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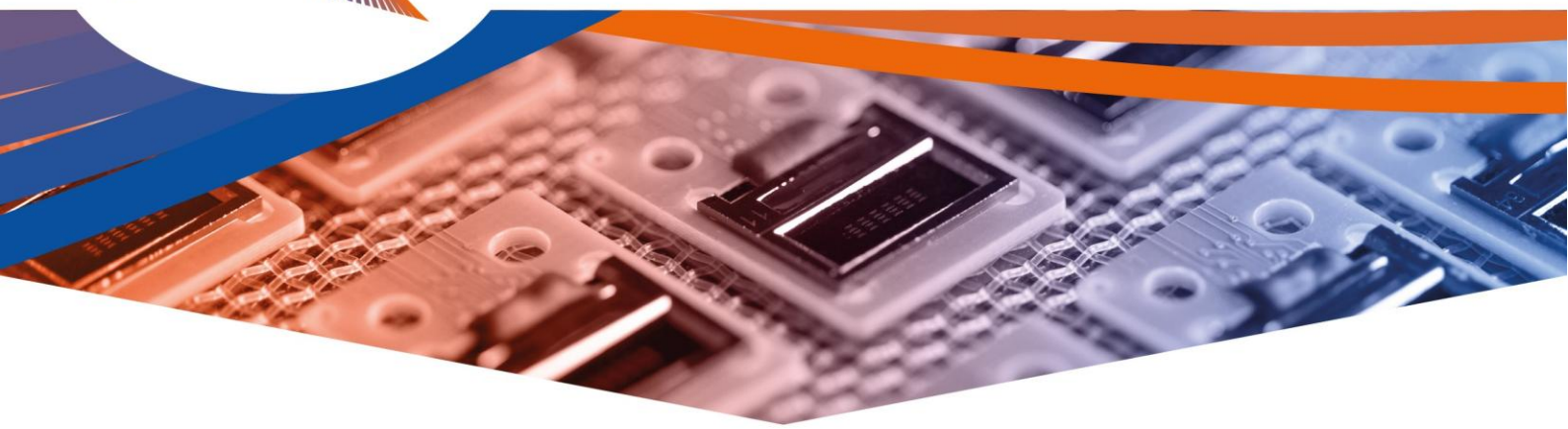
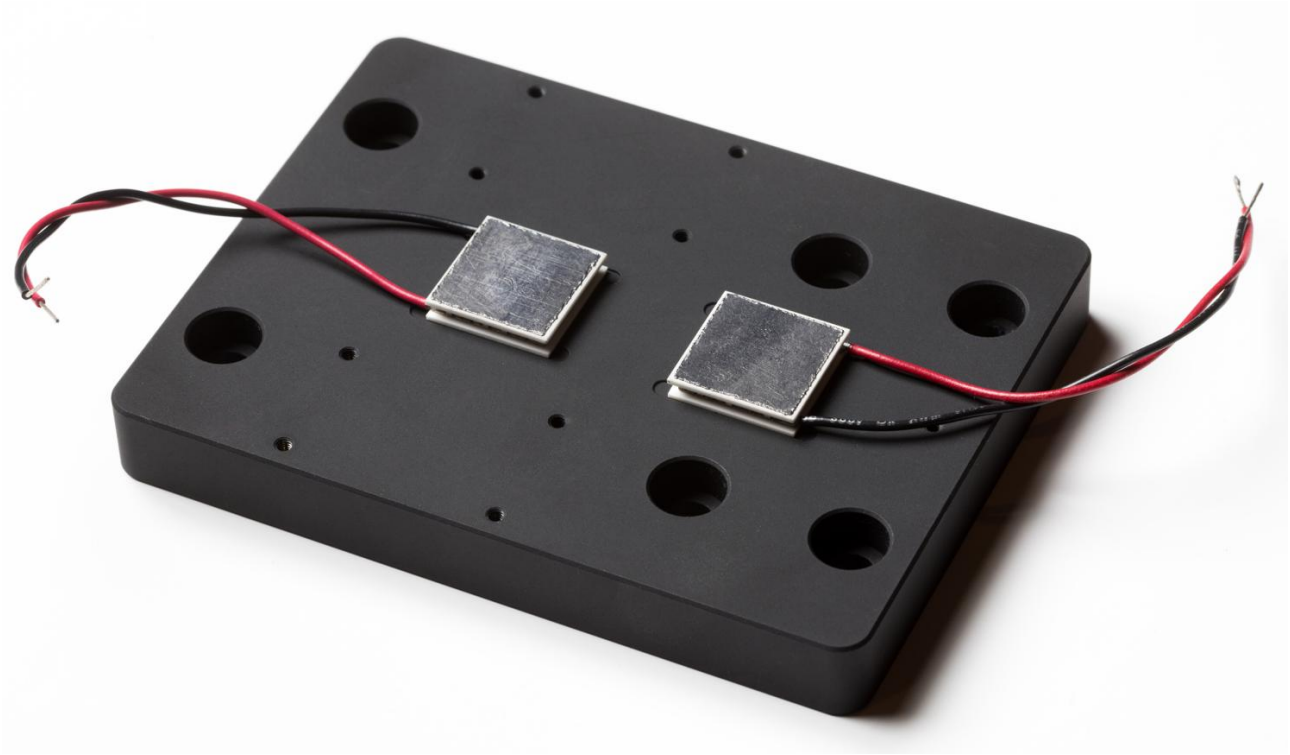


