PPLN Clip, Oven and Temperature Controller User Guidelines

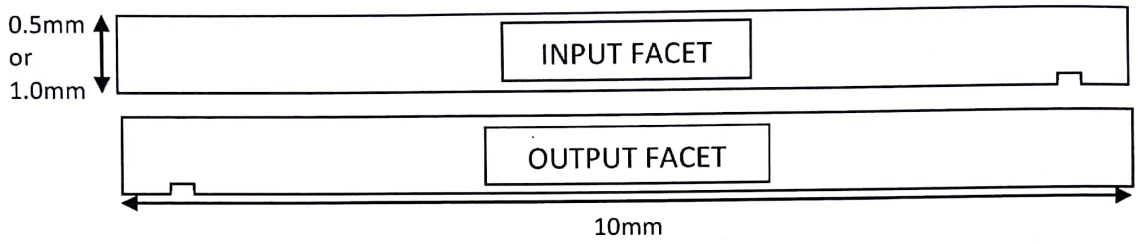
version 1.0/2010

covesion

Covesion offers several components which allow complete wavelength conversion solutions to be constructed. The **PPLN Clip**, in which PPLN crystals are mounted, is designed to allow easy handling and mounting of the crystal within the oven. The **PPLN Oven** permits operation of the PPLN crystal at elevated temperature, allowing temperature tuning and minimisation of photorefractive damage. The **OC1 Temperature Controller** is designed to offer optimum temperature control of the PPLN crystal within the oven. The following document describes the recommended operational procedures for the various components.

PPLN Clip

Covesion's PPLN crystals are supplied mounted in clips, consisting of a clip body, an ITO coated glass spacer, and the clip springs. The design of the clip ensures that the crystal is held in place precisely and as such can simply be mounted in a PPLN oven. Under no circumstance should the user attempt to remove the crystal from the clip. If unmounted crystals are required, then these can be obtained directly from Covesion Ltd.



The crystals are marked with an alignment groove on underneath, see the diagram above. For mounted 10, 20 and 40mm crystals, the serial number is scribed on the side of the clip and the crystal alignment mark is also on the same side. In the case of the 1mm crystals this can be obscured by the clip, therefore please note the serial number is scribed on the input facet side of the clip. The gratings within a crystal increase in period the closer they are to the alignment groove, i.e. period increases from left to right with respect to the input facet.

Users must take care not to mark the optical facets of a PPLN crystal during handling. If the optical facet does become contaminated during use, then it can be wiped with a cotton bud soaked in Isopropanol (IPA), although care must be taken not to damage antireflection coatings that are present.

PPLN Oven

Covesion's PPLN oven is designed for optimum operation of PPLN crystals at elevated temperatures, and also offers a convenient and accurate method of mounting and aligning optical crystals within an optical train.

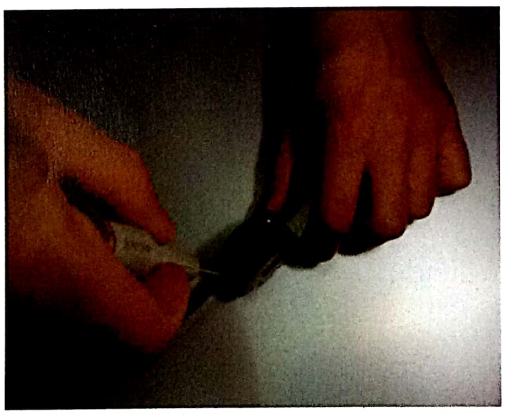


Figure 1. Oven top removal

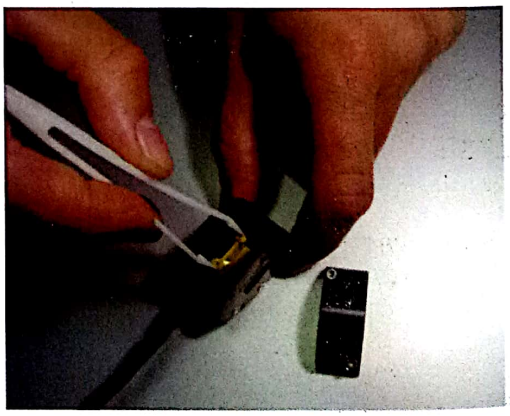


Figure 2. PPLN clip installation

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The oven top is removable using a 2mm hex driver to take out the two retaining bolts (or four in the case of the PV40). Then slide the top in the vertical direction to remove the insulation and expose the heater (shown in figure 1). The PPLN Clip sits on top of the heater, locating on the dowel pins. When installing a PPLN Clip ensure that it is safely located on the dowels, and is sitting flat on the heater thus ensuring maximum heat transfer to the clip (shown in figure 2).

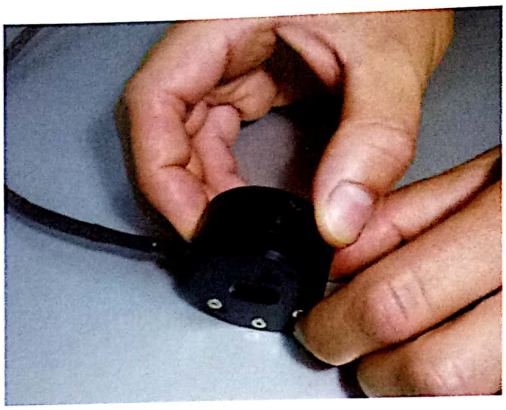

Figure 3. Oven top replacement

When replacing the oven top, check that the recess for the cable is on the correct side. It must also be ensured that the spring pins, which push the clip onto the heater, locate properly and will not be damaged as the top is pushed on. As the oven top is relocated gently push down towards the heater and tighten the retaining bolts (shown in figure 3). Do not use excessive force to tighten the retaining bolts, otherwise thread damage may occur making it impossible to fasten the oven top.

The PPLN oven can be operated in a number of different configurations, which through the removal of insulation allows increased access to the PPLN crystal, however a decrease in oven efficiency and stability will occur. The oven can be operated without the oven top in place, this can be achieved by following the removal procedure outlined above. If greater access to the PPLN crystals optical facets is required, then the end plates of the oven can be removed. The end plate is removed by using a 1.5mm hex driver to take out the three retaining bolts. When replacing the end plates, a similar degree of care must be taken as is associated with the removal and replacement of the oven top, excessive force applied to the retaining bolts may result in damage to the oven.

