

High IP3

Frequency Mixer

Level 17 (LO Power +17 dBm) 345 to 480 MHz

HJK-481H+



Generic photo used for illustration purposes only

CASE STYLE: TTT881

+RoHS Compliant

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

Available Tape and Reel at no extra cost	
Reel Size	Devices/Reel
7"	10, 20, 50, 100, 200
13"	500

Maximum Ratings

Operating Temperature	-45°C to 85°C
Storage Temperature	-55°C to 100°C
LO Power	+19 dBm
RF Power	+20 dBm

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

LO	2
RF	1
IF	3
GROUND	4,5,6

Features

- high IP3, 32 dBm typ.
- excellent L-R isolation, 55 dB typ.;
- L-I isolation, 38 dB typ.

Applications

- base stations
- communication systems
- wireless application in Health care
- weather instruments/radar/satellites
- general aviation air to ground telephone
- land mobile radio

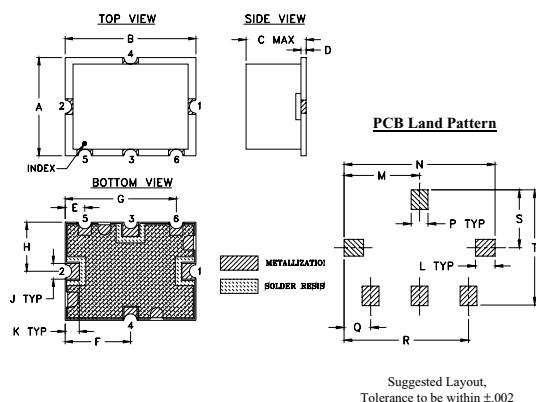
Electrical Specifications

FREQUENCY (MHz)			CONVERSION LOSS (dB)			RF in at 1dB Compr (dBm)	IP3 (dBm)	LO-RF ISOLATION (dB)		LO-IF ISOLATION (dB)	
RF	LO	IF	Typ.	σ	Max.			Typ.	Min.	Typ.	Min.
345-480	395-530	30-150	6.5	0.1	8.0	+20	32	55	43	38	28

Typical Performance Data

Frequency		Conversion Loss (dB)	Isolation L-R	Isolation L-I	VSWR RF Port	VSWR LO Port	IP3 (dBm)
RF MHz	LO MHz	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm
345.00	395.10	6.36	52.91	34.97	1.40	1.76	32.12
354.00	404.10	6.34	53.27	34.94	1.38	1.57	41.07
363.00	413.10	6.34	53.37	34.97	1.36	1.39	39.39
372.00	422.10	6.31	53.19	34.66	1.37	1.23	32.40
381.00	431.10	6.30	53.18	34.99	1.38	1.10	34.22
390.00	440.10	6.33	53.53	35.06	1.39	1.09	35.61
399.00	449.10	6.30	54.14	35.88	1.43	1.22	35.58
408.00	458.10	6.29	54.70	36.24	1.45	1.36	32.77
417.00	467.10	6.26	54.91	36.59	1.48	1.52	32.19
426.00	476.10	6.29	55.95	37.44	1.54	1.68	34.37
435.00	485.10	6.36	57.29	37.91	1.57	1.84	35.54
444.00	494.10	6.39	57.39	39.04	1.61	2.00	32.95
453.00	503.10	6.44	56.87	39.62	1.67	2.16	31.91
462.00	512.10	6.53	58.12	40.50	1.71	2.30	32.23
471.00	521.10	6.61	59.23	41.32	1.75	2.44	32.06
480.00	530.10	6.70	60.34	42.15	1.80	2.57	32.67

Outline Drawing

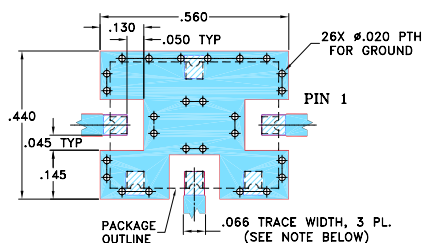


Outline Dimensions (inch)

A	B	C	D	E	F	G	H	J	K
.38	.50	.23	.020	.075	.250	.425	.187	.050	.050
9.65	12.70	5.84	0.51	1.91	6.35	10.80	4.75	1.27	1.27

L	M	N	P	Q	R	S	T	wt.
.070	.270	.540	.060	.095	.445	.208	.415	grams
1.78	6.86	13.72	1.52	2.41	11.30	5.28	10.54	0.8

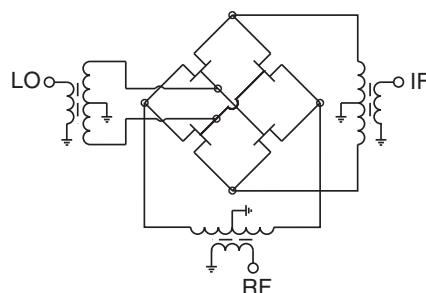
Demo Board MCL P/N: TB-12 Suggested PCB Layout (PL-079)



NOTE:

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES TO EXPOSE METAL UNDER THE ENTIRE UNIT GROUND PAD FOR IMPROVED GROUNDING, IT IS RECOMMENDED A SOLDER MASK DAM BE APPLIED AROUND EACH GROUND PAD TO ENSURE FILLET AND CONNECTION AT GROUND PADS.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

