

Rapid Temperature-Change Testing

Preface

MAXMAC subjects ion modules to repeated transitions between -40°C and $+85^{\circ}\text{C}$. The procedure specifies the dwell at each limit, the transition time and a functional check halfway through the 100-cycle program.

The six-sample record includes checks before exposure, after 50 cycles and after 100 cycles. All six samples passed the current, LIN communication, ion-output, appearance and shake checks at every recorded stage.

Test Conditions

Parameter	Specified condition
Temperature limits	-40°C / $+85^{\circ}\text{C}$
Cold dwell, t1	30 minutes
Hot dwell, t2	30 minutes
Transition time, t3	≤ 30 seconds
Cycle count	100
Exposure mode	1.1; unpowered
Intermediate check	After 50 cycles
Samples	6 modules; 43#-48#

One Programmed Cycle

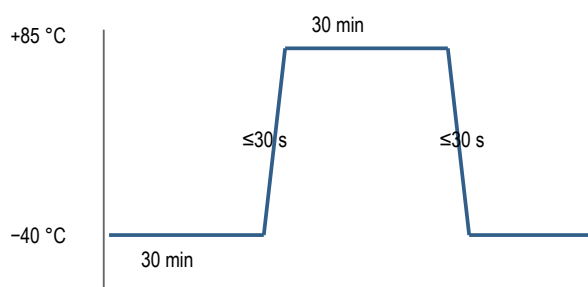


Figure 1 Schematic of the specified dwell and transition sequence.

Programmed dwell total:

$$100 \times (30 + 30) \text{ min} = 100 \text{ h.}$$

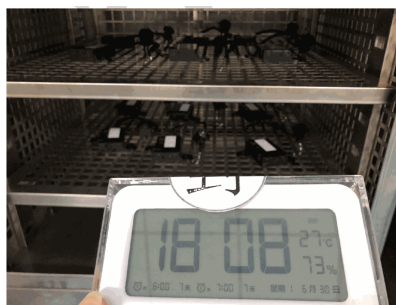
$$\text{Temperature span: } 85 - (-40) = 125^{\circ}\text{C.}$$

Test Sequence and Arrangement

1. Record current, LIN, ion output, appearance and shake-check results before exposure.
2. Arrange modules on the chamber tray and run the specified rapid-change program.
3. At 50 completed cycles, check electrical and mechanical function and surface condition.
4. Complete 100 cycles and allow natural recovery to room temperature.
5. Repeat the functional and physical checks. Before ion-output measurement after cold exposure, stand for more than 2 hours and allow condensation to evaporate.



First 50-cycle chamber arrangement.



Second 50-cycle chamber arrangement.

Figure 2 Original tray arrangements from the two halves of the program.

Three-Stage Checks and Recorded Results

The same six samples were checked at all three stages. Every working-current reading met ≤ 100 mA; LIN communication was OK; the ion counter recorded over-range above 20 million ions/cm³. All appearance and shake checks were normal.

Sample	Before Current (mA)	After 50 cycles Current (mA)	After 100 cycles Current (mA)	LIN / ion / physical checks, all stages
43#	13.4507	13.2829	13.3577	All pass
44#	14.5414	13.8043	14.0870	All pass
45#	13.0303	13.2246	12.9833	All pass
46#	14.3183	13.8547	13.9506	All pass
47#	13.7264	13.8666	13.8858	All pass
48#	13.3070	13.8158	13.3140	All pass

Table 1 Original current readings and associated results, source p. 17.

Before: Sample 43#

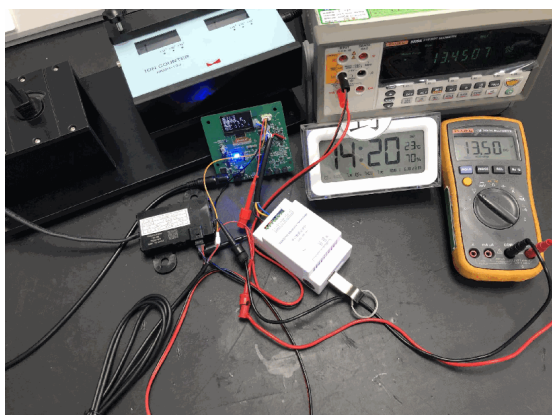


Figure 3 Initial functional check photograph.

After: Sample 43#

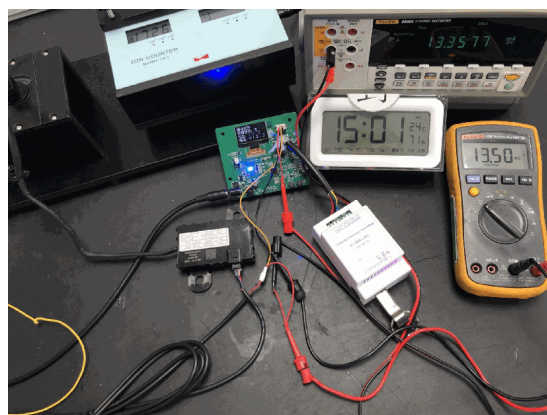


Figure 4 Functional check after 100 cycles.

Original Chamber Process Record



Figure 5 Original controller photograph showing the repeated hot/cold history.

Checks and Acceptance

Current: working current ≤ 100 mA.
LIN: no message errors or faults.
Ion output: > 20 million ions/cm³.
Appearance: no abnormality.
Shake check: no abnormal internal sound.
Overall result: all six samples passed.

Test Basis and Equipment

Q/MAT 5502-2023, 9.7.
 KVTs-415T-TL thermal-shock chamber; NKMH-103 ion counter;
 PROVA AVM-07 anemometer.
 Leg6 pp. 16-23. Test dates: 28 June-3 July 2025. Testing:
 MAXMAC laboratory.
 Version 1.0: 26 October 2026.