

Frequency Mixer

Level 13 (LO Power +13 dBm) 20 to 1500 MHz

TUF-5MH+



Generic photo used for illustration purposes only

CASE STYLE: B02

+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	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

Features

- low conversion loss, 7.0 dB typ.
- wideband, 20 to 1500 MHz
- good L-R isolation, 41 dB typ.
- rugged welded construction

Applications

- VHF/UHF
- satellite distribution
- cellular
- GPS

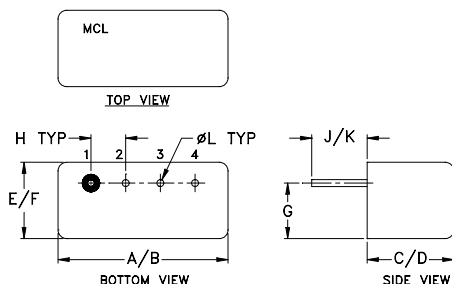
Electrical Specifications

FREQUENCY (MHz)		CONVERSION LOSS (dB)				LO-RF ISOLATION (dB)						LO-IF ISOLATION (dB)					
LO/RF	IF	Mid-Band m		Total Range	Max.	L	M	U	L	M	U	L	M	U	L	M	U
f_L-f_U		$\bar{X}$	σ	Max.	Max.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Min.
20-1500	DC-1000	7.0	0.25	8.5	9.0	50	40	41	30	35	25	38	25	28	18	20	8

1 dB COMP.: +9 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 $f_U/2$]

Outline Drawing



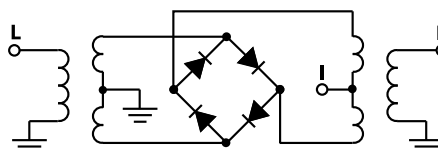
Outline Dimensions (inch/mm)

A	B	C	D	E	F
.480	.500	.240	.255	.210	.230
12.19	12.70	6.10	6.48	5.33	5.84
G	H	J	K	L	wt
.16	.100	.14	.20	.020	grams
4.06	2.54	3.56	5.08	0.51	1.9

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 +13dBm	LO +13dBm	LO +13dBm	LO +13dBm	LO +13dBm
20.00	50.00	5.87	65.81	50.21	1.57	2.60
50.00	80.00	5.57	58.31	42.94	1.38	2.52
100.00	70.00	5.41	52.44	37.15	1.37	2.40
158.75	128.75	5.37	48.96	34.29	1.48	2.28
200.00	170.00	5.43	47.29	32.96	1.56	2.37
297.50	267.50	5.51	45.30	30.09	1.77	2.30
436.25	406.25	5.79	45.57	27.35	2.15	2.34
500.00	470.00	5.90	45.56	26.32	2.23	2.33
575.00	545.00	6.21	44.68	25.44	2.70	2.39
713.75	683.75	6.95	43.61	24.34	3.13	2.40
750.00	720.00	7.16	43.15	24.17	3.17	2.43
760.00	730.00	7.15	43.01	24.16	3.31	2.44
852.50	822.50	7.16	41.36	23.95	3.52	2.50
991.25	961.25	7.16	39.32	22.75	3.65	2.58
1000.00	970.00	7.32	39.30	22.64	3.71	2.59
1130.00	1100.00	7.38	36.80	20.71	3.70	2.62
1222.50	1192.50	7.32	38.30	18.60	3.63	2.70
1361.25	1331.25	7.13	37.67	15.58	3.42	2.64
1453.75	1423.75	7.10	37.62	13.78	3.33	2.62
1500.00	1470.00	7.00	37.26	12.95	3.23	2.57