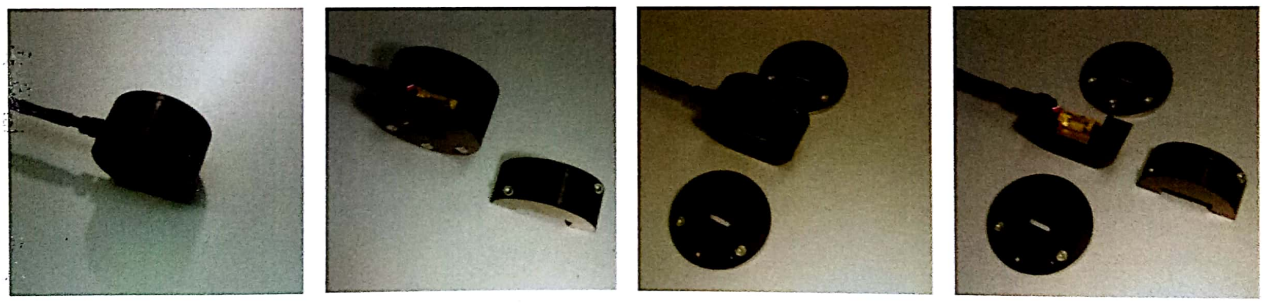

Figure 4. Oven configurations

The oven can therefore be operated in one of four configurations; fully insulated (recommended), top off only, end plates off only, and top and end plates off (all configurations shown in figure 4). Care must be taken not to touch hot components when the PPLN oven is operated in any state other than the recommend fully insulated configuration.

The PPLN oven utilises a 12-24V 3.6-15W element and a PT100 resistance temperature sensor, which are cabled and connected to a plug for convenient connection to the OC1 temperature controller. The variable power rating of the heater allows the heating characteristics to be tailored to the specific oven being using, for example 3.6W produces stable operation for a fully insulated PV10 (oven suitable for crystals of length 10mm and below) but for an uninsulated PV40 (oven suitable for crystals of length 40mm and below) up to 15W may be required in order to produce suitable operating parameters. The PPLN oven offers a stability of ±0.01°C, when used with

Covesion's OC1 controller and when the oven is fully insulated. The maximum continuous operating temperature for the PPLN oven is 210°C, with an absolute maximum temperature rating of 220°C. The PPLN oven and any PPLN crystals should not be heated or cooled at a rate greater than 25°C/min. Exceeding maximum operating temperature or ramp rates can result in oven or crystal damage. The OC1 controller is tuned such that it does not exceed the maximum ramp rate when heating the PPLN clip, crystal and oven. The maximum OC1 set temperature is 200°C.

Operating Parameters

Maximum Operating Temperature	PPLN Clip + Crystal	210°C continuous 220°C max
	PPLN Oven	210°C continuous 220°C max
Maximum Ramp Rate	PPLN Clip + Crystal	25°C/min
	PPLN Oven	25°C/min
Operating Voltage (Power)	PPLN Oven	12V (3.6W) 18V (8.3W) 24V (15W)

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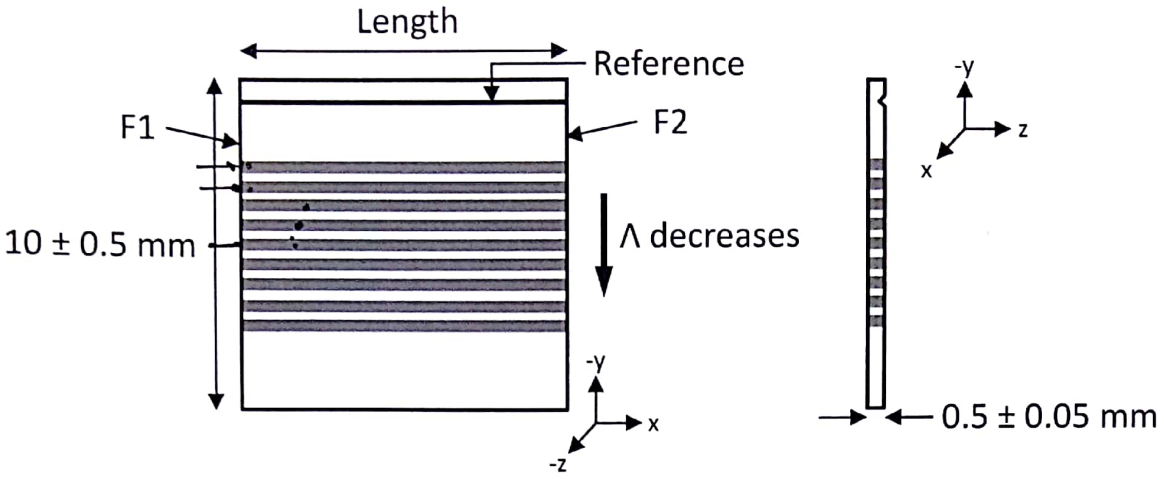
Specification

MSHG1550-0.5-xx

version 3.0/2013

Quantum Walks



[Image for reference only. Not to scale.]

Description	MgO doped PPLN SHG crystal for 1530-1620nm pump
Thickness(z)	0.5mm±0.05mm
Width(y)	10mm±0.5mm
Length(x)	40mm±0.5mm, 20mm±0.5mm, 10mm±0.2mm, 1mm±0.1mm or 0.5mm±0.05mm
Periods(Λ)	18.50, 18.80, 19.10, 19.40, 19.70, 20.00, 20.30, 20.60, 20.90µm

NOTES:

1 The SHG device material is Magnesium doped Lithium Niobate with nine periodically poled gratings. Each grating is 0.5mm wide with individual periods as listed above. A saw-cut reference mark is provided on the +z face of the crystal to determine the largest grating period (see above diagram). Each poled grating is separated by 0.2mm wide regions of unpoled material.

2 The average mark-to-space ratio of each grating is better than 70:30.

3 Each device is etched to make the poled gratings visible. Due to the wet-etch nature of this process the top and bottom surface finish of each device may appear cloudy or uneven.

4 Perpendicularity of input/output facets F1 and F2 to gratings is within ±0.15°. Parallelism between end facets F1 and F2 is within ±5 minutes.

5 Optical finish of facets F1 and F2 is within 20/10 scratch dig with λ/8@1064nm. No more than two 100µm size chips per end facet.

