ThermoElectric Cooling (TEC)

Detector cooling reduces noise, increases responsivity and, in some devices, improves high frequency response. Two-, three- and four-stage TE coolers are available. TEC is biased with DC power. All specifications are given for 300 K heat sink temperature.

TEC are characterized by:

Maximum Temperature Difference: ΔT_{max}

ΔT_{max} rated at Q=0, at other Q the ΔT should be estimated as $\Delta T = \Delta T_{max}(1 - Q/Q_{max})$.

Optimum Current: I_{opt}

Supply current giving the highest temperature difference (ΔT_{max}) at the specified conditions stated in Detector Final Test Report.

Maximum TEC Voltage: V_{max}

Voltage drop at ΔT_{max}.

Maximum Heat Pumping Capacity: Q_{max}

Q_{max} rated at ΔT=0, at other ΔT cooling capacity should be estimated as $Q = Q_{max}(1 - \Delta T/\Delta T_{max})$

Standard TEC Parameters

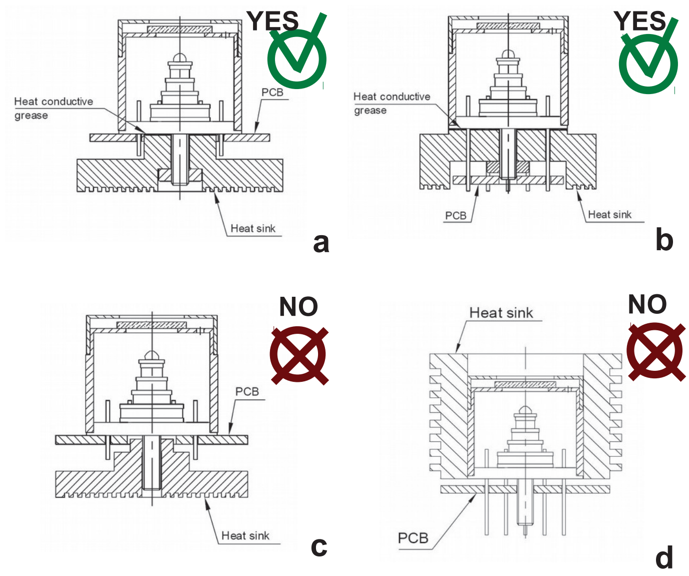
Parameter	Unit	2TE	3TE	4TE
T_{det}	K	~230	~210	~195
V_{max}	V	1.3	3.6	8.3
I_{max}	A	1.2	0.45	0.5
Q_{max}	W	0.36	0.27	0.28
ΔT_{max}	K	92	114	125

Temperature Sensor

The built-in thermistor serves as a sensor of the detector operation temperature. TE-cooled detectors are equipped with thermistor type **NCP03XM222E05RL** as a standard.

Heat Sinking

Suitable heat sinking is necessary to dissipate heat generated by the Peltier cooler or excessive optical irradiation. Since heat is almost 100% dissipated at the base of the detector housing, it must be firmly attached to the heat sink (Figures a and b). Heat sinking via the mounting screw or via the detector housing cylindrical walls is not sufficient (Figures c and d). A thin layer of heat conductive epoxy or silicone grease should be applied to improve thermal contact between detector housing and heat sink.
A heat sink thermal resistance of ~2 K/W is typically required for the most two- and three-stage Peltier coolers. Four-stage cooler requires ~1 K/W.



Figures. Heat dissipation from TE-cooled detector

ThermoElectric Cooler Controllers (TECC)

VIGO System offers the standard TEC controller STCC-04, the miniature TEC controller MTCC-01 and programmable “smart” TEC controllers PTCC-01 (available options: OEM, Basic and Advanced).

Temperature Sensor Inputs

Temperature sensor pins – might be connected with any polarity.

TEC Supply Input (+) and (-)

Supply polarity for the TEC. Those pins are floating, which means they are not connected to the GND.

Maximum TEC Controller Output Current: I_{TEC}

Maximum current that is provided by the controller to the TEC.

Maximum TEC Controller Output Voltage: V_{TEC}

Maximum voltage that is provided by the controller to the TEC.

Ripple of Output Current

It is a small unwanted residual periodic variation of the DC (direct current) output of a power supply (or other device) which has been derived from an AC (alternating current) source. This ripple is due to incomplete suppression of the rectified DC waveform within the power supply.

Output Current of the Built-In Power Supply

Maximum current that can be delivered by power supply to the preamplifier, usually +/-100 mA.

Series Resistance of the Connecting Cable

Material parameter - resistance of the supply cable. It depends on cable length.

Settling Time of the Set Detector Temperature

The time taken by the cooling system to reach appropriate temperature of the detector.

Maximum Voltage Across TEC Element

Maximum voltage for TEC supplying.

