

High- and Low-Temperature Operation Testing

Preface

MAXMAC operates ion modules under defined cold and hot conditions and records their functional and physical condition. Each stage combines powered operation, a temperature record, natural recovery to room temperature and functional inspection.

Six samples, 25#-30#, completed $-40\text{ }^{\circ}\text{C}$ and $+85\text{ }^{\circ}\text{C}$ operating stages, each lasting 48 hours in working mode 3.2. Both stages received a passing judgment. This note links the setup, operating sequence, original curves and sample photographs to the recorded results.

Operating Conditions

Parameter	Cold operation	Hot operation
Temperature	$-40 \pm 2\text{ }^{\circ}\text{C}$	$+85 \pm 2\text{ }^{\circ}\text{C}$
Hold time	48 hours	48 hours
Module state	Powered; mode 3.2	Powered; mode 3.2
Samples	25#-30#; 6 pcs	25#-30#; 6 pcs

Cold and Hot Operating Sequences

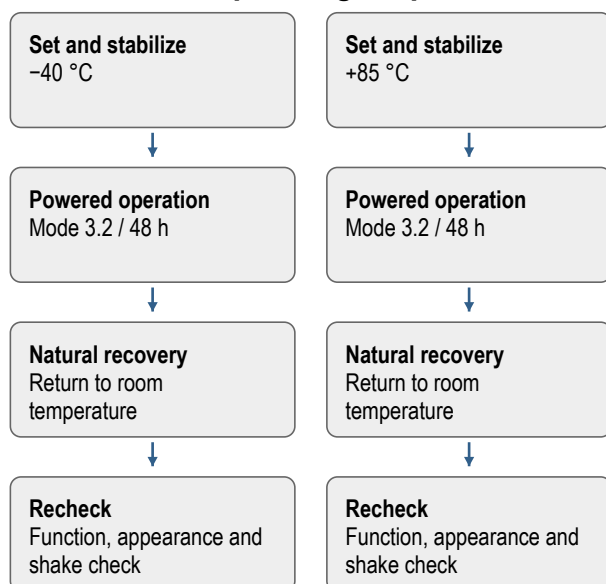
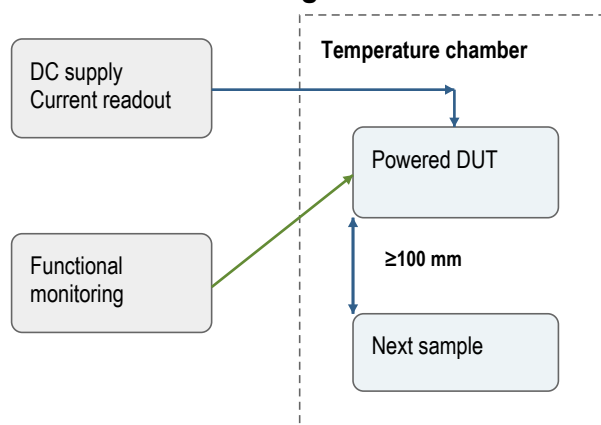


Figure 1 Cold and hot operating stages, each with its own 48-hour hold and recovery sequence.

Cold-stage ion output: stand for more than 2 hours and allow condensation to evaporate before ion-output measurement.

Powered Test Arrangement



Also $\geq 100\text{ mm}$ from chamber walls

Figure 2 Powered module connections and specified sample clearances.

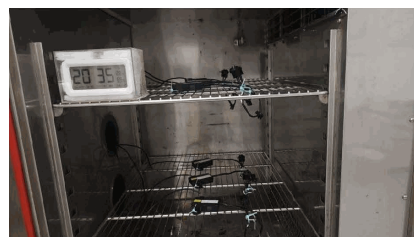


Figure 3 Original cold-stage chamber setup.



Figure 4 Original hot-stage chamber setup.

