Up Converter

Frequency Mixer

HJK-U232H+

Level 17 (LO Power +17 dBm) 850 to 2360 MHz

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	-20°C to 85°C
Storage Temperature	-55°C to 100°C
LO Power	+19dBm
IF Power	+20dBm

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

Pin Connections

LO	2
IF (IN)	3
RF (OUT)	1
GROUND	4,5,6

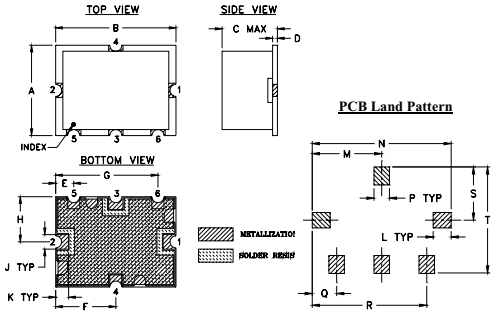
Features

- up converter mixer
- very high IP3, 31 dBm typ.
- excellent L-R isolation, 46 dB typ; L-I isolation, 35 dB typ.
- protected by US Patent 6,807,407

Applications

- base stations
- communication systems
- cellular
- mobile satellite
- GPS
- fixed microwave

Outline Drawing



Suggested Layout,
Tolerance to be within ±.002

Outline Dimensions (inch / mm)

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

Electrical Specifications

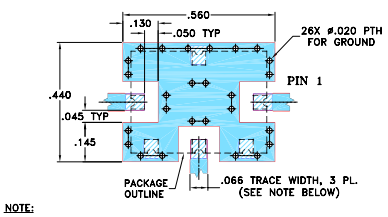
FREQUENCY (MHz)			CONVERSION LOSS (dB)			LO-IF (IN) ISOLATION (dB)		LO-RF (OUT) ISOLATION (dB)		IP3 at center band (dBm)
IF (IN)	LO	RF (OUT)	Typ.	σ*	Max.	Typ.	Min.	Typ.	Min.	Typ.
850-1850	370-510	1220-2360	6.8	0.1	8.8	35	28	46	40	31

1 dB COMPR. +20 dBm typ.
* σ is a standard deviation.

Typical Performance Data

Frequency (MHz)			Conversion Loss (dB)	Isolation L-I (dB)	Isolation L-R (dB)	VSWR RF Port (:1)	VSWR LO Port (:1)	IP3 (dBm)
IF (IN)	LO	RF (OUT)	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm	LO +17dBm
850.00	370.00	1220.00	7.23	36.84	48.48	2.40	3.96	28.09
910.00	380.00	1290.00	7.24	36.40	48.08	2.22	3.40	29.57
1030.00	400.00	1430.00	7.05	35.53	47.30	2.28	2.33	32.57
1071.00	405.50	1476.50	7.14	35.32	47.10	2.06	2.10	34.48
1112.00	411.00	1523.00	6.98	35.16	46.98	2.11	1.90	37.69
1194.00	422.00	1616.00	7.00	34.92	46.68	1.90	1.57	37.65
1276.00	433.00	1709.00	6.99	34.84	46.56	1.66	1.33	34.59
1358.00	444.00	1802.00	6.96	34.88	46.38	1.51	1.23	34.25
1440.00	455.00	1895.00	6.65	35.03	46.34	1.45	1.28	34.00
1481.00	460.50	1941.50	6.60	35.13	46.37	1.48	1.35	33.57
1563.00	471.50	2034.50	6.45	35.37	46.52	1.46	1.55	31.93
1645.00	482.50	2127.50	6.53	35.65	46.82	1.52	1.79	30.58
1768.00	499.00	2267.00	6.97	36.15	47.25	1.71	2.15	29.44
1809.00	504.50	2313.50	7.13	36.32	47.38	1.83	2.25	29.11
1850.00	510.00	2360.00	7.43	36.50	47.46	1.97	2.35	29.07

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

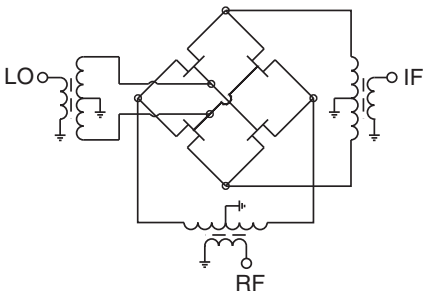


NOTE:
1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES 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.