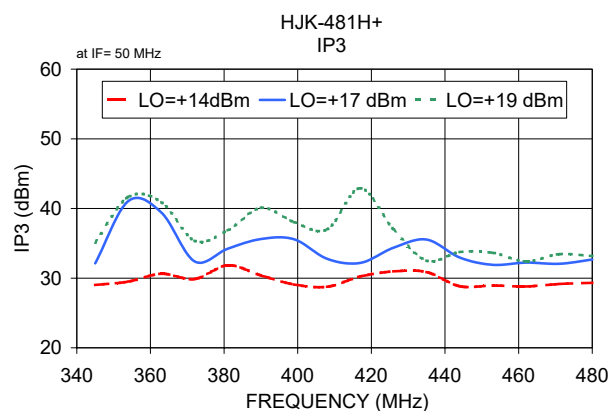
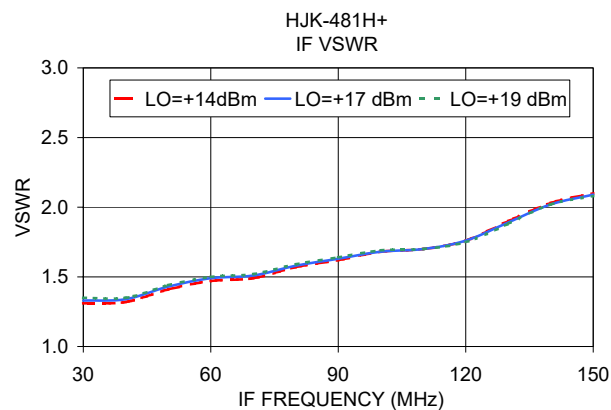
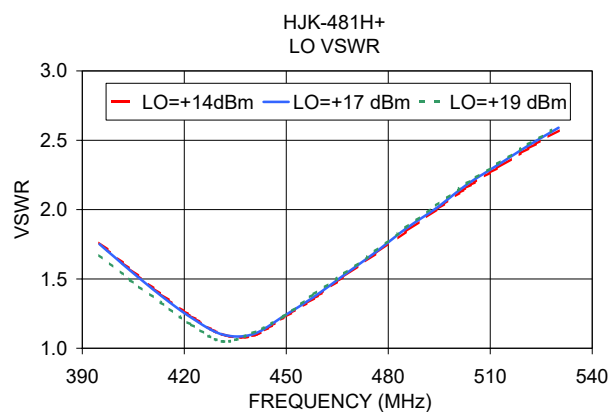
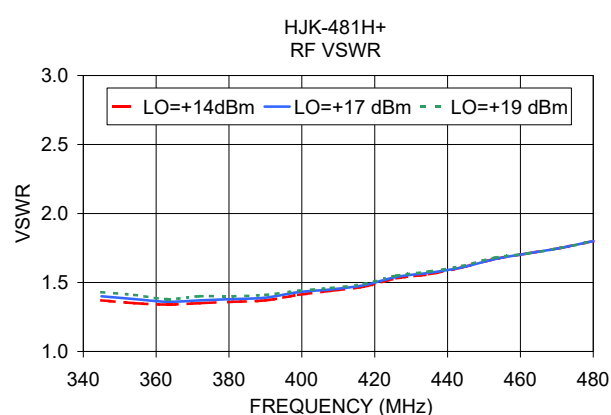
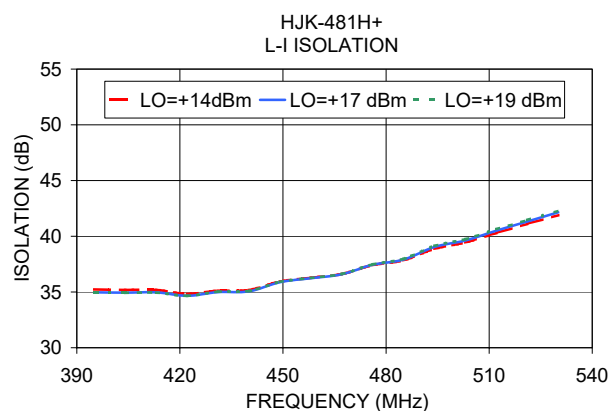
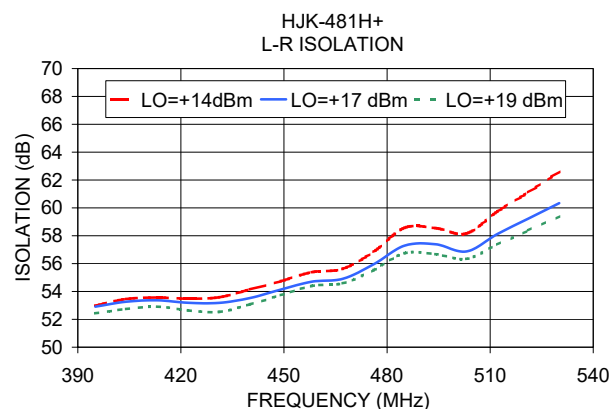
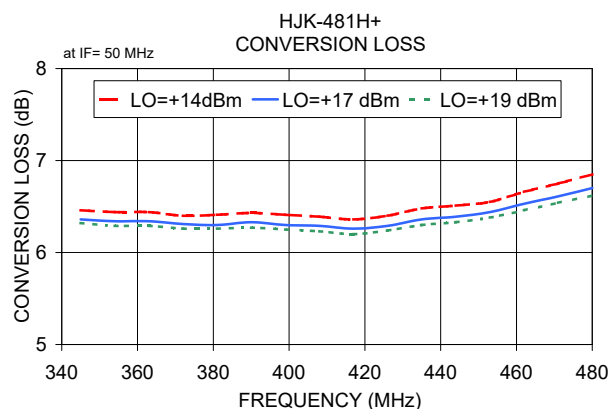
Electrical Schematic



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





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Frequency Mixer

HJK-481H+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	CONVERSION LOSS IF FIXED @IF(OUT)=30MHz (dB)		
		@LO (dBm)		
		+14	+17	+20
120.0	150.0	15.35	15.37	14.13
153.0	183.0	11.60	11.55	11.20
186.0	216.0	9.04	8.99	8.44
219.0	249.0	8.07	8.02	7.86
252.0	282.0	7.61	7.48	7.34
285.0	315.0	7.17	7.00	6.86
340.0	370.0	6.70	6.53	6.40
347.7	377.7	6.67	6.50	6.38
355.8	385.8	6.63	6.46	6.36
363.9	393.9	6.61	6.45	6.35
372.0	402.0	6.56	6.41	6.33
380.1	410.1	6.56	6.39	6.30
388.2	418.2	6.51	6.36	6.28
396.3	426.3	6.50	6.34	6.26
404.4	434.4	6.51	6.36	6.28
412.5	442.5	6.53	6.37	6.29
420.6	450.6	6.56	6.40	6.31
428.7	458.7	6.58	6.42	6.33
436.8	466.8	6.61	6.45	6.35
444.9	474.9	6.68	6.51	6.40
455.7	485.7	6.72	6.54	6.42
463.8	493.8	6.77	6.59	6.46
471.9	501.9	6.85	6.66	6.52
480.0	510.0	6.94	6.74	6.59
532.0	562.0	7.32	7.09	6.90
595.0	625.0	7.99	7.68	7.43
658.0	688.0	8.69	8.30	8.00
721.0	751.0	9.21	8.78	8.45
784.0	814.0	9.71	9.20	8.82
847.0	877.0	9.96	9.40	9.00
910.0	940.0	10.26	9.62	9.15
973.0	1003.0	10.57	9.85	9.33
1036.0	1066.0	10.72	9.94	9.40
1120.0	1150.0	11.13	10.26	9.64
1183.0	1213.0	11.44	10.48	9.79
1246.0	1276.0	11.52	10.52	9.82
1309.0	1339.0	11.77	10.70	9.96
1372.0	1402.0	11.96	10.82	10.05
1435.0	1465.0	12.08	10.89	10.13
1477.0	1507.0	12.36	11.09	10.29

RF (IN) (MHz)	LO (MHz)	IP-3 INPUT (dBm)		
		@LO (dBm)		
		+14	+17	+20
120.0	150.0	27.88	30.36	27.42
153.0	183.0	19.65	22.04	24.98
186.0	216.0	19.96	21.77	24.33
219.0	249.0	22.93	25.32	28.52
252.0	282.0	22.38	24.49	27.00
285.0	315.0	22.32	25.41	29.82
318.0	348.0	23.68	27.18	32.15
347.7	377.7	25.44	29.23	34.65
355.8	385.8	26.33	30.43	36.61
363.9	393.9	26.89	31.01	38.28
372.0	402.0	27.69	31.91	40.38
380.1	410.1	28.12	32.50	43.89
388.2	418.2	28.64	32.92	40.70
396.3	426.3	29.07	33.37	39.78
404.4	434.4	29.70	33.98	38.57
412.5	442.5	29.18	32.33	39.30
420.6	450.6	30.29	33.90	40.42
428.7	458.7	30.76	34.65	40.95
436.8	466.8	30.86	34.85	43.86
444.9	474.9	31.46	35.38	45.20
455.7	485.7	31.70	34.99	40.08
463.8	493.8	32.16	35.72	39.13
471.9	501.9	31.82	35.25	37.86
480.0	510.0	31.90	35.82	38.16
532.0	562.0	27.00	27.45	30.61
595.0	625.0	23.99	25.59	26.19
658.0	688.0	21.06	22.89	23.47
721.0	751.0	18.40	20.10	20.98
784.0	814.0	16.12	17.98	19.49
847.0	877.0	15.07	16.93	18.48
910.0	940.0	14.53	16.41	17.92
973.0	1003.0	13.99	15.80	17.40
1036.0	1066.0	13.86	15.62	17.37
1120.0	1150.0	13.65	15.59	17.49
1183.0	1213.0	13.17	15.21	17.25
1246.0	1276.0	13.04	15.08	17.12
1309.0	1339.0	12.80	14.83	16.61
1372.0	1402.0	12.44	14.44	16.28
1435.0	1465.0	12.47	14.36	15.89
1477.0	1507.0	12.48	14.18	15.56