Temperature Records and Function Checks

Cold Operation: -40 °C / 48 h

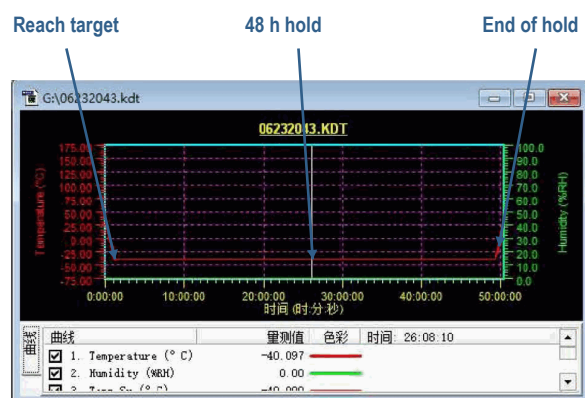


Figure 5 Original cold-stage temperature curve.

The plot records temperature against elapsed time. The marked stages identify reaching the test condition, the 48-hour hold and the end of temperature exposure.

Hot Operation: +85 °C / 48 h

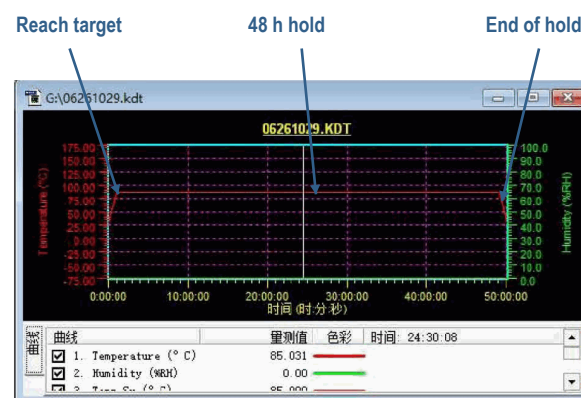


Figure 6 Original hot-stage temperature curve.

The plot records temperature against elapsed time. The marked stages identify reaching the test condition, the 48-hour hold and the end of temperature exposure.

Sample 25#: Function Check

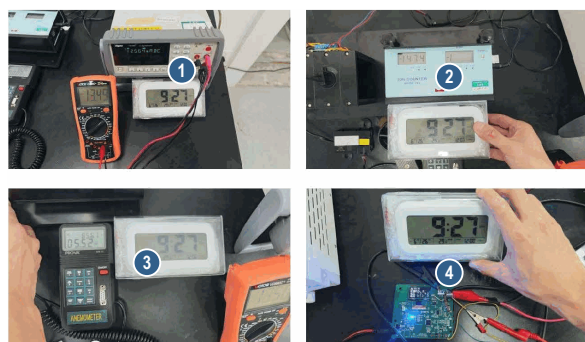


Figure 7 Sample 25#, cold-stage function record.

1 Supply / current-check instruments; 2 ion counter; 3 air-speed meter; 4 functional monitoring. The clock records time and ambient conditions.

Sample 25#: Function Check



Figure 8 Sample 25#, hot-stage function record.

1 Supply / current-check instruments; 2 ion counter; 3 air-speed meter; 4 functional monitoring. The clock records time and ambient conditions.

Acceptance Requirements and Recorded Observations

Check	Requirement	Recorded result / evidence
Function and current	Class A; $I \leq 0.1 \text{ A} = 100 \text{ mA}$	Class A; Pass. Function-check records: Figures 7-8.
Ion-generation function	Normal ion-generation function	Recorded as meeting the functional requirement.
Appearance	No damage or abnormality	No abnormality recorded.
Shake check	No abnormal internal sound	No abnormal internal sound recorded.

Table 1 Both the cold and hot operating stages received a passing judgment for samples 25#-30#.

Sample Photographs and Result Traceability

The source record identifies each module individually. The photographs below align the same sample across the cold and hot operating test records.

