

Frequency Mixer

TUF-3SM+

Level 7 (LO Power +7 dBm) 0.15 to 400 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, 4.7 dB typ.
- excellent L-R isolation, 46 dB typ.; L-I, 47 dB typ.
- rugged welded construction

Applications

- HF/VHF
- defense & federal communication

Electrical Specifications

FREQUENCY (MHz)	CONVERSION LOSS (dB)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)			IP3 @ CENTER BAND (dBm)						
		L	M	U	L	M	U							
0.15-400	DC-400	60	50	46	30	35	25	60	40	47	25	35	20	11

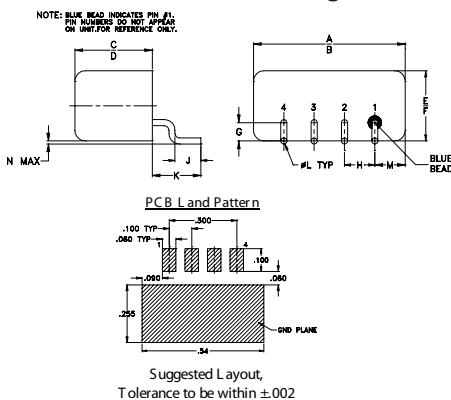
1 dB COMP.: +1 dBm typ.
For phase detection, DC positive polarity with in-phase RF & LO.

L = 50-100 MHz M = 100-500 MHz U = upper range [$f_c/2$ 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)
0.15	30.15	5.37	10.00	68.68	61.84	2.59
0.23	30.23	5.27	20.00	65.36	56.87	2.60
0.30	30.30	5.21	30.00	63.22	54.20	2.59
0.50	30.50	5.16	40.00	61.75	52.09	2.58
1.00	31.00	5.08	76.00	57.56	47.59	2.54
2.80	32.80	4.91	94.00	56.48	45.97	2.50
6.40	36.40	4.91	112.00	54.90	44.70	2.50
10.00	40.00	4.73	149.00	52.63	42.36	2.57
28.00	58.00	4.71	168.00	54.13	42.02	2.55
64.00	94.00	4.75	206.00	49.62	38.81	2.62
100.00	130.00	4.83	225.00	48.10	38.56	2.66
138.00	168.00	4.85	244.00	48.03	37.82	2.68
157.00	187.00	4.88	282.00	53.65	37.79	2.67
195.00	225.00	4.92	301.00	55.10	38.07	2.76
233.00	263.00	4.97	320.00	54.03	37.59	2.82
252.00	282.00	5.10	340.00	52.86	36.62	2.76
271.00	301.00	5.17	360.00	51.53	35.44	2.69
290.00	320.00	5.15	390.00	47.44	33.11	2.86
370.00	340.00	5.38	410.00	45.39	32.24	3.05
400.00	370.00	5.41	430.00	44.42	32.17	3.06

Outline Drawing

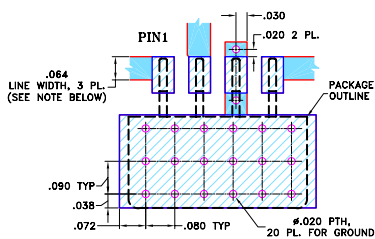


Outline Dimensions (inch)

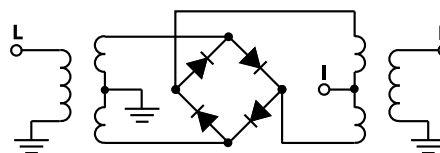
A	B	C	D	E	F	G
.50	.48	.255	.240	.23	.21	.06
12.70	12.19	6.48	6.10	5.84	5.33	1.52

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)

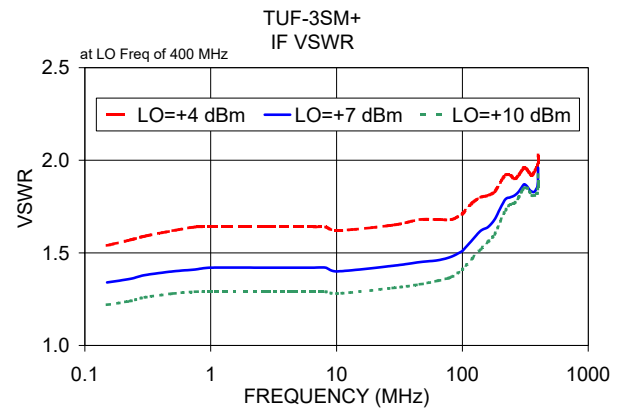
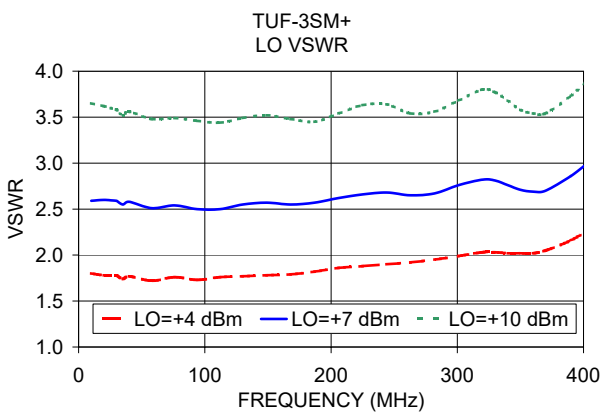
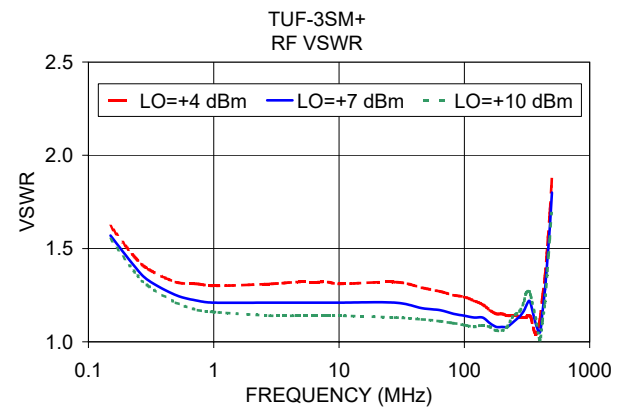
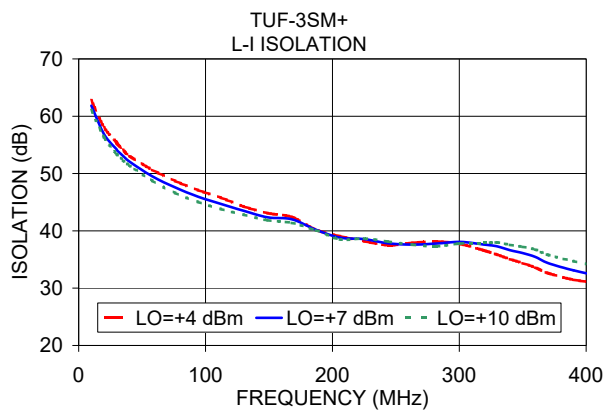
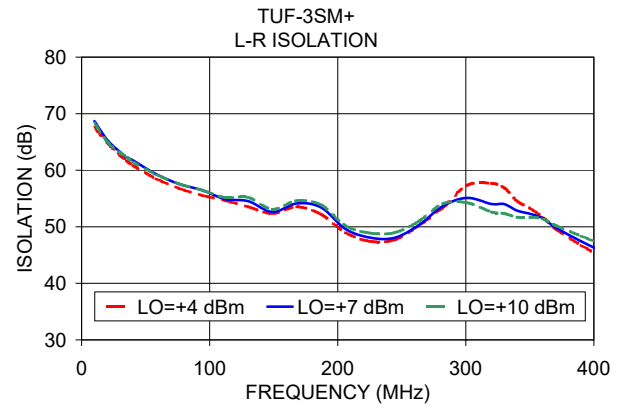
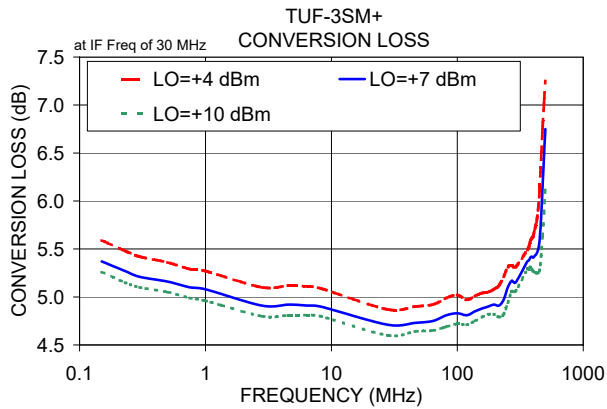