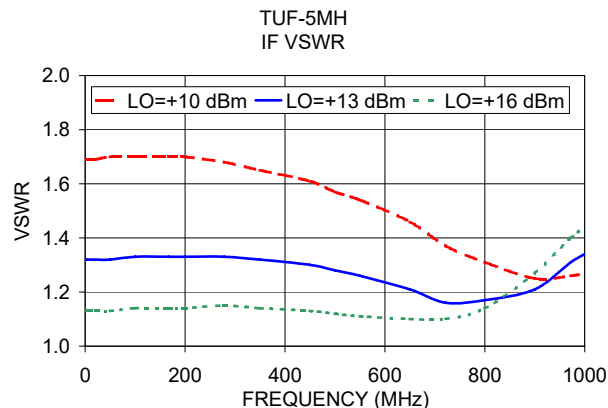
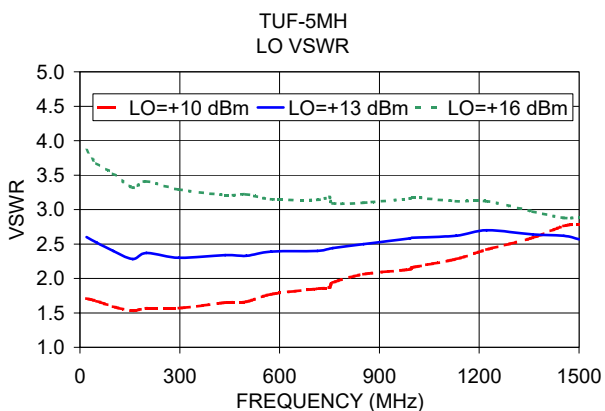
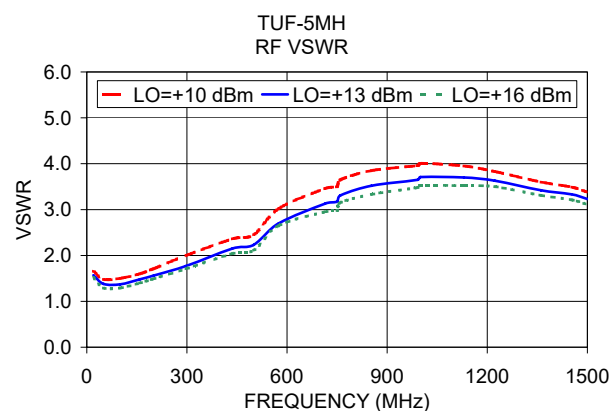
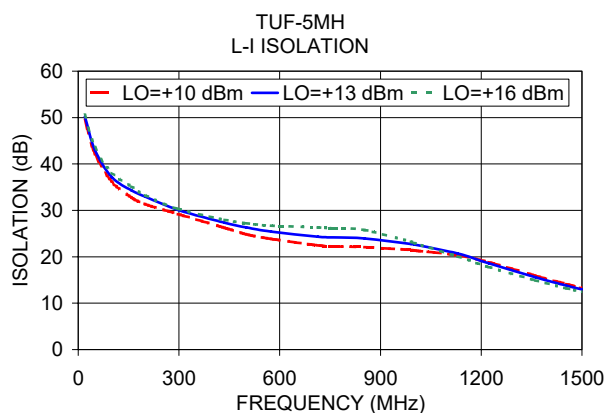
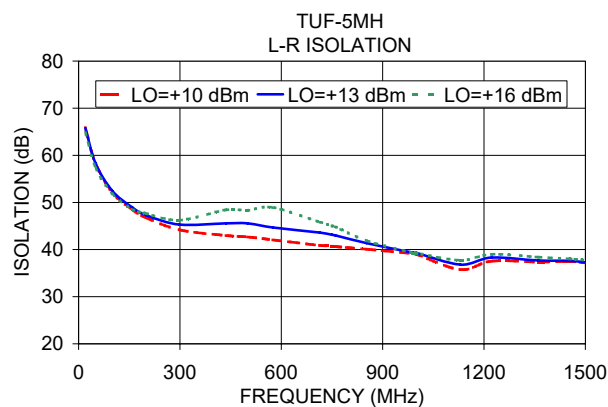
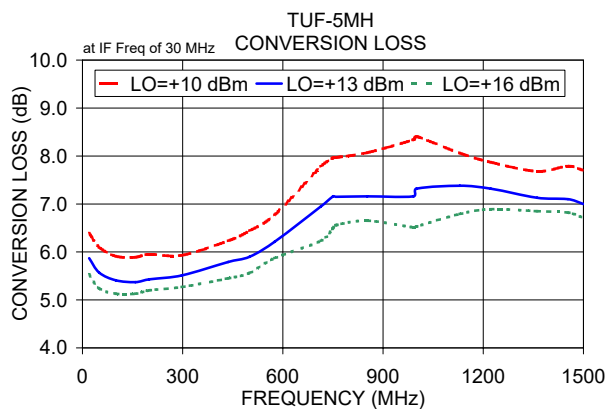
Electrical Schematic



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.
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





Notes

- 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.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- 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-5MH+

