

Operating Instruction & Manual

Cilix-2 drive unit



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1 - Concept overview

Cilix-2 is a dual / parallel motor driver/controller able to support both BLDC (Brush-Less-Direct-Current) motor's and STEP motors.

Both motor principles are designed to drive via Head-Plate-Drive (HPD) or via Magnetic-Stirrer-Table (MST) a variety of:

- Single-Use-Bioreactor's
- Single-use-Fermenter's
- Single-Use-Mixer's
- Stirred-Tank-Reactor's

or

- Free-standing peristaltic pumps with STEP motors

The BLDC motor (with encoder) combined with Cilix-2 is a unique combination. World only option to give detailed real-time information about the power (Watt) lost to the agitated liquid (and various system friction) and hereby in real-time calculate and show the actual Power Number with reference to RPM.

1.1 – Product purpose BLDC (with encoder)

Cilix-2 with BLDC motor facilitate several purposes:

1. Agitate Single-Use-Bioreactors (SUBs), Single-Use-Fermenters (SUFs), Single-Use-Mixers (SUMs) and Stirred-Tank-Reactors (STRs) ranging from 0.5 to 30-liter Vessel Volume (VV)
2. Gives scientific data information about Power Number – otherwise very difficult to establish.
3. Optional operate as part of the configurable Process-Control-System (PCS) from www.cronus-pcs.com under Lucullus or DeltaV or similar software via OPC-UA

1.2 – Product purpose STEP (without encoder)

Cilix-2 with STEP motor is further designed to drive free-standing peristaltic pump's from www.cerell.com and www.Cronus-PCS.com with STEP motor's.

2 - Device Overview

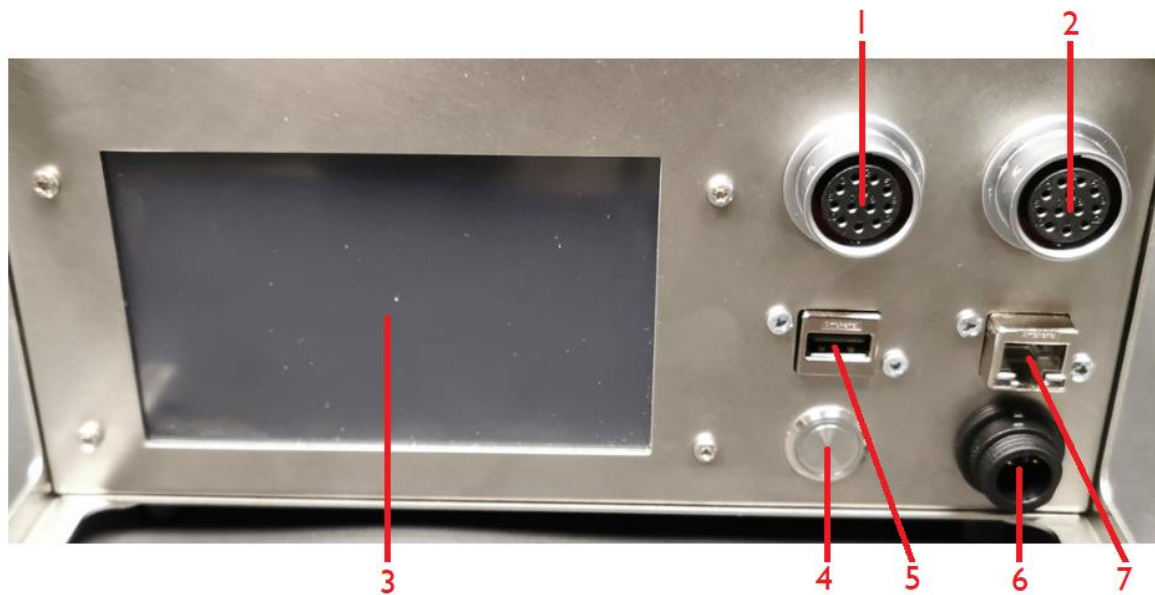
The Cilix-2 motor driver/controller is a product manufactured by www.cronus-pcs.com and housed in a U2 cabinet.