RF (IN) (MHz)	LO (MHz)	COMPRESSION @RF IN=+20dBm (dB)		
		@LO (dBm)		
		+14	+17	+20
120.0	150.0	-0.46	-0.73	-0.48
153.0	183.0	0.53	0.13	-0.17
186.0	216.0	1.92	1.34	0.93
219.0	249.0	1.84	1.14	0.67
252.0	282.0	1.64	0.85	0.46
285.0	315.0	1.06	0.38	0.16
340.0	370.0	0.69	0.33	0.17
347.7	377.7	0.56	0.23	0.10
355.8	385.8	0.45	0.18	0.08
363.9	393.9	0.37	0.14	0.05
372.0	402.0	0.26	0.08	0.00
380.1	410.1	0.22	0.04	-0.03
388.2	418.2	0.26	0.07	0.00
396.3	426.3	0.38	0.16	0.07
404.4	434.4	0.45	0.21	0.08
412.5	442.5	0.56	0.28	0.15
420.6	450.6	0.63	0.33	0.19
428.7	458.7	0.66	0.35	0.21
436.8	466.8	0.60	0.30	0.17
444.9	474.9	0.52	0.23	0.13
455.7	485.7	0.49	0.18	0.10
463.8	493.8	0.50	0.14	0.07
471.9	501.9	0.61	0.17	0.07
480.0	510.0	0.74	0.24	0.11
532.0	562.0	1.91	0.75	0.34
595.0	625.0	3.84	2.07	0.91
658.0	688.0	4.34	2.46	1.08
721.0	751.0	5.66	3.74	2.11
784.0	814.0	6.64	4.87	3.23
847.0	877.0	6.70	5.01	3.36
910.0	940.0	7.98	6.17	4.39
973.0	1003.0	8.86	7.10	5.36
1036.0	1066.0	8.79	7.02	5.19
1120.0	1150.0	9.52	7.79	5.96
1183.0	1213.0	10.46	8.83	7.04
1246.0	1276.0	10.24	8.70	7.02
1309.0	1339.0	10.52	8.96	7.27
1372.0	1402.0	11.16	9.65	8.03
1435.0	1465.0	11.03	9.59	8.02
1477.0	1507.0	11.20	9.77	8.21

Frequency Mixer

HJK-481H+

Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=412.5MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=345MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=480MHz (dB)
		@LO (dBm)			@LO (dBm)			@LO (dBm)
		+17			+17			+17
10.0	422.5	6.22	10.0	355.0	6.71	454.0	26.0	18.20
32.5	445.0	6.31	20.5	365.5	6.69	439.0	41.0	20.14
58.8	471.3	6.38	31.0	376.0	6.71	424.0	56.0	20.73
77.5	490.0	6.43	41.5	386.5	6.66	409.0	71.0	19.07
103.8	516.3	6.50	52.0	397.0	6.63	394.0	86.0	19.02
126.3	538.8	6.56	62.5	407.5	6.65	379.0	101.0	22.45
148.8	561.3	6.85	73.0	418.0	6.62	364.0	116.0	22.29
218.0	630.5	7.48	87.0	432.0	6.58	344.0	136.0	18.41
242.0	654.5	7.96	97.5	442.5	6.60	329.0	151.0	16.04
266.0	678.5	8.54	108.0	453.0	6.64	314.0	166.0	14.08
294.0	706.5	9.02	118.5	463.5	6.68	299.0	181.0	12.90
318.0	730.5	9.41	129.0	474.0	6.68	284.0	196.0	11.97
342.0	754.5	10.05	139.5	484.5	6.79	269.0	211.0	10.77
366.0	778.5	10.81	150.0	495.0	6.95	254.0	226.0	10.10
477.5	890.0	13.69	214.0	559.0	7.54	239.0	241.0	9.39
531.5	944.0	14.92	235.0	580.0	7.99	224.0	256.0	8.83
585.5	998.0	16.75	256.0	601.0	8.54	209.0	271.0	8.45
648.5	1061.0	18.46	277.0	622.0	8.89	194.0	286.0	8.31
702.5	1115.0	19.96	298.0	643.0	9.19	179.0	301.0	8.10
756.5	1169.0	21.62	319.0	664.0	9.57	164.0	316.0	7.82
390.0	22.5	16.39	347.0	692.0	10.60	141.0	339.0	7.43
378.0	34.5	17.08	368.0	713.0	11.25	132.0	348.0	7.30
366.0	46.5	17.62	389.0	734.0	11.59	123.0	357.0	7.25
354.0	58.5	16.94	410.0	755.0	11.96	114.0	366.0	7.21
340.0	72.5	16.49	431.0	776.0	12.61	102.0	378.0	7.17
328.0	84.5	16.22	452.0	797.0	13.45	96.0	384.0	7.16
316.0	96.5	15.62	473.0	818.0	14.06	87.0	393.0	7.17
292.0	120.5	14.21	518.0	863.0	14.95	78.0	402.0	7.10
268.0	144.5	13.47	545.0	890.0	16.03	69.0	411.0	7.04
244.0	168.5	12.22	572.0	917.0	17.01	60.0	420.0	7.01
216.0	196.5	9.71	599.0	944.0	17.53	51.0	429.0	6.96
192.0	220.5	8.48	626.0	971.0	18.16	42.0	438.0	6.90
168.0	244.5	7.97	653.0	998.0	19.29	30.0	450.0	6.88
144.0	268.5	7.21	689.0	1034.0	20.27	27.0	453.0	6.85
109.0	303.5	6.64	716.0	1061.0	20.79	24.0	456.0	6.83
91.0	321.5	6.48	743.0	1088.0	21.73	21.0	459.0	6.82
73.0	339.5	6.49	770.0	1115.0	22.85	18.0	462.0	6.81
52.0	360.5	6.42	797.0	1142.0	23.44	15.0	465.0	6.80
34.0	378.5	6.34	824.0	1169.0	24.12	12.0	468.0	6.82
16.0	396.5	6.29	842.0	1187.0	24.91	10.0	470.0	6.74