6 Dual coating to less than R<1% at 775 & 1550nm on both input/output facets.

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Device Specification

MSHG1550-0.5-xx

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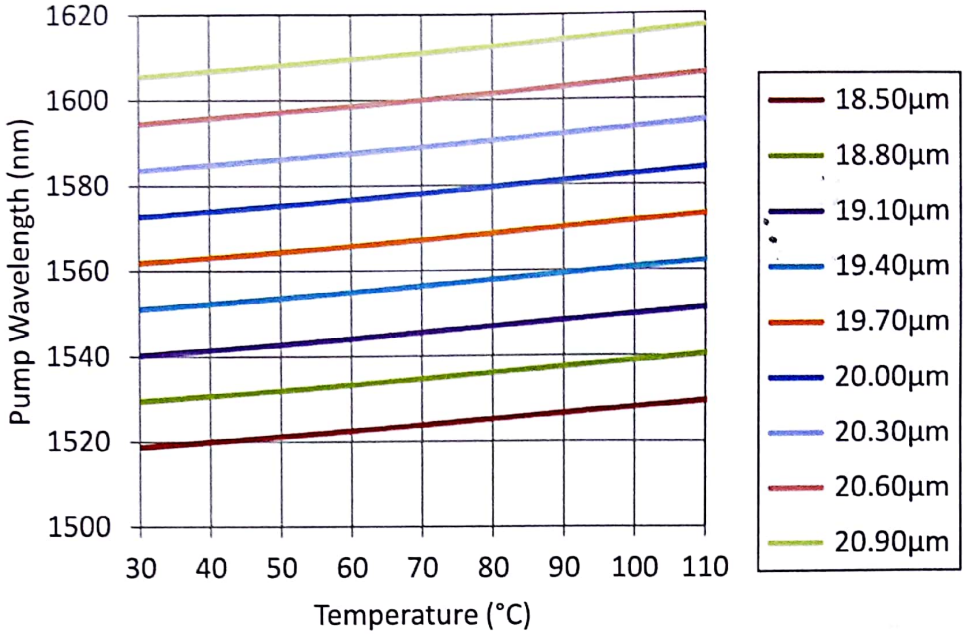

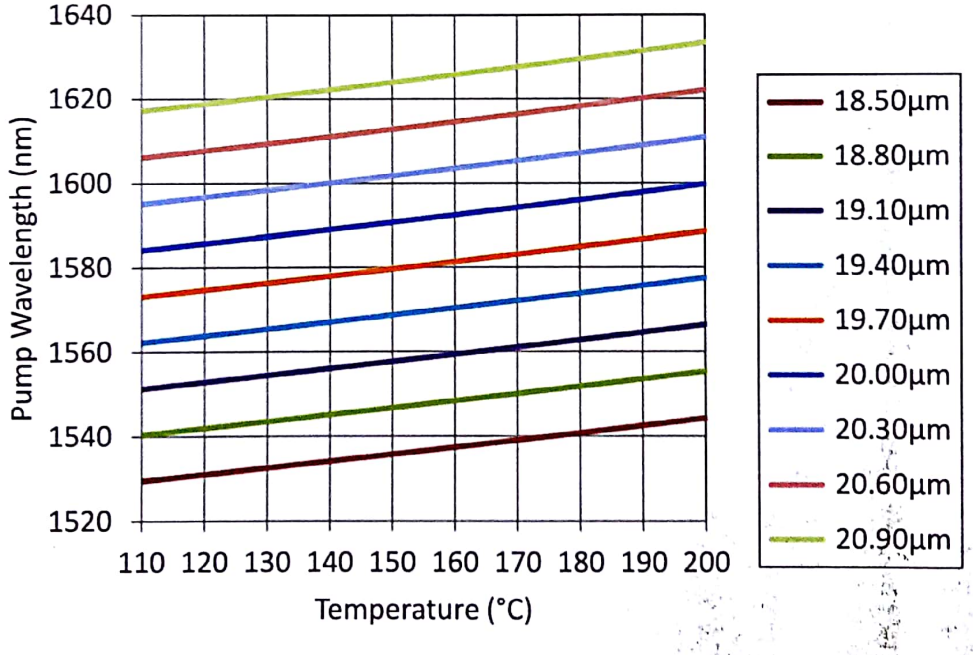

Please note these are calculated tuning curves only and actual values may vary.

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Covesion Ltd

OC2 Temperature Controller

Operating Manual v1.3

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Covesion's OC2 temperature controller provides stable temperature conditions for PPLN crystals when used in conjuction with a Covesion oven (e.g. PV oven series). The unit can tune from a 5°C above ambient temperature up to 200°C and provides a temperature stability of 0.01°C.

The OC2 temperature controller is suitable for Covesion ovens only. When an oven is connected to the OC2 output, the unit immediately identifies the oven type which is indicated on the LCD display.

Connection to a PC via USB allows remote control of the OC2 via Covesion's temperature controller software. LabVIEW drivers are also available.

An upgrade kit, OC1-USB, is available for OC1 units allowing connection to a PC via USB, enabling the same functionality as the OC2. Please contact us for more information.