Electrical Schematic



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-Circuit's 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-Circuit's website at www.minicircuits.com/MCLStore/terms.jsp





Notes

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp



Frequency Mixer

TUF-3SM+

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
0.15	30.2	5.84	5.60	5.46	10.1	40.1	17.19	21.35	19.03	10.1	40.1	1.15	0.81	0.57
0.2	30.2	5.75	5.52	5.39	27.8	57.8	18.32	18.01	19.22	27.8	57.8	1.07	0.80	0.57
0.3	30.3	6.69	5.47	5.33	45.5	75.5	19.83	18.86	24.60	45.5	75.5	1.22	0.83	0.61
0.5	30.5	5.64	5.41	5.28	63.2	93.2	20.63	23.22	18.46	63.2	93.2	1.05	0.77	0.54
1.0	31.0	5.54	5.31	5.20	80.9	110.9	16.80	26.58	16.94	80.9	110.9	0.97	0.74	0.52
1.5	31.5	5.47	5.25	5.14	98.6	128.6	25.04	16.13	14.33	98.6	128.6	1.00	0.64	0.52
2.0	32.0	5.44	5.22	5.10	116.3	146.3	18.41	17.83	17.27	116.3	146.3	0.96	0.66	0.49
5.0	35.0	5.44	5.19	5.06	133.9	163.9	18.99	15.58	14.06	133.9	163.9	0.94	0.72	0.53
10.0	40.0	5.46	5.21	5.07	151.6	181.6	14.11	13.19	13.45	151.6	181.6	0.96	0.72	0.56
27.8	57.8	5.11	4.78	4.63	169.3	199.3	12.04	10.62	10.62	169.3	199.3	0.83	0.64	0.49
45.5	75.5	5.16	4.84	4.72	187.0	217.0	14.03	12.27	13.06	187.0	217.0	0.89	0.64	0.50
98.6	128.6	5.10	4.84	4.72	204.7	234.7	21.75	26.48	21.67	204.7	234.7	0.92	0.69	0.51
116.3	146.3	5.16	4.92	4.79	222.4	252.4	19.43	19.51	21.84	222.4	252.4	0.94	0.72	0.57
133.9	163.9	5.14	4.93	4.79	240.1	270.1	10.61	10.51	11.18	240.1	270.1	1.08	0.83	0.65
151.6	181.6	5.19	4.95	4.78	257.8	287.8	9.99	9.60	10.16	257.8	287.8	1.25	0.93	0.73
169.3	199.3	5.29	5.04	4.87	275.5	305.5	9.05	9.09	9.47	275.5	305.5	1.43	1.04	0.81
187.0	217.0	5.31	5.04	4.87	293.2	323.2	8.02	8.83	10.18	293.2	323.2	1.63	1.19	0.91
222.4	252.4	5.44	5.16	4.96	310.9	340.9	8.21	9.85	12.08	310.9	340.9	1.78	1.25	0.94
240.1	270.1	5.45	5.22	5.05	328.6	358.6	6.41	10.59	13.64	328.6	358.6	2.01	1.50	1.10
257.8	287.8	5.43	5.24	5.10	346.3	376.3	4.33	8.82	15.99	346.3	376.3	2.00	1.67	1.31
275.5	305.5	5.41	5.21	5.09	363.9	393.9	2.25	5.33	11.08	363.9	393.9	1.99	1.76	1.49
293.2	323.2	5.46	5.19	5.08	381.6	411.6	1.43	3.34	7.25	381.6	411.6	1.90	1.69	1.53
310.9	340.9	5.59	5.31	5.15	399.3	429.3	2.08	3.41	5.95	399.3	429.3	1.68	1.55	1.49
346.3	376.3	6.23	5.62	5.19	417.0	447.0	2.94	3.92	5.87	417.0	447.0	1.40	1.32	1.27
363.9	393.9	6.64	5.98	5.36	434.7	464.7	3.70	4.97	6.58	434.7	464.7	1.17	1.12	1.07
381.6	411.6	6.92	6.28	5.55	452.4	482.4	4.07	5.57	7.07	452.4	482.4	1.10	1.04	1.01
399.3	429.3	7.15	6.50	5.79	470.1	500.1	6.38	8.50	10.40	470.1	500.1	1.07	0.99	0.97
417.0	447.0	7.57	6.99	6.25	487.8	517.8	10.01	12.67	16.66	487.8	517.8	1.14	1.02	0.90
452.4	482.4	8.14	7.44	6.86	505.5	535.5	13.53	16.04	15.00	505.5	535.5	1.20	1.10	0.94
470.1	500.1	8.03	7.40	6.92	523.2	553.2	14.72	13.43	13.07	523.2	553.2	1.34	1.18	0.97
487.8	517.8	7.98	7.42	7.06	540.9	570.9	10.55	13.42	12.55	540.9	570.9	1.49	1.23	1.01
505.5	535.5	8.12	7.55	7.22	558.6	588.6	8.68	12.20	13.85	558.6	588.6	1.51	1.07	0.83
540.9	570.9	7.97	7.45	7.21	576.3	606.3	8.28	11.47	13.65	576.3	606.3	1.39	0.93	0.71
558.6	588.6	7.95	7.52	7.44	593.9	623.9	8.60	10.97	12.11	593.9	623.9	1.38	0.88	0.66
576.3	606.3	8.19	7.87	7.79	611.6	641.6	8.94	11.82	12.88	611.6	641.6	1.33	0.83	0.65
593.9	623.9	8.53	8.17	8.11	629.3	659.3	10.22	12.68	12.12	629.3	659.3	1.30	0.75	0.65
611.6	641.6	8.76	8.45	8.41	647.0	677.0	10.42	10.90	11.99	647.0	677.0	1.13	0.66	0.62
647.0	677.0	9.48	9.19	9.21	664.7	694.7	11.02	10.57	9.90	664.7	694.7	1.05	0.64	0.63
682.4	712.4	10.44	10.16	10.11	682.4	712.4	10.02	9.84	9.42	682.4	712.4	1.19	0.76	0.80
700.1	730.1	10.89	10.62	10.53	700.1	730.1	10.10	11.11	9.05	700.1	730.1	1.32	0.82	0.80