Frequency Mixer

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Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)			RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB)		
	@LO (dBm)			@LO (dBm)					@LO (dBm)		
	+14	+17	+20	+14	+17	+20			+14	+17	+20
150.0	49.20	49.29	51.72	45.00	45.25	45.82	120.0	150.0	26.54	26.68	23.46
183.0	54.70	55.27	55.58	48.15	48.37	49.09	153.0	183.0	26.13	25.31	24.65
216.0	60.02	60.40	54.91	47.16	47.08	46.55	186.0	216.0	23.22	22.53	31.12
249.0	57.62	56.75	57.79	43.87	43.67	43.70	219.0	249.0	24.10	24.00	24.26
282.0	56.13	55.79	55.32	42.00	41.78	41.81	252.0	282.0	28.73	29.10	30.42
315.0	54.44	54.42	53.68	39.18	38.96	38.94	285.0	315.0	31.32	31.49	33.60
348.0	53.92	54.13	54.14	37.21	36.96	36.92	318.0	348.0	34.09	34.30	35.37
377.7	54.14	54.34	54.67	35.92	35.66	35.66	347.7	377.7	37.61	37.85	35.01
385.8	54.25	54.41	55.49	35.43	35.19	35.45	355.8	385.8	38.62	38.86	36.98
393.9	54.32	54.47	56.33	35.10	34.88	35.37	363.9	393.9	39.71	39.86	37.76
402.0	54.62	54.69	57.43	34.71	34.53	35.21	372.0	402.0	40.58	40.71	38.55
410.1	54.86	54.94	58.33	34.50	34.35	35.15	380.1	410.1	41.69	41.77	39.91
418.2	55.16	55.13	59.02	34.44	34.32	35.21	388.2	418.2	42.76	42.77	41.03
426.3	55.42	55.39	59.35	34.59	34.49	35.40	396.3	426.3	43.81	43.85	42.06
434.4	55.75	55.68	59.30	34.66	34.58	35.44	404.4	434.4	44.93	44.98	42.36
442.5	56.09	55.98	59.09	34.96	34.92	35.75	412.5	442.5	46.34	46.32	42.38
450.6	56.56	56.39	58.82	35.35	35.35	36.12	420.6	450.6	47.83	47.48	41.95
458.7	57.05	56.80	58.60	35.70	35.73	36.43	428.7	458.7	49.75	49.28	41.55
466.8	57.74	57.39	58.27	36.06	36.13	36.71	436.8	466.8	52.21	51.29	40.71
474.9	58.74	58.30	58.50	36.60	36.73	37.23	444.9	474.9	55.40	53.81	40.34
485.7	60.28	59.74	59.94	37.30	37.48	37.86	455.7	485.7	60.62	58.37	41.89
493.8	61.47	60.78	59.39	37.85	38.08	38.32	463.8	493.8	64.09	66.72	44.19
501.9	62.55	61.64	60.12	38.51	38.79	39.08	471.9	501.9	64.67	67.82	47.79
510.0	64.07	62.75	61.01	39.13	39.45	39.77	480.0	510.0	59.70	60.06	49.46
562.0	79.83	71.39	69.98	43.37	43.84	44.42	532.0	562.0	48.00	47.61	47.91
625.0	62.29	63.45	66.42	48.83	49.62	50.42	595.0	625.0	44.10	44.28	43.96
688.0	57.32	58.20	58.95	56.23	57.65	59.08	658.0	688.0	42.92	42.88	42.88
751.0	54.21	54.65	55.36	64.02	62.80	61.53	721.0	751.0	42.26	42.24	42.17
814.0	54.02	54.36	54.79	55.70	54.82	54.13	784.0	814.0	42.31	42.21	42.19
877.0	54.32	55.17	56.16	51.48	51.07	50.77	847.0	877.0	41.63	41.51	41.47
940.0	53.31	54.27	54.87	48.43	48.22	48.04	910.0	940.0	40.93	40.82	40.35
1003.0	52.61	53.58	54.32	46.73	46.62	46.52	973.0	1003.0	40.45	40.48	40.29
1066.0	51.59	52.56	53.63	44.94	44.89	44.84	1036.0	1066.0	39.36	39.42	38.91
1150.0	50.22	50.94	51.85	43.02	43.00	42.99	1120.0	1150.0	38.57	38.69	38.81
1213.0	49.92	50.59	52.80	42.15	42.13	42.13	1183.0	1213.0	38.37	38.56	38.94
1276.0	49.22	49.84	50.99	41.25	41.24	41.24	1246.0	1276.0	37.88	38.10	38.50
1339.0	48.56	49.13	50.60	40.25	40.25	40.24	1309.0	1339.0	37.92	38.20	39.01
1402.0	47.78	48.23	49.05	39.84	39.83	39.83	1372.0	1402.0	37.99	38.28	38.77
1465.0	46.59	46.91	47.70	39.08	39.08	39.08	1435.0	1465.0	37.75	38.00	38.56
1507.0	46.20	46.39	46.59	38.86	38.86	38.84	1477.0	1507.0	38.06	38.27	38.68



P.O. Box 350166, Brooklyn, New York 11235-0003 • (718) 934-4500 • Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site
 The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com



IF/RF MICROWAVE COMPONENTS

REV. X2
 HJK-481H+
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Frequency Mixer

HJK-481H+

Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1)			LO (MHz)	LO VSWR (:1)			IF (OUT) (MHz)	IF VSWR @LO=530MHz (:1)		
		@LO (dBm)				@LO (dBm)				@LO (dBm)		
		+14	+17	+20		+14	+17	+20		+14	+17	+20
120.0	150.0	1.61	1.67	1.69	150.0	3.19	3.17	3.32	10.0	1.23	1.27	1.32
153.0	183.0	1.54	1.62	1.76	183.0	3.79	3.79	3.79	16.0	1.22	1.27	1.31
186.0	216.0	2.07	2.30	2.00	216.0	4.07	4.06	4.12	22.0	1.24	1.28	1.33
219.0	249.0	2.22	2.41	2.53	249.0	4.05	4.03	4.01	30.0	1.27	1.31	1.35
252.0	282.0	1.92	2.04	2.13	282.0	3.84	3.83	3.81	34.0	1.28	1.31	1.35
285.0	315.0	1.63	1.71	1.77	315.0	3.42	3.41	3.40	40.0	1.28	1.32	1.35
318.0	348.0	1.38	1.44	1.48	348.0	2.81	2.79	2.69	46.0	1.30	1.33	1.36
347.7	377.7	1.25	1.30	1.37	377.7	2.17	2.15	1.98	51.0	1.33	1.35	1.38
355.8	385.8	1.24	1.29	1.36	385.8	1.98	1.96	1.79	54.0	1.35	1.37	1.40
363.9	393.9	1.25	1.29	1.37	393.9	1.80	1.78	1.61	57.0	1.37	1.39	1.42
372.0	402.0	1.27	1.30	1.39	402.0	1.63	1.61	1.46	60.0	1.40	1.42	1.44
380.1	410.1	1.29	1.33	1.40	410.1	1.46	1.45	1.33	63.0	1.42	1.44	1.46
388.2	418.2	1.32	1.35	1.42	418.2	1.31	1.29	1.21	66.0	1.44	1.46	1.48
396.3	426.3	1.36	1.38	1.45	426.3	1.17	1.15	1.13	70.0	1.46	1.48	1.50
404.4	434.4	1.41	1.42	1.47	434.4	1.05	1.04	1.12	76.0	1.49	1.50	1.52
412.5	442.5	1.46	1.47	1.51	442.5	1.08	1.10	1.19	82.0	1.52	1.53	1.54
420.6	450.6	1.50	1.50	1.53	450.6	1.21	1.22	1.30	88.0	1.56	1.56	1.58
428.7	458.7	1.55	1.55	1.58	458.7	1.34	1.36	1.42	94.0	1.61	1.61	1.61
436.8	466.8	1.59	1.59	1.61	466.8	1.49	1.51	1.56	100.0	1.66	1.65	1.66
444.9	474.9	1.64	1.63	1.64	474.9	1.63	1.66	1.70	106.0	1.70	1.70	1.70
455.7	485.7	1.72	1.70	1.70	485.7	1.83	1.85	1.88	114.0	1.78	1.77	1.77
463.8	493.8	1.78	1.76	1.75	493.8	1.97	2.00	2.02	120.0	1.85	1.83	1.83
471.9	501.9	1.84	1.81	1.80	501.9	2.11	2.14	2.16	126.0	1.91	1.90	1.89
480.0	510.0	1.88	1.85	1.83	510.0	2.25	2.28	2.30	132.0	1.97	1.95	1.93
532.0	562.0	2.24	2.19	2.14	562.0	2.99	3.00	3.02	138.0	2.01	1.98	1.97
595.0	625.0	2.68	2.59	2.52	625.0	3.48	3.49	3.52	144.0	2.05	2.02	2.00
658.0	688.0	3.08	2.98	2.90	688.0	3.71	3.74	3.78	150.0	2.11	2.07	2.05
721.0	751.0	3.26	3.19	3.12	751.0	3.78	3.81	3.83	156.0	2.18	2.14	2.12
784.0	814.0	3.29	3.23	3.17	814.0	3.76	3.80	3.85	162.0	2.28	2.24	2.21
847.0	877.0	3.23	3.17	3.12	877.0	3.69	3.72	3.76	168.0	2.36	2.32	2.28
910.0	940.0	3.16	3.11	3.06	940.0	3.60	3.63	3.66	174.0	2.43	2.38	2.35
973.0	1003.0	3.05	2.99	2.94	1003.0	3.47	3.47	3.48	180.0	2.50	2.44	2.40
1036.0	1066.0	2.87	2.81	2.76	1066.0	3.35	3.35	3.36	186.0	2.57	2.51	2.46
1120.0	1150.0	2.68	2.60	2.53	1150.0	3.19	3.19	3.18	194.0	2.66	2.60	2.55
1183.0	1213.0	2.55	2.47	2.43	1213.0	3.08	3.07	3.08	200.0	2.75	2.68	2.62
1246.0	1276.0	2.38	2.29	2.22	1276.0	2.94	2.94	2.94	206.0	2.83	2.75	2.69
1309.0	1339.0	2.23	2.13	2.07	1339.0	2.81	2.80	2.80	212.0	2.92	2.84	2.78
1372.0	1402.0	2.10	1.98	1.89	1402.0	2.68	2.67	2.67	218.0	3.02	2.94	2.87
1435.0	1465.0	1.94	1.82	1.70	1465.0	2.53	2.52	2.52	224.0	3.15	3.06	2.99
1477.0	1507.0	1.89	1.75	1.60	1507.0	2.44	2.43	2.43	228.0	3.24	3.15	3.07

Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	--	--	13.25	50.51	49.46	49.12	43.13	53.43	34.30	49.08	38.80	52.78
1	--	42.75	--	45.55	32.65	53.84	32.26	52.96	38.03	54.92	37.80	74.83
2	89.82	79.78	58.09	61.75	68.92	85.18	85.38	79.27	96.24	75.53	68.71	69.15
3	91.12	109.03	76.09	89.72	74.85	99.04	96.33	100.46	82.23	102.56	73.39	100.93
4	127.45	118.94	120.00	114.12	102.50	98.41	113.47	119.88	118.93	119.25	110.19	112.02
5	126.90	119.47	119.50	118.89	116.36	111.28	96.34	118.88	119.79	119.75	116.40	117.10
6	127.28	117.50	113.66	120.32	119.58	117.05	102.85	102.25	108.69	119.45	114.25	118.63
7	126.60	118.35	117.81	119.62	118.81	119.92	112.70	111.89	111.00	118.39	119.58	119.65
8	125.59	117.04	116.92	119.74	117.32	115.76	119.78	114.62	109.36	111.62	119.56	120.07
9	128.60	119.07	117.87	117.82	118.11	118.38	119.42	120.01	106.79	115.36	106.04	119.57
10	128.87	119.51	118.38	118.69	117.83	118.87	119.22	119.70	118.93	109.43	110.93	110.67
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 412.50 MHz; 0.00 dBm.
 LO IN: 462.50 MHz; +17.00 dBm
 IF OUT: 50.00 MHz; -6.35 dBm

RF HARMONICS ORDER

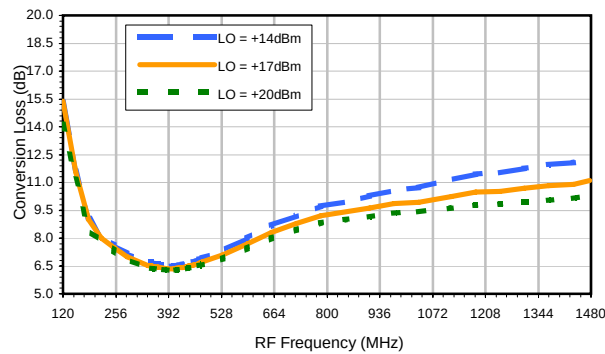
	(-dBm)	(-dBc)										
0	--	--	24.25	56.40	58.41	54.89	56.04	59.07	45.97	51.80	51.70	54.95
1	--	37.80	--	58.55	34.52	59.49	31.42	59.98	37.14	56.11	40.64	54.64
2	69.09	68.86	50.63	50.33	61.38	77.95	82.89	67.42	76.70	64.24	59.87	63.21
3	61.35	96.91	60.06	87.57	58.74	81.23	82.30	90.02	63.58	86.69	54.77	75.40
4	91.34	100.69	109.37	95.01	81.67	87.44	84.34	115.23	93.04	96.28	86.51	82.49
5	100.95	105.80	87.94	116.02	78.67	95.57	72.90	103.90	98.31	109.25	85.53	107.80
6	113.36	108.30	109.68	115.17	115.36	100.32	101.17	91.54	107.92	115.04	113.74	104.78
7	113.63	109.17	101.06	113.93	105.63	115.78	91.81	98.78	85.94	115.67	108.03	114.43
8	124.74	111.47	113.33	115.53	114.52	114.71	115.95	108.24	108.71	104.92	115.05	115.00
9	127.94	114.10	112.72	113.99	113.99	115.31	115.33	115.01	103.08	115.00	99.01	114.90
10	128.71	112.13	111.00	87.42	113.27	114.41	114.44	115.56	114.42	114.69	114.36	113.93
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

Test conditions: RF IN: 412.50 MHz; 10.00 dBm.
 LO IN: 462.50 MHz; +17.00 dBm
 IF OUT: 50.00 MHz; 3.56 dBm

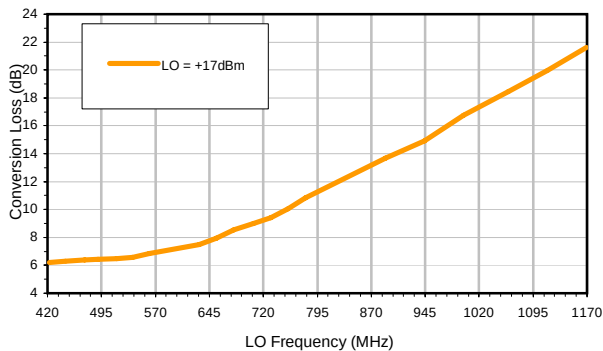
- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT
 2. + entry denotes harmonics are in (dBc) above IF OUTPUT
 3. RF Cal represents the Harmonics level of the RF Input Signal to the mixer

