Operating Instruction & Manual
Harmonia Temperature Controller

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Contents

1. Pre-face

Harmonia is a **dual channel** electrical heating controller for temperature regulation for **endothermic** reactions primarily in cultivation of mammalian cell applications with from 0.5 to 50 litre VV / thermal mass. Harmonia is able to work in stand-alone setup or chained with other Cronus-PCS components.

Harmonia is designed and manufactured by www.cronus-pcs.com

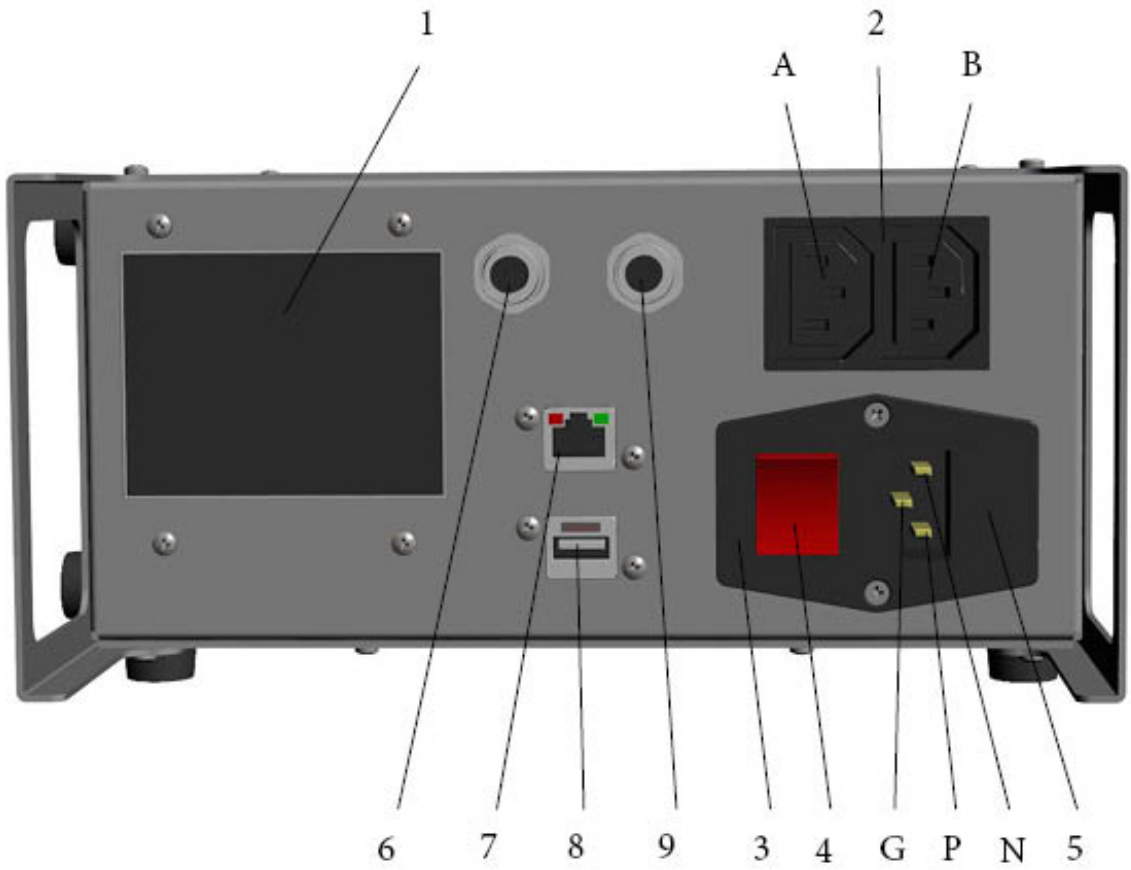
1.1 Product purpose

The scope of the Harmonia product is:

- Thermal control of two Single-Use-Bioreactors (SUB) in parallel.
- The temperature control PID system receives the actual process temperature from a single Pt100 element mounted inside the non-invasive thermo well of each of the two SUB.
- The temperature is regulated by adjusting the electrical energy being added from exposing the heating blanket to electrical power converted to heat.

2. Device Overview

The Harmonia is a standard product from www.Cronus-PCS.com housed in a Hephaestus U2 cabinet.