Frequency Mixer

TUF-3SM+

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)
		+7			+7			+7
190.0	10.1	5.14	10.0	20.1	4.69	390.0	10.1	6.14
185.4	14.7	5.14	19.7	29.8	4.68	380.3	19.8	6.10
180.8	19.3	5.10	29.5	39.6	4.64	370.5	29.6	6.04
176.2	23.9	5.04	39.2	49.3	4.68	360.8	39.3	6.01
171.5	28.6	5.03	49.0	59.1	4.75	351.0	49.1	6.00
166.9	33.2	4.98	58.7	68.8	4.70	341.3	58.8	5.96
162.3	37.8	4.97	68.5	78.6	4.77	331.5	68.6	5.95
157.7	42.4	4.97	78.2	88.3	4.79	321.8	78.3	6.01
153.1	47.0	4.98	87.9	98.0	4.77	312.1	88.0	6.01
148.5	51.6	4.96	97.7	107.8	4.79	302.3	97.8	5.95
143.8	56.3	4.95	107.4	117.5	4.78	292.6	107.5	5.95
139.2	60.9	4.95	117.2	127.3	4.80	282.8	117.3	5.94
134.6	65.5	4.93	126.9	137.0	4.80	273.1	127.0	5.94
130.0	70.1	4.94	136.7	146.8	4.85	263.3	136.8	5.97
125.4	74.7	4.95	146.4	156.5	4.90	253.6	146.5	6.05
120.8	79.3	4.96	156.2	166.3	4.90	243.8	156.3	6.05
116.2	83.9	4.96	165.9	176.0	4.90	234.1	166.0	6.02
111.5	88.6	4.96	175.6	185.7	4.91	224.4	175.7	6.02
106.9	93.2	4.95	185.4	195.5	4.94	214.6	185.5	6.02
102.3	97.8	4.91	195.1	205.2	4.88	204.9	195.2	6.01
97.7	102.4	4.91	204.9	215.0	4.87	195.1	205.0	6.02
93.1	107.0	4.94	214.6	224.7	4.93	185.4	214.7	6.01
88.5	111.6	4.95	224.4	234.5	4.93	175.6	224.5	5.97
83.8	116.3	4.96	234.1	244.2	5.01	165.9	234.2	5.92
79.2	120.9	4.95	243.8	253.9	5.19	156.2	243.9	5.96
74.6	125.5	4.95	253.6	263.7	5.27	146.4	253.7	5.96
70.0	130.1	4.95	263.3	273.4	5.23	136.7	263.4	5.92
65.4	134.7	4.94	273.1	283.2	5.26	126.9	273.2	5.97
60.8	139.3	4.93	282.8	292.9	5.21	117.2	282.9	5.98
56.2	143.9	4.95	292.6	302.7	5.08	107.4	292.7	5.88
51.5	148.6	4.95	302.3	312.4	5.11	97.7	302.4	5.90
46.9	153.2	4.93	312.1	322.2	5.07	87.9	312.2	5.92
42.3	157.8	4.95	321.8	331.9	4.97	78.2	321.9	5.85
37.7	162.4	4.96	331.5	341.6	4.99	68.5	331.6	5.75
33.1	167.0	4.96	341.3	351.4	4.97	58.7	341.4	5.65
28.5	171.6	4.99	351.0	361.1	4.97	49.0	351.1	5.65
23.8	176.3	5.01	360.8	370.9	5.11	39.2	360.9	5.70
19.2	180.9	4.98	370.5	380.6	5.18	29.5	370.6	5.77
14.6	185.5	5.05	380.3	390.4	5.14	19.7	380.4	5.95
10.0	190.1	5.04	390.0	400.1	5.19	10.0	390.1	6.03

Frequency Mixer

TUF-3SM+

Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)		
	@LO (dBm)			@LO (dBm)		
	+4	+7	+10	+4	+7	+10
0.15	82.59	77.37	74.58	60.69	63.67	66.98
0.2	83.04	77.64	74.35	60.44	63.64	66.75
0.3	82.49	77.00	74.12	60.19	63.40	66.52
0.5	81.86	76.78	74.01	60.36	63.48	66.51
1.0	80.26	76.45	73.66	60.46	63.55	66.86
1.5	80.37	75.88	73.40	60.37	63.58	66.40
2.0	79.14	75.76	73.07	60.34	63.46	66.57
5.0	77.84	74.18	72.40	60.54	63.18	65.20
10.0	74.42	72.35	70.36	59.32	61.65	63.66
27.8	63.36	64.37	64.63	65.82	64.86	63.03
45.5	59.13	60.10	60.69	61.27	59.10	58.04
98.6	52.71	53.38	53.86	52.07	52.15	51.66
116.3	50.71	51.70	52.21	51.00	51.11	50.48
133.9	49.83	50.33	50.90	48.95	49.53	48.82
151.6	49.09	50.12	50.47	48.78	49.06	47.96
169.3	46.78	47.47	48.21	48.66	48.85	47.25
187.0	45.40	45.85	46.04	49.47	48.40	47.07
222.4	45.59	45.68	45.92	47.27	45.31	43.31
240.1	46.94	46.37	46.00	44.01	42.26	40.97
257.8	49.47	48.54	47.19	42.36	40.12	38.69
275.5	53.60	51.81	49.42	44.13	39.87	37.68
293.2	49.36	48.94	47.44	46.76	40.23	37.20
310.9	46.45	48.13	48.53	50.46	40.02	36.05
346.3	43.55	46.50	48.48	43.66	36.70	32.41
363.9	43.37	46.26	49.20	38.59	35.36	31.91
381.6	43.61	46.24	49.52	35.50	33.67	31.30
399.3	46.01	50.53	59.92	32.90	31.38	29.23
417.0	45.82	49.32	53.26	30.76	29.64	27.85
452.4	43.93	45.55	47.26	27.62	26.66	25.59
470.1	42.42	43.87	45.53	26.75	25.85	24.76
487.8	39.39	39.99	40.47	25.79	25.09	23.81
505.5	37.41	38.12	37.97	24.69	24.25	22.78
540.9	33.55	34.16	33.19	22.22	22.21	20.41
558.6	32.20	33.05	31.90	21.18	21.39	19.33
576.3	30.41	31.10	29.80	20.16	20.30	18.32
593.9	28.62	29.15	27.73	18.89	19.10	17.27
611.6	26.80	27.33	26.40	17.39	17.51	16.24
647.0	23.27	23.69	23.30	14.91	15.10	14.35
682.4	20.87	21.10	20.88	13.92	13.89	13.07
700.1	20.19	20.35	20.16	13.64	13.45	12.65