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=+9dBm (dB)		
		@LO (dBm)					@LO (dBm)					@LO (dBm)		
		+10	+13	+16			+10	+13	+16			+10	+13	+16
10.1	40.1	6.12	5.68	5.46	10.1	40.1	19.72	21.85	25.11	10.1	40.1	1.39	1.15	0.99
70.4	100.4	5.98	5.59	5.38	70.4	100.4	20.29	22.74	20.70	70.4	100.4	1.53	1.28	1.08
130.6	160.6	5.85	5.50	5.34	130.6	160.6	19.90	17.74	18.70	130.6	160.6	1.63	1.33	1.12
190.9	220.9	5.94	5.57	5.38	190.9	220.9	16.05	16.73	19.18	190.9	220.9	1.57	1.27	1.07
251.1	281.1	5.97	5.61	5.43	251.1	281.1	14.67	16.80	20.03	251.1	281.1	1.61	1.29	1.10
311.4	341.4	6.09	5.70	5.50	311.4	341.4	14.52	17.04	20.77	311.4	341.4	1.57	1.32	1.12
371.6	401.6	6.21	5.81	5.58	371.6	401.6	14.68	17.30	22.08	371.6	401.6	1.60	1.37	1.21
431.9	461.9	6.21	5.80	5.59	431.9	461.9	14.76	20.12	25.09	431.9	461.9	1.68	1.48	1.28
492.1	522.1	6.35	5.93	5.68	492.1	522.1	14.99	17.43	21.91	492.1	522.1	1.84	1.58	1.43
552.4	582.4	6.62	6.07	5.82	552.4	582.4	15.68	19.45	22.08	552.4	582.4	1.97	1.77	1.56
612.6	642.6	6.96	6.20	5.78	612.6	642.6	13.67	21.85	23.74	612.6	642.6	1.89	1.88	1.75
672.9	702.9	7.25	6.60	6.10	672.9	702.9	13.99	16.85	22.49	672.9	702.9	1.70	1.65	1.64
733.1	763.1	7.64	6.94	6.43	733.1	763.1	15.52	17.35	19.89	733.1	763.1	1.65	1.53	1.53
793.4	823.4	7.83	7.05	6.61	793.4	823.4	14.77	16.20	17.12	793.4	823.4	1.55	1.52	1.44
853.6	883.6	7.71	6.87	6.39	853.6	883.6	13.74	15.65	17.67	853.6	883.6	1.53	1.62	1.58
913.9	943.9	7.76	6.79	6.31	913.9	943.9	14.21	16.42	19.02	913.9	943.9	1.45	1.73	1.57
974.1	1004.1	7.86	6.94	6.36	974.1	1004.1	15.29	15.54	16.77	974.1	1004.1	1.21	1.47	1.48
1034.4	1064.4	7.61	6.97	6.45	1034.4	1064.4	16.32	15.87	15.96	1034.4	1064.4	1.23	1.28	1.32
1094.6	1124.6	7.40	6.93	6.49	1094.6	1124.6	16.65	16.24	15.38	1094.6	1124.6	1.25	1.20	1.17
1154.9	1184.9	7.37	6.89	6.51	1154.9	1184.9	17.36	16.32	15.43	1154.9	1184.9	1.32	1.17	1.14
1215.1	1245.1	7.30	6.90	6.55	1215.1	1245.1	17.46	16.43	14.80	1215.1	1245.1	1.36	1.12	1.07
1275.4	1305.4	7.14	6.76	6.50	1275.4	1305.4	17.19	15.72	14.85	1275.4	1305.4	1.33	1.15	1.06
1335.6	1365.6	7.23	6.76	6.49	1335.6	1365.6	16.02	16.38	15.55	1335.6	1365.6	1.47	1.18	1.08
1395.9	1425.9	7.32	6.81	6.48	1395.9	1425.9	15.06	16.67	19.56	1395.9	1425.9	1.53	1.15	1.05
1456.2	1486.2	7.23	6.67	6.29	1456.2	1486.2	15.07	20.63	17.99	1456.2	1486.2	1.38	1.13	0.99
1516.4	1546.4	7.23	6.48	6.12	1516.4	1546.4	16.10	16.79	18.30	1516.4	1546.4	1.66	1.28	0.89
1576.7	1606.7	7.21	6.31	6.11	1576.7	1606.7	15.19	17.56	21.01	1576.7	1606.7	2.04	1.26	0.73
1636.9	1666.9	6.84	6.26	6.12	1636.9	1666.9	15.01	20.21	22.15	1636.9	1666.9	2.05	1.09	0.64
1697.2	1727.2	6.96	6.35	6.17	1697.2	1727.2	14.67	20.06	21.02	1697.2	1727.2	2.16	1.10	0.69
1757.4	1787.4	7.77	6.54	6.26	1757.4	1787.4	13.46	20.69	23.37	1757.4	1787.4	2.22	1.35	0.81
1817.7	1847.7	8.31	6.81	6.39	1817.7	1847.7	15.86	18.91	23.99	1817.7	1847.7	1.82	1.38	0.84
1877.9	1907.9	8.76	7.05	6.56	1877.9	1907.9	19.16	17.87	21.09	1877.9	1907.9	1.53	1.35	0.90
1938.2	1968.2	10.07	7.35	6.71	1938.2	1968.2	13.43	17.28	19.38	1938.2	1968.2	0.97	1.38	0.91
1998.4	2028.4	11.26	7.70	6.82	1998.4	2028.4	10.17	16.83	18.34	1998.4	2028.4	0.21	1.39	1.00
2058.7	2088.7	11.25	7.94	6.94	2058.7	2088.7	10.31	16.25	17.71	2058.7	2088.7	0.19	1.28	1.03
2118.9	2148.9	12.50	8.36	6.99	2118.9	2148.9	8.04	16.24	16.64	2118.9	2148.9	-0.52	1.21	1.07
2199.3	2229.3	13.59	8.91	7.21	2199.3	2229.3	6.79	16.86	15.54	2199.3	2229.3	-1.35	0.99	1.01
2259.5	2289.5	15.67	9.75	7.53	2259.5	2289.5	4.35	16.62	16.21	2259.5	2289.5	-2.81	0.76	0.89
2339.8	2369.8	15.06	9.71	7.74	2339.8	2369.8	5.41	17.56	16.72	2339.8	2369.8	-2.28	0.76	0.80
2400.1	2430.1	17.75	10.61	7.97	2400.1	2430.1	3.09	14.25	17.68	2400.1	2430.1	-3.48	0.68	0.98

Frequency Mixer

TUF-5MH+

Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=750.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=20.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=1500.1MHz (dB)
		@LO (dBm)			@LO (dBm)			@LO (dBm)
		+13			+13			+13
710.0	40.1	6.17	10.0	30.1	6.00	1000.0	500.1	7.54
692.1	58.0	6.24	30.2	50.3	5.84	979.8	520.3	7.44
674.1	76.0	6.34	50.4	70.5	5.84	959.6	540.5	7.37
656.2	93.9	6.31	70.6	90.7	5.91	939.4	560.7	7.33
638.2	111.9	6.39	90.8	110.9	5.83	919.2	580.9	7.27
620.3	129.8	6.38	111.0	131.1	5.81	899.0	601.1	7.25
602.3	147.8	6.46	131.2	151.3	5.80	878.8	621.3	7.18
584.4	165.7	6.48	151.4	171.5	5.84	858.6	641.5	7.18
566.4	183.7	6.59	171.6	191.7	5.78	838.4	661.7	7.22
548.5	201.6	6.59	191.8	211.9	5.76	818.2	681.9	7.22
530.5	219.6	6.59	212.0	232.1	5.76	798.0	702.1	7.24
512.6	237.5	6.53	232.2	252.3	5.72	777.8	722.3	7.19
494.6	255.5	6.58	252.4	272.5	5.77	757.6	742.5	7.20
476.7	273.4	6.55	272.7	292.8	5.74	737.3	762.8	7.03
458.7	291.4	6.64	292.9	313.0	5.73	717.1	783.0	7.04
440.8	309.3	6.65	313.1	333.2	5.73	696.9	803.2	7.05
422.8	327.3	6.60	333.3	353.4	5.71	676.7	823.4	6.95
404.9	345.2	6.52	353.5	373.6	5.76	656.5	843.6	6.92
386.9	363.2	6.53	373.7	393.8	5.73	636.3	863.8	6.88
369.0	381.1	6.52	393.9	414.0	5.73	616.1	884.0	6.79
351.0	399.1	6.62	434.3	454.4	5.75	575.7	924.4	6.64
333.1	417.0	6.61	454.5	474.6	5.78	555.5	944.6	6.64
315.1	435.0	6.60	494.9	515.0	5.78	515.1	985.0	6.52
297.2	452.9	6.61	515.1	535.2	5.74	494.9	1005.2	6.52
279.2	470.9	6.57	555.5	575.6	5.84	454.5	1045.6	6.58
261.3	488.8	6.71	575.7	595.8	5.79	434.3	1065.8	6.53
243.3	506.8	6.71	616.1	636.2	5.83	393.9	1106.2	6.66
225.4	524.7	6.74	636.3	656.4	5.90	373.7	1126.4	6.67
207.4	542.7	6.72	676.7	696.8	5.95	333.3	1166.8	6.69
189.5	560.6	6.70	696.9	717.0	6.02	313.1	1187.0	6.79
171.5	578.6	6.70	737.3	757.4	6.18	272.7	1227.4	6.85
153.6	596.5	6.73	757.6	777.7	6.16	252.4	1247.7	6.86
135.6	614.5	6.66	798.0	818.1	6.26	212.0	1288.1	6.88
117.7	632.4	6.68	818.2	838.3	6.23	191.8	1308.3	6.79
99.7	650.4	6.61	858.6	878.7	6.33	151.4	1348.7	6.79
81.8	668.3	6.82	878.8	898.9	6.37	131.2	1368.9	6.80
63.8	686.3	6.86	919.2	939.3	6.42	90.8	1409.3	6.80
45.9	704.2	6.92	939.4	959.5	6.58	70.6	1429.5	6.85
27.9	722.2	6.90	979.8	999.9	6.79	30.2	1469.9	6.73
10.0	740.1	7.09	1000.0	1020.1	6.84	10.0	1490.1	6.86

Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)		
	@LO (dBm)			@LO (dBm)		
	+10	+13	+16	+10	+13	+16
10.1	77.50	78.21	78.42	58.38	59.85	60.55
70.4	59.26	60.45	61.43	41.84	43.45	44.89
130.6	54.21	55.74	56.91	37.17	39.32	41.16
190.9	51.12	52.65	53.75	34.71	37.03	38.43
251.1	49.01	50.68	52.00	33.29	35.27	36.47
311.4	47.29	49.13	50.59	31.91	33.74	34.93
371.6	46.36	48.18	49.51	30.83	32.57	33.91
431.9	45.26	47.22	48.85	29.45	31.35	32.89
492.1	44.22	46.15	47.66	28.29	30.53	32.45
552.4	43.51	45.36	46.71	27.47	29.72	31.74
612.6	42.65	44.60	46.25	26.80	29.18	31.23
672.9	41.53	43.82	45.43	25.95	28.39	30.73
733.1	40.93	43.12	44.84	25.64	27.77	29.84
793.4	40.76	42.84	44.70	25.71	27.57	29.10
853.6	40.54	42.37	43.99	25.26	26.64	27.69
913.9	40.31	42.11	43.61	24.76	25.84	26.19
974.1	40.74	42.47	43.93	24.38	24.82	24.60
1034.4	40.97	42.99	44.57	23.77	23.92	23.29
1094.6	40.62	43.40	45.49	23.22	23.19	22.16
1154.9	40.66	43.50	46.11	22.45	22.10	21.07
1215.1	40.99	44.12	47.51	21.66	21.08	20.03
1275.4	40.48	43.91	48.20	21.09	20.13	19.25
1335.6	40.23	43.03	46.76	20.02	19.11	18.21
1395.9	40.34	43.08	47.07	18.60	17.81	16.97
1456.2	40.49	43.22	47.43	17.47	16.72	15.63
1516.4	40.22	43.23	46.41	16.27	15.43	14.48
1576.7	41.49	45.93	47.78	14.94	14.14	13.54
1636.9	43.24	49.05	48.59	13.98	13.36	12.93
1697.2	43.87	50.05	47.65	13.23	12.68	12.41
1757.4	46.34	52.31	47.49	12.42	12.28	12.03
1817.7	46.60	57.56	48.79	11.87	11.83	11.59
1877.9	44.39	58.77	49.55	11.49	11.48	11.27
1938.2	43.93	60.16	51.05	11.04	11.09	11.02
1998.4	44.15	56.81	49.84	10.77	10.82	10.79
2058.7	43.58	52.56	46.79	10.62	10.67	10.58
2118.9	42.43	49.80	45.38	10.40	10.57	10.65
2199.3	41.55	46.48	42.19	10.31	10.37	10.64
2259.5	41.69	44.02	39.81	10.20	10.38	10.58
2339.8	40.26	42.11	38.13	10.22	10.41	10.60
2400.1	39.22	40.79	37.61	10.25	10.42	10.80

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB)		
		@LO (dBm)		
		+10	+13	+16
10.1	40.1	54.32	57.37	56.00
70.4	100.4	48.00	48.29	47.07
130.6	160.6	43.44	43.10	42.82
190.9	220.9	40.97	40.25	40.15
251.1	281.1	39.53	38.53	38.25
311.4	341.4	38.23	37.16	36.92
371.6	401.6	36.59	35.63	35.17
431.9	461.9	34.88	34.28	33.83
492.1	522.1	33.90	33.36	33.06
552.4	582.4	32.59	32.01	31.63
612.6	642.6	30.96	30.55	30.11
672.9	702.9	29.91	29.47	29.09
733.1	763.1	29.26	28.74	28.48
793.4	823.4	28.86	28.63	28.37
853.6	883.6	27.92	27.95	27.71
913.9	943.9	26.81	27.19	27.15
974.1	1004.1	25.68	26.19	26.47
1034.4	1064.4	24.62	24.83	25.20
1094.6	1124.6	23.73	23.84	24.16
1154.9	1184.9	23.15	23.22	23.37
1215.1	1245.1	22.44	22.54	22.66
1275.4	1305.4	21.95	22.11	22.27
1335.6	1365.6	21.50	21.79	21.89
1395.9	1425.9	21.01	21.51	21.71
1456.2	1486.2	21.21	21.69	22.05
1516.4	1546.4	21.66	22.28	22.58
1576.7	1606.7	22.39	23.09	23.31
1636.9	1666.9	23.54	24.06	24.21
1697.2	1727.2	24.32	24.97	25.29
1757.4	1787.4	24.65	25.67	26.19
1817.7	1847.7	25.03	26.40	26.98
1877.9	1907.9	25.52	27.01	27.74
1938.2	1968.2	25.69	27.48	28.46
1998.4	2028.4	26.06	28.26	29.32
2058.7	2088.7	27.23	29.56	30.99
2118.9	2148.9	28.16	31.21	33.48
2199.3	2229.3	30.14	34.40	38.84
2259.5	2289.5	31.76	37.79	45.58
2339.8	2369.8	37.84	54.88	40.60
2400.1	2430.1	43.43	42.71	35.03