PHIX Cooling Carrier XL – User Manual

The PHIX Cooling Carrier XL is an optional add-on to the PHIX RF Characterization Package. It consists of two thermoelectric coolers (TEC) on a mounting base suitable for easy connection to an optical table or heatsink. The unit provides cooling to the packaged photonic integrated circuit (PIC) and, in combination with a thermistor and TEC controller, it allows the PIC to be kept at a constant temperature.



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1 Key features

- Works in conjunction with the PHIX RF Characterization Package and its integrated thermistor.
- Mounting base with 50 mm hole pattern for mounting on optical baseplates.
- Durable thermal interface pad suitable for replacing the PHIX RF Characterization Package connected to the Cooling Carrier.
- Two powerful TECs for up to 20W of continuous cooling power at a convenient 10V operation (4A). PHIX advises connecting the TECs in series. Please see more details on how to properly connect them in section 3.3.
- The PHIX Cooling Carrier XL is also compatible with the DC-only PHIX Characterization Package.

2 Mounting base

The dimensions of the aluminum cooling carrier XL are shown in figure 1 below. It is supplied with 6x M2.5 screws for mounting the PHIX RF Characterization package.

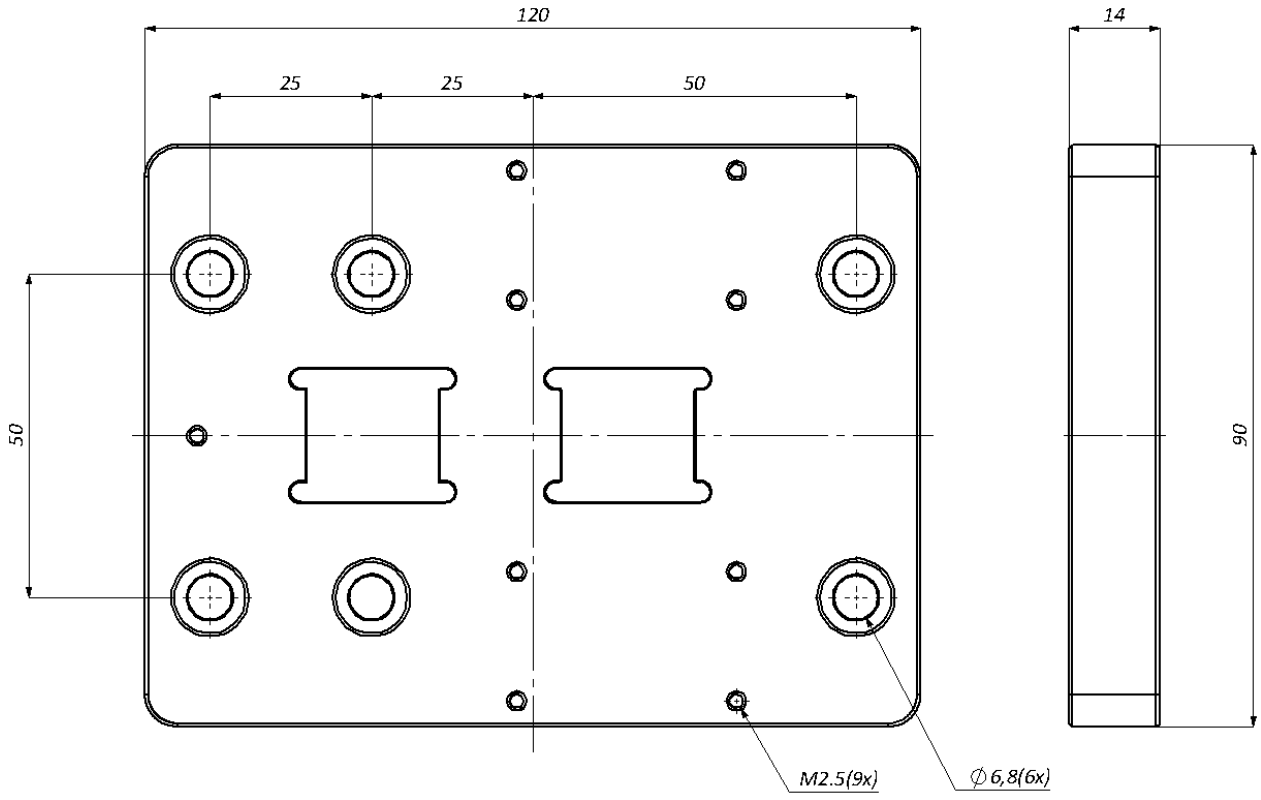

Figure 1: PHIX Cooling Carrier XL mounting base dimensions

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3 Thermoelectric coolers (TECs)

3.1 TEC specifications

The cold side of the thermoelectric coolers (TECs) can be identified as the side with markings on it. This is also the side where the thermal interface pad is applied. The red wire is the positive pole for cooling and the blue or black wire is the negative pole. If heating is required, the polarity can simply be reversed.

Parameters			**Remarks**
Internal Resistance	1.05Ω ±10%		Measured by AC 4-terminal method at 25°C
I_{max}	6A		Maximum current at T_{max}
V_{max}	8.8V		Maximum voltage at T_{max}
-	T_{hot} = 27°C	T_{hot} = 50°C	-
Q_{max}	27.9W	32.7W	Max. cooling capacity at I_{max}, V_{max} and ΔT = 0°C
ΔT_{max}	70°C	77°C	Max. temperature difference at I_{max}, V_{max} and Q = 0 W (Max. parameters are measured in a vacuum 1.3 P)
Solder melting point	235°C		This is the solder melting point of the thermoelectric module
Max. compression	1MPa		Recommended maximum compression (not the destruction limit)
Operating temperature	-40°C to +100°C		

3.2 TEC recommendations

- Take care in handling, because dropping the unit or exerting mechanical shock will cause breakage.
- For optimal reliability and performance it is recommended that the module be utilized at < $0.7 \cdot I_{max}$.