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB)		
		@LO (dBm)		
		+4	+7	+10
10.1	40.1	41.02	36.72	39.99
27.8	57.8	31.44	32.31	32.00
45.5	75.5	28.16	28.67	28.44
63.2	93.2	26.34	26.37	26.37
80.9	110.9	24.81	25.10	25.16
98.6	128.6	23.64	23.75	24.00
116.3	146.3	23.28	23.47	23.65
133.9	163.9	22.66	23.09	23.33
151.6	181.6	22.34	22.83	23.38
169.3	199.3	22.24	22.56	22.94
187.0	217.0	22.96	23.18	23.38
204.7	234.7	24.00	24.27	24.42
222.4	252.4	25.41	26.21	26.83
240.1	270.1	25.85	27.03	28.34
257.8	287.8	24.66	25.82	26.80
275.5	305.5	22.30	22.91	23.41
293.2	323.2	20.22	20.34	20.39
310.9	340.9	18.84	18.70	18.56
328.6	358.6	17.74	17.42	17.23
346.3	376.3	16.94	16.73	16.59
363.9	393.9	16.36	16.21	16.15
381.6	411.6	16.28	16.17	16.10
399.3	429.3	16.54	16.31	16.22
417.0	447.0	17.05	16.85	16.72
434.7	464.7	17.22	17.06	16.93
452.4	482.4	17.00	16.93	16.97
470.1	500.1	16.33	16.36	16.44
487.8	517.8	15.44	15.47	15.58
505.5	535.5	14.77	14.88	14.83
523.2	553.2	13.94	13.88	13.69
540.9	570.9	13.20	13.04	12.70
558.6	588.6	12.41	12.06	11.56
576.3	606.3	11.44	11.02	10.43
593.9	623.9	10.63	10.17	9.67
611.6	641.6	9.69	9.25	8.81
629.3	659.3	8.83	8.41	8.00
647.0	677.0	8.05	7.67	7.34
664.7	694.7	7.36	7.02	6.68
682.4	712.4	6.95	6.61	6.36
700.1	730.1	6.62	6.30	6.07

Frequency Mixer

TUF-3SM+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1)		
		@LO (dBm)		
		+4	+7	+10
5.0	35.0	1.27	1.21	1.22
10.0	40.0	1.19	1.09	1.07
27.8	57.8	1.33	1.22	1.15
45.5	75.5	1.37	1.25	1.16
63.2	93.2	1.30	1.23	1.15
80.9	110.9	1.30	1.20	1.14
98.6	128.6	1.28	1.19	1.13
116.3	146.3	1.29	1.18	1.12
133.9	163.9	1.27	1.18	1.12
151.6	181.6	1.27	1.17	1.10
169.3	199.3	1.25	1.16	1.11
187.0	217.0	1.24	1.16	1.11
204.7	234.7	1.20	1.11	1.08
222.4	252.4	1.21	1.12	1.09
240.1	270.1	1.18	1.12	1.10
257.8	287.8	1.15	1.09	1.09
275.5	305.5	1.11	1.05	1.07
293.2	323.2	1.07	1.02	1.07
310.9	340.9	1.11	1.02	1.03
328.6	358.6	1.22	1.12	1.07
346.3	376.3	1.37	1.25	1.19
363.9	393.9	1.54	1.43	1.33
381.6	411.6	1.70	1.58	1.47
399.3	429.3	1.85	1.73	1.60
417.0	447.0	2.14	2.01	1.85
434.7	464.7	2.34	2.19	2.03
452.4	482.4	2.42	2.26	2.10
470.1	500.1	2.40	2.26	2.12
487.8	517.8	2.40	2.27	2.17
505.5	535.5	2.55	2.42	2.34
523.2	553.2	2.58	2.45	2.38
540.9	570.9	2.52	2.41	2.34
558.6	588.6	2.48	2.40	2.34
576.3	606.3	2.52	2.45	2.39
593.9	623.9	2.57	2.52	2.45
611.6	641.6	2.58	2.51	2.45
629.3	659.3	2.51	2.45	2.41
647.0	677.0	2.51	2.45	2.42
664.7	694.7	2.49	2.44	2.41
682.4	712.4	2.47	2.41	2.37
700.1	730.1	2.43	2.35	2.32

LO (MHz)	LO VSWR (:1)		
	@LO (dBm)		
	+4	+7	+10
5.0	1.81	2.60	3.64
10.0	1.71	2.50	3.52
27.8	1.58	2.44	3.49
45.5	1.58	2.37	3.40
63.2	1.51	2.21	3.12
80.9	1.49	2.14	2.98
98.6	1.50	2.19	3.06
116.3	1.57	2.30	3.22
133.9	1.62	2.36	3.29
151.6	1.61	2.30	3.18
169.3	1.60	2.26	3.10
187.0	1.62	2.29	3.13
204.7	1.70	2.39	3.26
222.4	1.77	2.47	3.36
240.1	1.82	2.50	3.35
257.8	1.82	2.49	3.34
275.5	1.84	2.50	3.35
293.2	1.90	2.57	3.44
310.9	1.98	2.66	3.54
328.6	2.06	2.70	3.55
346.3	2.12	2.73	3.54
363.9	2.19	2.81	3.60
381.6	2.27	2.94	3.76
399.3	2.35	3.08	3.94
417.0	2.43	3.17	4.07
434.7	2.46	3.18	4.07
452.4	2.48	3.17	4.05
470.1	2.53	3.22	4.09
487.8	2.60	3.30	4.19
505.5	2.68	3.37	4.25
523.2	2.72	3.38	4.23
540.9	2.75	3.36	4.16
558.6	2.78	3.37	4.14
576.3	2.85	3.40	4.15
593.9	2.93	3.45	4.18
611.6	3.03	3.51	4.21
629.3	3.18	3.59	4.25
647.0	3.36	3.73	4.32
664.7	3.54	3.88	4.43
682.4	3.67	4.03	4.55
700.1	3.73	4.11	4.61