2.1 Specification

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

External sensors	Integrated encoders in BLDC motor – Hall and Optical
Power breaker	Integrated fuse
GUI	5" TFT display
Computer power	900 MHz quad-core ARM Cortex-A7 CPU running Linux with Code-Sys PLC software
USB socket	data download and external Wi-Fi antenna adapter
RJ45 socket	for IP/TCP via LAN – ModBus and OPC
Power supply	24 VDC Net-adapter
Noise level, dBa	<45
Duty cycle	100%
Orientation	any
Cabinet material	Micro polished AISI304 – DIN EN 1.4301
Operating conditions	10°C to 50°C, <80% relative humidity, non condensing
Drive unit life-time, estimated, hours	50,000
MTBM (mean time before maintenance)	10,000
BLDC motor life-time – full load, hours	10,000
Weight, kilo	5 kg

2.3 – Cilix-2 drive unit



Cilix-2 front panel is equipped with:

1. Motor connection 1
2. Motor connection 2
3. 5" touch sensitive TFT display
4. On/off button
5. USB socket for Wi-Fi access and software upgrade
6. Power input 24 V DC
7. RJ45 socket for Local-Area-Network (LAN) connection



Illustration of where the motor cables are mounted on Cilix-2.

3 - Operation Manual

At activation of power button Cilix-2 (or restoring of power 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 GUI 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. Cilix-2 is pre-programmed from the manufacturer with simple routines. If there are no faults found with the Cilix-2 software - then ready to operate.

3.1 – How to setup and connect Cilix-2 unit to the BLCD motor

3.1.1 – How-to plug-in cables correctly and in the right places

Cilix-2 drive has 2 motor connections – the LEFT and the RIGHT.

3.2 – Cilix-2 GUI explanation



Cilix-2 has a black background / Graphic-User-Interface (GUI) design.

Shown above are the first user interface, one will see after power up. This is also here one must set up the main details of the process by following steps below.

3.3 – Auto setup motor

The following is very important for setting up the unit.

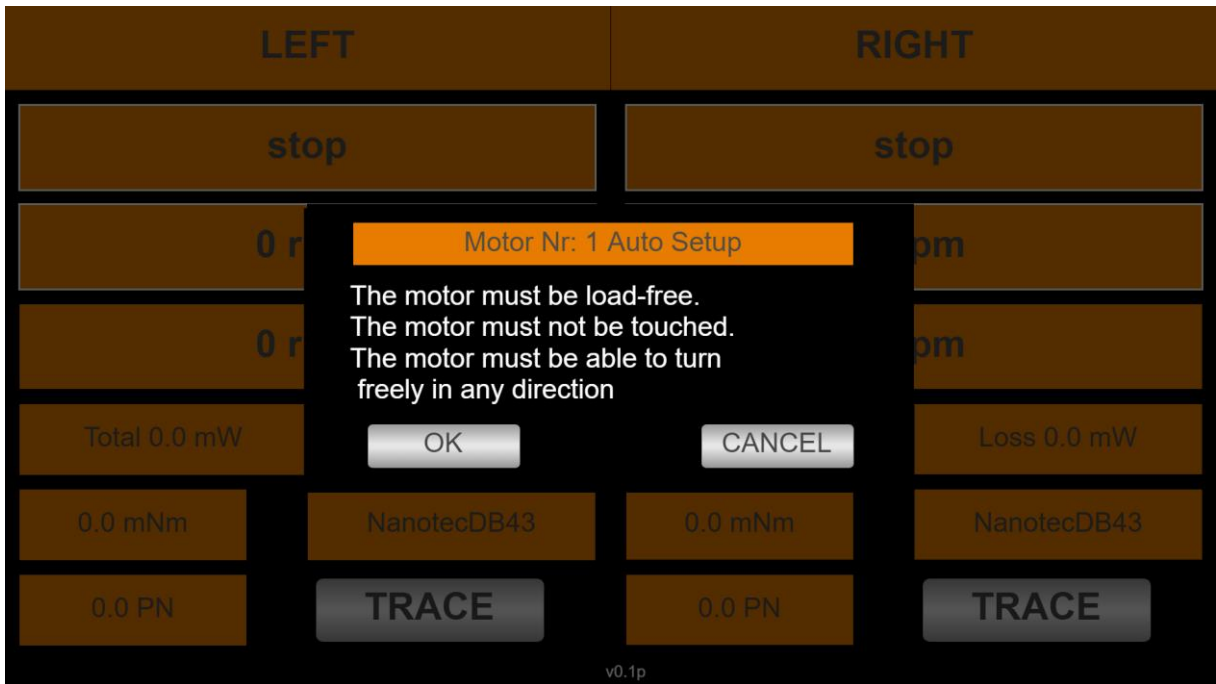
By pressing the display field “stop” (with white surrounding) of the chosen motor, a selection window will appear and then choose “Set Auto”, this will set the motor setting for the specific motor that is connected inside the driver. (If the Auto tuning have been performed and the motor is the same, it is not necessary to repeat the above, even after a shutdown of Cilix-2), but beware that the motor must:

- be load-free
- not to be touched
- be able to turn freely in any direction (not connected to anything)

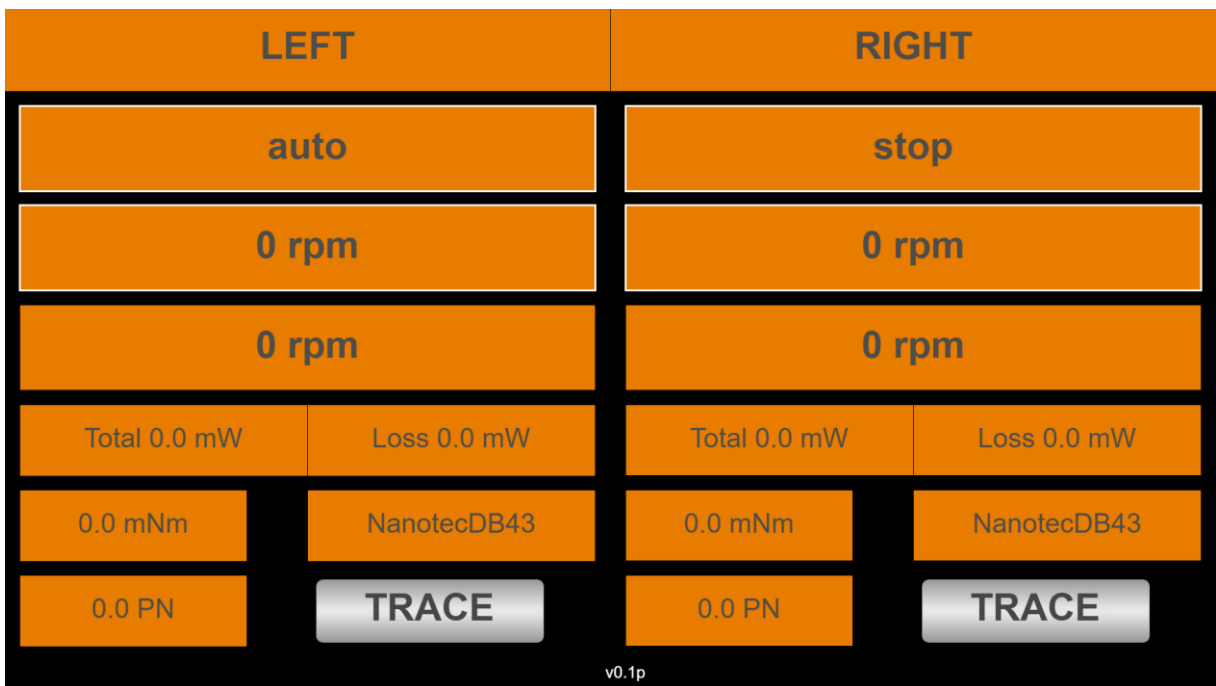
Finish by pressing “OK” to confirm the changes or “CANCEL” to go back to the start screen without any changes, see pictures below:



Cilix-2 Motor Auto Setup 1



Cilix-2 Motor Auto Setup 2



Cilix-2 Motor Auto Setup 3

When the “Auto” field again shows “Stop” the setup is finished with the auto setup of the chosen motor. Which normally takes around 1-2 minutes.

