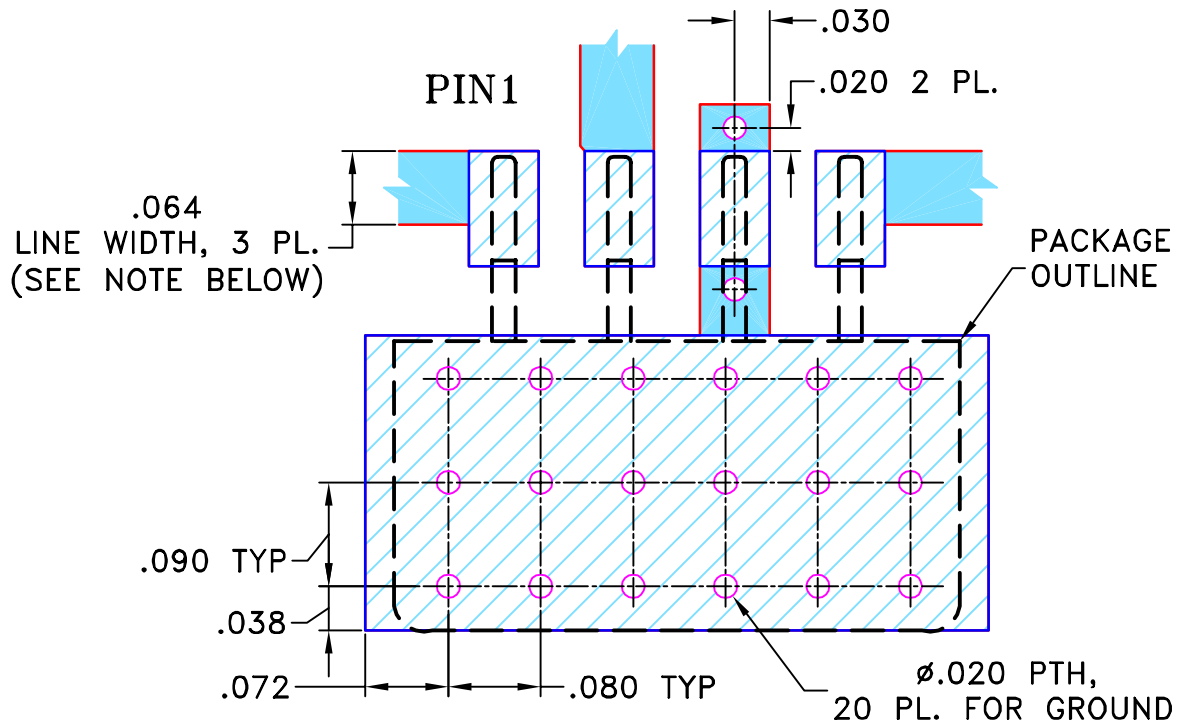
THIRD ANGLE PROJECTION



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

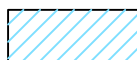
**SUGGESTED MOUNTING CONFIGURATION
FOR NNN150 CASE STYLE, "z"/"cm" PIN CONNECTIONS.**



NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS 0.030" $\pm$ 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

TOLERANCES ON:

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

DRAWN

GF

04/11/03

CHECKED

AV

04/15/03

APPROVED

DJ

04/15/03



Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

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

SIZE
A

CODE IDENT
15542

DRAWING NO:
98-PL-081

REV:
A

FILE: 98PL081

SCALE: 6:1

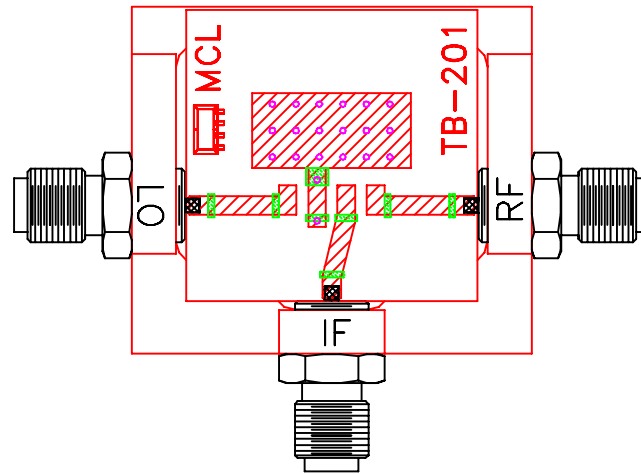
SHEET: 1 OF 1

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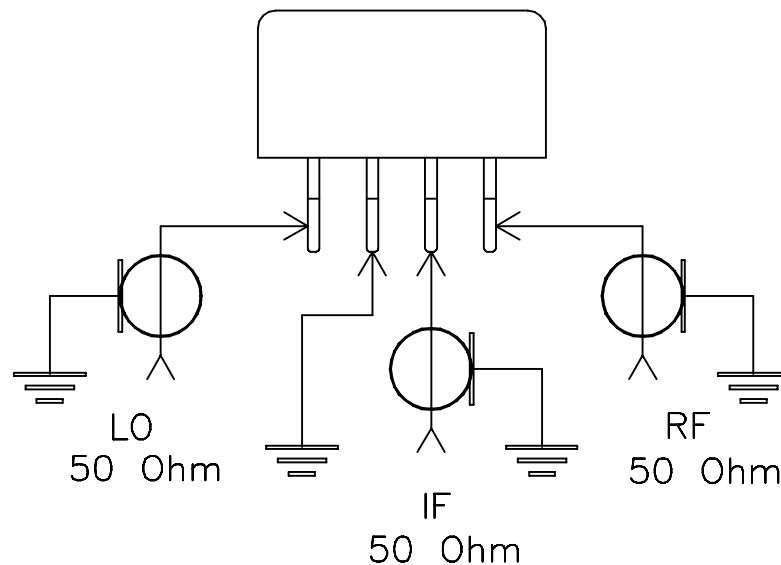
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ASHEETA1.DWG REV:A DATE:01/12/95

Evaluation Board and Circuit



TB-201



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	-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



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Specification	Test/Inspection Condition	Reference/Spec
Barometric Pressure	100,000 Feet	MIL-STD-202, Method 105, Condition D