Temperature Module for Heating and Cooling

Accuracy, Uniformity and Time-to-Temperature

Product Description

The Opentrons Temperature Module is an easy-to-use hot and cold plate module that is able to maintain steady state temperatures for use within the OT-2 liquid handler or as a standalone benchtop product. The module can readily be used with the Opentrons OT software app. Temperature capacity ranges from 4ºC to 95ºC and can be used with or without the Opentrons thermal blocks.

The data in this paper illustrates the accuracy, uniformity and time-to-temperature of the module along with the 1.5-mL , 2.0-mL and PCR thermal block accessories. All results were collected in real-world environments to better simulate conditions users are expected to experience in their own labs.

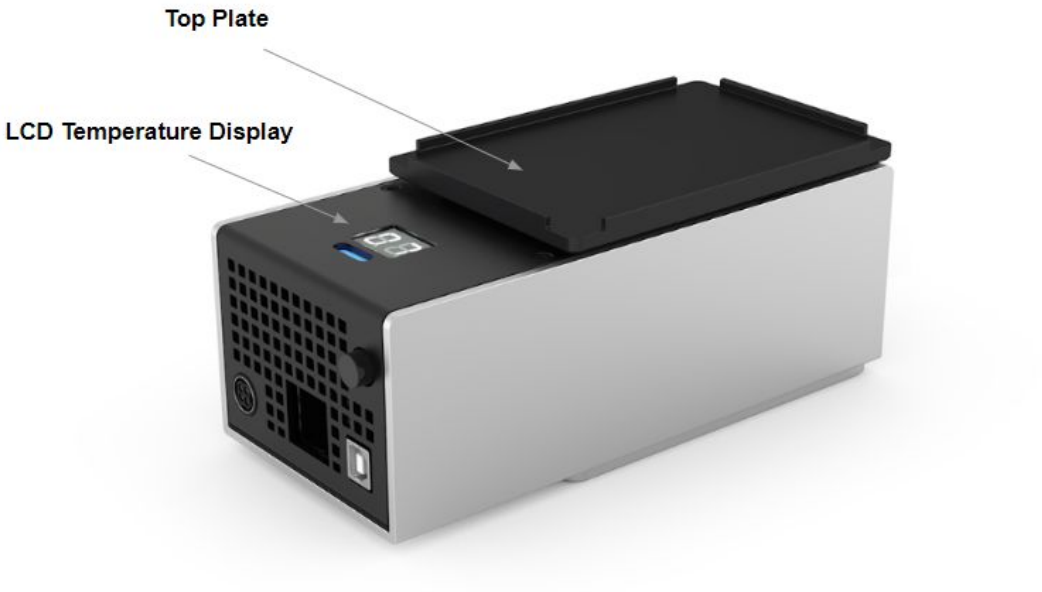
Standalone Temp Deck

Temp Deck with 1.5 - 2mL Thermal Block

Temp Deck with PCR Thermal Block

Temp Deck with Flat Plate Adapter

Standalone Temperature Module



LCD Display Temperature (C)	Top Plate Accuracy (C)	Top Plate Uniformity (C)	Time-to-Temp From Ambient (minutes)
4	± 1	± 1	4:00
37	± 1	± 0.4	1:00
65	± 1	± 1	2:00
95	± 1.5	± 2	3:00