3.4 - select which RPM and gearbox ratio do you want to use

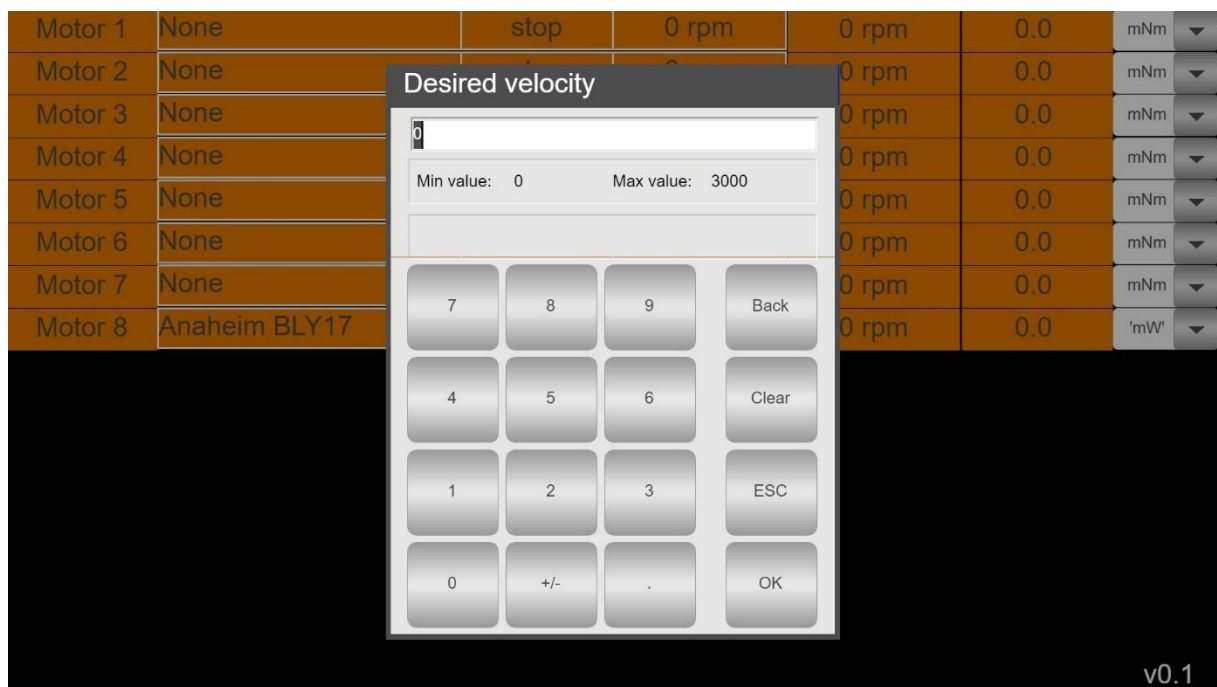
Press the field with “0 rpm” (with white surrounding), a numpad will appear where you can enter the desired value.

Back: is used for deleting only 1 character/number.

Clear: is used for deleting all characters/numbers.

ESC: is used for going back to the start screen without any changes.