Frequency Mixer

TUF-5MH+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1)		
		@LO (dBm)		
		+10	+13	+16
10.1	40.1	1.61	1.55	1.53
70.4	100.4	1.20	1.09	1.05
130.6	160.6	1.19	1.08	1.04
190.9	220.9	1.26	1.15	1.12
251.1	281.1	1.32	1.23	1.20
311.4	341.4	1.40	1.32	1.28
371.6	401.6	1.50	1.41	1.37
431.9	461.9	1.60	1.51	1.46
492.1	522.1	1.73	1.64	1.57
552.4	582.4	1.92	1.80	1.74
612.6	642.6	2.20	2.03	1.90
672.9	702.9	2.53	2.36	2.20
733.1	763.1	2.87	2.68	2.53
793.4	823.4	3.14	2.91	2.77
853.6	883.6	3.29	2.99	2.82
913.9	943.9	3.41	3.07	2.90
974.1	1004.1	3.53	3.21	3.00
1034.4	1064.4	3.47	3.24	3.02
1094.6	1124.6	3.35	3.17	2.98
1154.9	1184.9	3.27	3.06	2.89
1215.1	1245.1	3.16	2.96	2.78
1275.4	1305.4	3.04	2.84	2.67
1335.6	1365.6	2.99	2.77	2.57
1395.9	1425.9	2.89	2.64	2.42
1456.2	1486.2	2.70	2.39	2.18
1516.4	1546.4	2.50	2.16	2.00
1576.7	1606.7	2.35	1.99	1.87
1636.9	1666.9	2.14	1.90	1.78
1697.2	1727.2	2.11	1.88	1.75
1757.4	1787.4	2.27	1.91	1.77
1817.7	1847.7	2.33	1.92	1.77
1877.9	1907.9	2.32	1.92	1.76
1938.2	1968.2	2.47	1.94	1.77
1998.4	2028.4	2.61	2.00	1.80
2058.7	2088.7	2.56	2.02	1.81
2118.9	2148.9	2.63	2.06	1.79
2199.3	2229.3	2.60	2.04	1.76
2259.5	2289.5	2.67	2.05	1.76
2339.8	2369.8	2.53	1.99	1.79
2400.1	2430.1	2.69	2.08	1.84

LO (MHz)	LO VSWR (:1)		
	@LO (dBm)		
	+10	+13	+16
10.1	1.48	2.19	3.06
70.4	1.58	2.36	3.37
130.6	1.59	2.42	3.47
190.9	1.56	2.33	3.31
251.1	1.58	2.35	3.33
311.4	1.57	2.32	3.25
371.6	1.68	2.46	3.41
431.9	1.69	2.40	3.29
492.1	1.70	2.37	3.19
552.4	1.81	2.48	3.30
612.6	1.87	2.47	3.19
672.9	1.87	2.46	3.16
733.1	1.94	2.51	3.19
793.4	2.03	2.53	3.15
853.6	2.07	2.48	3.04
913.9	2.12	2.51	3.05
974.1	2.24	2.65	3.16
1034.4	2.29	2.72	3.19
1094.6	2.26	2.66	3.13
1154.9	2.34	2.73	3.17
1215.1	2.39	2.74	3.15
1275.4	2.39	2.69	3.08
1335.6	2.43	2.68	3.06
1395.9	2.45	2.67	3.01
1456.2	2.46	2.59	2.90
1516.4	2.44	2.51	2.81
1576.7	2.47	2.57	2.88
1636.9	2.66	2.70	2.93
1697.2	2.94	2.83	3.00
1757.4	3.21	3.02	3.14
1817.7	3.41	3.15	3.21
1877.9	3.70	3.31	3.29
1938.2	3.89	3.49	3.42
1998.4	3.97	3.58	3.47
2058.7	4.24	3.82	3.64
2118.9	4.37	3.95	3.73
2199.3	4.60	4.22	3.91
2259.5	4.82	4.40	4.14
2339.8	4.96	4.67	4.38
2400.1	5.13	4.79	4.51

IF (OUT) (MHz)	IF VSWR @LO=1500.1MHz (:1)		
	@LO (dBm)		
	+10	+13	+16
10.0	1.80	1.52	1.27
30.2	1.55	1.24	1.06
50.4	1.40	1.15	1.15
70.6	1.37	1.09	1.11
90.8	1.42	1.14	1.11
111.0	1.49	1.19	1.03
131.2	1.53	1.22	1.06
151.4	1.46	1.16	1.06
171.6	1.41	1.12	1.09
191.8	1.48	1.18	1.06
212.0	1.53	1.22	1.04
232.2	1.48	1.18	1.08
252.4	1.46	1.18	1.12
272.7	1.48	1.19	1.09
292.9	1.48	1.18	1.06
313.1	1.48	1.19	1.10
333.3	1.52	1.23	1.13
353.5	1.50	1.21	1.10
373.7	1.47	1.18	1.12
393.9	1.50	1.23	1.15
434.3	1.52	1.23	1.13
454.5	1.52	1.25	1.16
494.9	1.58	1.30	1.16
515.1	1.55	1.28	1.18
555.5	1.59	1.30	1.17
575.7	1.59	1.31	1.17
616.1	1.62	1.35	1.24
636.3	1.57	1.30	1.19
676.7	1.64	1.37	1.24
696.9	1.66	1.39	1.26
737.3	1.58	1.34	1.27
757.6	1.60	1.36	1.25
798.0	1.66	1.43	1.33
818.2	1.64	1.43	1.36
858.6	1.58	1.37	1.30
878.8	1.64	1.42	1.35
919.2	1.62	1.46	1.43
939.4	1.56	1.42	1.43
979.8	1.56	1.40	1.39
1000.0	1.59	1.46	1.45