- For proper cooling performance the aluminum base needs to be mounted onto a heatsinking structure. This could be an optical table or dedicated heatsink with optional fan.
- Suggested TEC controllers:
  - 12W, Thorlabs TED200C (10k Ohm NTC, -45 to 145°C)
  - 4W, Thorlabs TTC001 (10k Ohm NTC, -45 to 125°C)
  - 18W, Thorlabs PTC1 (10k Ohm NTC, 5 to 45°C)
- More info about TEC controllers can be found at: https://www.laserdiodecontrol.com/tec-controller-basics

3.3 TEC connection in series

To ensure homogenous heat control and reliable mechanical support over the large copper mount, PHIX advises connecting the two supplied TECs in series with each other before plugging them in to the TEC controller. Connecting TECs in series is a method to increase the total voltage requirement (doubled compared to a single TEC) while maintaining the same current through each TEC.

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Follow these steps to connect the TECs in series:

1. Identify the terminals:
   Each TEC has two terminals, one positive and one negative.
   - The positive terminal is typically marked or colored red.
   - The negative terminal is typically marked or colored black.
2. Connect the TECs:
   - Connect the negative terminal of the first TEC to the positive terminal of the second TEC.
3. Power supply connection:
   - Once all the TECs are connected, connect the positive terminal of the first TEC to the positive output of the power supply.
   - Connect the negative terminal of the last TEC in the chain to the negative output of the power supply.
4. Ensure current capacity:
   The power supply should provide sufficient current for the two TECs in series. The current requirement remains the same as for one TEC, but the required voltage doubles with the addition of the second TEC.

4 Thermistor

4.1 Thermistor types

For standard configurations, the PHIX Characterization Package ships with an integrated negative thermal coefficient (NTC) thermistor placed inside the gold-plated copper base.
For some of our custom packages we make use of a chip NTC, instead of the standard thermistor. This is a smaller component that can be integrated more closely or even onto the PIC.

4.2 Using the thermistor

By measuring the resistance of the thermistor, the temperature of the copper block can be derived. The relationship between temperature and resistance is defined, by approximation, by the thermistor's beta value, but is best determined from a temperature table or calculation tool. The basic characteristics of both models can be found in the table below.

	Standard thermistor	**Chip thermistor**
Model	Vishay NTCLE300E3103SB	Mitsubishi VH05 series 6D103C
Resistance at 25°C (R_{25})	10,000 Ω	10,000 Ω
Beta value	3977 K ($\beta_{25/85}$)	3930 K ($\beta_{25/50}$)
Beta value tolerance	0.75%	1%
Datasheet	Click here	Click here