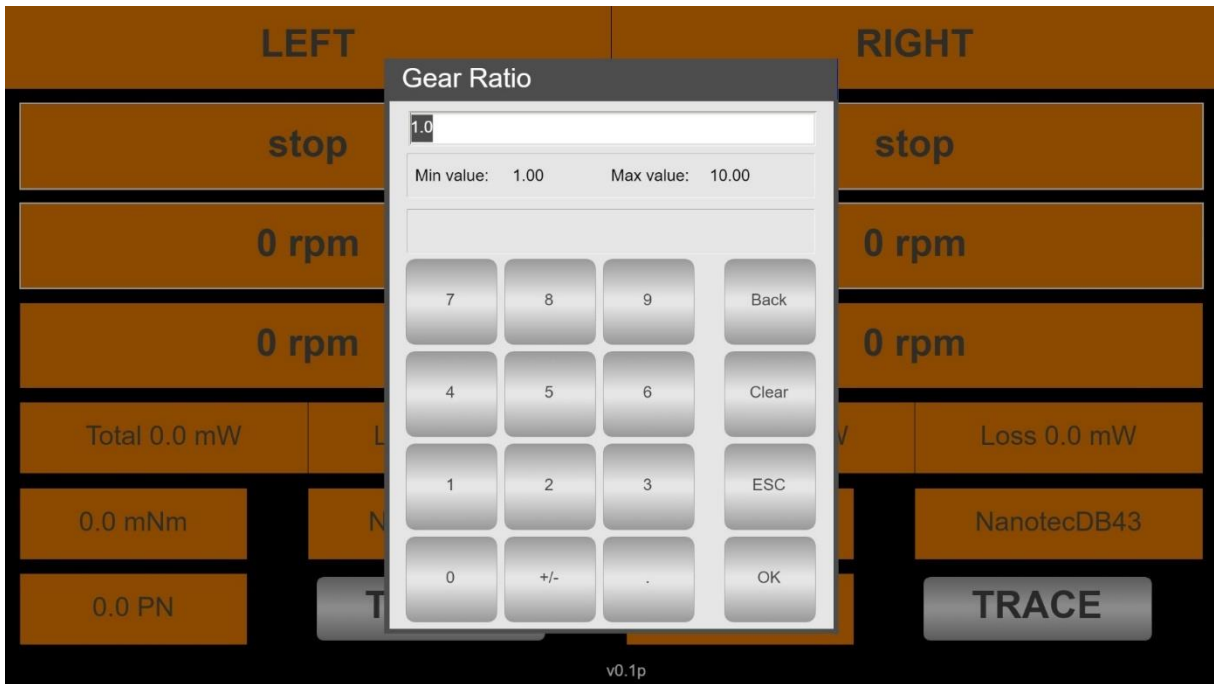
OK: is used for going back to the start screen accepting the changes.



Cilix-2 RPM selection numpad pop up window.

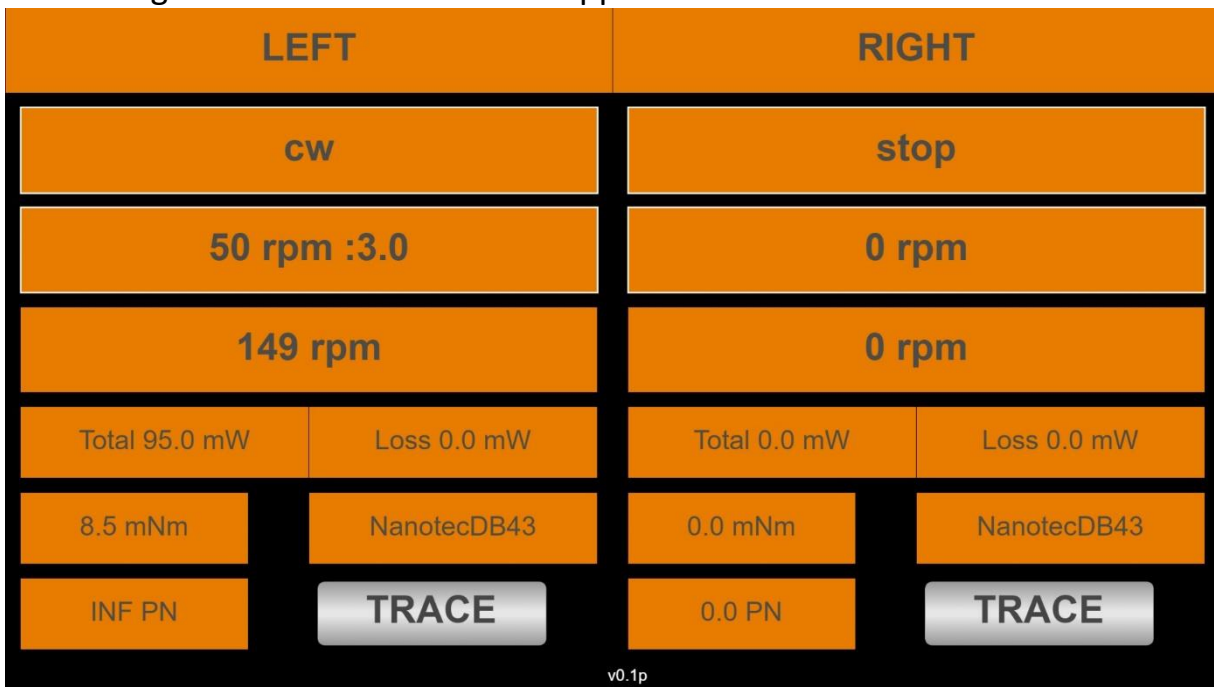
ONLY IF THE MOTOR HAS A GEARBOX!

