ULTRA·REL® Ceramic Hermetic

Frequency Mixers

MAC Series

300 MHz to 12 GHz LO Levels 4 to 17 dBm

The Big Deal

- 3-Year Guarantee
- Hermetically sealed LTCC construction
- Low-profile case, 0.06” high
- Priced for outstanding VALUE

CASE STYLE: DZ1650

MIL Screening Available
Please consult Applications Dept.

Product Overview

Mini-Circuits’ MAC mixers employ a unique new design and a highly repeatable, tightly controlled, automated process that delivers industry-leading reliability at a remarkably affordable price. Schottky diode quads meeting our strict specifications are bonded to a multilayer integrated LTCC substrate, and then hermetically sealed under a controlled atmosphere with gold-plated covers and eutectic AuSn solder. These passive, double-balanced mixers are capable of meeting MIL requirements for gross leak, fine leak, thermal shock, vibration, acceleration, mechanical shock, and HTOL (The testing can be done if requested), and every MAC mixer is backed with our 3-year guarantee.

Key Features

Feature	Advantages
Low, Flat Conversion Loss	No need to compensate for variations over frequency.
Hermetically Sealed	Ideal for use anywhere long-term reliability adds bottom-line value: high moisture areas, busy production lines, high-speed distribution centers, heavy industry, outdoor settings, and unmanned facilities, as well as military applications.
Rugged LTCC/Hermetic Construction	Demonstrated reliability in harsh, physically abusive environments with high vibration, acceleration, and/or mechanical shock.
Wide Operating Temperature Range	Guaranteed performance from -55 to +125°C. MAC mixers have also passed thermal shock testing from -55 to +150°C, through 1000 cycles, 15 minutes per cycle.
Exposed Termination Ends	Our unique case design allows for easy visual inspection of side solder fillets per IPC-A-610 section 8.3.4.6, and features gold-plated terminations for excellent solderability.
Incredible Performance/Price	Game-changing affordability brings Hi-Rel hermetic mixers within the reach of commercial budgets.

Ceramic, Hermetically Sealed

Frequency Mixer WIDE BAND

MAC-60MH+

Level 13 (LO Power+13 dBm) 1600 to 6000 MHz

CASE STYLE: DZ1650

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

Maximum Ratings

Operating Temperature	-55°C to 125°C
Storage Temperature	-65°C to 150°C
RF Power	50 mW
IF Current	40 mA

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

Pin Connections

LO	10
RF	5
IF	3
GROUND	1,2,4,6,7,8,9

Features

- wide bandwidth, 1600 to 6000 MHz
- low conversion loss, 6.5 dB typ.
- excellent L-R isolation, 35 dB typ.
- LTCC double balanced mixer
- aqueous washable
- low cost
- low profile, 0.060"
- protected by US Patent 7,027,795
- 3-YEAR GUARANTEE -The Most Reliable Mixers

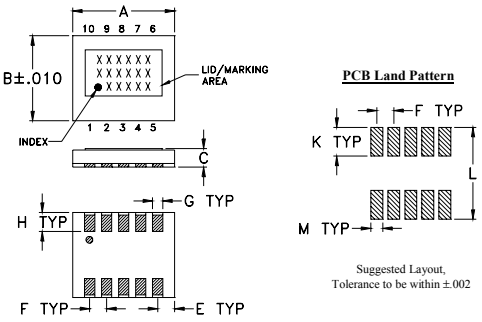
Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200
13"	500,1000

Applications

- PCN
- defense and weather radar
- WCDMA
- defense communications

Outline Drawing



Outline Dimensions (inch / mm)