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

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Electrical Schematic



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

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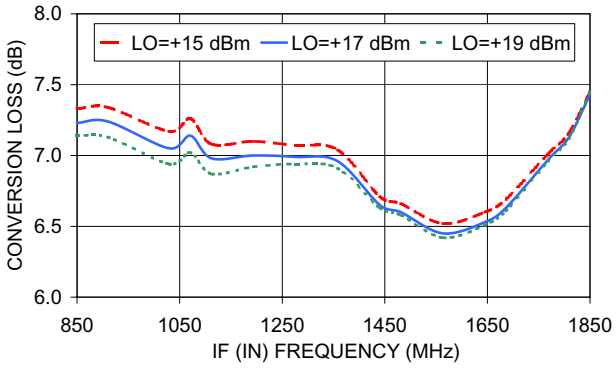
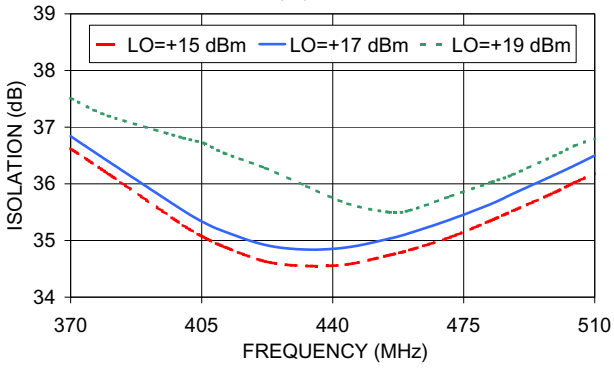
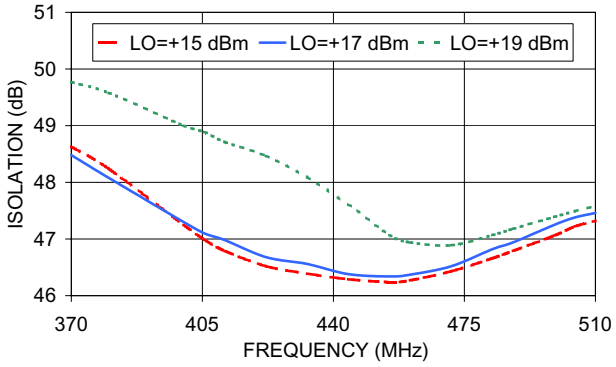
HJK-U232H+
CONVERSION LOSS