Typical Performance Curves

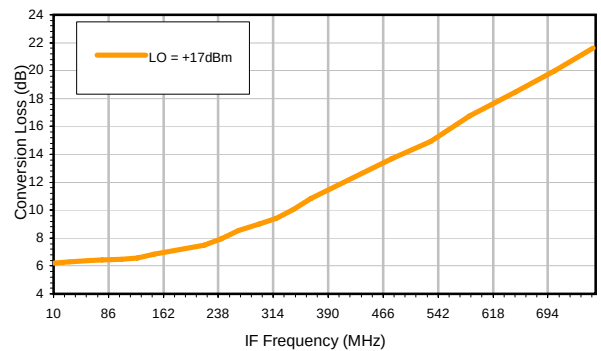
Conversion Loss @IF=30 MHz



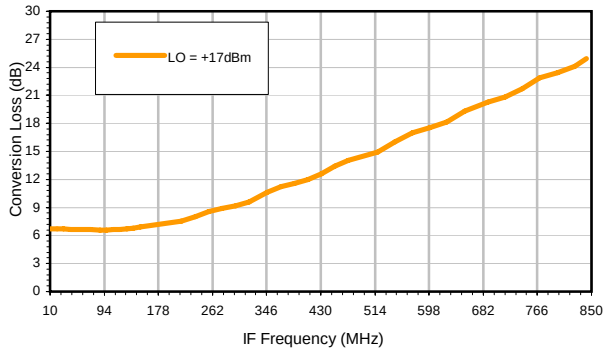
Conversion Loss vs. LO @ RF=412.5 MHz



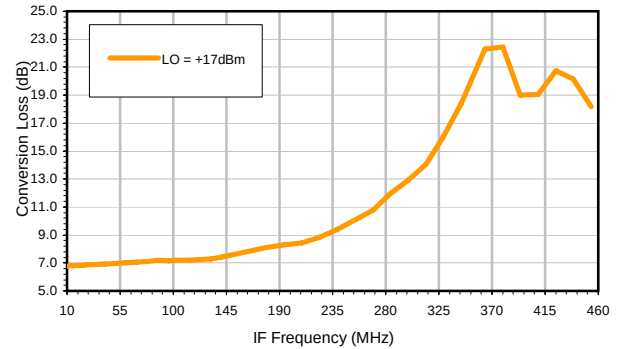
Conversion Loss vs. IF @ RF=412.5 MHz



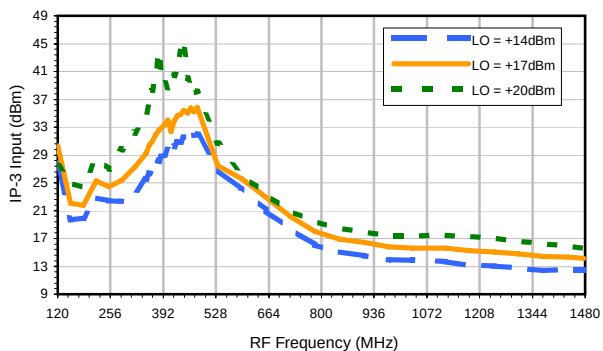
Conversion Loss vs. IF @ RF=345 MHz



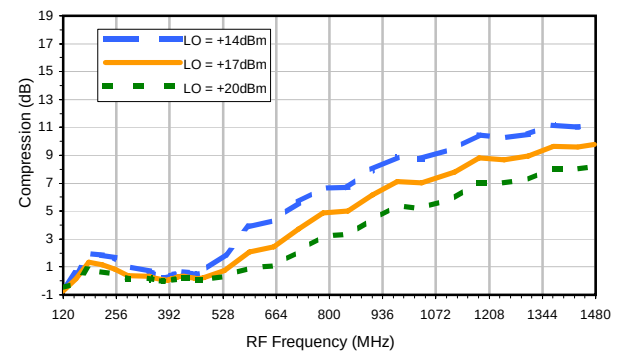
Conversion Loss vs. IF @ RF=480 MHz



IP-3 Input

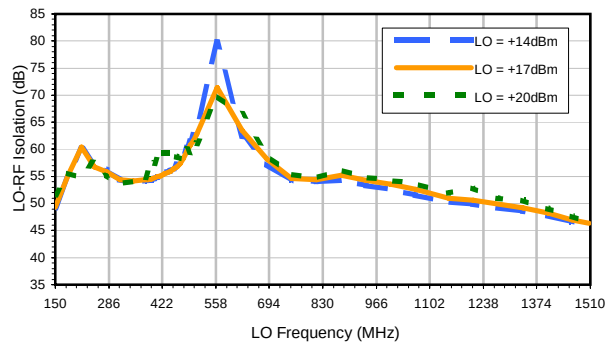


Compression @RF IN=+20 dBm

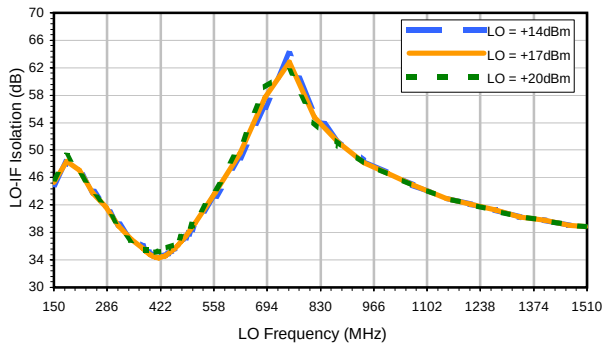


Typical Performance Curves

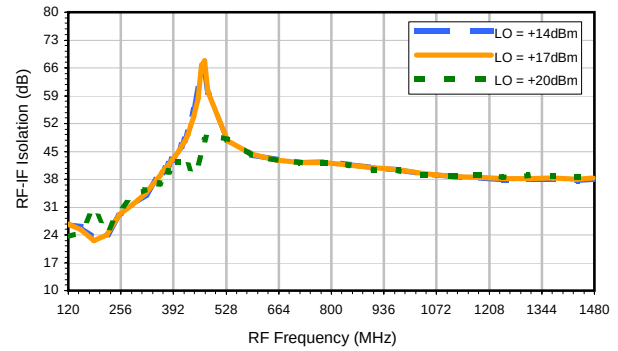
LO-RF Isolation



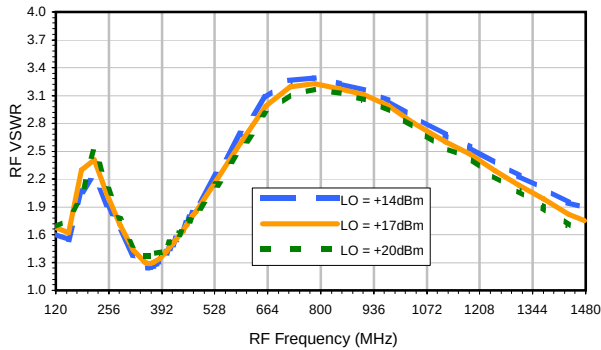
LO-IF Isolation



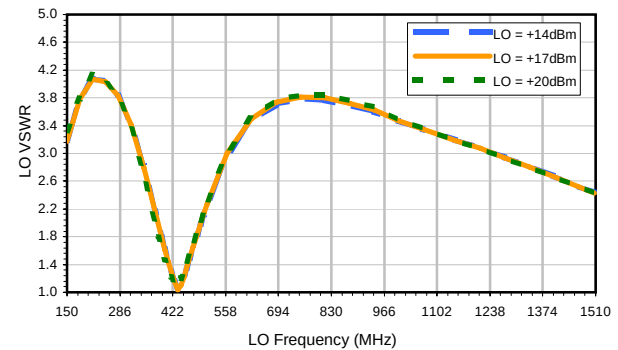
RF-IF Isolation



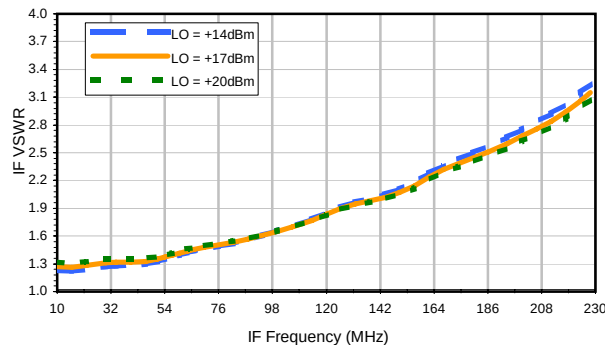
RF VSWR



LO VSWR



IF VSWR



Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	--	--	13.25	50.51	49.46	49.12	43.13	53.43	34.30	49.08	38.80	52.78
1	--	42.75	--	45.55	32.65	53.84	32.26	52.96	38.03	54.92	37.80	74.83
2	89.82	79.78	58.09	61.75	68.92	85.18	85.38	79.27	96.24	75.53	68.71	69.15
3	91.12	109.03	76.09	89.72	74.85	99.04	96.33	100.46	82.23	102.56	73.39	100.93
4	127.45	118.94	120.00	114.12	102.50	98.41	113.47	119.88	118.93	119.25	110.19	112.02
5	126.90	119.47	119.50	118.89	116.36	111.28	96.34	118.88	119.79	119.75	116.40	117.10
6	127.28	117.50	113.66	120.32	119.58	117.05	102.85	102.25	108.69	119.45	114.25	118.63
7	126.60	118.35	117.81	119.62	118.81	119.92	112.70	111.89	111.00	118.39	119.58	119.65
8	125.59	117.04	116.92	119.74	117.32	115.76	119.78	114.62	109.36	111.62	119.56	120.07
9	128.60	119.07	117.87	117.82	118.11	118.38	119.42	120.01	106.79	115.36	106.04	119.57
10	128.87	119.51	118.38	118.69	117.83	118.87	119.22	119.70	118.93	109.43	110.93	110.67
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

LO HARMONICS ORDER

Test conditions: RF IN: 412.50 MHz; 0.00 dBm.
 LO IN: 462.50 MHz; +17.00 dBm
 IF OUT: 50.00 MHz; -6.35 dBm