IF (OUT) (MHz)	IF VSWR @LO=400.1MHz (:1)		
	@LO (dBm)		
	+4	+7	+10
5.0	1.67	1.41	1.23
10.0	1.68	1.41	1.23
20.0	2.01	1.61	1.31
30.0	2.16	1.75	1.44
40.0	2.23	1.84	1.50
50.0	2.28	1.86	1.53
60.0	2.24	1.85	1.52
70.0	2.25	1.84	1.52
80.0	2.20	1.81	1.52
90.0	2.28	1.88	1.54
100.0	2.31	1.89	1.57
110.0	2.28	1.90	1.58
120.0	2.27	1.89	1.58
130.0	2.28	1.89	1.59
140.0	2.31	1.92	1.61
150.0	2.37	1.99	1.66
160.0	2.44	2.04	1.71
170.0	2.42	2.04	1.72
180.0	2.38	2.01	1.70
190.0	2.32	1.96	1.66
200.0	2.29	1.94	1.65
210.0	2.26	1.94	1.67
220.0	2.29	1.96	1.70
230.0	2.36	2.03	1.75
240.0	2.40	2.08	1.81
250.0	2.39	2.08	1.83
260.0	2.34	2.05	1.81
270.0	2.30	2.00	1.77
280.0	2.32	2.00	1.76
290.0	2.30	2.01	1.79
300.0	2.30	2.04	1.83
310.0	2.33	2.04	1.85
320.0	2.33	2.05	1.85
330.0	2.31	2.05	1.86
340.0	2.28	2.02	1.85
350.0	2.30	2.02	1.83
360.0	2.33	2.03	1.83
370.0	2.36	2.07	1.85
380.0	2.35	2.05	1.86
390.0	2.28	2.01	1.84
400.0	2.28	2.02	1.87

Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	16	31	11	52	19	43	24	39	37	47
1	-	19	+0	24	11	35	30	42	38	43	39	48
2	>100	57	56	55	57	56	51	72	59	67	59	>81
3	>100	76	71	74	65	72	65	77	73	72	66	75
4	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
5	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
6	>100	>81	>81	>81	>81	>81	78	>81	>81	>81	>81	>81
7	>100	>81	>81	>81	>81	>81	>81	72	>81	>81	>81	>81
8	>100	>81	>81	>81	>81	>81	>81	>81	62	>81	>81	>81
9	>100	>81	>81	>81	>81	>81	>81	>81	>81	75	>81	>81
10	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -14.00 dBm.
 LO IN: 230.01 MHz; +7.00 dBm
 IF OUT: 29.91 MHz; -19.24 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	26	39	21	55	30	61	39	50	50	60
1	-	19	+0	25	11	34	32	48	38	48	45	57
2	>100	54	50	52	52	50	46	64	53	58	52	66
3	>100	51	41	49	45	53	39	65	55	55	53	56
4	>100	68	68	66	64	64	64	66	62	83	67	76
5	>100	70	60	56	51	62	51	63	53	65	68	68
6	>100	89	86	84	79	81	78	84	>91	79	87	90
7	>100	89	90	83	75	69	71	72	67	75	67	82
8	>100	>91	>91	>91	>91	>91	86	87	70	89	81	86
9	>100	>91	88	>91	90	>91	76	78	76	79	79	90
10	>100	>91	>91	>91	>91	>91	>91	>91	>91	>91	89	>91
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -4.00 dBm.
 LO IN: 230.01 MHz; +7.00 dBm
 IF OUT: 29.91 MHz; -9.22 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.

REV. X2
 TUF-3SM+
 100818
 Page 5 of 5



IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED • RoHS compliant
 P.O. Box 350166, Brooklyn, New York 11235-0006 (718) 934-4500 Fax (718) 332-4661