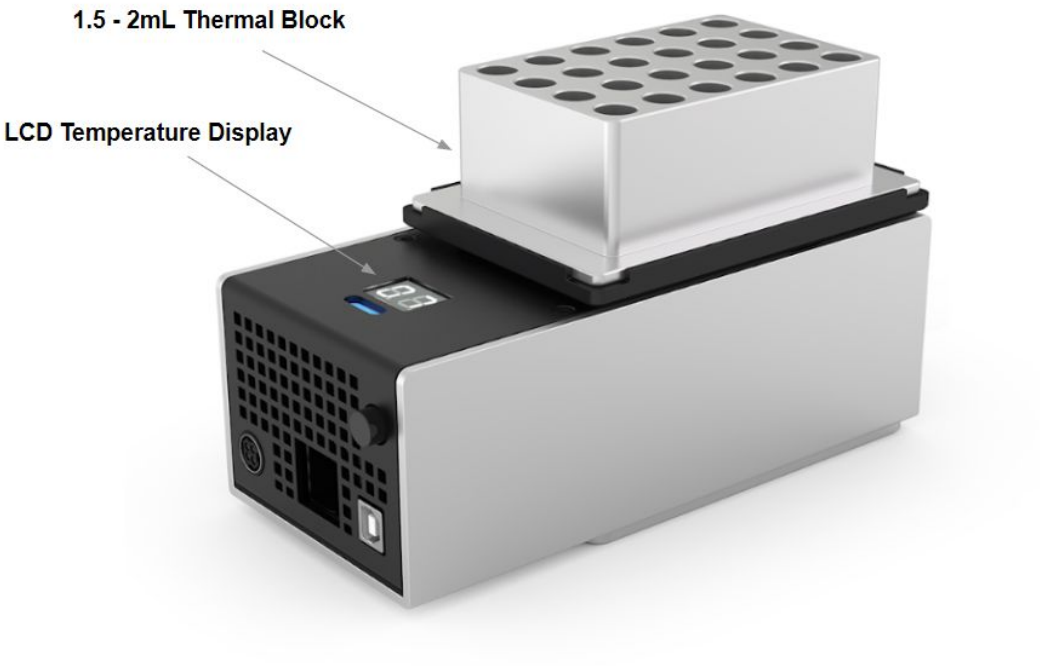
Accuracy indicates the maximum measured difference between the LCD temperature display and the average measured top plate temperature.

Uniformity indicates the temperature variation (+/-) measured across the entirety of the top plate surface.

Time-to-Temp indicates the total time for the temperature module top plate to reach the desired steady state temperature after starting from ambient conditions.

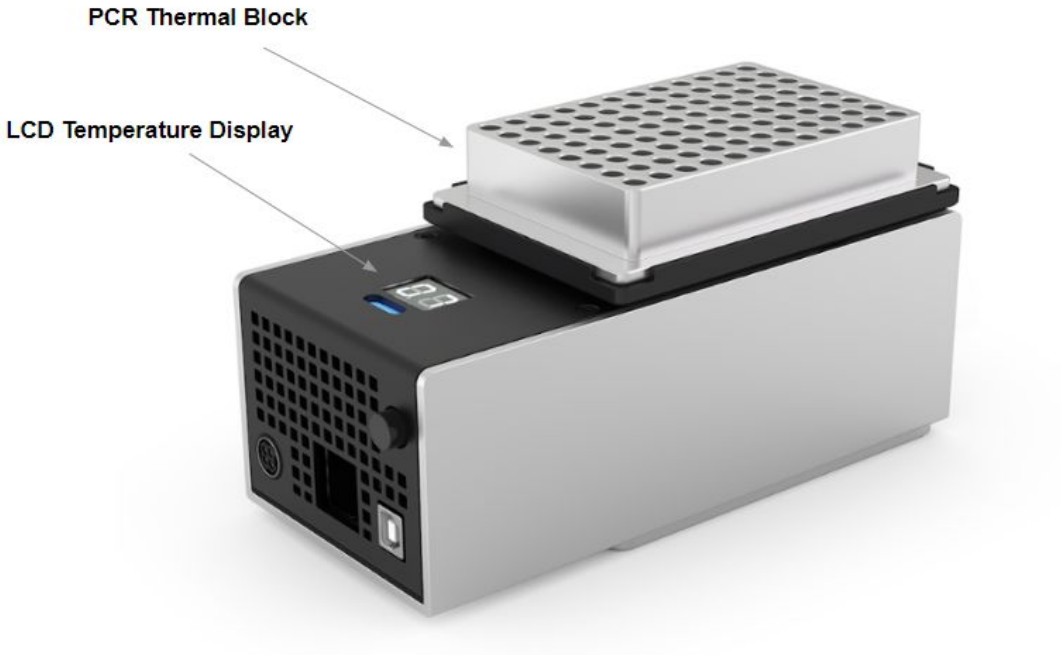
Environmental Test Conditions: Data shown was collected at 22ºC and 37% relative humidity. Different test conditions may provide for different results.