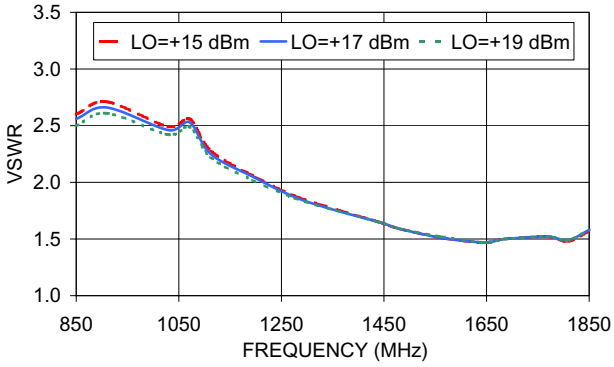
HJK-U232H+
L-I (IN) ISOLATION



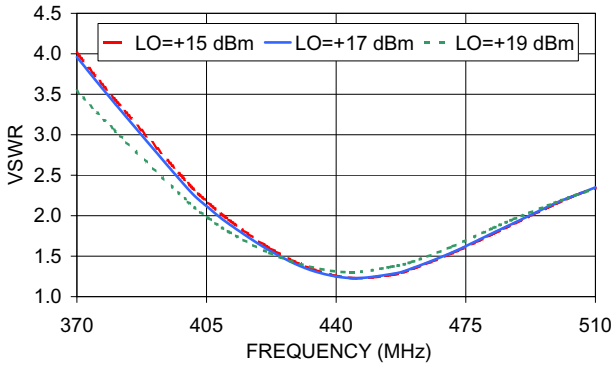
HJK-U232H+
L-R (OUT) ISOLATION



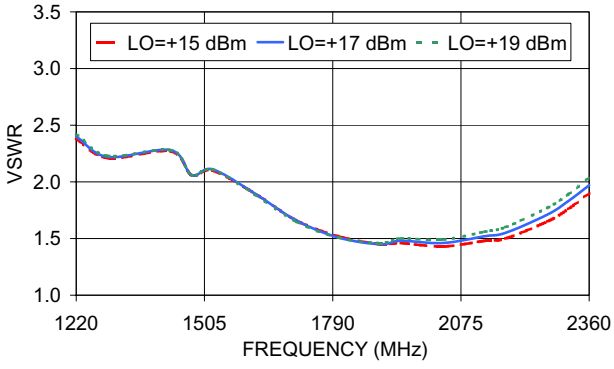
HJK-U232H+
IF (IN) VSWR



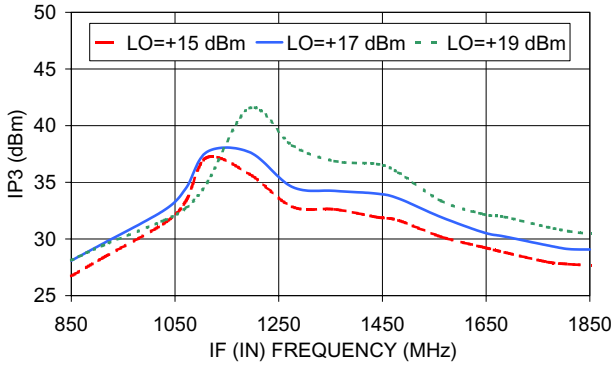
HJK-U232H+
LO VSWR



HJK-U232H+
RF (OUT) VSWR



HJK-U232H+
IP3



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Frequency Mixer (Upconverter) HJK-U232H+

Typical Performance Data

IF INPUT (MHz)	LO INPUT (MHz)	RF OUTPUT (MHz)	CONVERSION LOSS (dB)			LO-IF ISOLATION (dB)			LO-RF ISOLATION (dB)			IP3 INPUT (dBm)		
			@LO (dBm)			@LO (dBm)			@LO (dBm)			@LO (dBm)		
			+15	+17	+19	+15	+17	+19	+15	+17	+19	+15	+17	+19
548.0	350.0	898.0	7.13	7.11	7.11	37.58	37.81	38.37	48.52	48.35	49.10	22.39	23.66	24.62
699.0	360.0	1059.0	6.93	6.83	6.83	37.06	37.29	37.87	48.75	48.53	49.66	25.32	26.54	26.99
850.0	370.0	1220.0	7.33	7.23	7.23	36.62	36.84	37.51	48.63	48.48	49.77	26.73	28.09	28.13
910.0	380.0	1290.0	7.34	7.24	7.24	36.18	36.40	37.20	48.24	48.08	49.58	28.31	29.57	29.41
970.0	390.0	1360.0	7.37	7.26	7.26	35.75	35.99	36.98	47.72	47.63	49.35	29.88	30.97	30.54
1030.0	400.0	1430.0	7.17	7.05	7.05	35.27	35.53	36.81	47.25	47.30	49.00	31.41	32.57	31.66
1071.0	405.5	1476.5	7.26	7.14	7.14	35.06	35.32	36.72	46.99	47.10	48.89	33.35	34.48	32.73
1112.0	411.0	1523.0	7.08	6.98	6.98	34.89	35.16	36.54	46.79	46.98	48.71	37.20	37.69	34.95
1153.0	416.5	1569.5	7.15	7.05	7.05	34.72	35.03	36.41	46.67	46.81	48.58	45.25	44.51	37.35
1194.0	422.0	1616.0	7.10	7.00	7.00	34.63	34.92	36.28	46.52	46.68	48.47	35.71	37.65	41.54
1235.0	427.5	1662.5	7.02	6.93	6.93	34.55	34.87	36.12	46.47	46.65	48.25	33.91	35.64	39.54
1276.0	433.0	1709.0	7.07	6.99	6.99	34.55	34.84	35.96	46.39	46.56	48.09	32.85	34.59	38.26