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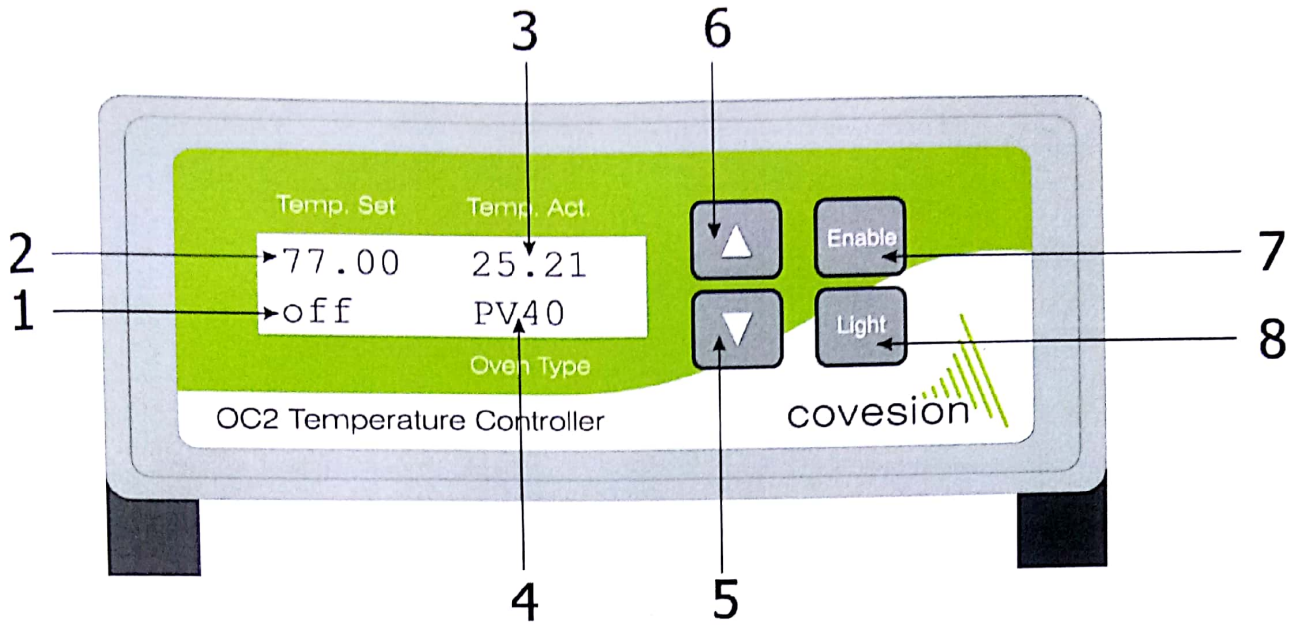
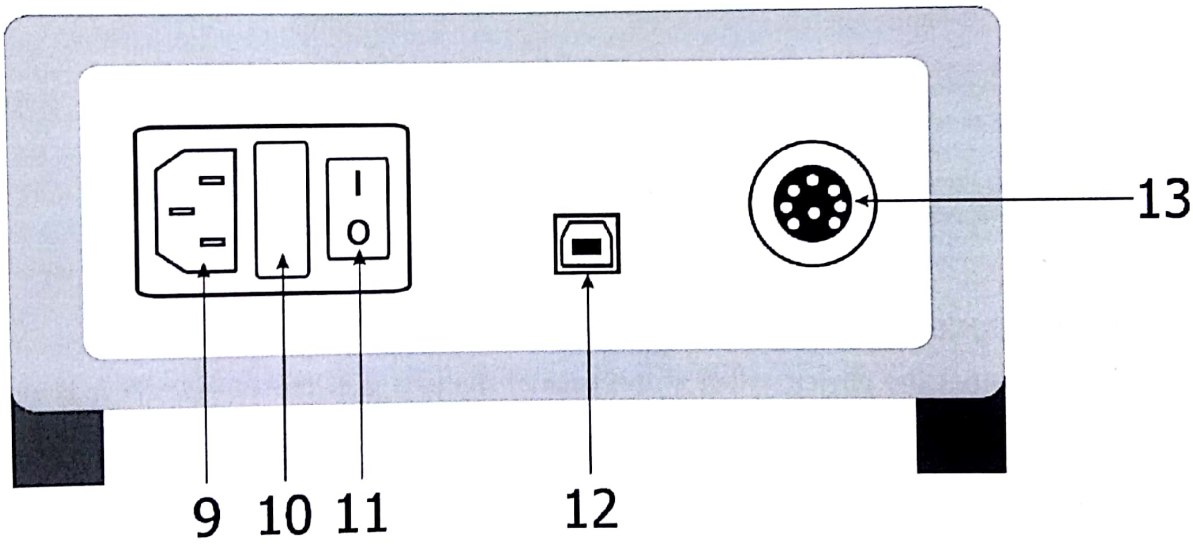
1 Front and Rear Panel





1. Controller output state (on/off)
2. Set temperature (°C)
3. Oven temperature (°C)
4. Oven type
5. Decrease set temperature
6. Increase set temperature
7. Enable oven heater
8. LCD backlight
9. AC power socket (120V or 240V)
10. Fuse (250V)
11. AC power switch
12. Type B USB connector
13. Controller output (oven connection)

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2 Specifications

Parameter	Min	Typ	Max	Unit
Input voltage	100		250	VAC
Ouput power			35	WDC
Output voltage			24	VDC
Temperature control range [1]	15		200	°C
Set-point resolution	0.01			°C
Absolute temperature accuracy [2]		+/-0.1		°C
Temperature stability (24 hour) [3]		+/-0.01		°C
Heating time from ambient to 200°C		7		minutes
Cooling time from 200°C to 60°C [4]		20		minutes
Cooling time from 60°C to 30°C [4]		20		minutes
Operating temperature (external)	10		50	°C
External Dimensions (L x W x H)		199 x158 x74		mm
Weight		840		g

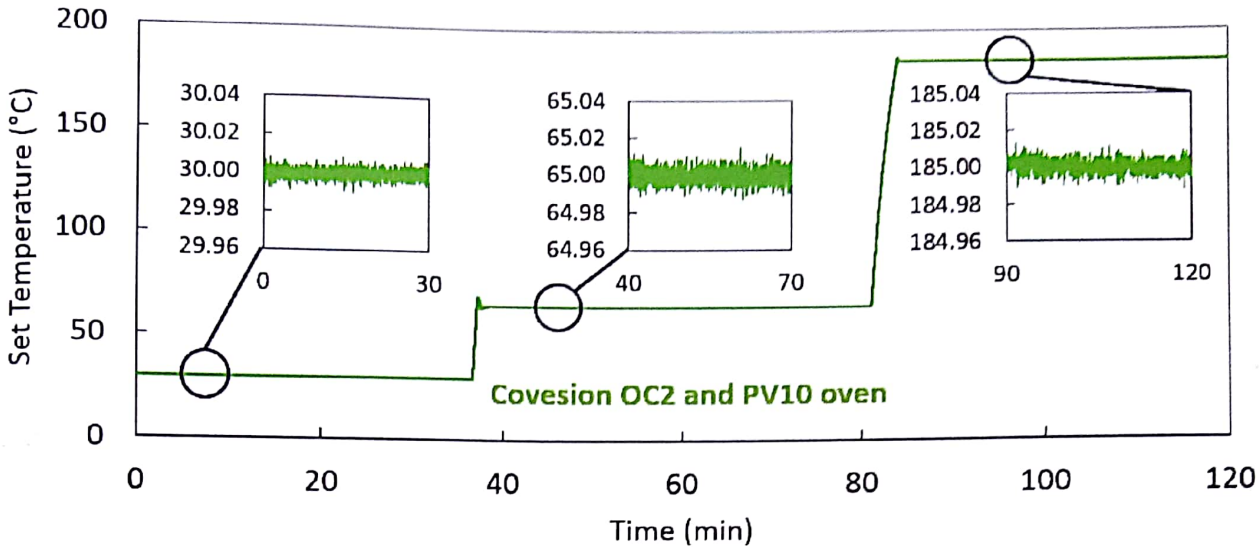
1. Covesion oven types are suitable for heating only. The external oven temperature must be lower than the set-point temperature.
2. Does not account for sensor tolerances.
3. From 5°C above ambient temperature to 200°C
4. Room temperature at 25°C

3 Stand-alone operation

- Ensure that the power switch at the back of the unit is in the OFF position. Connect the mains power lead to the unit and then plug it into the AC mains (100-250V universal input).
- Connect the oven lead to the OC2 oven connector output. Ensure the oven lead is securely screwed in place.
- Turn on the power switch at the back of the unit. The LCD screen will show a brief start up display before displaying the main operation screen. The "OVEN TYPE" should be correctly identified and displayed at the bottom right corner of the screen.
- The oven set temperature "TEMP SET" and actual operating temperature "TEMP ACTUAL" will be displayed on-screen. TEMP SET is adjusted using the up (▲) and down (▼) keypads. A single key press results in a 0.01°C increment. Holding down the key results in bigger increments from 0.1°C to 1°C, and finally to 10°C.
- Once the desired "TEMP SET" is reached, press the "ENABLE" keypad to turn on the oven. The word "ENABLED" will be displayed on-screen.
- The "TEMP ACT" display automatically shows the measured internal temperature of the oven. The oven temperature will oscillate around the set point before stability is reached.