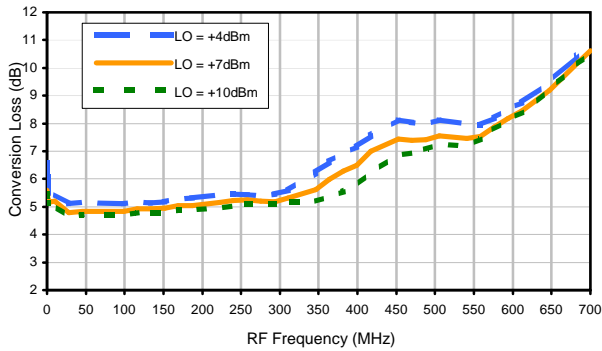


The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see

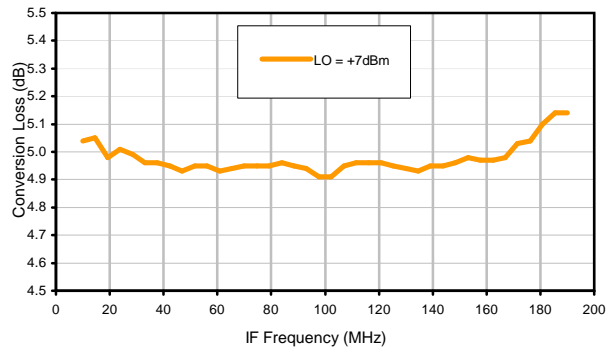


Typical Performance Curves

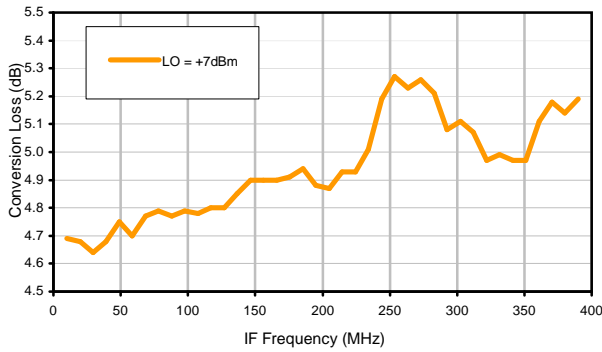
Conversion Loss @ IF=30MHz



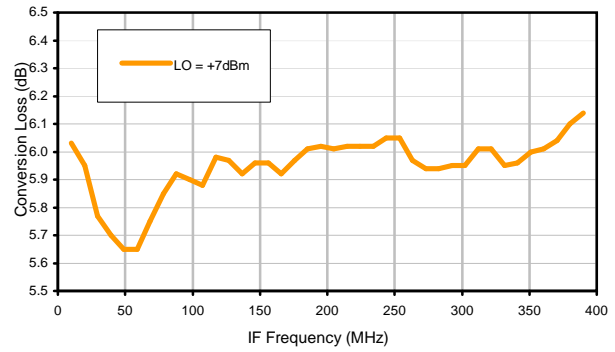
Conversion Loss vs. IF @ RF=200.1MHz



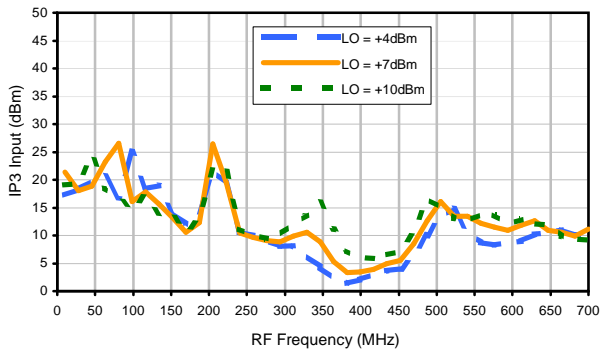
Conversion Loss vs. IF @ RF=10.1MHz



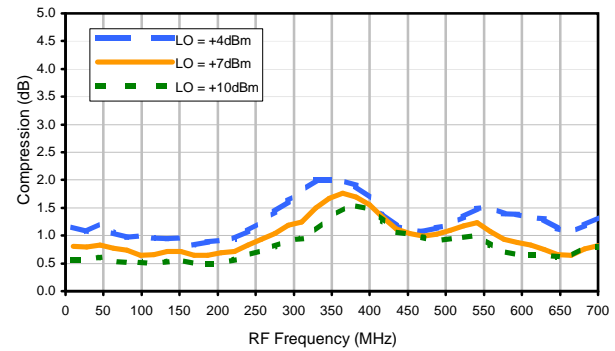
Conversion Loss vs. IF @ RF=400.1MHz



IP3 Input

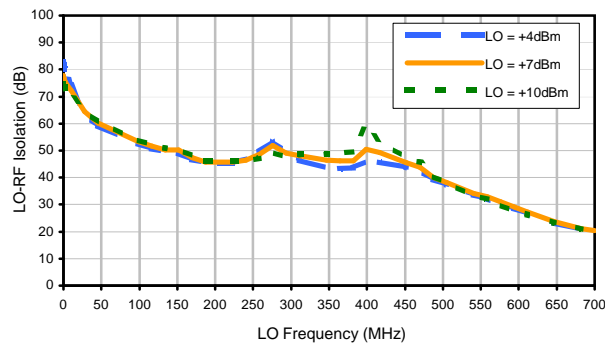


Compression @ RF IN=+1dBm

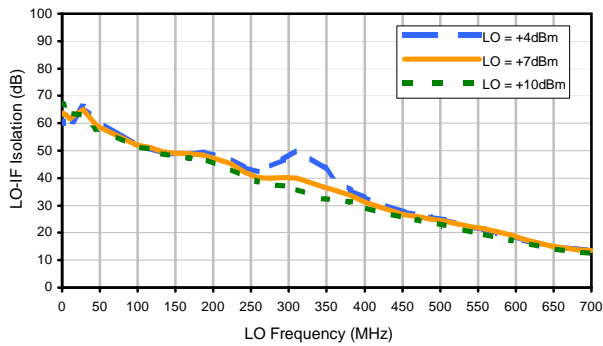


Typical Performance Curves

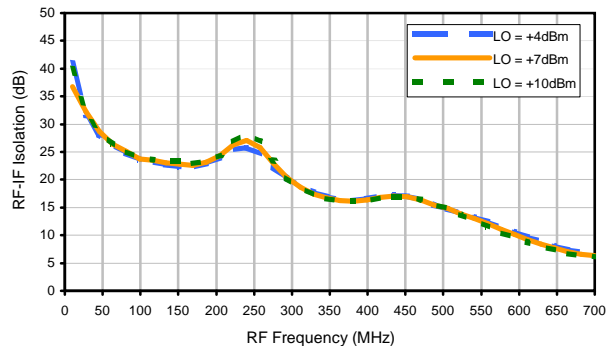
LO-RF Isolation



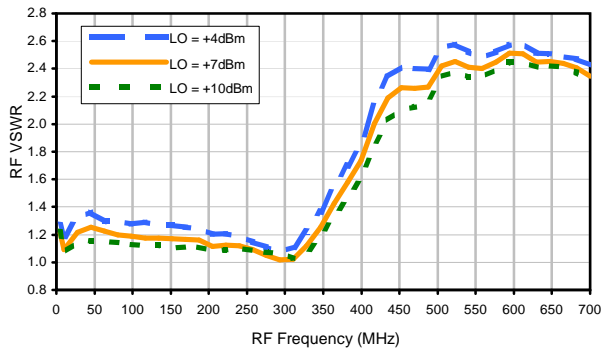
LO-IF Isolation



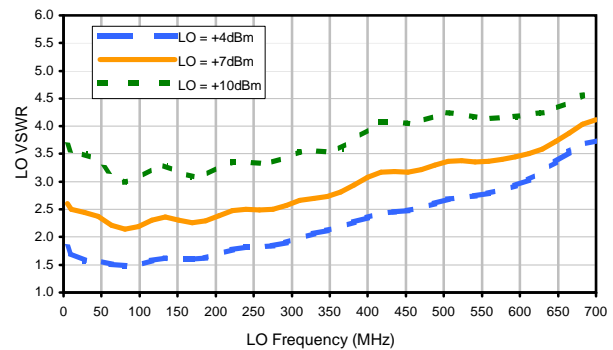
RF-IF Isolation



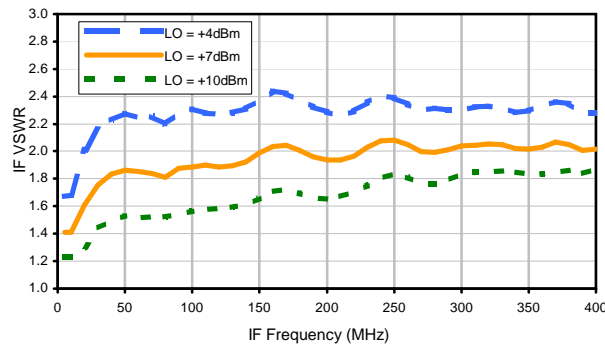
RF VSWR



LO VSWR



IF VSWR



Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	16	31	11	52	19	43	24	39	37	47
1	-	19	+0	24	11	35	30	42	38	43	39	48
2	>100	57	56	55	57	56	51	72	59	67	59	>81
3	>100	76	71	74	65	72	65	77	73	72	66	75
4	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
5	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
6	>100	>81	>81	>81	>81	>81	78	>81	>81	>81	>81	>81
7	>100	>81	>81	>81	>81	>81	>81	72	>81	>81	>81	>81