1317.0	438.5	1755.5	7.04	6.97	6.97	34.54	34.84	35.79	46.30	46.43	47.83	32.41	34.21	36.60
1358.0	444.0	1802.0	7.04	6.96	6.96	34.58	34.88	35.65	46.29	46.38	47.61	32.62	34.25	36.87
1399.0	449.5	1848.5	6.92	6.86	6.86	34.64	34.92	35.53	46.25	46.38	47.35	32.77	34.42	37.38
1440.0	455.0	1895.0	6.71	6.65	6.65	34.74	35.03	35.50	46.24	46.34	47.07	31.92	34.00	36.61
1481.0	460.5	1941.5	6.66	6.60	6.60	34.83	35.13	35.53	46.27	46.37	46.94	31.64	33.57	35.86
1522.0	466.0	1988.0	6.53	6.47	6.47	34.94	35.26	35.67	46.29	46.42	46.86	30.70	32.22	34.02
1563.0	471.5	2034.5	6.52	6.45	6.45	35.06	35.37	35.78	46.43	46.52	46.89	30.19	31.93	33.37
1604.0	477.0	2081.0	6.53	6.47	6.47	35.20	35.51	35.90	46.50	46.69	46.96	29.54	30.95	32.58
1645.0	482.5	2127.5	6.60	6.53	6.53	35.36	35.65	36.03	46.66	46.82	47.07	29.27	30.58	32.18
1686.0	488.0	2174.0	6.69	6.63	6.63	35.52	35.82	36.16	46.79	46.94	47.18	28.81	30.21	31.94
1727.0	493.5	2220.5	6.87	6.81	6.81	35.69	35.98	36.32	46.93	47.13	47.29	28.53	29.94	31.39
1768.0	499.0	2267.0	7.01	6.97	6.97	35.84	36.15	36.49	47.06	47.25	47.39	27.97	29.44	31.05
1809.0	504.5	2313.5	7.16	7.13	7.13	36.02	36.32	36.67	47.22	47.38	47.49	27.78	29.11	30.69
1850.0	510.0	2360.0	7.45	7.43	7.43	36.18	36.50	36.80	47.32	47.46	47.58	27.66	29.07	30.44
1870.0	520.0	2390.0	7.56	7.55	7.55	36.42	36.72	37.07	47.46	47.58	47.72	27.45	28.63	30.07
1890.0	530.0	2420.0	7.74	7.73	7.73	36.62	36.90	37.22	47.50	47.70	47.84	27.03	28.16	29.27
1910.0	540.0	2450.0	7.80	7.78	7.78	36.78	37.07	37.40	47.45	47.67	47.79	26.60	27.71	28.88
1945.0	557.5	2502.5	8.12	8.10	8.10	37.33	37.62	37.91	47.33	47.45	47.61	26.07	27.17	28.15
1980.0	575.0	2555.0	8.44	8.43	8.43	38.14	38.42	38.72	47.85	47.95	48.12	25.64	26.89	27.82