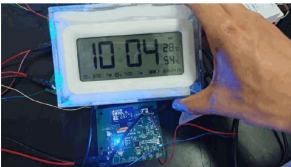
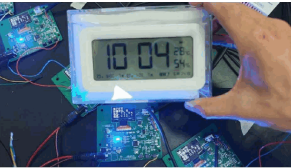
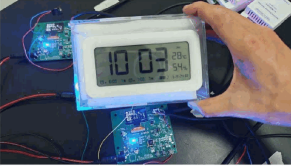
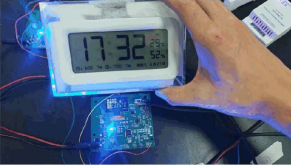
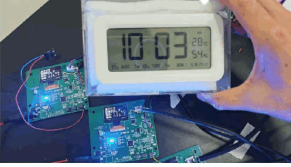
Sample	Cold-operation record	Hot-operation record	Source pages
25#			Cold: p. 58 Hot: p. 69
26#			Cold: p. 58 Hot: p. 69
27#			Cold: p. 59 Hot: p. 70
28#			Cold: p. 59 Hot: p. 70
29#			Cold: p. 59 Hot: p. 70
30#			Cold: p. 60 Hot: p. 71

Figure 9 Original individual module photographs, indexed by sample and test stage.

Recorded Test Results

All six modules met the Class A requirement for both operating stages. Appearance checks recorded no abnormality; shaking produced no abnormal internal sound. The completed tests were judged **Pass**.

Test Basis and Records

Cold: **Q/MAT 5502-2023, 9.2.3.**

Hot: **Q/MAT 5502-2023, 9.3.2.**

Source: MAXMAC Leg3, cold pp. 53-63; hot pp. 64-74. Testing: Zhejiang Kezheng Electronic Information Product Inspection Co., Ltd.

Revision 1.1: 26 October 2026. Added setup and stage diagrams, curve annotations, sample evidence and check-to-result references.

Temperature Alternation Testing

Preface

MAXMAC tests ion-module function during repeated changes between cold and hot conditions. The method combines a defined temperature profile, specified powered check periods, natural room-temperature recovery and final functional inspection.

Samples 25#-30# completed 30 programmed cycles between -40°C and $+85^{\circ}\text{C}$. The recorded result met Class A, with no abnormal appearance or internal sound during shaking. This section presents the method and original process evidence.

Test Conditions

Parameter	Specified condition
Temperature limits	-40°C / $+85^{\circ}\text{C}$
Cycle count	30
Modes	3.1 / 3.2
Sample count	6 modules; 25#-30#
Clearance	≥ 100 mm between samples and from chamber walls

Time-Temperature Program

Time (min)	Temperature ($^{\circ}\text{C}$)
0	20
60	-40
150	-40
210	20
300	85
410	85
480	20

Table A1 One prescribed cycle, source p. 75.

Program calculations:

$480 \text{ min} / 60 = 8 \text{ h per cycle}$.

$30 \times 8 \text{ h} = 240 \text{ h}$.

Cold hold: $150 - 60 = 90 \text{ min}$.

Hot hold: $410 - 300 = 110 \text{ min}$.

Chamber Arrangement



Figure A1 Original sample arrangement for temperature alternation.

Operating and Check Sequence

1. Load the prescribed temperature sequence and repeat it for 30 cycles.
2. After the module temperature stabilizes at -40°C , briefly power the DUT in mode 3.2, check function and disconnect power immediately afterward.
3. Power the DUT again during the interval from 210 to 400 minutes in the programmed cycle.
4. After the program, allow natural recovery to room temperature and check function.

Ion-output measurement after cold exposure: stand for more than 2 hours and allow condensation to evaporate before measuring.

Test basis: Q/MAT 5502-2023, 9.6.

Dates: 30 June-10 July 2025.

Record: Leg3 pp. 75-86.