Temperature Module with Thermal Blocks



Temperature Module with 1.5 - 2mL Thermal Block

LCD Screen Temperature (C)	1.5 - 2mL Thermal Block Accuracy (C)	1.5 - 2mL Thermal Block Uniformity (C)	Time-to-Temp From Ambient (minutes)
4	± 1	± 0.2	18:00
37	± 1	± 0.1	3:00
65	± 1	± 0.2	6:00
95	± 1.5	± 0.4	9:00



Temperature Module with PCR Thermal Block

LCD Screen Temperature (C)	PCR Thermal Block Accuracy (C)	PCR Thermal Block Uniformity (C)	Time-to-Temp From Ambient (minutes)
4	± 1	± 0.2	12:00
37	± 1	± 0.1	3:00
65	± 1	± 0.2	4:00
95	± 1.5	± 0.4	8:00

Accuracy indicates the maximum measured difference between the LCD temperature display and the average measured thermal block temperature.

Uniformity indicates the +/- temperature variation measured across the throughout the thermal block wells.

Time-to-Temp indicates the total time for both the top plate and thermal block to reach the desired steady state temperature starting from ambient conditions.

Environmental Test Conditions: Data shown was collected at 22ºC and 37% relative humidity. Different test conditions may provide for different results.

Environmental Conditions and Condensation

It is recommended that **laboratory conditions be ≤ 22°C, ≤ 40% relative humidity** in order for the temperature module and its corresponding thermal blocks to reach the desired cold state temperatures near 4°C. Opentrons has not validated that the temperature module will function as desired within lab conditions of a higher temperature, humidity, or some combination of the two.

The operator may observe **condensation** on the module's cold surfaces upon reaching values below room temperature. The exact temperature at which condensation will occur depends on the atmospheric temperature and relative humidity conditions. Refer to the "ASHRAE Psychrometric Chart, 2005 ASHRAE Handbook of Fundamentals" for detailed information on the relationship between condensation, temperature and humidity.

Water Bath Plastic Tubes, Strips and Plates

It is **highly recommended that users place water between aluminum thermal blocks and plastic well tubes, strips and/or plates**. Water baths allow for the highest temperature uniformity, accuracy, and time-to-temperature for the liquid inside the wells. Air gaps, container sizes/brands, and pressure applied to the container can all significantly affect temperature results without use of a water bath. The following tables provide suggested thermal block water bath volumes for adequate coverage of each well size.

PCR Thermal Block	0.2uL Strip or Plate	0.5uL Strip or Plate
Water Bath Volume	110 uL	60 uL

