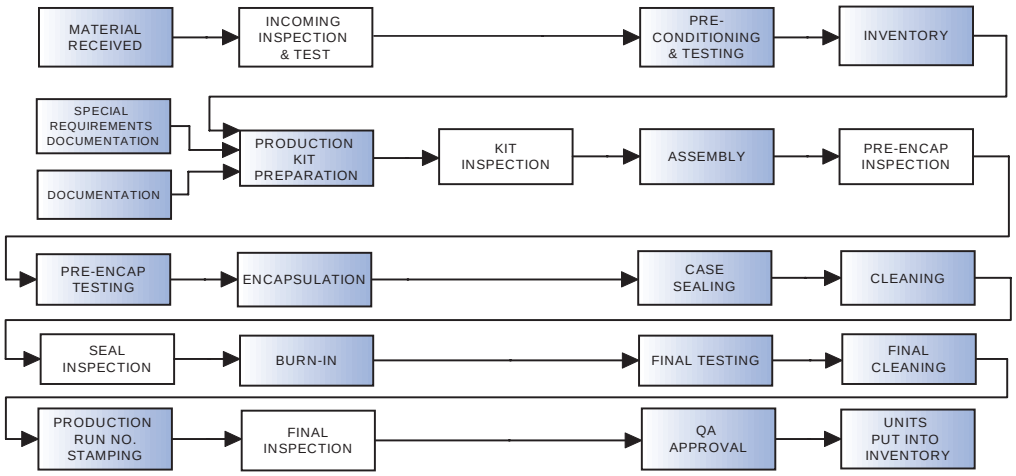
MINI-CIRCUITS GUARANTEES QUALITY

Although we have gone beyond our past objective of exceeding 0.1% AQL- no rejects, not even one per 1000 units- this is not satisfactory anymore. Our present commitments are to achieve a Cpk of 1.5, or 4.5 sigma: not even 4 rejects per million units. Mini-Circuits' process controls using SPC, pre-control and design of experiments reduce variability of performance. "Skinny Sigma" is our way of life and it can be yours. Specify Mini-Circuits RF signal processing components to reduce your inspection costs and improve your production yields.

How Mini-Circuits achieves high reliability



Environmental Specifications

All MCL 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 tests of MIL-STD-202, unless otherwise noted. For amplifiers, see the table of environmental specifications at the beginning of the amplifier section.

Rating or Test	MIL-STD-202		PACKAGE TYPE			
				Non-Hermetic		
	Method	Condition	Hermetic	Metal	Plastic	Connectored
Temperature Operating, °C[1]	—	—	-55° to 100°	-55° to 100°	-40° to 85°	-55° to 100°
Temperature Storage, °C[1]	—	—	-55° to 100°	-55° to 100°	-55° to 100°	-55° to 100°[4]
Altitude: 150,000 feet	105	E	Yes	Yes	Yes	Yes
Humidity: 90%RH, 65°C	106	—	Yes	Yes[2]	[3]	Yes[2][5]
Thermal Shock: -65 to 125°C	107	B	Yes	Yes	-55° to 100°	-55° to 100°
Fine Leak, atm-cc/s	112	C	1x10-7	Not Appl.	Not Appl.	Not Appl.
Gross Leak, atm-cc/s	112	D	1x10-5	Not Appl.	Not Appl.	Not Appl.
Vibration: 10 to 2000 Hz, 20 G's, 12 hours	204	D	Yes	Yes	Yes	Yes
Solderability: 95% coverage	208	—	Yes	Yes	Yes	Not Appl.
Solder heat: 260°C 10 seconds	210	B	Yes	Yes	Yes	Not Appl.
Terminal tensile strength: 4-1/2 lbs., 10 seconds	211	A	Yes	Yes	Yes	Not. Appl.
Terminal fatigue: 2 lbs. 3 cycles	211	C	Yes	Yes	Yes	Not. Appl.
Mechanical shock: 100 G's, 6 ms	213	I	Yes	Yes	Yes	Yes
Solvent resistance	215	—	Yes	Yes	Yes	Not. Appl.

For surface mount models, see surface mount environmental specifications in General Information.

Notes:
1. Extended temperature ranges are available for some models; consult factory.
2. Non-hermetic metal-cased units may require bake-out after test to restore full performance.
3. Humidity capabilities of plastic-cased units available on special request.
4. For BW attenuators, with connectors unmated -55°C to +85°C.
5. Reference MIL standard is MIL-STD-202, method 103, cond. B

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PRODUCT ENVIRONMENTALS & HIGH RELIABILITY TESTING

Ultra-Rel®

Mini-Circuit's mixers, phase detectors, frequency doublers and limiters are "Ultra-Rel®": They carry a five-year guarantee, a reliability breakthrough attributed mainly to unique Ultra-Rel® diodes that easily meet and exceed MIL-STD-883 tests. Each type of diode must pass the following grueling tests:

LIFE	1000 hrs. TA + 125°C, 50 mA ac
THERMAL SHOCK	-65° to +125°C, 200 cycles, 5 min. dwell
MECHANICAL SHOCK	1.5k G's, 0.5 msec pulse
VIBRATION	variable frequency 20 to 2,000 Hz.
TEMPERATURE CYCLE	-65°C to +125°C, 200 cycles, 10 min. dwell
MOISTURE RESISTANCE	85°C/@85%humidity 1000 hrs., no bias
HI-TEMPERATURE STORAGE	125°C, 160 hrs.