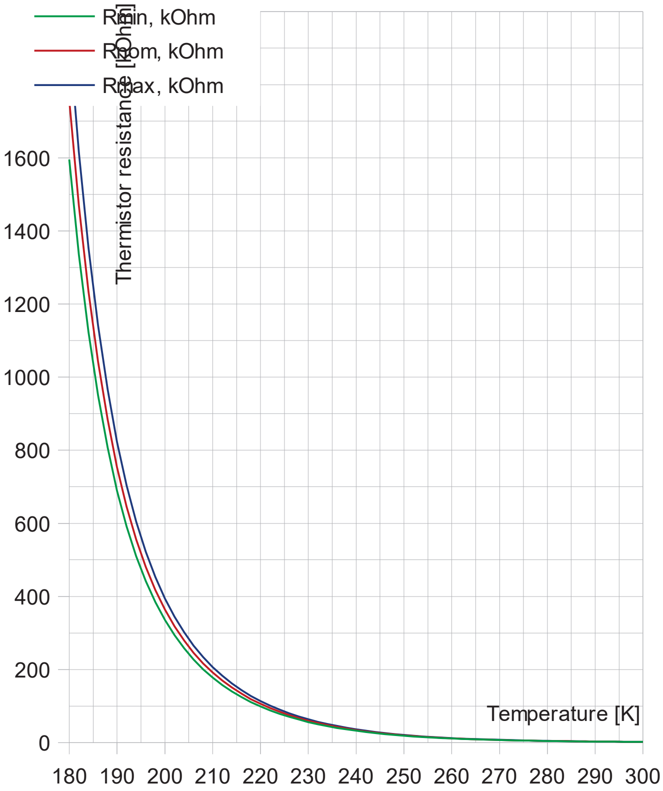
NCP03XM222E05RL Thermistor Characteristic

The electricity applied to between terminals of thermistors should be under the maximum power dissipation at 25 °C (100 mW) not to destroy the thermosensor. For the measurement of resistance, the power should not exceed 1 mW.
The relation between the resistance and the temperature:

$$R_T = R_{T0} \cdot \exp\left(\beta \cdot \frac{T_0 - T}{T \cdot T_0}\right)$$

Values for NCP03XM222E05RL thermistor:

- R_{T0} = 2.2 kΩ ± 3% at T_0 = 298 K;



T [K]	T [°C]	Rmin [kΩ]	Rnom [kΩ]	Rmax [kΩ]
180	-93	1594,97	1757,95	1935,84
182	-91	1336,02	1469,90	1615,75
184	-89	1124,16	1234,66	1354,81
186	-87	950,46	1042,11	1141,58
188	-85	807,57	883,99	966,78
190	-83	689,57	753,62	822,88
192	-81	591,68	645,64	703,89
194	-79	510,07	555,75	604,98
196	-77	441,68	480,54	522,34
198	-75	384,05	417,25	452,91
200	-73	335,23	363,71	394,26
202	-71	293,65	318,17	344,43
204	-69	258,05	279,23	301,88
206	-67	227,41	245,76	265,36
208	-65	200,91	216,85	233,85
210	-63	177,89	191,77	206,55

Resistance vs Temperature for NCP03XM222E05RL Thermistor

T [K]	T [°C]	Rmin [kΩ]	Rnom [kΩ]	Rmax [kΩ]
212	-61	157,81	169,92	182,79
214	-59	140,22	150,80	162,03
216	-57	124,76	134,02	143,83
218	-55	111,14	119,25	127,83
220	-53	99,10	106,21	113,72
222	-51	88,44	94,67	101,25
224	-49	78,98	84,44	90,21
226	-47	70,57	75,37	80,42
228	-45	63,09	67,30	71,73
230	-43	56,42	60,12	64,01
232	-41	50,49	53,74	57,15
234	-39	45,19	48,05	51,04
236	-37	40,47	42,98	45,61
238	-35	36,26	38,47	40,77
240	-33	32,51	34,45	36,47
242	-31	29,16	30,87	32,64
244	-29	26,18	27,68	29,24
246	-27	23,51	24,84	26,21
248	-25	21,14	22,30	23,51
250	-23	19,02	20,05	21,11
252	-21	17,13	18,04	18,98
254	-19	15,45	16,25	17,07
256	-17	13,95	14,65	15,38
258	-15	12,61	13,23	13,87
260	-13	11,41	11,96	12,53
262	-11	10,34	10,83	11,33
264	-9	9,38	9,82	10,26
266	-7	8,52	8,91	9,31
268	-5	7,75	8,10	8,45
270	-3	7,07	7,37	7,69
272	-1	6,45	6,72	7,00
274	1	5,89	6,13	6,38
276	3	5,38	5,60	5,83
278	5	4,93	5,13	5,32
280	7	4,52	4,69	4,87
282	9	4,15	4,30	4,46
284	11	3,81	3,95	4,09
286	13	3,50	3,63	3,75
288	15	3,22	3,33	3,45
290	17	2,96	3,06	3,17
292	19	2,73	2,82	2,91
294	21	2,51	2,59	2,68
296	23	2,32	2,39	2,46
298	25	2,13	2,20	2,27