Stability is typically achieved within a few minutes of reaching the set temperature. Please note that the system is slower on cooling than heating, particularly when the set point is close to the ambient temperature.

- The backlight of the LCD display can be turned on or off using the "LIGHT" keypad.



Faults

In the event that "Fault" is displayed in the "TEMP ACTUAL" field the controller cannot be enabled. This indicates a temperature sensor error which can be caused by:

- no sensor or oven connected
- damaged sensor

If the "OVEN TYPE" field is empty the controller cannot be enabled. Failure to recognise an oven type when an oven lead is connected can be caused by:

- incompatible oven connected
- faulty oven connection

4 Connection to a PC

4.1 Installation

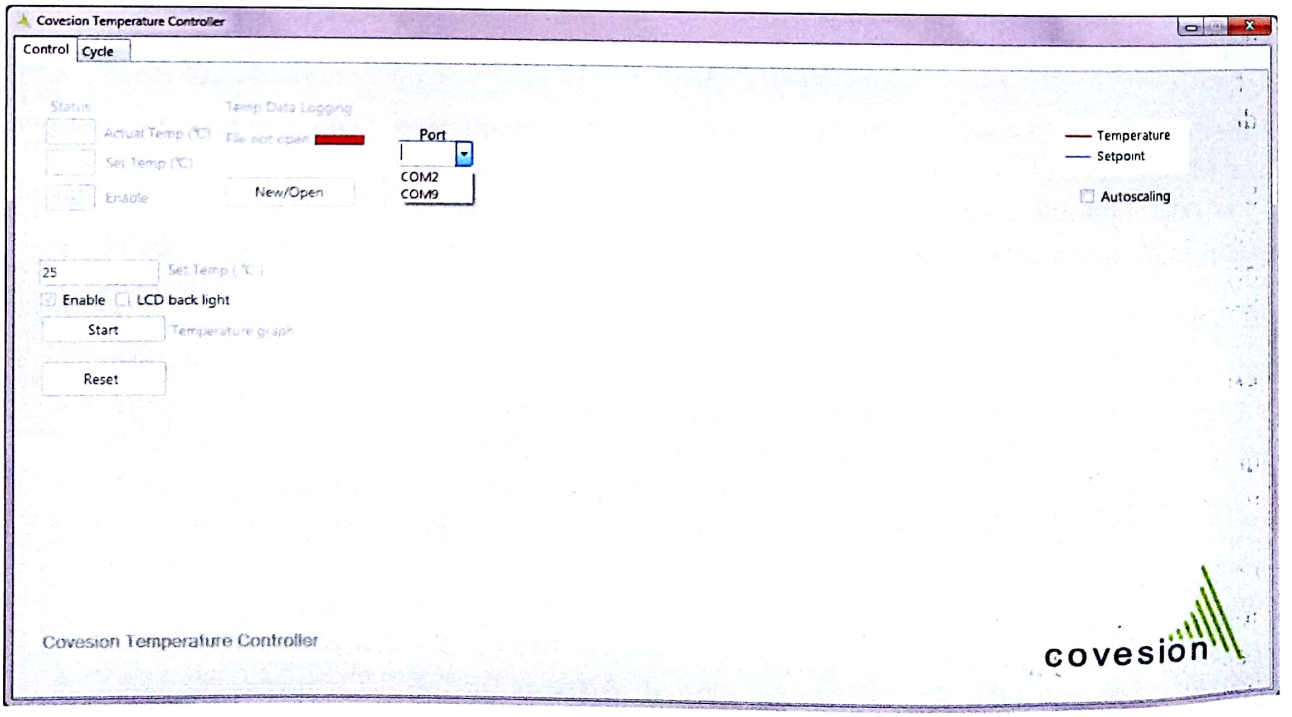
The OC2 temperature controller can be controlled from a PC via USB using the Covesion Temperature Controller software application. Please follow the installation instructions below for the USB driver:

- Connect the Temperature controller to a free USB Port on your Microsoft Windows PC. Then the PC will detect the unit automatically and the communication will be established in approximately 30 sec. If you are facing any issues related to the USB COM PORT drivers please download and execute the .exe file form the link bellow.
  http://www.ftdichip.com/Drivers/CDM/CDM%20v2.12.06%20WHQL%20Certified.exe
- If you are facing further difficulties installing the drivers (for the USB Temperature Controller) please contact us.