Temperature Alternation: Process Records and Results

Original Chamber Temperature Record

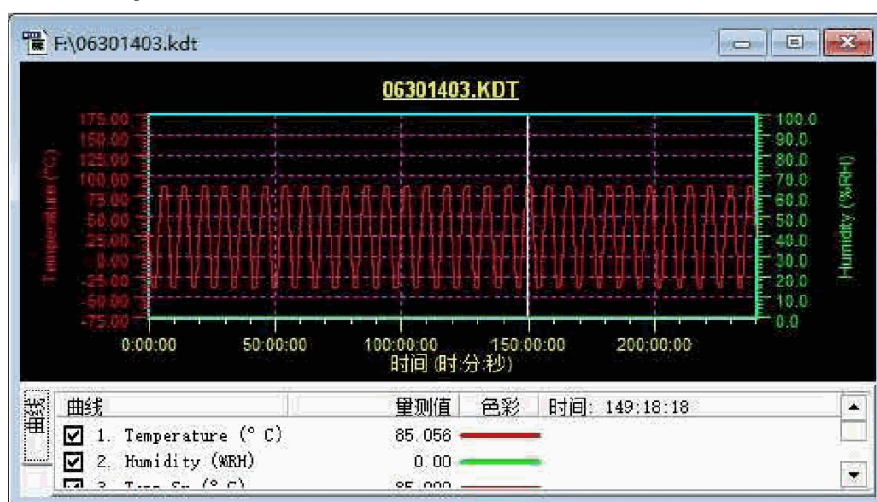


Figure A2 Original temperature curve for the repeated cold/hot program, source p. 86.

Sample 25#: During the Program



Figure A3 Original in-test functional monitoring photograph, source p. 81.

Sample 25#: After the Program



Figure A4 Original final check photographs, source p. 83.

Requirements and Recorded Observations

Check	Specified requirement	Recorded result
Functional status	Class A; working current ≤ 0.1 A; normal function and ion generation	Meets Class A.
Appearance	No damage	No abnormality recorded.
Shake check	No abnormal internal sound	No abnormal internal sound recorded.
Overall judgment	All six samples meet the requirements	Pass; 25#-30#.

Table A2 Requirements from source p. 75 and observations / conclusion from pp. 80 and 86.

Records and equipment: Leg3 pp. 75-86. KTHE-715TBS chamber; TY3060A DC supplies; TH1941 and VC890C meters. Testing performed by Zhejiang Kezheng Electronic Information Product Inspection Co., Ltd.

Temperature Gradient Testing

Preface

MAXMAC checks module function across a stepped temperature program. The chamber progresses from room temperature to the cold limit, then to the hot limit and back to room temperature. Functional checks are performed near the end of each temperature hold.

Samples 31#-36# completed one temperature-gradient cycle using nominal 5 °C steps, a 1 °C/min change rate and 30-minute holds. The test received a Pass judgment. Original chamber, supply and functional photographs accompany the recorded result.

Test Conditions

Parameter	Specified condition
Starting / final temperature	23 °C
Cold / hot limits	-40 °C / +85 °C
Nominal step size	5 °C
Temperature-change rate	1 °C/min
Hold at each step	30 min
Program count	1 cycle
Modes	3.1 / 3.2
Recorded test voltages	9 V / 16 V
Samples	6 modules; 31#-36#

Temperature Sequence

23 °C → -40 °C → +85 °C → 23 °C

At the end of each temperature step, briefly use **mode 3.2** to check function. After completion, allow natural recovery to room temperature and perform the final functional inspection.

Before ion-output measurement after cold exposure: stand for more than 2 hours and allow condensation to evaporate.