Press the field with “0 rpm” (with NO white surrounding), a numpad will appear where you can enter the gearbox ratio on the motor that is used on that channel if there is any gearbox on the motor.



Cilix-2 gearbox ratio selection numpad pop up window.

After the gear ratio is set it will then appear on the screen like this:



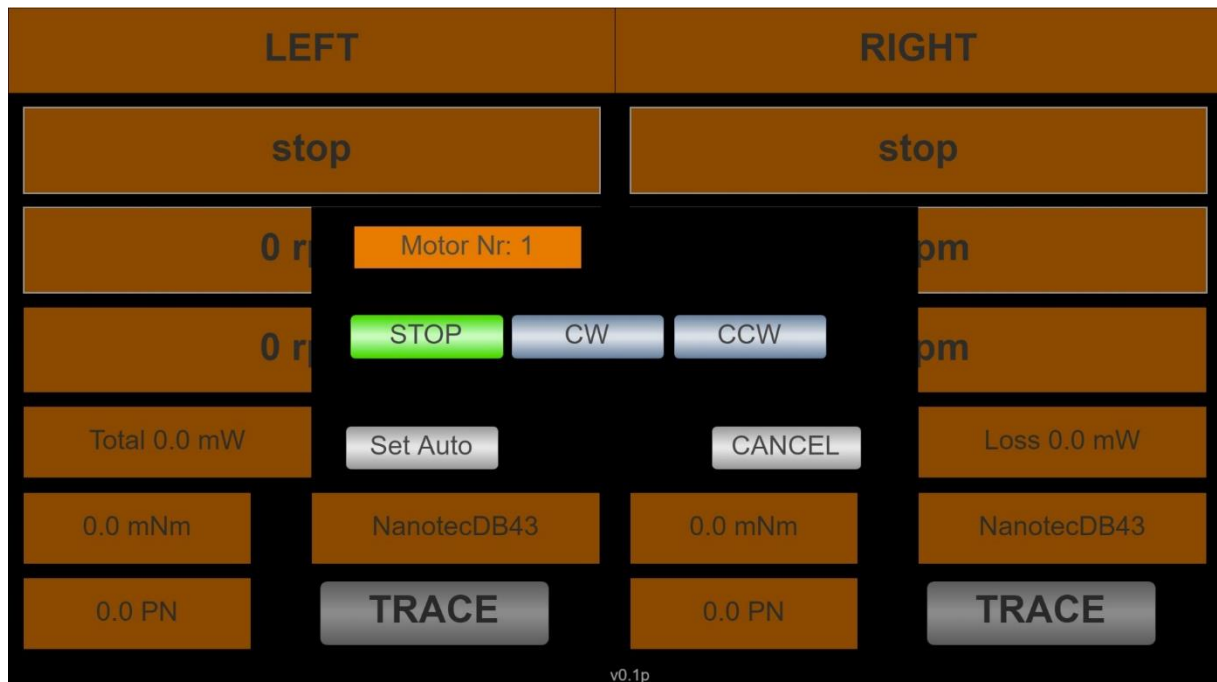
Cilix-2 motor direction selection pop up window.

So, when the target RPM is set to like 50 RPM, the actual RPM the motor perform (before the gearbox) is showed in the real-time RPM field, in this case it is 149 RPM, because it is almost 3 times the 50 RPM being the target after the gearbox and at the load.