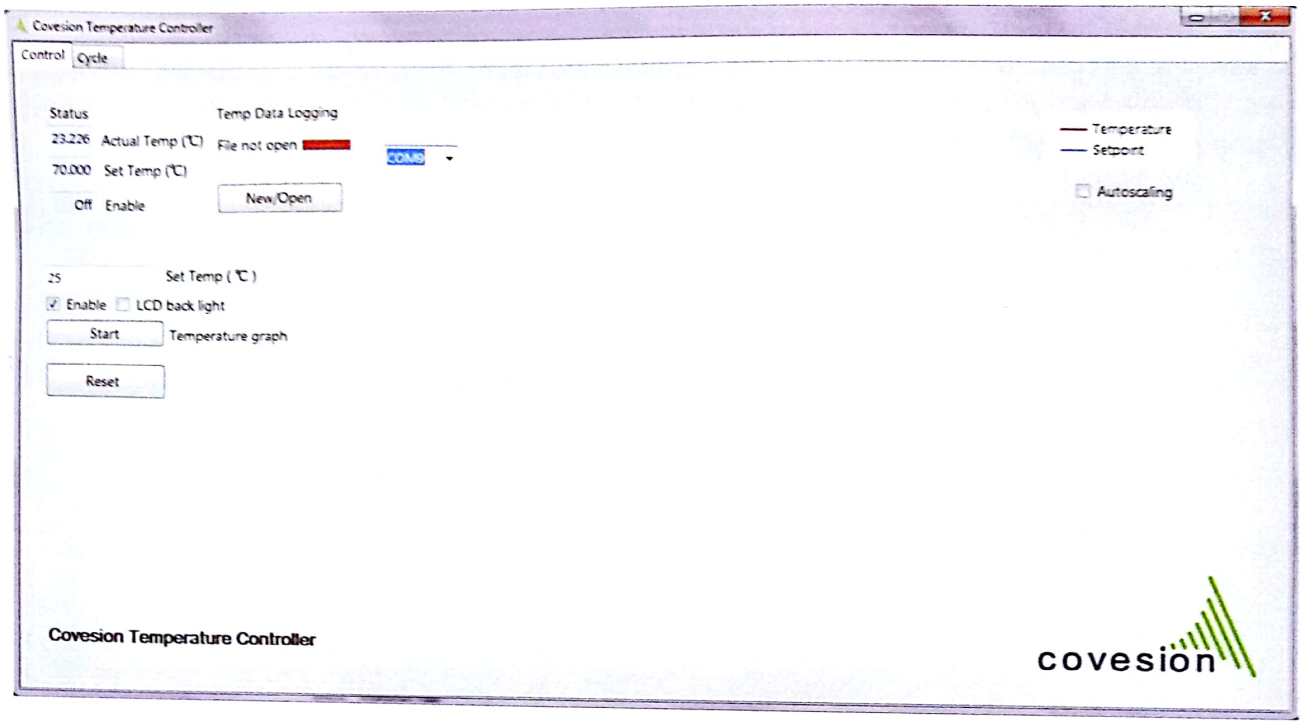
4.2 Temperature controller software application

4.2.1 COM port selection

- Open the "Covesion Temperature Controller" application
- Select the "Port" drop-down box which will reveal a list of connected COM ports. This can include other devices e.g. printer, PC monitor, as well as the Covesion OC2 unit.



- The correct COM port selection should instantly be verified by the temperature readouts in the "Status" box.
- [Note: If your computer has many COM ports connected, the correct port number can be initially identified from the Windows system Device Manager from the Control Panel.]



4.2.2 Control Tab

The control tab has all the functionality of the front LCD panel of the OC2 unit. The "Status" box displays the "Actual Temp", "Set Temp", and "Enable status" (ON or OFF) of the oven.

SET TEMP

To edit the set temperature, enter the desired temperature in the white text box, "Set Temp". Then press ENTER to apply the new value. You will then see the "Set Temp" value update in the "Status" box above.

ENABLE

To enable the heater, click on the "Enable" box. A checked tick-box turns the heater ON and unchecked, the heater is OFF. The "Enable" status will show whether the heater is ON or OFF.
[On start-up of the program, you may need to initialise the value by toggling the check box on/off.]

LCD Backlight

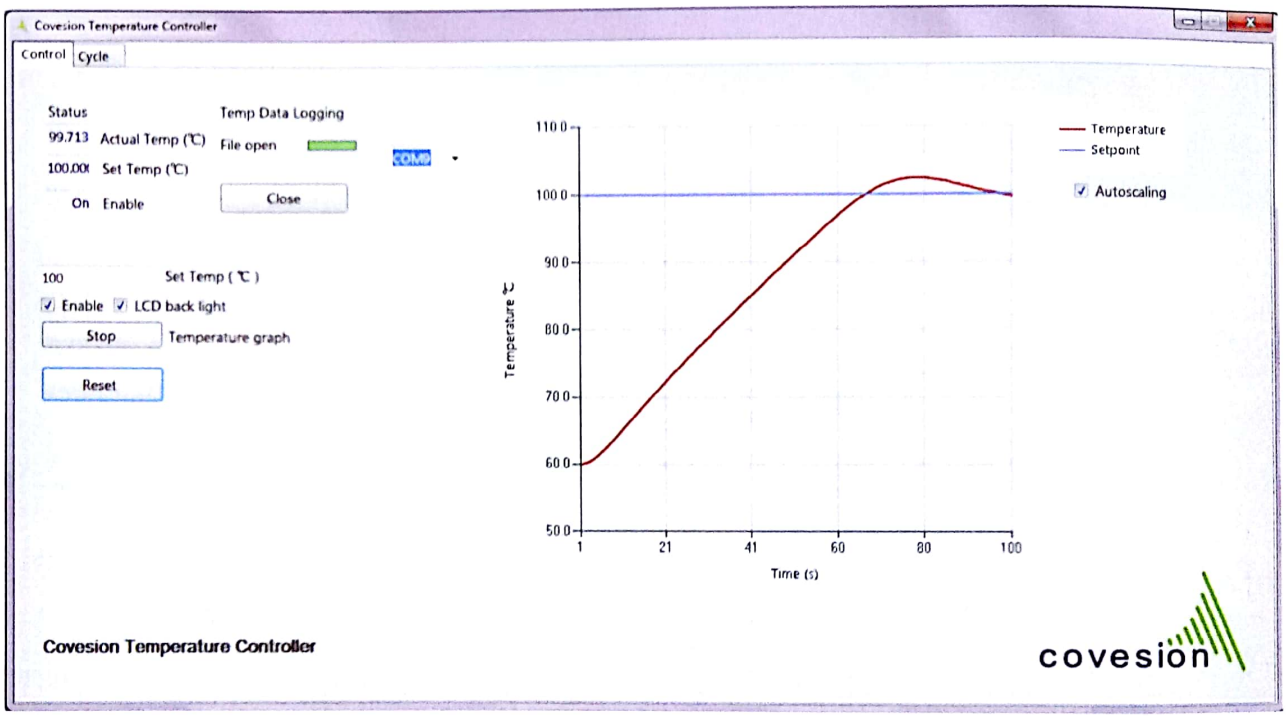
To turn on/off the LCD backlight, click on the "LCD Backlight" box. A checked tick-box turns the backlight ON and unchecked, the backlight is OFF.
[On start-up of the program, you may need to initialise the value by toggling the check box on/off.]

TEMPERATURE GRAPH

The "Start"/"Stop" button will activate/deactivate the graph displaying the "Actual Temp" and "Set Temp" as a function of time. The time axis is limited to a window of 100s. "Autoscaling" will adjust the y-axis accordingly. The "Reset" button, resets the time on the graph.

TEMP DATA LOGGING

To save the temperature data to a .csv file, select "New/Open" from which you can either create a new file or attach data to an existing file, e.g. "OC2 data.csv". To start saving data, "Start" the "Temperature Graph" if not already running. Select "Close" to stop saving data.



4.2.3 Cycle Tab

The Cycle Tab can be used to set up to 5 different set temperatures for a defined number of cycles. This function allows you to set the "Dwell time" and "Ramp rate" (optional) between the various temperatures.