REV. X2
TUF-5MH+
100818
Page 4 of 5

Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	12	52	34	50	27	55	42	70	50	76
1	-	24	+0	42	22	52	42	58	50	72	55	69
2	78	54	39	53	38	65	57	71	47	66	56	77
3	>100	56	37	53	35	56	43	64	42	74	58	75
4	>100	74	71	66	52	62	54	70	66	88	66	80
5	>100	65	57	72	55	74	51	83	59	79	56	74
6	>100	84	71	78	90	72	65	70	62	79	73	79
7	>100	89	76	92	66	85	59	73	55	75	66	85
8	>100	>97	>97	>97	79	91	87	88	67	79	68	88
9	>100	>97	>97	>97	96	90	80	96	72	84	71	>97
10	>100	>97	>97	>97	>97	>97	83	91	92	82	74	80
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions:

RF IN: 750.1 MHz; 4.00 dBm.

LO IN: 780.01 MHz; +13.00 dBm

IF OUT: 29.91 MHz; -2.91 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	1	36	26	42	14	44	33	60	39	61
1	-	25	+0	38	24	47	36	52	46	59	49	58
2	93	63	55	59	52	68	59	>87	57	73	56	80
3	>100	78	57	73	52	75	59	>87	58	76	71	85
4	>100	>87	>87	>87	86	>87	83	>87	>87	>87	78	>87
5	>100	>87	>87	>87	>87	>87	84	>87	>87	>87	86	>87
6	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
7	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
8	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
9	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
10	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions:

RF IN: 750.1 MHz; -6.00 dBm.

LO IN: 780.01 MHz; +13.00 dBm

IF OUT: 29.91 MHz; -13.18 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-5MH+

100818

Page 5 of 5



IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS9100 CERTIFIED • RoHS compliant

P.O. Box 350166, Brooklyn, New York 11235-0003 (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

