

Protocol

of environmental tests of the module TB-199-1.4-0.8 (Drift-0.8)HT.

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

Place of carrying out: Kryotherm company.

Period of carting out: 23.05.07-19.09.07.

Testing object: thermoelectric module TB-199-1.4-0.8HT.

Tests content:

1. High temperature storage $+85^{\circ}\text{C}$, time-170 hours;
2. Low temperature storage -40°C , time-170 hours;
3. Temperature cycling: $(-50\pm 2)^{\circ}\text{C}$ – $(+45\pm 2)^{\circ}\text{C}$, 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: $\text{RH}=(98\pm 2)\%$, $T=(+25\pm 2)^{\circ}\text{C}$, $t=48$ hours. The test carry out by method 207-2, degree of rigidity – 1;
5. Temperature cycling: -40°C - $+85^{\circ}\text{C}$, 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 $\pm 1,0\%$;
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	2,626	1,522	2,635	1,530	0,34	0,52	2,622	1,532	-0,15	0,66	2,623	1,533	-0,1	0,7
2	2,622	1,505	2,626	1,516	0,15	0,73	2,622	1,515	0,0	0,66	2,622	1,517	0,0	0,8
3	2,596	1,518	2,603	1,527	0,27	0,59	2,596	1,527	0,0	0,6	2,593	1,528	-0,1	0,6
4	2,629	1,513	2,627	1,526	-0,08	0,86	2,621	1,526	-0,3	0,86	2,622	1,525	-0,3	0,8
5	2,628	1,542	2,636	1,551	0,3	0,58	2,631	1,550	0,1	0,5	2,629	1,552	-0,04	0,6
6	2,640	1,506	2,645	1,517	-0,1	0,73	6,633	1,519	-0,27	0,9	2,634	1,520	-0,2	0,9

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	2,623	1,531	-0,1	0,6	2,621	1,533	-0,2	0,7,	2,625	1,544	-0,03	1,4
2	2,621	1,516	-0,04	0,7	2,618	1,516	-0,2	0,7	2,625	1,527	0,1	1,5
3	2,597	1,526	0,04	0,5	2,594	1,527	-0,1	0,6	2,599	1,538	0,1	1,3
4	2,625	1,524	-1,5	0,7	2,626	1,523	-0,1	0,7	2,633	1,534	0,15	1,4
5	2,624	1,553	-0,2	0,7	2,627	1,551	-0,04	0,6	2,633	1,562	0,2	1,3
6	2,643	1,515	0,1	0,6	2,640	1,517	0,0	0,7	2,640	1,530	0,0	1,6

Conclusion: After test's figure of merit Z remained inside of the allowed measurement accuracy limits. Resistance of some TECs increased but stand inside of limits of measurement accuracy. The tests results were approved successful.