1.5 - 2mL Thermal Block	1.5mL Tube	2.0mL Tube
Water Bath Volume	1.5 mL	1 mL

Test Measurement Equipment Used

Temperature Sensor: KS103J2 Thermistor

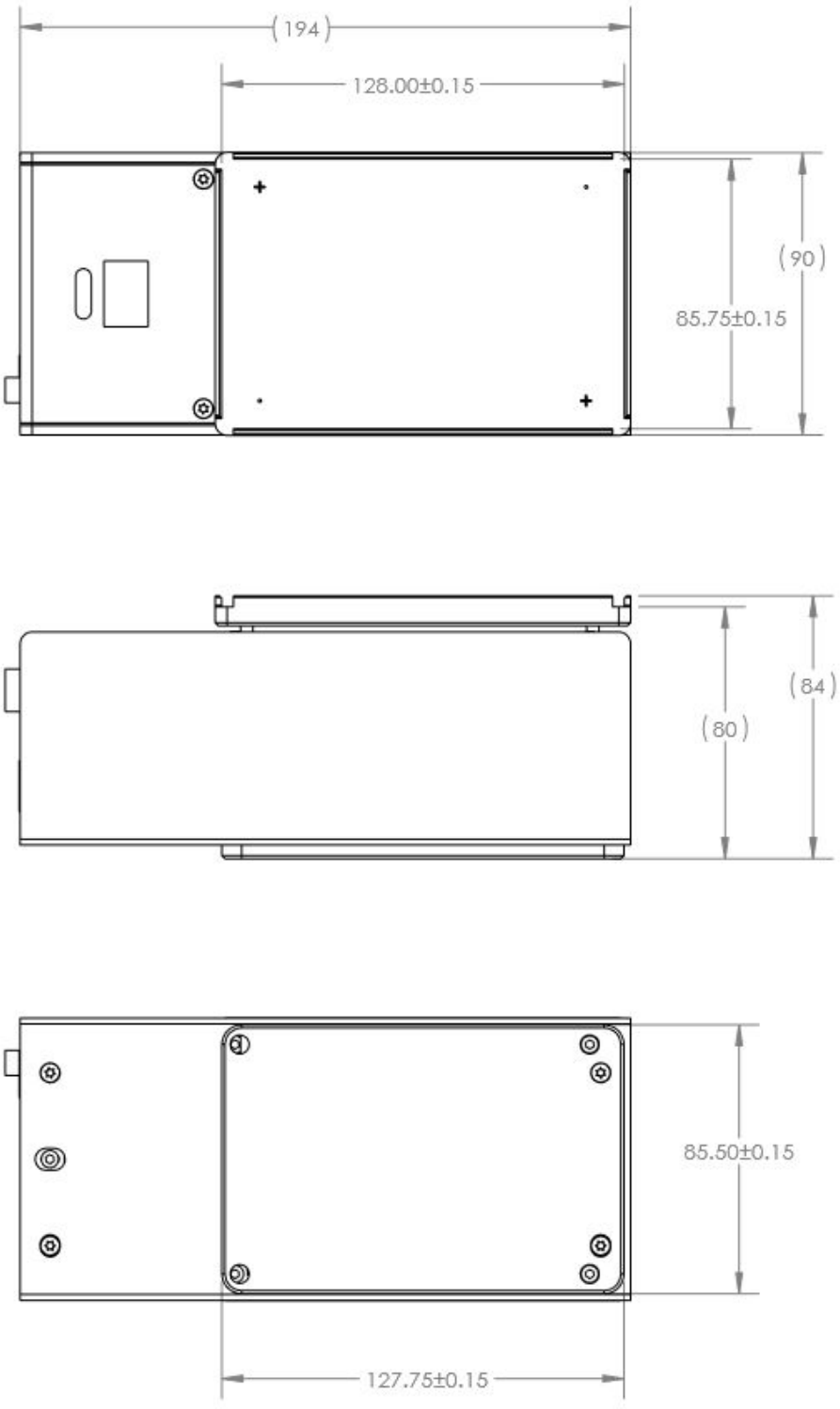
Power Usage

Module input: 36V, 6.1A (220W max)