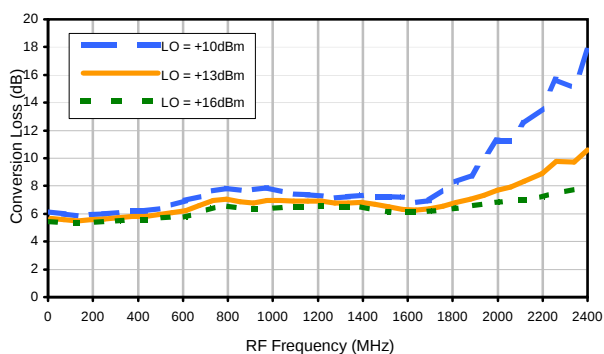


Frequency Mixer

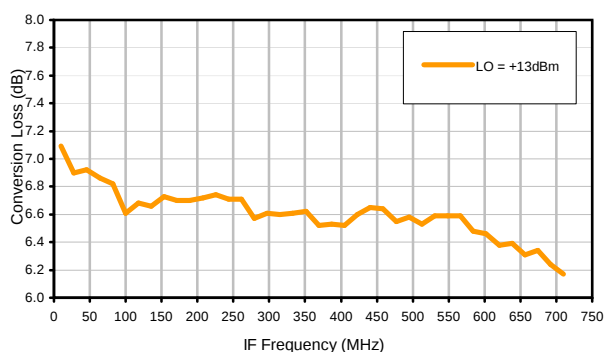
TUF-5MH+

Typical Performance Curves

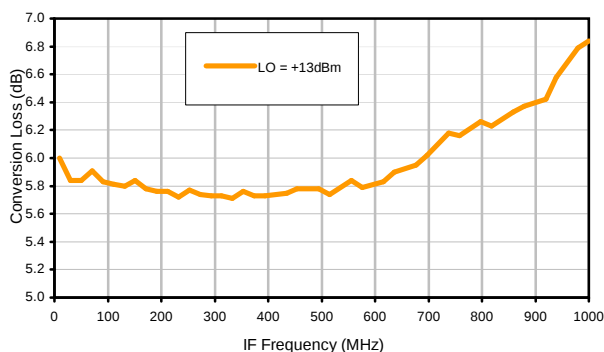
Conversion Loss @ IF=30MHz



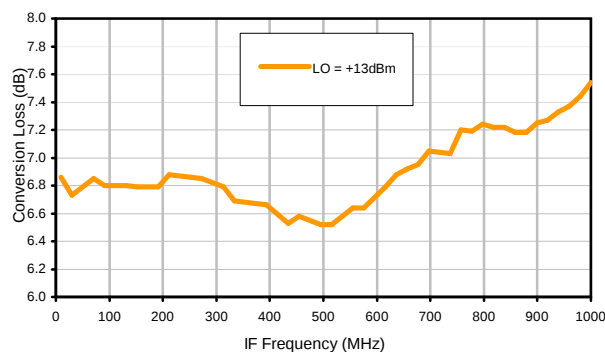
Conversion Loss vs. IF @ RF=750.1MHz



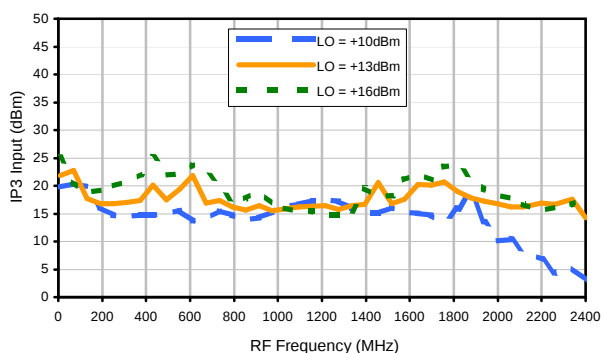
Conversion Loss vs. IF @ RF=20.1MHz



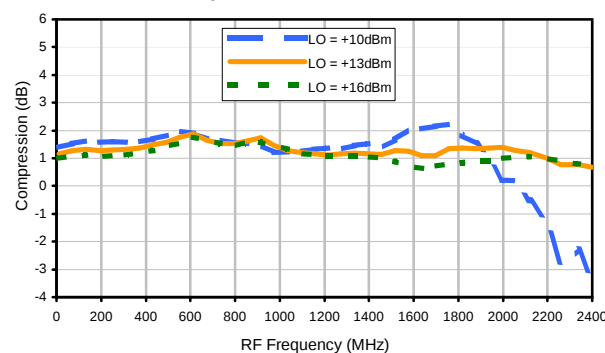
Conversion Loss vs. IF @ RF=1500.1MHz



IP3 Input



Compression @ RF IN=+9dBm



REV. X2
TUF-5MH+
100818
Page 1 of 3

Mini-Circuits®

IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED • RoHS compliant
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

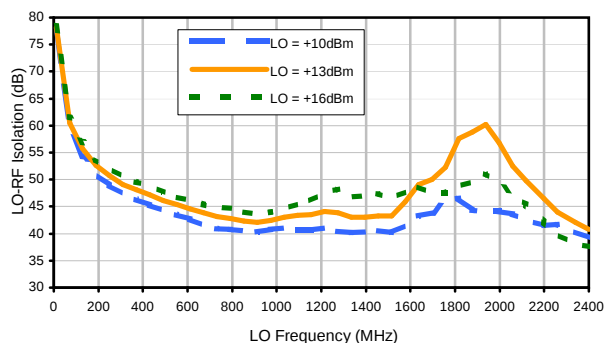


The Design Engineers Search Engine finds the model you need, instantly • For detailed performance specs & shopping online see