RF HARMONICS ORDER

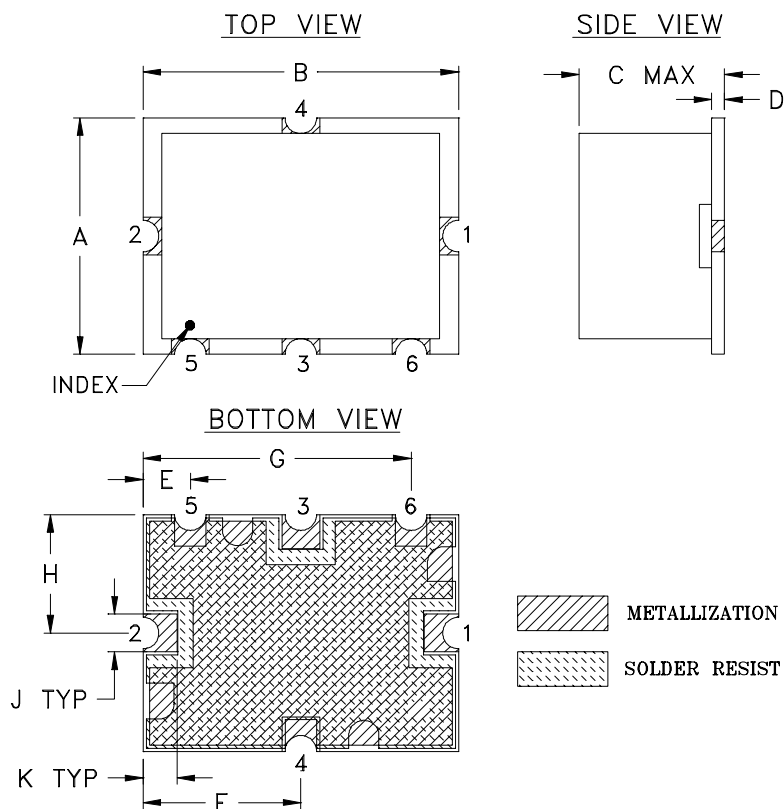
	(-dBm)	(-dBc)										
0	--	--	24.25	56.40	58.41	54.89	56.04	59.07	45.97	51.80	51.70	54.95
1	--	37.80	--	58.55	34.52	59.49	31.42	59.98	37.14	56.11	40.64	54.64
2	69.09	68.86	50.63	50.33	61.38	77.95	82.89	67.42	76.70	64.24	59.87	63.21
3	61.35	96.91	60.06	87.57	58.74	81.23	82.30	90.02	63.58	86.69	54.77	75.40
4	91.34	100.69	109.37	95.01	81.67	87.44	84.34	115.23	93.04	96.28	86.51	82.49
5	100.95	105.80	87.94	116.02	78.67	95.57	72.90	103.90	98.31	109.25	85.53	107.80
6	113.36	108.30	109.68	115.17	115.36	100.32	101.17	91.54	107.92	115.04	113.74	104.78
7	113.63	109.17	101.06	113.93	105.63	115.78	91.81	98.78	85.94	115.67	108.03	114.43
8	124.74	111.47	113.33	115.53	114.52	114.71	115.95	108.24	108.71	104.92	115.05	115.00
9	127.94	114.10	112.72	113.99	113.99	115.31	115.33	115.01	103.08	115.00	99.01	114.90
10	128.71	112.13	111.00	87.42	113.27	114.41	114.44	115.56	114.42	114.69	114.36	113.93
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

Test conditions: RF IN: 412.50 MHz; 10.00 dBm.
 LO IN: 462.50 MHz; +17.00 dBm
 IF OUT: 50.00 MHz; 3.56 dBm

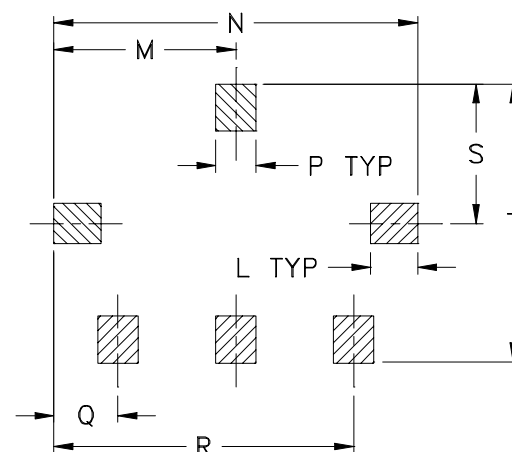
- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT
 2. + entry denotes harmonics are in (dBc) above IF OUTPUT
 3. RF Cal represents the Harmonics level of the RF Input Signal to the mixer

Outline Dimensions

TTT881



PCB Land Pattern



Suggested Layout,
Tolerance to be within ± 0.002

CASE #	A	B	C	D	E	F	G	H	J	K	L	M	N
TTT881	.38 (9.65)	.50 (12.70)	.23 (5.84)	.020 (0.51)	.075 (1.91)	.250 (6.35)	.425 (10.80)	.187 (4.75)	.050 (1.27)	.050 (1.27)	.070 (1.78)	.270 (6.86)	.540 (13.72)

CASE #	P	Q	R	S	T	WT. GRAM
TTT881	.060 (1.52)	.095 (2.41)	.445 (11.30)	.208 (5.28)	.415 (10.54)	.8

Dimensions are in inches (mm). Tolerances: 2 Pl. $\pm .01$; 3 Pl. $\pm .005$

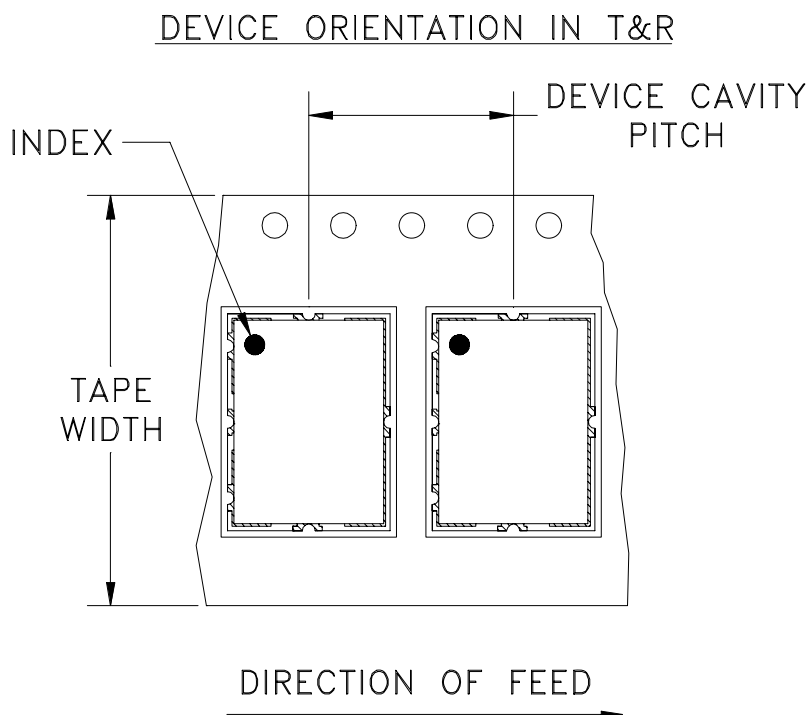
Note:

- Case material: Nickel-Silver alloy.
- Base material: Printed wiring laminate.
- Termination finish:
 - For RoHS Case Styles: 3-5 μ inch (.08-.13 microns) Gold over 120-240 μ inch (3.05-6.10 microns) Nickel plate. All models, (+) suffix.
 - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.



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Tape & Reel Packaging TR-F12



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
24	12	7	Small quantity standards (see note)	10
				20
				50
				100
				200
		13	Standard	500

Note: Please Consult individual model data sheet to determine device per reel availability.