Frequency Mixer (Upconverter) HJK-U232H+

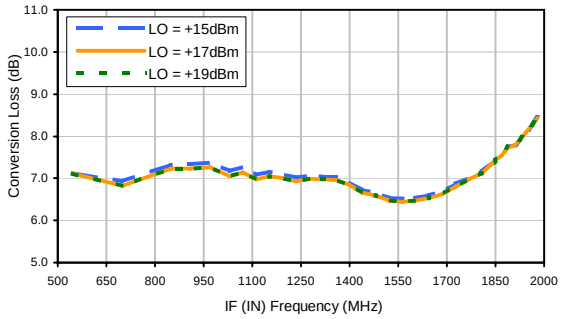
Typical Performance Data

IF INPUT (MHz)	LO INPUT (MHz)	IF VSWR (:1) @LO (dBm)			LO INPUT (MHz)	LO VSWR (:1) @LO (dBm)			RF OUTPUT (MHz)	RF VSWR (:1) @LO (dBm)		
		+15	+17	+19		+15	+17	+19		+15	+17	+19
548.0	350.0	1.80	1.79	1.79	350.0	5.23	5.19	4.68	898.0	3.45	3.48	3.50
699.0	360.0	2.77	2.75	2.74	360.0	4.58	4.53	4.05	1059.0	3.19	3.24	3.28
850.0	370.0	2.60	2.56	2.50	370.0	4.01	3.96	3.54	1220.0	2.38	2.40	2.42
910.0	380.0	2.71	2.66	2.61	380.0	3.45	3.40	3.06	1290.0	2.21	2.22	2.23
970.0	390.0	2.76	2.71	2.66	390.0	2.90	2.85	2.60	1360.0	2.22	2.23	2.24
1030.0	400.0	2.49	2.46	2.42	400.0	2.40	2.33	2.17	1430.0	2.27	2.28	2.28
1071.0	405.5	2.56	2.53	2.49	405.5	2.16	2.10	1.97	1476.5	2.06	2.06	2.06
1112.0	411.0	2.28	2.25	2.22	411.0	1.95	1.90	1.80	1523.0	2.10	2.11	2.11
1153.0	416.5	2.33	2.31	2.28	416.5	1.76	1.72	1.66	1569.5	1.93	1.94	1.93
1194.0	422.0	2.06	2.05	2.02	422.0	1.60	1.57	1.54	1616.0	1.90	1.90	1.89
1235.0	427.5	2.09	2.08	2.06	427.5	1.46	1.44	1.44	1662.5	1.78	1.78	1.77
1276.0	433.0	1.88	1.87	1.86	433.0	1.35	1.33	1.37	1709.0	1.66	1.66	1.65
1317.0	438.5	1.88	1.87	1.86	438.5	1.27	1.26	1.32	1755.5	1.62	1.61	1.61
1358.0	444.0	1.76	1.75	1.75	444.0	1.23	1.23	1.30	1802.0	1.52	1.51	1.51
1399.0	449.5	1.72	1.71	1.72	449.5	1.23	1.23	1.32	1848.5	1.56	1.56	1.57
1440.0	455.0	1.65	1.65	1.65	455.0	1.27	1.28	1.37	1895.0	1.45	1.45	1.46
1481.0	460.5	1.59	1.59	1.59	460.5	1.34	1.35	1.43	1941.5	1.46	1.48	1.50
1522.0	466.0	1.57	1.57	1.57	466.0	1.43	1.45	1.51	1988.0	1.40	1.42	1.44
1563.0	471.5	1.51	1.51	1.52	471.5	1.54	1.55	1.62	2034.5	1.43	1.46	1.49
1604.0	477.0	1.52	1.52	1.52	477.0	1.65	1.67	1.73	2081.0	1.42	1.45	1.49
1645.0	482.5	1.47	1.47	1.47	482.5	1.78	1.79	1.85	2127.5	1.48	1.52	1.56
1686.0	488.0	1.50	1.50	1.50	488.0	1.90	1.91	1.96	2174.0	1.50	1.55	1.60
1727.0	493.5	1.45	1.45	1.46	493.5	2.02	2.04	2.07	2220.5	1.58	1.63	1.69
1768.0	499.0	1.52	1.52	1.52	499.0	2.14	2.15	2.16	2267.0	1.65	1.71	1.77
1809.0	504.5	1.48	1.49	1.49	504.5	2.25	2.25	2.25	2313.5	1.76	1.83	1.89
1850.0	510.0	1.57	1.58	1.58	510.0	2.34	2.35	2.33	2360.0	1.90	1.97	2.04
1870.0	520.0	1.57	1.58	1.58	520.0	2.49	2.50	2.48	2390.0	1.96	2.04	2.12
1890.0	530.0	1.56	1.56	1.57	530.0	2.66	2.66	2.63	2420.0	2.00	2.08	2.15
1910.0	540.0	1.61	1.61	1.62	540.0	2.89	2.88	2.86	2450.0	2.11	2.20	2.28
1945.0	557.5	1.70	1.70	1.71	557.5	3.49	3.48	3.55	2502.5	2.20	2.29	2.37
1980.0	575.0	1.70	1.71	1.72	575.0	4.11	4.10	4.12	2555.0	2.45	2.56	2.66

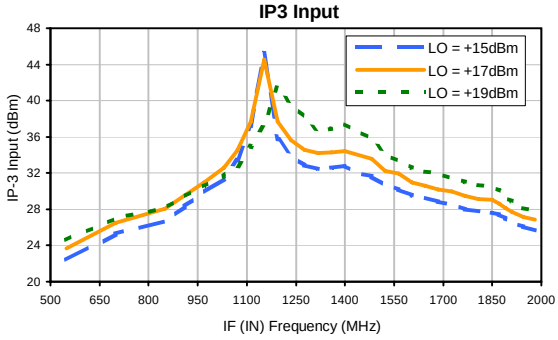
Frequency Mixer (Upconverter) HJK-U232H+