A	B	C	D	E	F	G
.30	.250	.060	--	.050	.050	.030
7.62	6.35	1.52	--	1.27	1.27	0.76

H	J	K	L	M		wt
.056	--	.085	.270	.035		grams
1.42	--	2.16	6.86	0.89		0.29

Electrical Specifications at 25°C

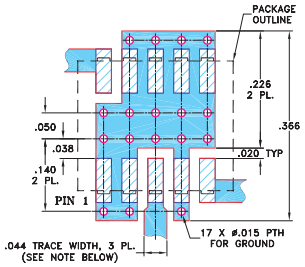
Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range, LO/RF			**1600 - 6000**		MHz
Frequency Range, IF			DC - 2000		MHz
Conversion Loss*	1600 - 4400	—	6.5	7.2	dB
	4400 - 6000	—	6.1	7.4	
LO to RF Isolation	1600 - 4400	30	35	—	dB
	4400 - 6000	20	24	—	
LO to IF Isolation	1600 - 4400	14	18	—	dB
	4400 - 6000	10	21	—	
IP3	1600 - 4400	—	17	—	dBm
	4400 - 6000	—	16	—	
RF Input Power at 1 dB Compression	1600 - 6000		+9		dBm

*Conversion Loss measured at 30 MHz IF.

Typical Performance Data at 25°C and LO=+13 dBm

Frequency (MHz) RF	Frequency (MHz) LO	Conversion Loss (dB) LO +13dBm	Isolation L-R (dB) LO +13dBm	Isolation L-I (dB) LO +13dBm	VSWR RF Port (:1) LO +13dBm	VSWR LO Port (:1) LO +13dBm
1600.1	1630.1	6.76	32.32	17.62	2.54	3.70
1800.1	1830.1	6.15	39.96	19.62	2.94	2.28
2000.1	2030.1	6.06	38.16	19.96	3.11	1.79
2200.1	2230.1	5.64	33.71	19.77	2.70	1.74
2400.1	2430.1	5.60	34.29	18.70	2.39	1.79
2600.1	2630.1	5.55	32.95	18.55	1.82	1.80
2800.1	2830.1	6.04	39.53	18.57	2.68	1.98
3000.1	3030.1	6.64	33.87	18.03	3.28	2.24
3200.1	3230.1	6.47	34.63	17.30	2.90	2.56
3400.1	3430.1	6.74	34.00	16.41	2.94	2.85
3600.1	3630.1	6.62	35.65	15.72	2.96	3.18
3800.1	3830.1	6.60	37.59	16.55	2.82	3.43
4000.1	4030.1	6.99	39.07	16.83	2.70	3.52
4600.1	4630.1	5.76	30.62	20.19	1.83	3.06
5000.1	5030.1	6.34	25.52	21.92	2.14	1.56
5200.1	5230.1	6.15	23.59	21.32	1.87	1.17
5400.1	5430.1	5.85	21.51	18.70	1.74	1.66
5600.1	5630.1	5.99	21.72	13.71	1.65	2.59
5800.1	5830.1	6.09	22.94	12.15	1.89	4.29
6000.1	6030.1	7.01	24.00	11.83	2.82	7.29

Demo Board MCL P/N: TB-956+
Suggested PCB Layout (PL-045)

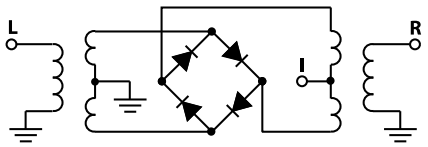


NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020" ± .0015"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