The front panel is equipped with:

1. TFT 3.5” colour display
2. Dual 230 VAC controlled power outlet, IEC female socket with ground, Channel A and Channel B
3. 230 VAC power inlet, IEC standard male with ground, max 10 amp
4. Red button main power breaker
5. Fuse tray, 10 amp, 5x20 mm
6. Pt100 sensor input via 4 leg M12 RKF socket – channel A
7. RJ45 socket for Local-Are-Network (LAN) connection
8. USB socket for Wi-Fi access and charging
9. Pt100 sensor input via 4 leg M12 RKF socket – channel B

2.1 Harmonia internal design

Important components inside Harmonia are:

- Micro-processor transmitter converting the Pt100 sensor span of 0-100°C to a linear signal (class C sensor is sufficient).
- Each channel facilitating 110 - 230 VAC span supply has a Crydom 12 amp Solid-State-Relay (SSD) breaker generating very little self-heating offering unlimited lifetime.

External sensors

- 2 RKF M12 type of connector mounted on front panel for 4-wire Pt100 sensor connection

2.2 Requirement

The unit must be properly installed according to the fluid diagram.

2.3 Specification

When connection to a suitable supply of power the spec is:

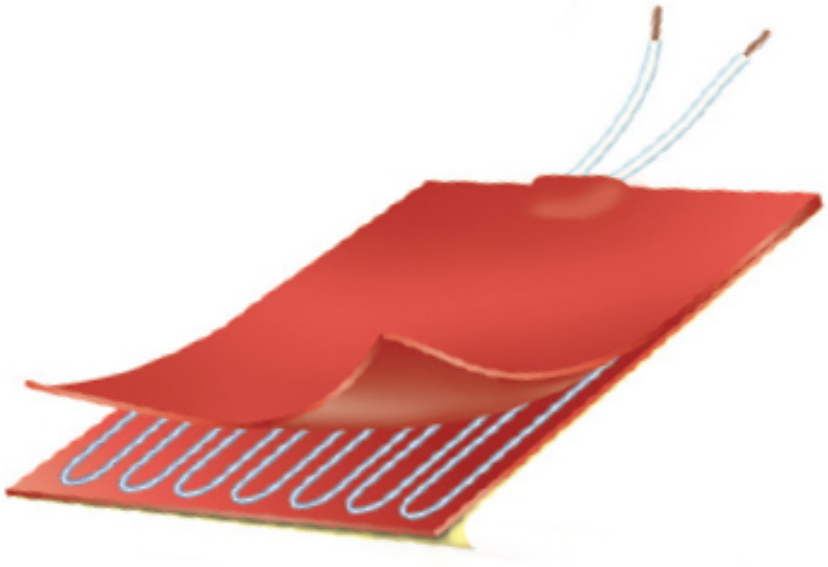
External sensor	P100
Power breaker	SSR 10 amp each
GUI	3.5” TFT display
Computer power	900 MHz quad-core ARM Cortex-A7 CPU running Linux with Code-Sys PLC software
USB socket	for Wi-Fi and even charging 5 VDC 1 amp
RJ45socket	for IP/TCP via LAN and ModBus
Power supply	230 VAC, max 2,000 watt
Noise level, dBa	<45
Duty cycle	100%
Orientation	any
Operating conditions	10°C to 50°C, <80% relative humidity, non condensing
Life time, estimated, hours	>50,000
MTBM (mean time before maintenance)	10,000
Cabinet size and material	U2 – AISI304
Weight, kilo	3.5

3. Heating design

Harmonia depend on heating elements or rods kept in good maintenance standard.

3.1 Electrical heating and handling

Construction of heating element - made up of a nickel-chrome or nickel-copper alloy heating wire wound in a spiral around a slender fibre glass core. This heating element is then placed between two layers of woven fibre glass impregnated with silicon elastomer. This material is an excellent electrical insulator (approx. 12 kV/mm), a good conductor of heat ($7x10^{-4}$ W/cm/K) and flexible. It can withstand continuous temperatures of around 200°C. The fibre glass weave endows the assembly with good mechanical resistance, while allowing it to remain very flexible.



Important procedure to follow before Power-On:

1. Finished filling the SUB with media, mounted on the MST or with HPD drive, all the hoses, etc.
2. Mount the heating blanket to the SUB and do **NOT** connect the plug to Harmonia IEC female socket.
3. Mount Pt100 sensor via appropriate cables to Harmonia - without the use of tools!
4. Mount Pt100 sensor by insertion inside the media filled SUB
5. Connection heating blanket plug to Harmonia socket

General precautions:

- heating blanket should be mounted tight with full contact to the SUB circumference
- thermocouple, Pt100 sensor mounted in the well with some ml glycerine oil for better thermal contact and connected to Jasion M12 RKF socket.
- media has been added to a sufficient height / volume covering **ALL of** the heating blanket.
- agitation has started.