/MIL and Hi-Rel Products

All hermetically sealed MCL models can be subjected to screening and to environmental testing. These tests are designed to eliminate early failures and to ensure performance in hostile environments. Many models having such testing performed are available from stock parts, designated by a /MIL, or Hi-Rel suffix to the model number. For your convenience, the table below summarizes availability and applicable MIL Spec by product line. A brief description of the test procedures follows the table.

Of course, if you have a specific screening requirement for any model, which is not available from a stock item, or for a non-hermetic model, contact our Applications Engineering staff and they will suggest the most cost-effective means of satisfying your reliability needs.

/MIL Models

Mixers, Frequency Doublers and Phase Detectors are tested in accordance with MIL-M-28837. Pre-conditioning, Group A (screened) and Group B are performed on each inspection lot.

Power Splitters are tested in accordance with MIL-P-23971. Group A and Group B are performed on each inspection lot.

These models may be ordered by adding the suffix /MIL to the model number.

Product Line	Applicable Suffix		Applicable Std. or Specification for reference
	*Hi-Rel	*/MIL	
Amplifiers	No	No	MIL-STD-883
Digital Step Attenuators	No	No	MIL-STD-883
Directional Couplers	Yes	No	MIL-C-15370
Electronic Attenuators/ Switches	Yes	Yes	MIL-M-28837
Filters	Yes	No	MIL-F-18327
Fixed Attenuators	Yes	No	MIL-A-3933
Frequency Doublers	Yes	Yes	MIL-M-28837
I & Q Modulators & Demodulators	No	No	MIL-M-28837
Limiters	No	No	MIL-M-28837
Mixers	Yes	Yes	MIL-M-28837
Phase Detectors	Yes	Yes	MIL-M-28837
Phase Modulators	No	No	MIL-M-28837
Power Splitter/Combiners	Yes	Yes	MIL-P-23971
Switches	Yes	No	MIL-STD-883
Terminations	No	No	MIL-D-39030
Transformers	Yes	No	MIL-T-55631

*Check with our Sales Department for specific models available as Hi-Rel. or MIL.

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Hi-Rel Models

Mixers, Phase Detectors, Frequency Doublers and Electronic Attenuators/Switches are tested to the following per MIL-STD-202:

I) THERMAL SHOCK	Method 107, Cond. A (100°C)
2) BURN-IN	Method 108, Cond. A (100°C, 8mA ac)
3) FINE AND GROSS LEAK	Method 112, Cond. C and D

Power splitter/combiners, Directional Couplers, Transformers, Fixed Attenuators, Filters and Limiters are tested to the following per MIL-STD-202:

1) BAKE-IN	Method 108, Cond. A (100°C, no excitation)
2) THERMAL SHOCK	Method 107, Cond. A (100°C)
3) FINE & GROSS LEAK	Method 112, Cond. C and D

Switches incorporating PIN diodes are tested to the following per MIL-STD-202, as a minimum:

1) THERMAL SHOCK	Method 107, Cond. A (100°C)
2) BURN-IN	Method 108, Cond. A (100°C, diode current applied)

For additional tests applicable to specific switch models, please consult our Sales Department.

These models may be ordered by adding the suffix Hi-Rel to the model number.

Compatibility with Cleaning Methods

Mini-Circuits products in hermetic packages will withstand all cleaning methods commonly applied by users when soldering onto PC boards, such as aqueous wash. **Caution**: Ultrasonic cleaning is not recommended; it may cause damage to internal parts.

Many non-hermetic models are also guaranteed to be aqueous washable. These include the plastic and ceramic case styles CG581 and QQQ569, for example, as well as wash-through and monolithic devices. Care should be taken regarding aqueous wash for other non-hermetic models, by noting the technical guidance given in this article, and requesting assistance as needed from our Sales or Applications departments. Often, selection or simple adaptation of our product will enhance its washability.

"Aqueous wash", as generally understood, means the use of high pH (caustic) saponifiers, and such chemicals can affect internal materials. These may attack copper, and/or may dissolve magnet wire insulation and soften epoxy-based bonding material if they remain in contact for an extended time.

"Water wash" generally means the use of DI (deionized) water only, without a saponifier. The only consequence of using water wash on a design which does not guarantee complete sealing is the possible need for a dry-out step after cleaning.

Connector Specifications

All coaxial connectors used in MCL products meet applicable requirements of MIL-PRF-39012 including mating compatibility, coupling proof torque, and contact retention. For applications with specific materials and finish requirements, consult factory.

Meeting Customer Needs

The following table outlines generic types of tests we do to satisfy customer's needs per specific contractual requirements. Each entry encompasses one or more QCPs (Quality Control Procedures) which are particularized as to test conditions. The principal MIL standards referenced in the QCPs are listed as a guide.

Mini-Circuits® QCP Group	Test	Methods of MIL-STD -202	-810	-883
02-00	Thermal Shock	107	503	1010
03-00	Random Vibration			
04-00	Mechanical Shock	207,213	516	
05-00	Constant Accelation	212		2001
06-00	Bake-In/Burn-In	108		1015
07-00	Seal Tests	112		
08-00	Moisture Resistance	106	507	
09-00	Radiographic	209		2012
10-00	Sine Vibration	201	514	
11-00	High Frequency Vibration	204		
12-00	Humidity	103		
13-00	Altitude (Barometric Pressure)	105	500	
14-00	Salt-Spray	101	509	
15-00	Terminal Strength	211		
16-00	Resistance to Solvents	215		
17-00	Solderability	208		
18-00	Resistance to Soldering Heat	210		
19-00	Immersion	104		
20-00	Explosion	109	511	
21-00	Sand and Dust	110	510	
22-00	Fungus Test		508	
25-00	Particle Impact Noise Detection (PIND)			2020

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