8	>100	>81	>81	>81	>81	>81	>81	>81	62	>81	>81	>81
9	>100	>81	>81	>81	>81	>81	>81	>81	>81	75	>81	>81
10	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -14.00 dBm.
 LO IN: 230.01 MHz; +7.00 dBm
 IF OUT: 29.91 MHz; -19.24 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	26	39	21	55	30	61	39	50	50	60
1	-	19	+0	25	11	34	32	48	38	48	45	57
2	>100	54	50	52	52	50	46	64	53	58	52	66
3	>100	51	41	49	45	53	39	65	55	55	53	56
4	>100	68	68	66	64	64	64	66	62	83	67	76
5	>100	70	60	56	51	62	51	63	53	65	68	68
6	>100	89	86	84	79	81	78	84	>91	79	87	90
7	>100	89	90	83	75	69	71	72	67	75	67	82
8	>100	>91	>91	>91	>91	>91	86	87	70	89	81	86
9	>100	>91	88	>91	90	>91	76	78	76	79	79	90
10	>100	>91	>91	>91	>91	>91	>91	>91	>91	>91	89	>91
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -4.00 dBm.
 LO IN: 230.01 MHz; +7.00 dBm
 IF OUT: 29.91 MHz; -9.22 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.

REV. X2
 TUF-3SM+
 100818
 Page 3 of 3



IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED • RoHS compliant
 P.O. Box 350166, Brooklyn, New York 11235-0006 (718) 934-4500 Fax (718) 332-4661

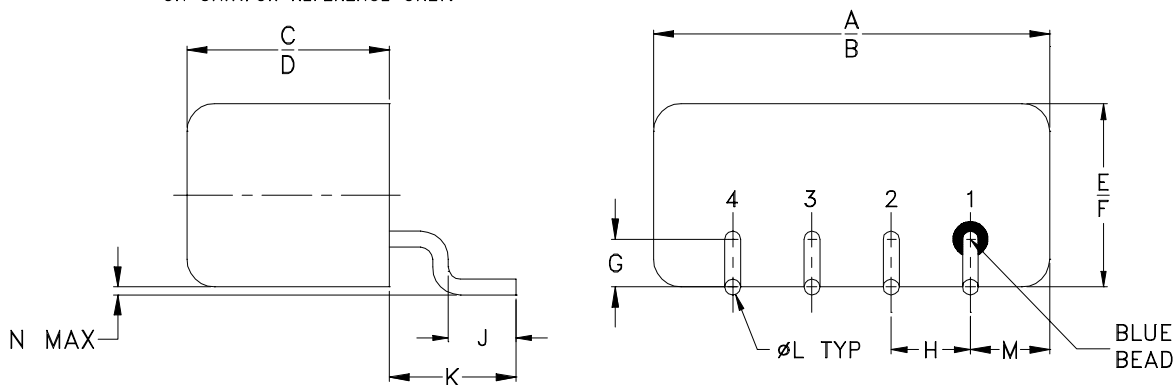


The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

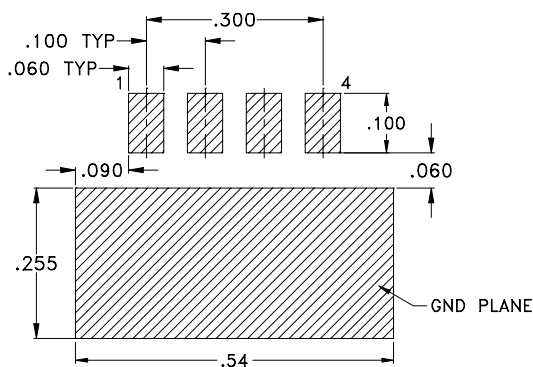
Outline Dimensions

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.



