

Protocol

of environmental tests of the module TB-127-1,4-1,15 (ICE-71)(139°C) 40x44 mm.

Purpose of test: reliability test of modules made by the approved technology.

Place of carrying out: Kryotherm company.

Period of carting out: 23.05.07-19.19.07.

Testing object: thermoelectric module TB-127-1.4-1.15(139°C).

Tests content:

1. High temperature storage +85°C, time-170 hours;
2. Low temperature storage -40°C, time-170 hours;
3. Temperature cycling: (-50±2)°C – (+45±2)°C, number of cycles – 3, time of isolation – 2 hours in the each chamber, time of transfer less than 5 min.. The test carry out by method 205-1, GOST 20.57.406;
4. The isolation in the humidity chamber: RH=(98±2)%, T=(+25±2)°C, t=48 hours. The test carry out by method 207-2, degree of rigidity – 1;
5. Temperature cycling: - 40°C - +85°C, number of cycles – 25, time of isolation – 30 minutes in the each chamber.

Tests method:

1. Tests carry out in the heat chamber STBV- 1000 and the environmental chamber 3522/51;
2. Control parameters: resistance R and figure of merit Z;
3. Measuring equipment – the automated complex AK;
4. The control method – Harman method;
5. Accuracy of dimensions +/- 1,0 %;
6. Index of successful tests – changing of R or Z less or equal 2%.

Table №1

	TEC parameters before tests		High temperature storage +85°C, time-170 hours.				Low temperature storage -40°C, time-170 hours.				Temperature cycling: -50–+45C, number of cycles – 3, time of isolation – 2 hours in the each chamber, time of transfer less than 5 min..			
№	Zx10 ⁻³ , 1/°C	R,Om	Zx10 ⁻³ , 1/°C	Rx10 ⁻³ , 1/°C	ΔZ/Z, %	ΔR/R, %	Zx10 ⁻³ , 1/°C	R,Om	ΔZ/Z, %	ΔR/R, %	Zx10 ⁻³ , 1/°C	R,Om	ΔZ/Z, %	ΔR/R, %
1	2.589	1.542	2.585	1.534	-0.15	-0.52	2.577	1.543	-0.5	0.06	2.575	1.546	-0.54	0.26
2	2.578	1.510	2.549	1.496	-1.1	-0.9	2.540	1.506	-1.5	-0.3	2.541	1.510	-1.43	0.0
3	2.607	1.536	2.603	1.528	-0.15	-0.5	2.595	1.537	-0.5	0.07	2.596	1.539	-0.42	0.19
4	2.574	1.580	2.551	1.548	-0.9	-2.0	2.549	1.555	-0.97	-1.6	2.543	1.561	-1.2	-1.2
5	2.594	1.540	2.569	1.539	-0.96	-0.06	2.563	1.546	-1.2	0.4	2.564	1.548	-1.2	0.52
6	2.584	1.567	2.580	1.552	-0.15	-0.96	2.564	1.565	-0.8	-0.13	2.567	1.569	-0.66	0.13

Table №2

	The isolation in the humidity chamber: RH=98%, T=+25°C, t=48hours.				Temperature cycling: - 40°C - +85°C , number of cycles – 25, time of isolation – 30 minutes in the each chamber.				The isolation in the humidity chamber: RH=95%, T=+70°C, t=170hours.			
№	Zx10 ⁻³ , 1/°C	R,Om.	ΔZ/Z, %	ΔR/R, %	Zx10 ⁻³ , 1/°C	R,Om	ΔZ/Z, %	ΔR/R, %	Zx10 ⁻³ , 1/°C	R,Om	ΔZ/Z, %	ΔR/R, %
1	2.574	1.540	-0.6	-0.1	2.569	1.570	-0.8	1.8	2.569	1.591	-0.8	3.2
2	2.537	1.512	-1.6	0.1	2.537	1.526	-1.0	3.0	2.544	1.584	-1.3	4.9
3	2.600	1.535	-0.3	-0.06	2.590	1.567	-0.7	2.0	2.595	1.584	-0.5	3.1
4	2.549	1.560	-0.97	-1.3	2.554	1.584	-0.8	0.25	2.557	1.629	-0.7	2.8
5	2.570	1.545	-0.9	0.3	2.564	1.577	-1.2	2.4	2.572	1.610	-0.8	2.1
6	2.570	1.565	-0.5	-0.1	2.560	1.602	-0.9	2.2	2.565	1.625	-0.7	1.4

Conclusion: After test's figure of merit Z remained inside of the allowed measurement accuracy limits. Resistance of some TECs increased that considered to be connected with TEC's aging and not with TECs quality decrease because the corresponded Z did not decrease. The tests results were approved successful.