Typical Performance Curves

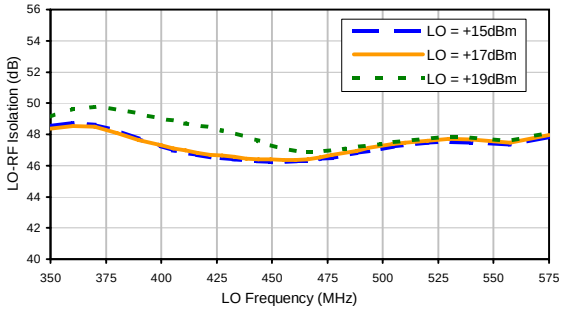
Conversion Loss



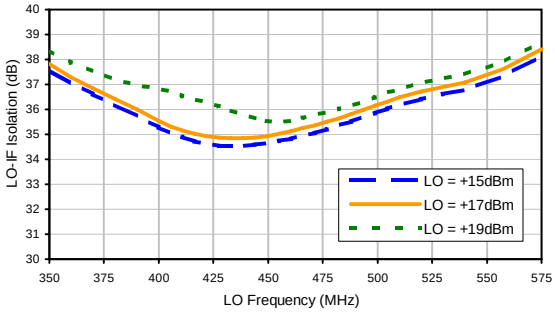
IP3 Input



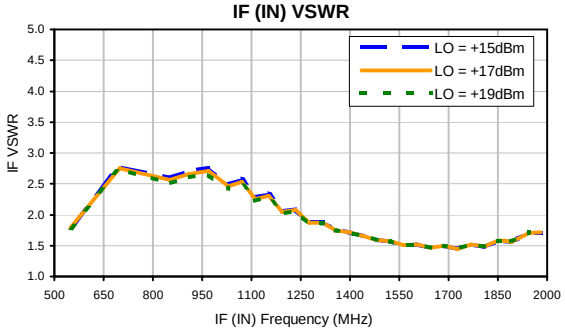
LO-RF Isolation



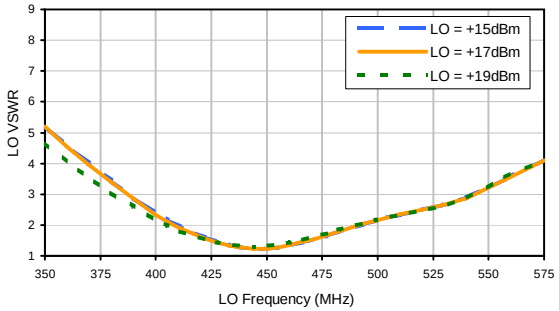
LO-IF Isolation



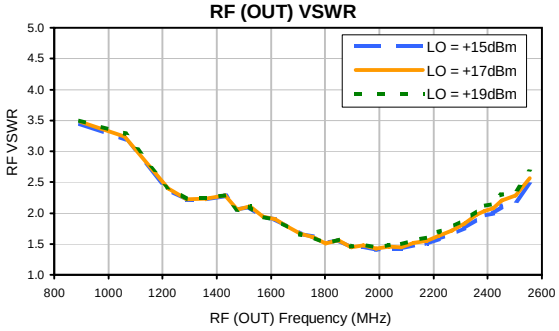
IF (IN) VSWR



LO VSWR



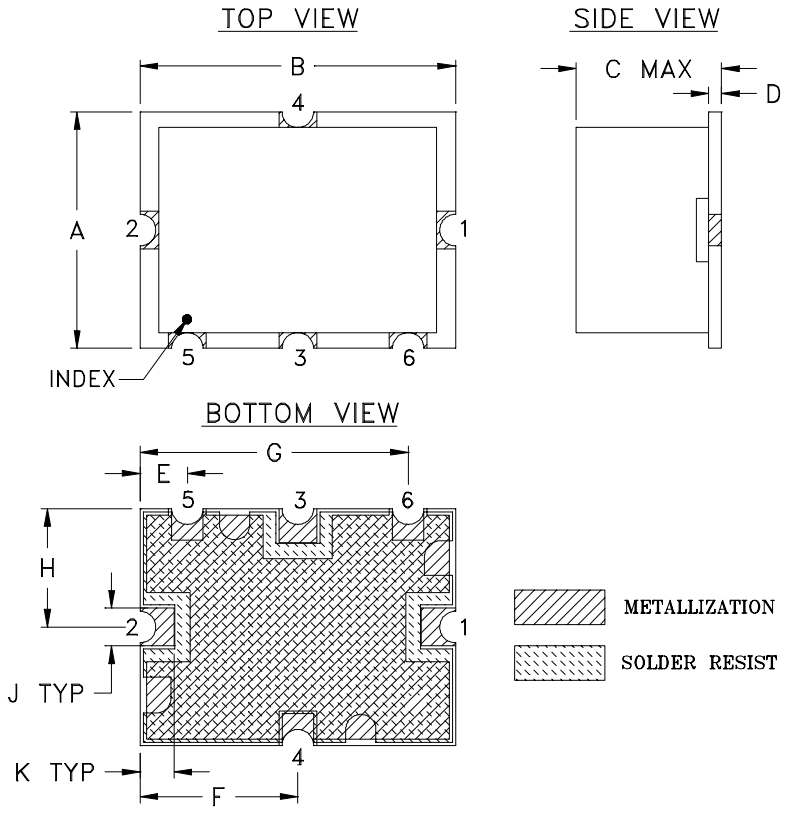
RF (OUT) VSWR



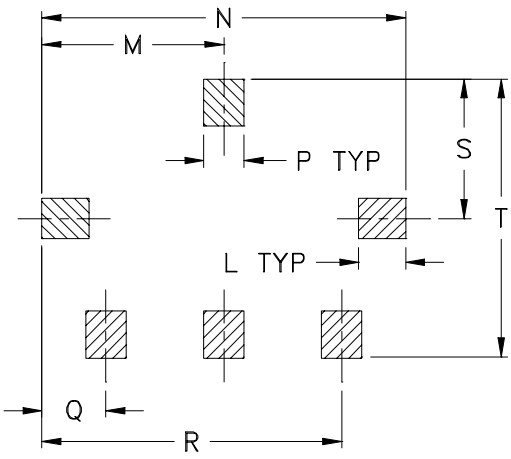
Case Style TTT

Outline Dimensions

TTT881



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.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