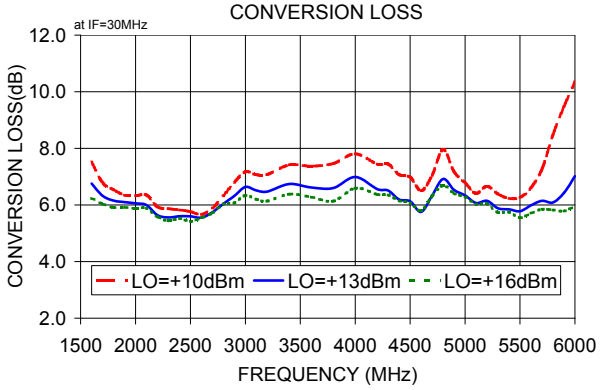
Electrical Schematic



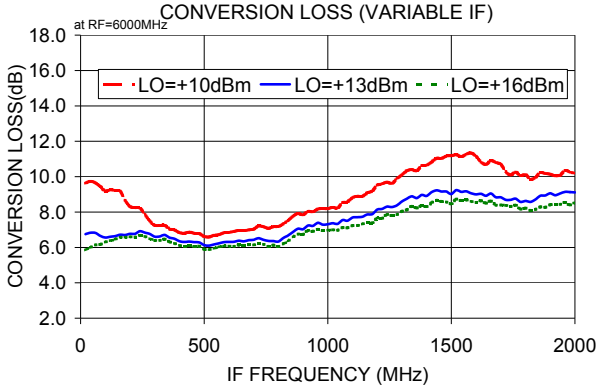
Notes

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

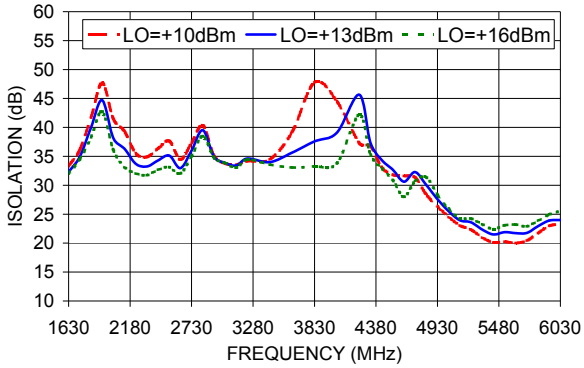
MAC-60MH+
CONVERSION LOSS



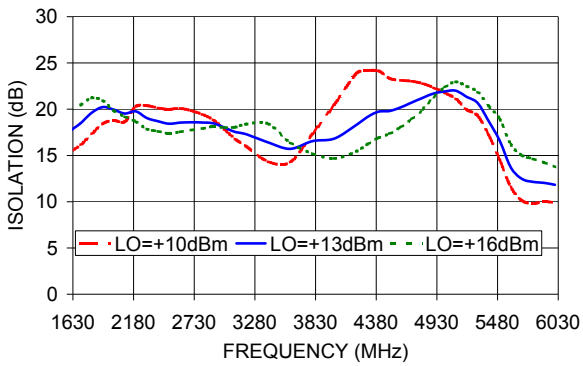
MAC-60MH+
CONVERSION LOSS (VARIABLE IF)