DWELL TIME

The time in seconds during which the oven maintains the "Set Temp". Please note that the "Dwell time" counter begins as soon the "Set Temp" is reached. Therefore you may need to add extra time to allow for any overshoot.

RAMP RATE

This is the rate at which the next set temperature is reached (i.e. the set temperature in the subsequent step). The default "Ramp Rate" is the maximum ramp rate for the oven i.e. the same ramp rate as under normal operation. A checked tick-box allows the user to define the ramp rate in

C/s. Values less than 0.02C/s are recommended. The maximum recommended ramp rate is 0.05C/s, but this can be unstable at temperatures <100C, and at higher temperatures can take a few minutes to linearize. Note that the ramp rate will be limited to the passive cooling rate of the oven, so for example, at set temperatures between 30-40C the ramp rate should be limited <0.01C/s.

CYCLE COUNT

"Max" defines the maximum number of cycles, and "Actual" is the number of occurred cycles.

TEMP DATA LOGGING

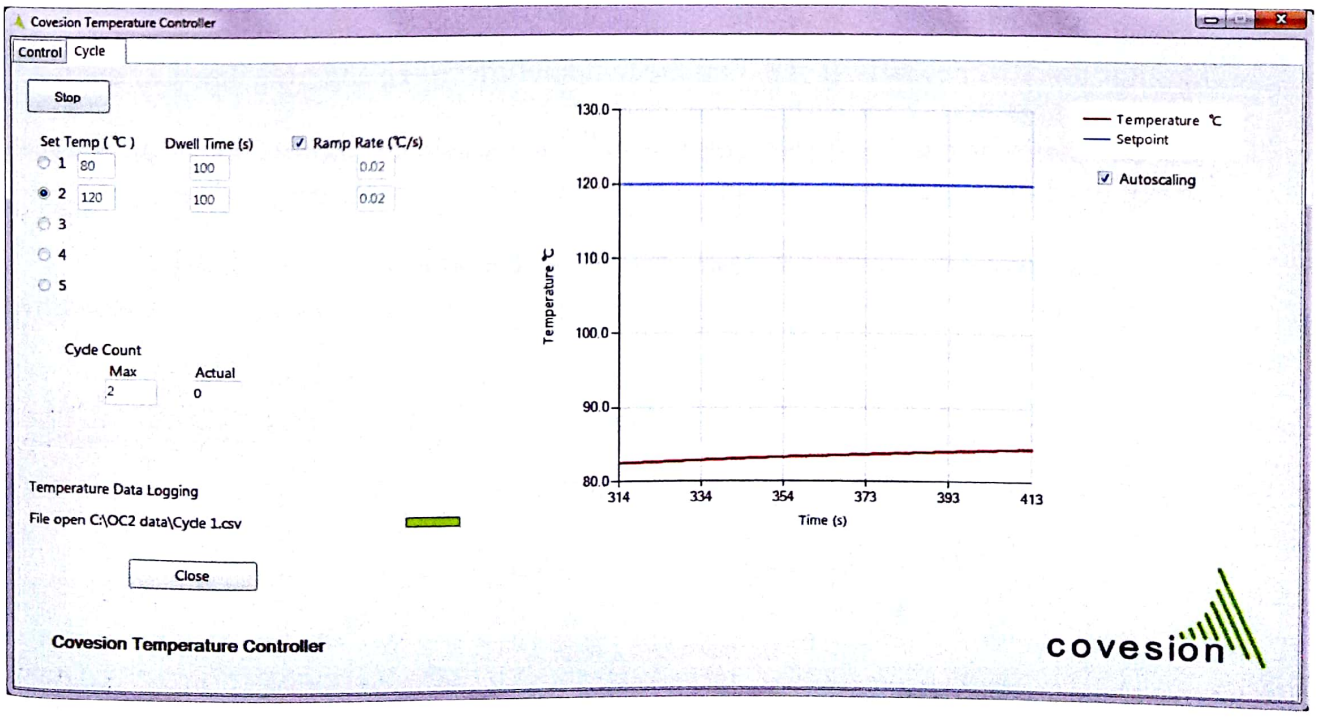
To save the temperature data to a .csv file, select "New/Open" from which you can either create a new file or attach data to an existing file, e.g. "OC2 cycle.csv". To start saving data, "Run" the cycle function if not already running. Select "Close" to stop saving data.

4.2.3.1 Example Applications

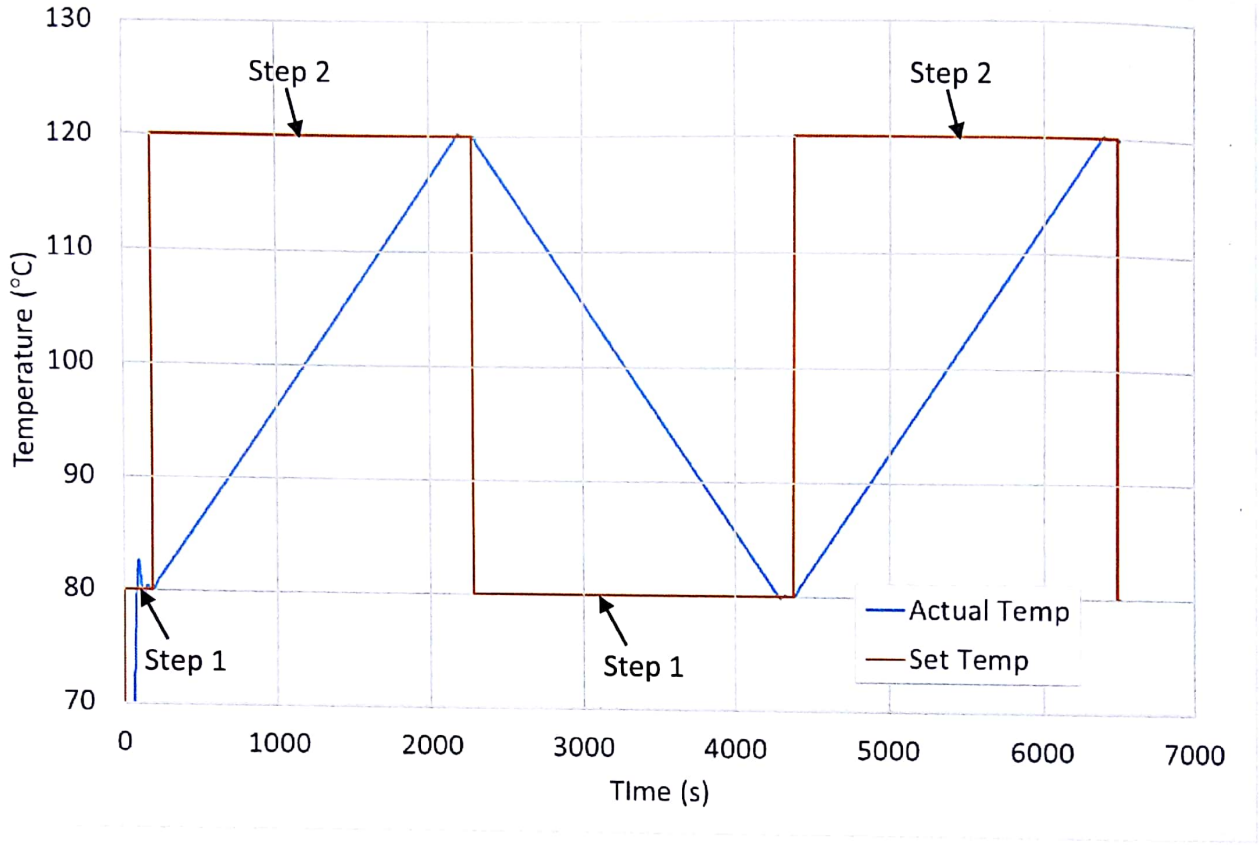
i. **Finding the phase matching peak for 1550nm SHG**