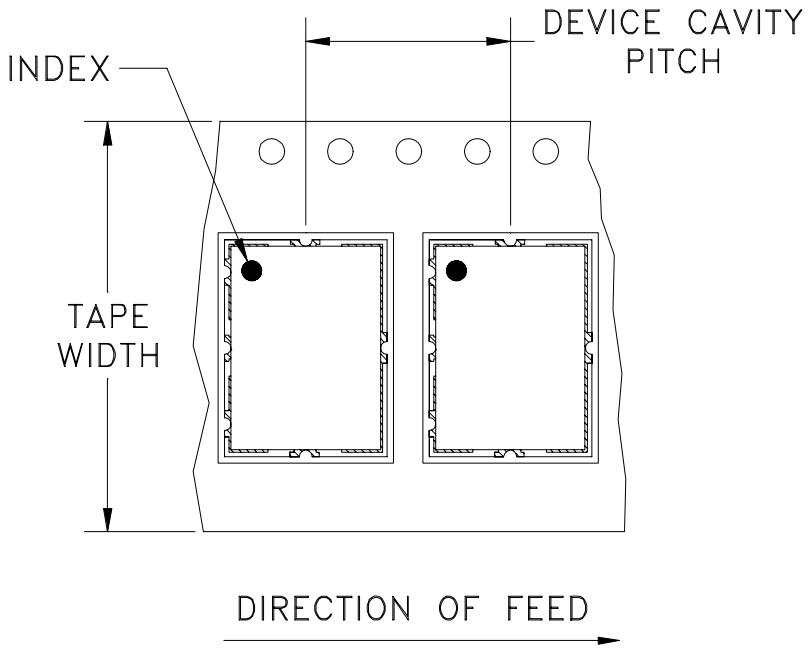
Dimensions are in inches (mm). Tolerances: 2 Pl. ± .01; 3 Pl. ± .005

Note:

1. Case material: Nickel-Silver alloy.
2. Base material: Printed wiring laminate.
3. 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.

Tape & Reel Packaging TR-F12

DEVICE ORIENTATION IN T&R



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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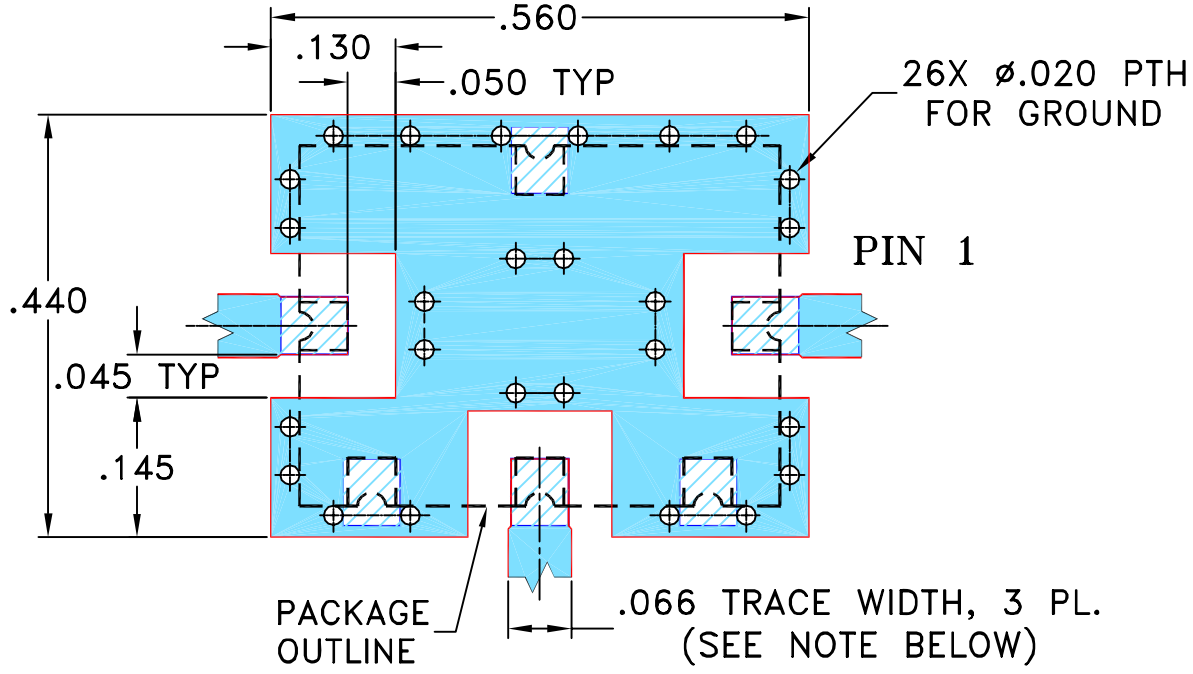
THIRD ANGLE PROJECTION

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 RO4350B 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.