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

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



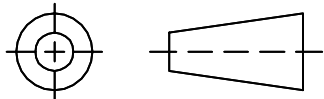
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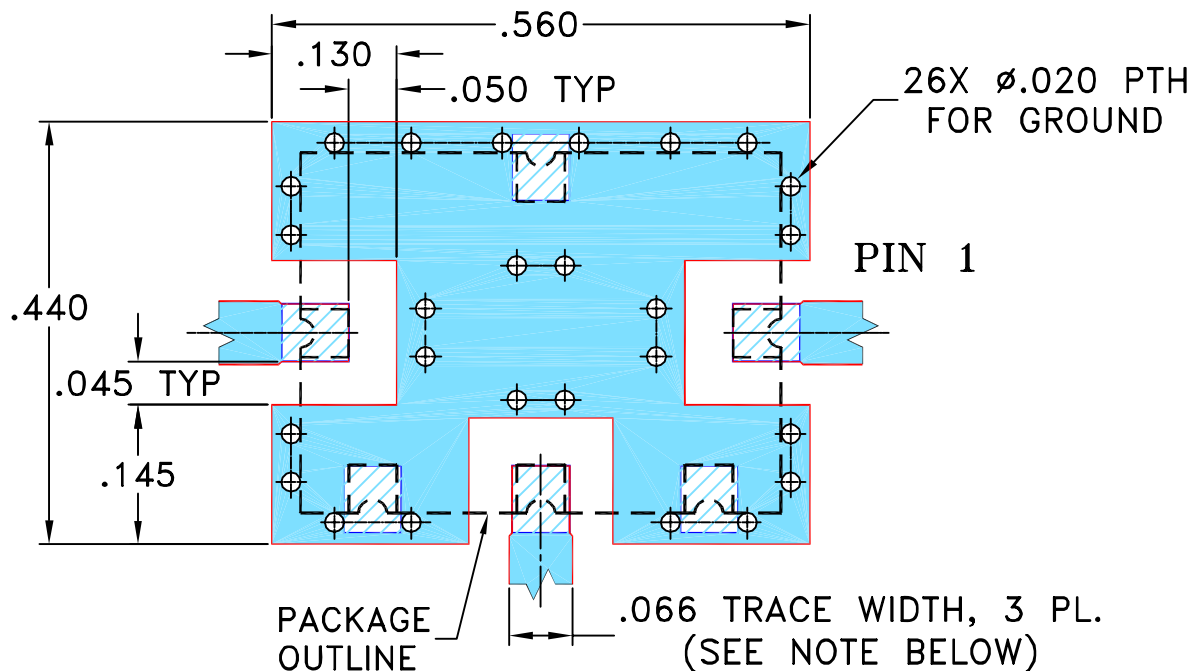
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
A	M86762	ADDED CONNECTIONS "lp & lq"	05/23/03	MMG	WL
B	M94598	ADDED CONNECTION "hk"	10/08/04	MMG	HY
C	M102713	UPDATED NOTES & DESCRIPTION	01/14/06	GF	IL
D	M132989	UPDATED NOTE 2	08/24/11	GF	DJ

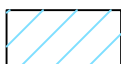
**SUGGESTED MOUNTING CONFIGURATION FOR
TTT166/167 CASE STYLE, "hk"/"lp"/"lq"
"x"/"ck"/"ec" PIN CONNECTIONS**

**NOTE:**

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030" $\pm$.002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES TO EXPOSE METAL UNDER THE ENTIRE UNIT GROUND PAD FOR IMPROVED GROUNDING, IT IS RECOMMENDED A SOLDER MASK DAM BE APPLIED AROUND EACH GROUND PAD TO ENSURE FILLET AND CONNECTION AT GROUND PADS.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.



DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER), SEE NOTE 2.



DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON:

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

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

INITIALS

DATE

DRAWN

GF

03/18/03

CHECKED

IL

04/15/03

APPROVED

DJ

04/15/03



Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

PL, hk/lp/lq/x/ck/ec, TTT166/167,
SYM/HJK/SYAS/SYPD, TB-12

SIZE
A

CODE IDENT
15542

DRAWING NO:
98-PL-079

REV:
D

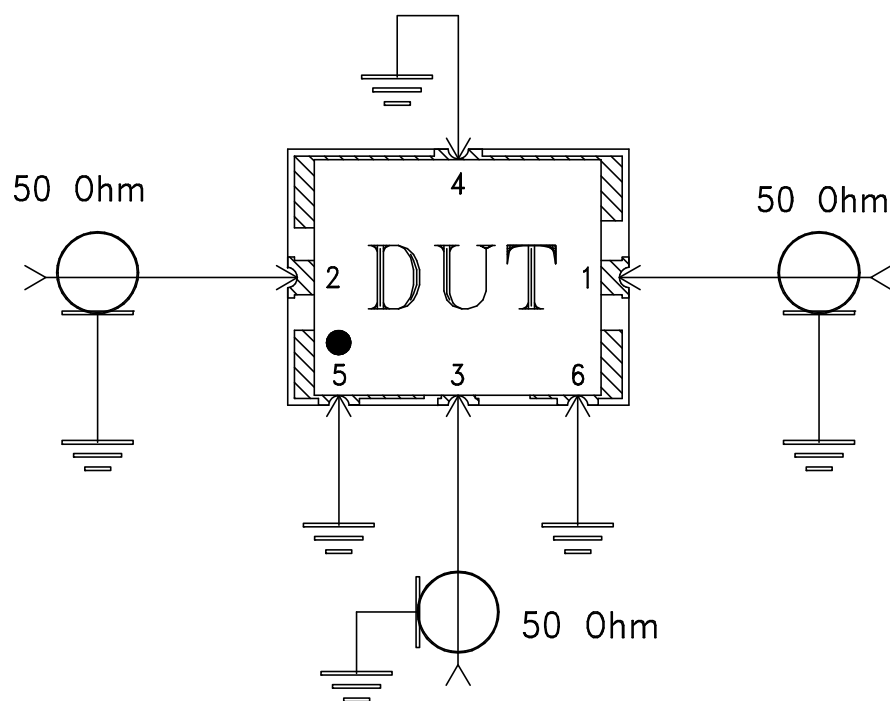
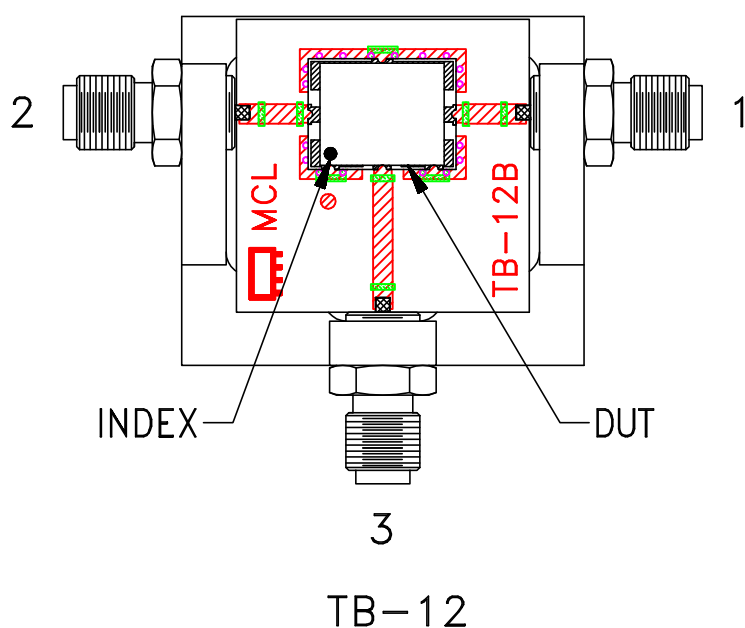
FILE: 98PL079

SCALE: 5:1

SHEET: 1 OF 1

Evaluation Board and Circuit

For Pin Connections Refer to Data Sheet of the DUT



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent, Dielectric Constant=3.5, Thickness=.030 inch.

 **Mini-Circuits®**



All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutetic Process: 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, 95% Coverage
Vibration (High Frequency)	20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)	MIL-STD-202, Method 204, Condition D
Mechanical Shock	50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes	MIL-STD-202, Method 213, Condition A
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215