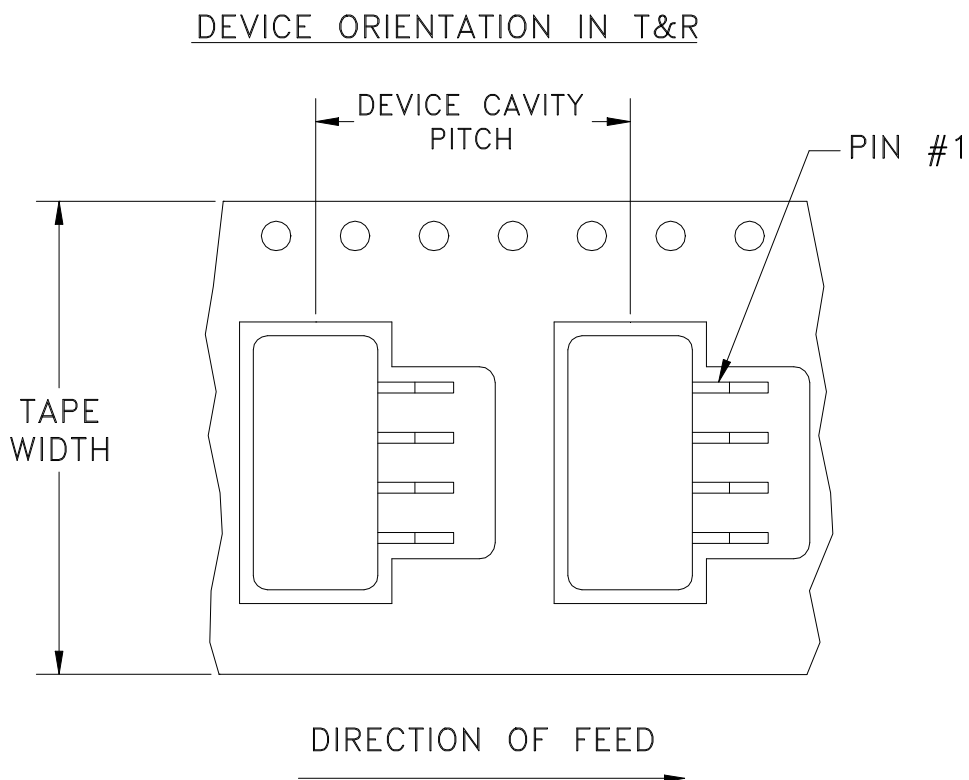
INTERNET <http://www.minicircuits.com>

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010

Mini-Circuits ISO 9001 & ISO 14001 Certified

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

 **Mini-Circuits**[®]

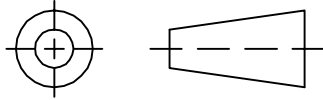
INTERNET <http://www.minicircuits.com>

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010

Mini-Circuits ISO 9001 & ISO 14001 Certified

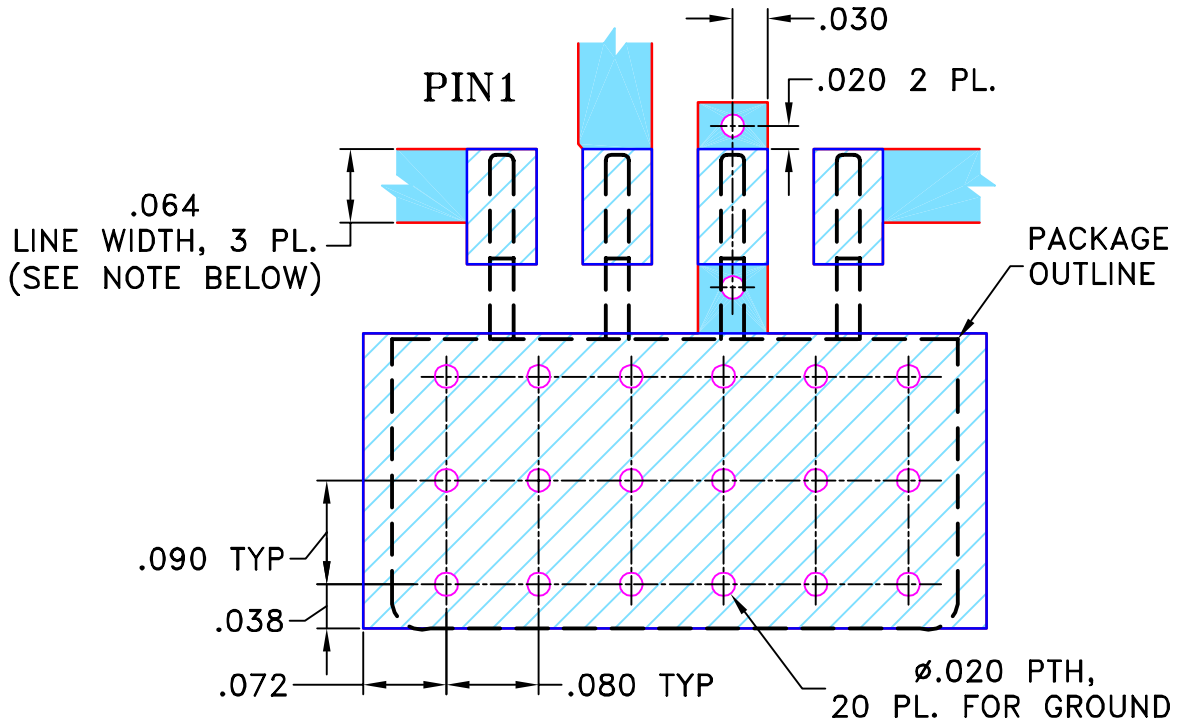
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M86549	NEW RELEASE	04/15/03	GF	DJ
A	M102713	UPDATED NOTES & DISCRPTION	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" ± 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 ± 3 PL DECIMALS ± .005 ANGLES ± FRACTIONS ±	DRAWN	GF	04/11/03
	CHECKED	AV	04/15/03
	APPROVED	DJ	04/15/03

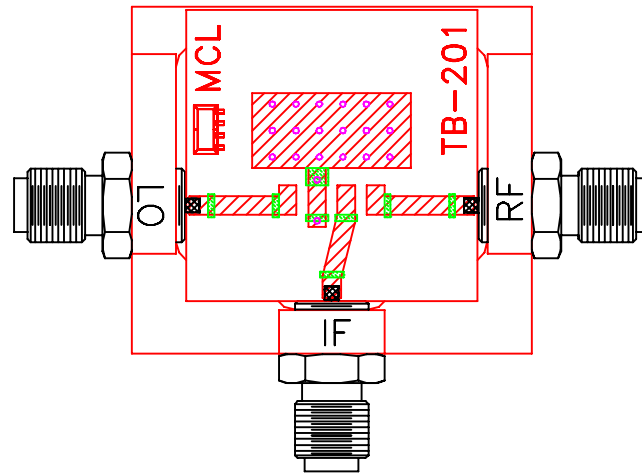
Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

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

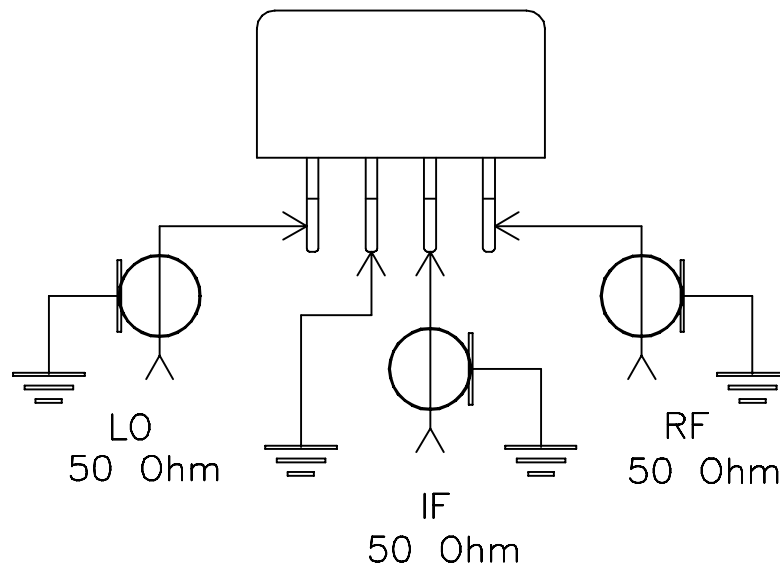
Mini-Circuits®
THIS DOCUMENT AND ITS CONTENTS ARE THE PROPERTY OF MINI-CIRCUITS. EXCEPT FOR USE EXPRESSLY GRANTED, IN WRITING, TO ITS VENDORS, VENDEE AND THE UNITED STATES GOVERNMENT, MINI-CIRCUITS RESERVES ALL PROPRIETARY DESIGN, USE, MANUFACTURING AND REPRODUCTION RIGHTS THERETO. THESE CONTENTS SHALL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

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-081	A
FILE:	98PL081	SCALE:	SHEET:
		6:1	1 OF 1

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



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