- For Covesion's MSHG1550-0.5-40, it is calculated that you can achieve phase matching in the 19.10µm grating period at 100°C.
- A slow ramp rate from 20C below the expected phase matching temperature to 20C above is a good search range to find the ideal phase matching temperature
- The screenshot below shows an example 2-step cycle function, set to run for 2 full cycles.

Step	Set Temperature (C)	Dwell Time (s)	Ramp Rate (C/s)
1	80	100	0.02
2	120	100	0.02



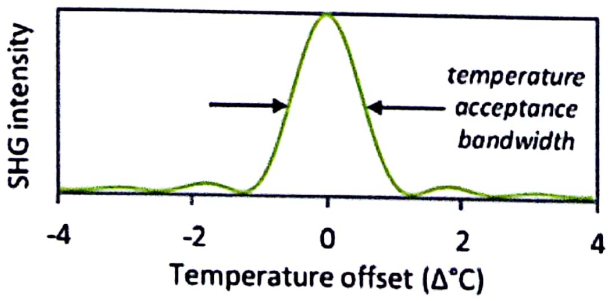
- The graph below is plotted from the saved .csv file, showing 2 full cycles. For the first step, the initial set temperature is reached using the default ramp rate.



- Monitor the SHG power output during the temperature sweep and note down where the maximum peak occurs.
- You can then narrow down the temperature range and start another cycle, or manually search for the optimum temperature using the keypad or "control tab".

ii. **Slow linear sweep for plotting the temperature dependence of SHG intensity**

- The SHG intensity shows a $Sinc^2$ dependence with temperature whose bandwidth is dependent on the crystal length.



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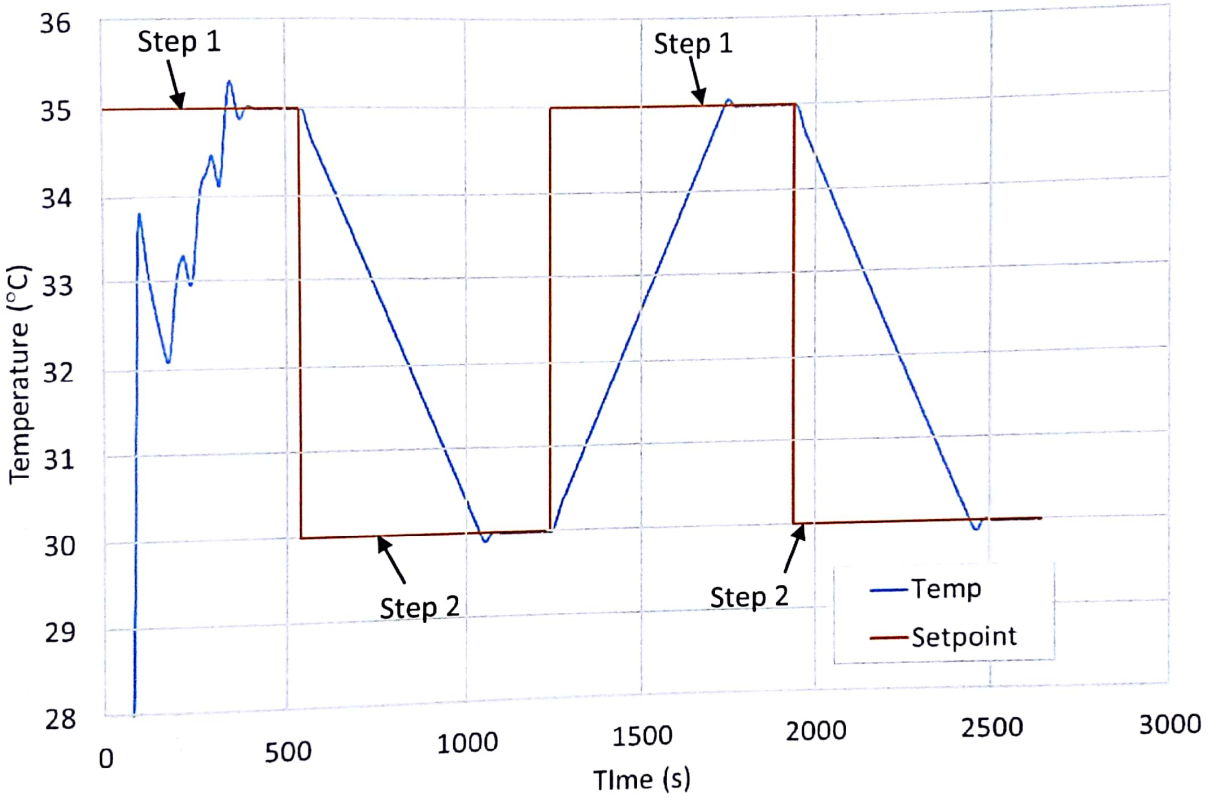
- Choose a very slow ramp rate (<0.01C/s) to allow the oven and crystal to equilibrate and maintain a linear temperature ramp rate.
- We recommend that you check the temperature data to confirm the linearity of the ramp rate.
- The graph below shows an example of a 2-step cycle function for 2 cycles between 35C and 30C, at a ramp rate of 0.01C/s

Step	Set Temperature (C)	Dwell Time (s)	Ramp Rate (C/s)
1	35	200	0.01
2	30	200	0.01



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