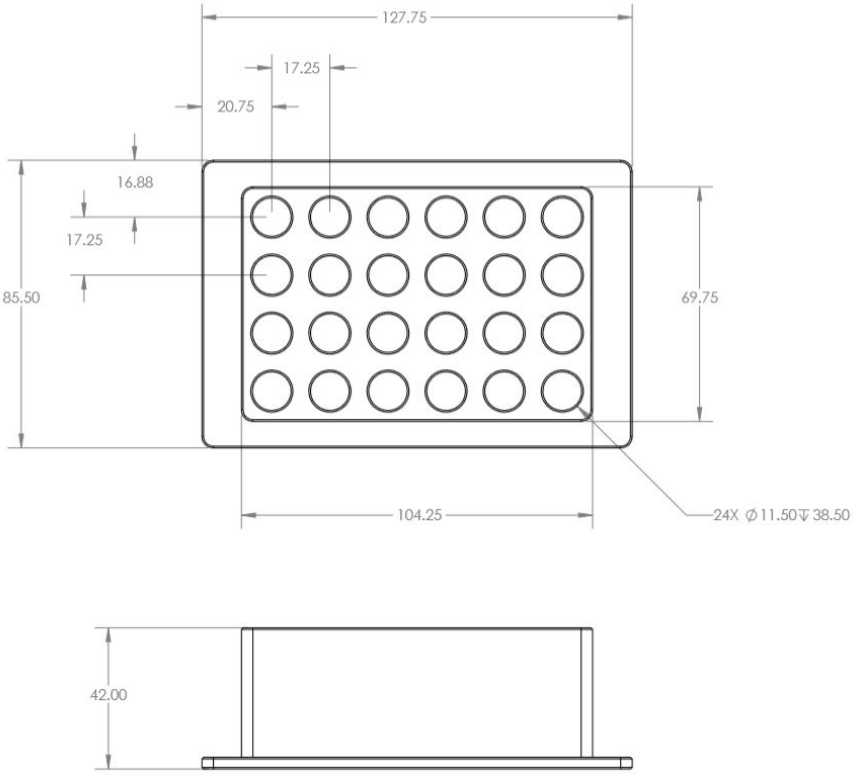
Power adapter input: 100-240VAC, 50/60Hz

Dimensional Drawings

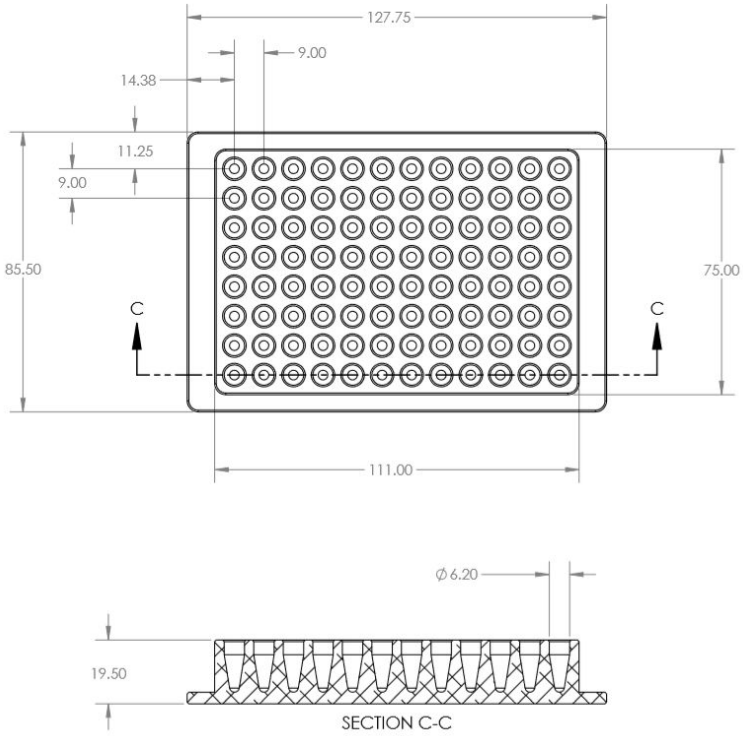
Temperature Module:
(Mass, 1.5kg)



1.5/2mL Aluminum Thermal Block:
(Mass, 0.6kg)



PCR Aluminum Thermal Block:
(Mass, 0.4kg)



All units in (mm)