Environmental Stress Screening (ESS)

Every H & M-Grade Maxi, Mini, and Micro as well as MI Family modules undergoes extensive post-production environmental stress screening (ESS) before shipment to verify compliance with Vicor's high quality and performance standards and to eliminate early life failures. To ensure the most effective routine for precipitating module failures, we continually evaluate our ESS program and make appropriate changes as new data become available or as product improvements occur. After burn-in and temperature cycling, each module undergoes final electrical testing over the specified temperature range. The program is outlined below.

	MI Family Module Screening		**Maxi, Mini and Micro Module Screening**	
	I-Grade	**M-Grade**	**H-Grade**	**M-Grade**
Operating Temperature	**MI-200** -55 to +85°C **MI-J00** -40 to +100°C	**MI-200** -55 to +85°C **MI-J00** -40 to +100°C	-40 to +100°C	-55 to +100°C
Storage Temperature	**MI-200** -55 to +100°C **MI-J00** -55 to +125°C	**MI-200** -65 to +100°C **MI-J00** -65 to +125°C	-55 to +125°C	-65 to +125°C
Temperature Cycling 17°C per minute nominal rate of change, dwell time until product stabilization.	12 cycles -65 to +100°C	12 cycles -65 to +100°C	12 cycles -65 to +100°C	12 cycles -65 to +100°C
Ambient Test @ 25°C	Yes	Yes	Yes	Yes
Power Cycling Burn-In • Power on 10 minutes, off 15 minutes • Module temperature cycling 35°C to 80°C • Load up to 100 W • Module output	12 hours, 29 cycles	96 hours, 213 cycles	12 hours, 29 cycles	24 hours, 58 cycles

continuously monitored while enabled				
Functional & Parametric ATE Tests Low & high temp.	-40 to +85°C	-55 to +85°C	-40 to +100°C	-55 to +100°C
AC Hi-Pot Test	Yes	Yes	Yes	Yes
Visual Inspection Before packing into ESD containers.	Yes	Yes	Yes	Yes

Mean Time Between Failure (MTBF)

Because operating temperature is one of the most important factors in determining overall module reliability, it is imperative that the user's system design allow for efficient heat transfer from the baseplate to system ambient. Since temperature and failure rate are exponentially related, just a 10°C decrease in baseplate temperature can have a dramatic increase in MTBF. Due to patented zero-voltage/zero-current switching topology, Vicor converters are highly efficient compared to those with more traditional topologies. High efficiency translates into both smaller size and lower temperature rises. To minimize thermal impedance, all major power dissipating components are mounted directly to the baseplate. Below are representative calculated MTBF values based on MIL-HDBK-217F. If you require information about a specific model, contact Vicor with the model number, expected baseplate temperature, and operating environment to obtain an individually prepared report.

		MTBF in 1000 Hours			
Model Number	**Baseplate Temperature**	**G.B.**	**G.F.**	**A.I.C.**	**N.S.**
MI-J71-MY	25°C	3,782	1,891	1,135	1,116
	50°C	2,307	1,154	692	681
	65°C	1,778	889	533	524

MI-274-MW	25°C 50°C 65°C	3,830 2,336 1,800	1,878 1,915 900	1,149 701 540	1,130 689 531
V24C3V3M75BL (Micro)	25°C 50°C 65°C	6,235 3,803 2,930	3,117 1,902 1,465	1,870 1,141 879	1,839 1,122 864
V24B5M200BL (Mini)	25°C 50°C 65°C	4,205 2,565 1,976	2,102 1,282 988	1,201 769 593	1,240 757 583
V24A12M400BL (Maxi)	25°C 50°C 65°C	3,428 2,091 1,611	1,714 1,282 806	1,028 627 483	845 617 475

Environmental Qualification

Fully encapsulated, Vicor Maxi, Mini, Micro, and MI family modules utilize a proprietary spin fill process that assures complete, void free encapsulation making them suitable for the harshest environments. In addition to providing mechanical rigidity, the encapsulant is thermally conductive to eliminate hot spots and aid in heat transfer to the baseplate. Modules are available with temperatures down to -55°C operating and -65°C storage.
To verify the suitability of Vicor's H & M-Grade Maxi, Mini, and Micro as well as MI Family modules for harsh environments, these products have been subjected to the environmental testing requirements of MIL-STD-810, MIL-S-901 and MIL-STD-202. These tests, listed below, are performed at an independent laboratory. Additional environmental tests can be done upon individual customer request.

Environment	**Maxi, Mini and Micro Modules**	**MI Family Modules**
Altitude	• MIL-STD-810F, Method 500.4, Procedure I & II,	• MIL-STD-810D, Method 500.2, Procedure III, explosive decompression (40

	40,000 ft.and 70,000 ft. Operational	K ft.) • MIL-STD-810D, Method 500.2, Procedure II, 40,000 ft., 1000 – 1500 ft./min. to 70,000 ft., unit functioning
Explosive Atmosphere	• MIL-STD-810F, Method 511.4, Procedure I, Operational	• MIL-STD-810C, Method 511.1, Procedure I
Vibration	• MIL-STD-810F, Method 514.5, Procedure I, category 14, sine and random vibration per Table 514.5C for helicopter AH-6J main rotor with overall level of 5.6 g rms for 4 hours per axis	• MIL-STD-810D, Method 514.3, Procedure I, category 6, helicopter, 20 g
	• MIL-STD-810F, Method 514.5C, general minimum integrity curve per Figure 514.5C-17 with overall level of 7.7 g rms for 1 hr per axis	• MIL-STD-810D, Method 514.3 random: 10 – 300 Hz @ 0.02 g^2/Hz, 2000 Hz @ 0.002 g^2/Hz, 3.9 total g rms 3 hrs/axis Sine: 30 Hz @ 20 g, 60 Hz @ 10 g, 90 Hz @ 6.6 g, 120 Hz @ 5.0 g, 16.0 total g rms, 3 axes • MIL-STD-810E, Method 514.4, Table 514.4-VII, ±6 db/octave, 7.7 g rms, 1hr/axis
Shock	• MIL-STD-810F, Method 516.5, Procedure I, functional shock, 40 g • MIL-S-901D, lightweight hammer shock, 3 impacts/axis,1, 3, 5 ft. • MIL-STD-202F, Method 213B, 60 g, 9 ms half sine	• MIL-STD-810D, Method 516.3, Procedure I, functional shock, 40 g • MIL-STD-202F, Method 213B, 18 pulses, 60 g, 9 msec • MIL-STD-202F, Method 213B, 75 g, 11 ms saw tooth shock

	• MIL-STD-202F, Method 213B, 75 g, 11 ms saw tooth shock	• MIL-STD-202F, Method 207A, 3 impacts / axis, 1, 3, 5 feet
Acceleration	• MIL-STD-810F, Method 513.5, Procedure II, Table 513.5-II, Operational, 2 – 7 g, 6 directions	• MIL-STD-810D, Method 513.3, Procedure II Operational test, 9 g for 1 minute along 3 mutually perpendicular axes
Humidity	• MIL-STD-810F, Method 507.4, 95% Relative Humidity	
Solder Test	• MIL-STD-202G, Method 208H, 8 hr aging	
Fungus	• MIL-STD-810F, Method 508.5	• MIL-STD-810C, Method 508.1
Salt Fog	• MIL-STD-810F, Method 509.4	• MIL-STD-810C, Method 509.1