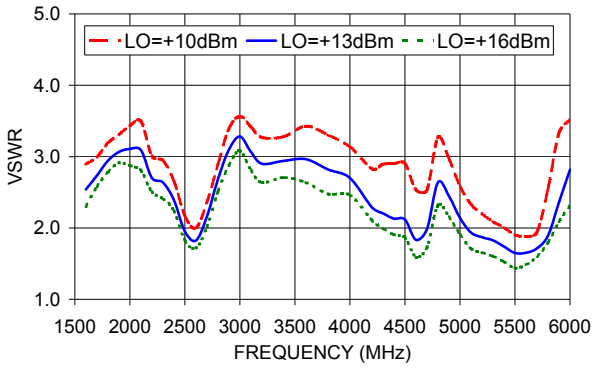
MAC-60MH+
L-R ISOLATION



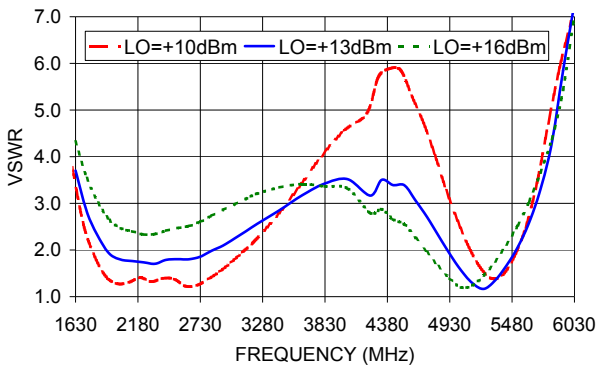
MAC-60MH+
L-I ISOLATION



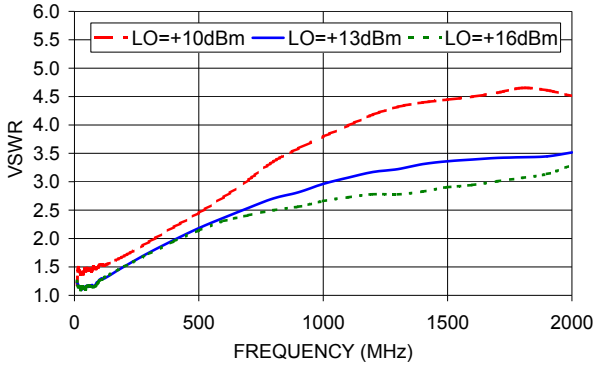
MAC-60MH+
RF VSWR



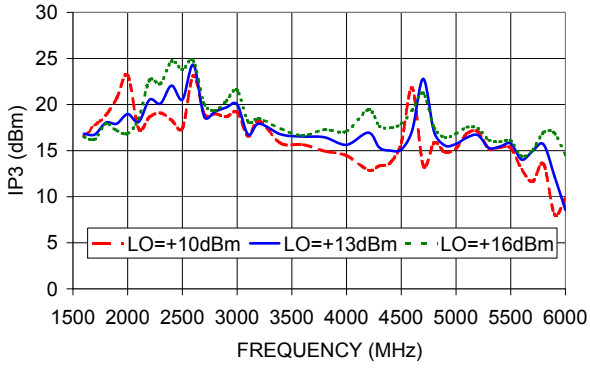
MAC-60MH+
LO VSWR



MAC-60MH+
IF VSWR



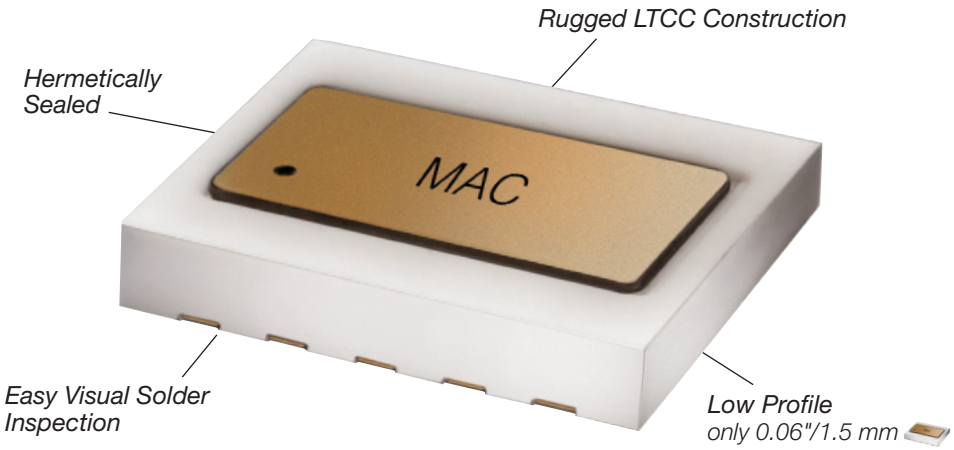
MAC-60MH+
IP3



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

Designed and Built for Long-Term Reliability in **HOSTILE ENVIRONMENTS**



Qualification Testing

The table below shows the initial qualification testing performed. If required, parts can be subjected to 100% screening and qualifications testing per MIL standard requirement.

Gross Leak	MIL-STD-202 Method 112, Condition D (100% of all MAC Mixers we ship)
Fine Leak	MIL-STD-202 Method 112, Condition C, Procedure IIIa
Thermal Shock	MIL-STD-202 Method 107 (-55/+100C°, 1000 cycles, 15 minutes) (-55/+150C°, 1000 cycles, 15 minutes)
Vibration	MIL-STD-202 Method 204, Condition D (10-2000Hz sine, 20g, 3 axis, 12 c.y.ea.)
Acceleration	MIL- STD-883 Method 2001, Condition E
Mechanical Shock	MIL-STD-202 Method 213, Condition A
HTOL	MIL-STD-202 Method 108, Condition D (1000 hours, 125°C, at rated LO level)
Multiple Reflow	JESD22-B102
Bend Test	JESD22-B113
Adhesion Strength	Push test >10lb

All Photos courtesy of U.S. Military and NASA

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