Blankets and info available from http://cronus-pcs.com/products/accessories/heating-blankets/

During operation check daily that the heating blanket is mounted properly and dry.

Whenever there is contact with splashing water or media, interrupt heating operations, remove the heating blanket from the culture vessel, clean and dry it thoroughly.

3.2 Description of functionality

When the process requires energy input (for cultivation) to increase or keep SUB temperature stable the SSD opens sequentially for the electrical heating elements.

- Precision when correctly tuned PID is better than 0.1°C
- The program is based on self-tuning functionality which learn and improves accuracy over time.

4. Start-up

The scope of the product is to thermally control two bioreactors.

Requirement

The system must be properly installed and connected in accordance with the specifications and previous information. Operator must also have gained familiarity with the Safety Instructions to be found separately on www.cronus-pcs.com/support/Safety_Instruction .

Make in particular sure that the 110 or 230 VAC wall plug have a ground connection fully functional.

Harmonia is factory pre-programmed to operate at 37.5 °C and will seek to obtain this temperature whenever powered up. Changing the set point required simple programming of the unit.

4.1 Fault information

The build-in display of Harmonia will inform about possible faults whenever detected.

- If T1 is not connected
- If temperature on T1 is not measured to be within 15 and 25°C within 10 seconds at start-up

5. Communication

Harmonia contain a webserver displaying on the build-in display ……are able to communicate vis two …….

Each Harmonia product has a fixed IP address shown at the Manufacturer´s Identification Label under the product.

5.1 Programming

It is of importance ……

……

5.2 PID routines

It is of importance ……

……

PID

6. Operation Manual

At activation of power bottom then Harmonia (or restoration of voltage after a power outage) starts up and the display will show:

- The operating system software (Linux) is loaded
- The system configuration is loaded.
- The operating software is loaded and actual information shown on display

Any user-defined parameters from a previous process are stored in a battery-buffered memory and can be used for the next process:

- Set points
- Calibration parameters

If there is no faults are found by the software with 10 seconds Harmonia will start to operate.

Harmonia is pre-programmed from the manufacturer to operate at 37 °C. Changing this set point required simple programming of the unit. Changing PID algorithm setting require special skills!

Photo of unit powered on – display visible

System parameters – cannot be modified by user
Calibration parameters – can be changed by user
PID parameters – can be changed by user
Setting parameters – can be changed by user

6.1 Operation principles

Assuming a correct assembly of all systems, connections, etc.

7. Safety precautions

Various component require individual attention. Operator must also have gained familiarity with the Safety Instructions to be found separately on www.cronus-pcs.com/support/Safety_Instruction .

7.1 Heating elements

Danger for electrical shock is highly likely if heating blanket is damaged!
Heating blanket and wiring should be porous, folded, kinked or chipped. The silicone foil should not be discoloured. This is a sign of short circuiting due to broken heating coils or a defective power cord.

Malfunction and dangerous operating states can occur if damage was overlooked during the pre-use check.

- If so, switch out the heating blanket and discontinue its use.

Inappropriate cleaning agents or procedures may cause damage. Do not use any cleaning agents or solvents that can corrode the power supply, silicone foil or silicone foam and make them porous.

- Do not use any hard and / or sharp objects to remove stubborn soiling.

Danger for electrical shock is highly likely if cables, sockets, connectors for both heating blankets and heating rods is damaged!

7.3 Documentation

Harmonia functionality must be checked on a regular basis and data of such testing kept recorded.

7.4 Declaration of Conformity

CE

CE Declaration of Conformity

Company: Cronus-PCS

Company address:
Malmmosevej 19C
DK-2840 Holte
www.cronus-pcs.com

We hereby declare that based on the design, construction and product placed on the market, the product designated below fulfils the relevant fundamental safety requirements and health regulations specified by the pertinent EC Directive.

The declaration shall become legally invalid if any modifications are made to the product, which have not been certified by Cronus-PCS.

Designation of the product: Harmonia - p/n 3110

Relevant directives of the EC:

- 2006/42/EC Machinery
- 2004/108/EC Electromagnetic Compatibility
- 2006/95/EC Electrical equipment designed for use within certain voltage limits
- 97/23/EC Pressure Equipment

Date of signature: 2015-10-20

Function of Signature
Per Stobbe
CEO and Director of R&D