3.5 – select motor direction and start the motor

Press the field with “stop” (with white surrounding), a selection window will appear with 4 buttons, the current direction used is highlighted with green:

- **STOP:** Can be pressed if the motor is running to stop the motor instantly.
- **CW:** Can be pressed if the motor is not running (STOP mode) or is in CCW mode and the motor will then start running towards the desired RPM on a clockwise direction.
- **CCW:** Can be pressed if the motor is not running (STOP mode) or is in CW mode and the motor will then start running towards the desired RPM on a counterclockwise direction.
- **CANCEL:** Can be used if no changes are needed and you just want to return to the start screen.



Cilix-2 motor direction selection pop up window.

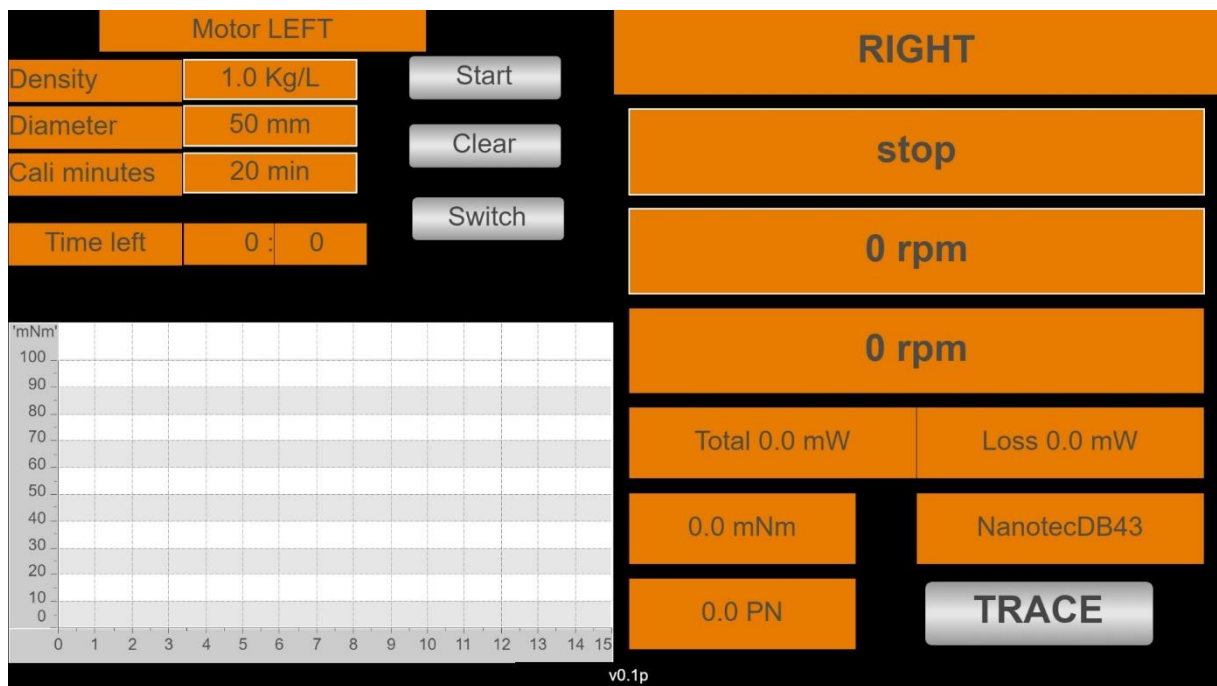
3.6 – Calibration for Power Number

This step is **only** needed if you want to find the Power Number (PN) of the impeller/turbine in use of the current system where the motor is used.

Cilix-2 will during calibration on an empty SUB measure friction in various bearings and seals.

When desired, make sure that the motor is not running (STOP mode), then add the motor and RPM selection as in (1 Select and 2 Select above). It is only possible to measure NP at one specific RPM at a time.

Then press the field “TRACE”. Then a calibration option will appear:



Calibration of LEFT motor for a Power Number test

These steps and data are needed to calculate the PN.