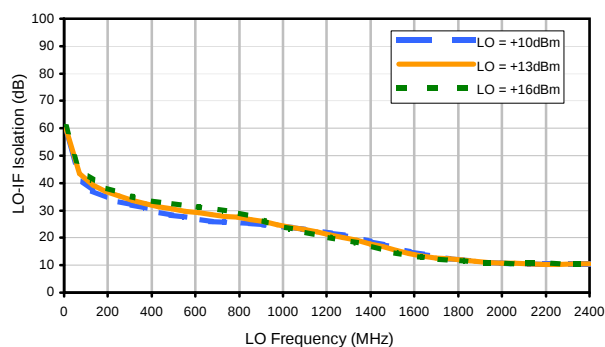


Typical Performance Curves

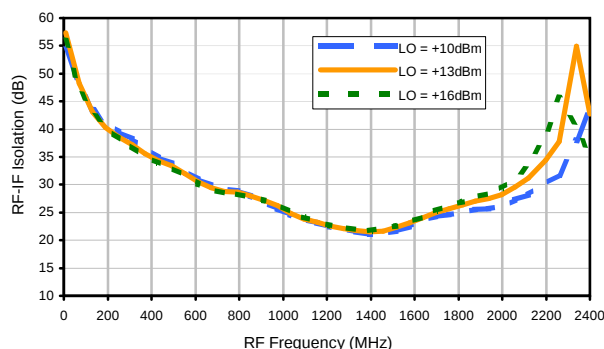
LO-RF Isolation



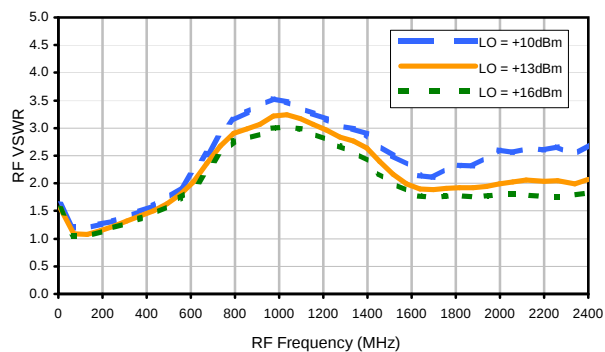
LO-IF Isolation



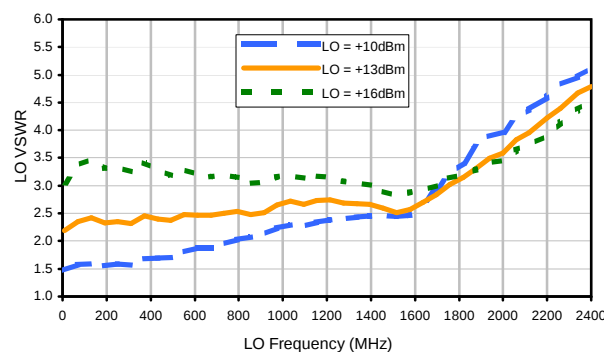
RF-IF Isolation



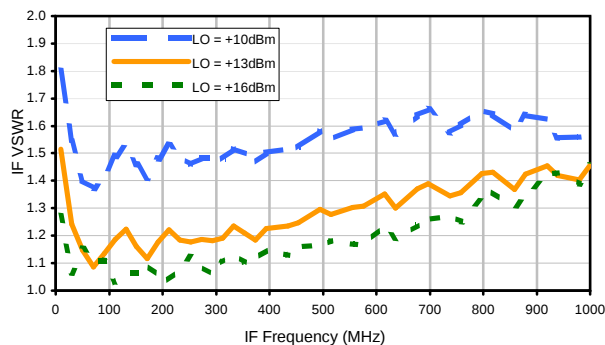
RF VSWR



LO VSWR



IF VSWR



Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	12	52	34	50	27	55	42	70	50	76
1	-	24	+0	42	22	52	42	58	50	72	55	69
2	78	54	39	53	38	65	57	71	47	66	56	77
3	>100	56	37	53	35	56	43	64	42	74	58	75
4	>100	74	71	66	52	62	54	70	66	88	66	80
5	>100	65	57	72	55	74	51	83	59	79	56	74
6	>100	84	71	78	90	72	65	70	62	79	73	79
7	>100	89	76	92	66	85	59	73	55	75	66	85
8	>100	>97	>97	>97	79	91	87	88	67	79	68	88
9	>100	>97	>97	>97	96	90	80	96	72	84	71	>97
10	>100	>97	>97	>97	>97	>97	83	91	92	82	74	80
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions:

RF IN: 750.1 MHz; 4.00 dBm.

LO IN: 780.01 MHz; +13.00 dBm

IF OUT: 29.91 MHz; -2.91 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	1	36	26	42	14	44	33	60	39	61
1	-	25	+0	38	24	47	36	52	46	59	49	58
2	93	63	55	59	52	68	59	>87	57	73	56	80
3	>100	78	57	73	52	75	59	>87	58	76	71	85
4	>100	>87	>87	>87	86	>87	83	>87	>87	>87	78	>87
5	>100	>87	>87	>87	>87	>87	84	>87	>87	>87	86	>87
6	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
7	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
8	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
9	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
10	>100	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87	>87
RF CAL	0	1	2	3	4	5	6	7	8	9	10	

LO HARMONICS ORDER

Test conditions:

RF IN: 750.1 MHz; -6.00 dBm.

LO IN: 780.01 MHz; +13.00 dBm

IF OUT: 29.91 MHz; -13.18 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-5MH+

100818

Page 3 of 3



IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS9100 CERTIFIED • RoHS compliant

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



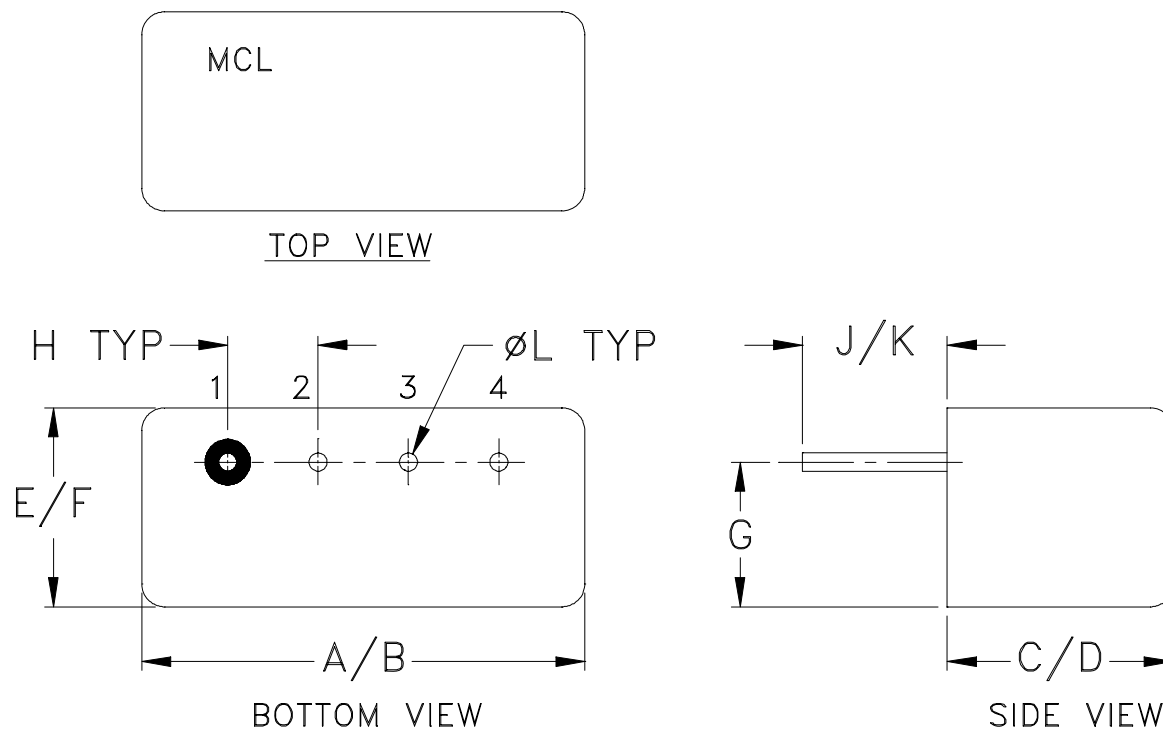
The Design Engineers Search Engine finds the model you need, instantly • For detailed performance specs & shopping online see



B02

B13

Outline Dimensions



CASE#	A	B	C	D	E	F	G	H	J	K	L	WT, GRAM
B02	.480 (12.19)	.500 (12.70)	.240 (6.10)	.255 (6.48)	.210 (5.33)	.230 (5.84)	.16 (4.06)	.100 (2.54)	.14 (3.56)	.20 (5.08)	.020 (.51)	1.9
B13			.390 (9.91)	.405 (10.29)								2.3

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

Notes:

- Header material: C.R.S.
Pin material: #52 alloy.
Cover material: Cupro-Nickel.
- Pin finish: Electro Tin-Silver.
- Tolerance on pin diameter $\pm .005$ inch.
- Glass meniscus 0.015 inch max.
- Blue bead indicates Pin 1. Pin numbers do not appear on unit, for reference only.



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



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