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		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	GF	03/18/03
TOLERANCES ON:	CHECKED	IL	04/15/03
2 PL DECIMALS ±	APPROVED	DJ	04/15/03
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

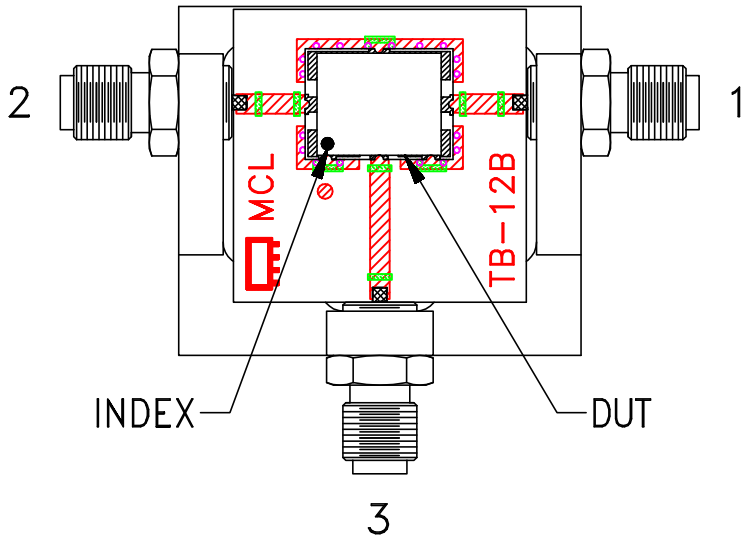
PL, hk/lp/lq/x/ck/ec, TTT166/167, SYM/HJK/SYAS/SYPD, TB-12

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-079	D

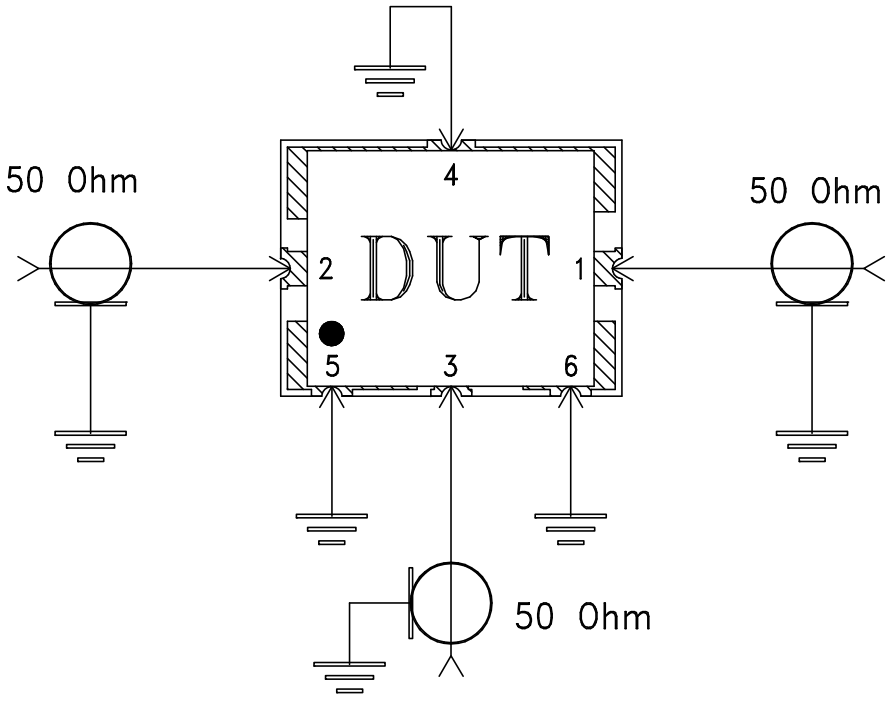
FILE:	SCALE:	SHEET:
98PL079	5:1	1 OF 1

Evaluation Board and Circuit

For Pin Connections Refer to Data Sheet of the DUT



TB-12



Schematic Diagram

Notes:

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

Mini-Circuits®

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Environmental Specifications ENV02

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	-20° 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