- **Density:** The density of the liquid inside the vessel, press the “Kg/L” field, and type in the desired value like on the 2 Select.
- **Diameter:** Is the diameter of the impeller/turbine, press “mm” and type in the desired value like on the 2 Select.
- **Cali minutes:** Is the time of the calibration, we recommend 30 min or longer time for more precise measurement.

- **Start:** Starts the rotation of the motor, which will be clockwise during calibration with no liquid inside the vessel, it will use the RPM setting that is set on the start screen.
- **Clear:** For clearing the calibration data before a new calibration starts.
- **Switch:** Will show the start screen where it is possible to stop the motor if the calibration needs to be interrupted.



Ongoing calibration on a Cilix-2

Further instruction for PN setup:

- Run the calibration on an empty vessel with the chosen RPM for at least 30 minutes. Allow Cilix-2 to know the power consumption of the system without liquid load on the impeller/turbine. (Remember to add all the variables)
- When the calibration procedure has finished, add liquid to the vessel, and repeat at the same RPM (as at calibration) and start the rotation as explained in section 3.5 - *select motor direction and start the motor*. The PN output is an average value, that is calculated for around 5 minutes, so wait at least 5-10 minutes to read out the PN, to see the most accurate value.
- Never trust the value of the PN unless you have performed the calibration.

NOTES:

The calibration software tool in Cilix-2 is designed for BLDC motors – and NOT STEP motors.

If the motor is calibrated while cold, the mechanical Power Number will during operation fall until the motor has reached its operating temperature at a given speed/resistance. This as the motor will use less power to overcome internal friction when it gets warmer.

Try the above out and with a new “warm” calibration and hereby secure the correct Power Number to drive the actual impeller design.

4 - Operation principles

Assuming the correct assembly of all systems parts, connections, etc. according to your Fluid Diagram – check all connections are tight.

4.1 – Wi-Fi connection

When Cilix-2 is equipped with the Wi-Fi access point the internal webhost will be accessible from a PC, PAD, mobile phone browser.

Go into “Settings”/ Wi-Fi NETWORKS” and check if you can see Cilix-2 and select. Return to a browser and write anything in the address line for access to Apollon PLC inside Cilix-2.

Cilix-2 can be controlled via an USB Wi-Fi antenna adapter:

SSID: cilix-X-cronus

Phrase: cronus-cilix

After connected via WiFi go to the browser and type

<http://192.168.42.1:8080/webvisu.htm>

4.2 – LAN IP/TCP connection

Check present development status on <https://cronus-pcs.com/support/>

4.3 – Software upgrade

Check out www.cronus-pcs.com/support/communication/software-upgrade

4.4 – Power supply

CE and UL power plug with EIC C13 inlet.

Be sure to use cabling and wall socket with earth

5 - Safety precautions

Various components require individual attention. Operator must be familiar with the Safety Instructions to be found on <https://cronus-pcs.com/support/>

5.1 – Documentation

Cilix-2 and BLDC motor functionality must be checked on a regular basis and data of such testing kept recorded.

5.2 – Maintenance

The Cilix-2 unit must be kept away from liquids. No SUBs or liquid containers placed on top of Cilix-2.

Do not open the Cilix-2 unit.

Its of outmost importance that power cables are checked regularly and insure they follow local instructions with proper earth, ground.

5.3 – Electrical security

Cilix-2 is equipped with an UL and CE certified XP Power VEH150PS24 power supply which operates from 110 to 240 VAC and rated at 24 VDC/6.25 amp.

5.2 – CE Declaration of Conformity



CE Declaration of Conformity	
Company: Cronus-PCS A/S	
Company address: Nørrelundvej 10 DK-2730 Herlev Denmark 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 approved and certified by Cronus-PCS.

Designation of the product: Cilix-2

Relevant directives of the EC:

- 2006/42/EC Machinery
- Electromagnetic Compatibility - DIN EN 61000-3-2:2014
- Electrical equipment designed for use within certain voltage limits – EIC 61010-1:2010

Date of signature: 2022-09-13

Function of Signature

Per Stobbe

CEO and Director of R&D