Original Test Arrangement

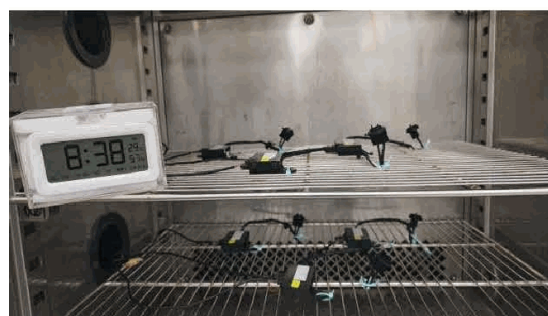


Figure B1 Original chamber arrangement.



Figure B2 Original supply / monitoring arrangement.

Test Steps

1. Arrange the modules with ≥100 mm between samples and from chamber walls.
2. Set the chamber for the specified stepped cold-to-hot sequence.
3. Use 30-minute holds and check function near the end of each step.
4. Complete the cycle, recover to room temperature and perform the final checks.

Test basis: Q/MAT 5502-2023, 9.4.

Dates: 25-28 June 2025.

Record: Leg4 pp. 50-64.

Temperature Gradient: Curves and Functional Checks

Original Temperature Record: 9 V

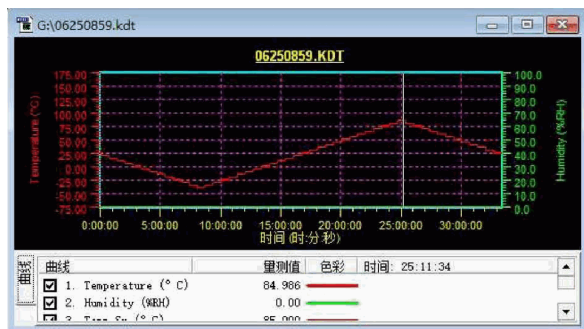


Figure B3 Original curve, source p. 63.

Original Temperature Record: 16 V

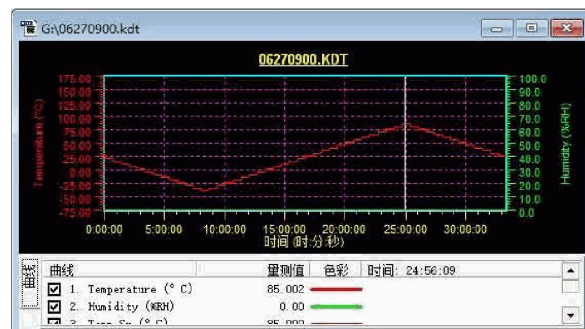
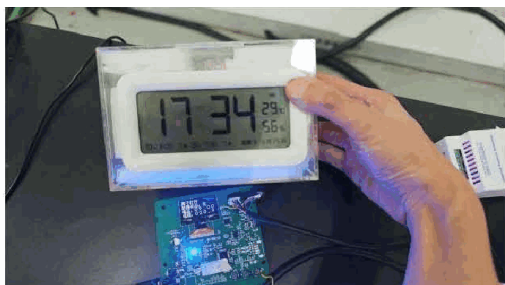


Figure B4 Original curve, source p. 64.

Sample 31#: Checks during the Test



Cold-end functional photograph: -40°C / 9 V, source p. 54.



Hot-end functional photograph: $+85^{\circ}\text{C}$ / 16 V, source p. 58.

Figure B5 Original sample 31# monitoring photographs from the cold and hot test records.

Sample 31#: Final Functional Check



Figure B6 Original post-test check photographs, source pp. 60-61. Air-speed meter and ion counter above; module monitoring and electrical instruments below.

Recorded Results

Check	Recorded result
Functional status	Class A; normal function and ion generation.
Appearance	No abnormality.
Shake check	No abnormal internal sound.
Overall judgment	Pass; samples 31#-36#.

Records: Leg4 pp. 50-64. Final conclusion: p. 64.

Equipment: KTHE-715TBS chamber, TY3060A supplies, TH1941 / VC890C meters.

Testing: Zhejiang Kezheng Electronic Information Product Inspection Co., Ltd.