



# CEREBRAL-55

SMART DC-DC CONVERTER

**USER GUIDE**



# SAFETY, HANDLING & SUPPORT

**WARNING:** Failure to follow these safety instructions could result in fire, electric shock, other injuries, or damage to CEREBRAL-55 Smart DC-DC Converter (CEREBRAL-55) or other property. Read all the safety information below before using CEREBRAL-55.

**Handling** Handle CEREBRAL-55 with care. It comprises half-brick DC-DC converter modules, printed circuit board, electronic components, heat sinks and cooling fans. CEREBRAL-55 is not designed for extreme conditions, rough handling, vibration, shock or drop. Keep CEREBRAL-55 away from heat, flame, strong sunlight, water, dust, soil or mud. Do not use a damaged CEREBRAL-55.

**Repairing** Do not disassemble or tamper with CEREBRAL-55. Do not troubleshoot, repair or replace any component by yourself.

**Ventilation** Operate CEREBRAL-55 in a well ventilated environment. Hot air exiting from the cooling fans shall not be obstructed or restricted.

**Connectors, ports and buttons** Never force a connector into a port or apply excessive pressure to a button. If the connector and port do not join with reasonable ease, they probably do not match. Check for obstructions and ensure that the connector matches the correct port.

**Disposal and recycling** As CEREBRAL-55 contains electronic components, it must be disposed of separately from household waste. When CEREBRAL-55 reaches its end of life, follow local laws and regulations for proper disposal and recycling options.

**High-consequence activities** CEREBRAL-55 is a customized system with pending safety tests and certifications. It is not intended for use where the failure of the system could lead to death, personal injury or severe environmental damage.

**Disclaimer** Every effort has been made to ensure that the information in this manual is accurate. This manual serves to adequately recommend safe operating procedures, but shall not be treated as comprehensive. Do not use CEREBRAL-55 in any other way than the one recommended in this manual. Spectronik reserves the right to change system specifications, appearance or discontinue the product at any time.

**Warranty** Spectronik warrants the included hardware product and accessories against defects in materials and workmanship for the first 30 days after delivery. Spectronik does not warrant against normal wear and tear, nor damage caused by accident or abuse.

*To obtain service, contact [support@spectronik.com](mailto:support@spectronik.com)*

# 1 SPECIFICATIONS

## 1.1 CEREBRAL-55 SPECIFICATIONS

Description	5.5kW 90V 75A Smart DCDC Converter Regulated Non-Isolated Buck-Boost
Features	Wide input & output voltage ranges User-configurable Voltage and Current output via GUI User-configurable Current output ramp rate via GUI Power output On/Off switch Live monitoring of input Current and Voltage from source Live data logging (csv file) via GUI Load sharing among the internal DC-DC modules Inrush Current limiter Integrated thermal control with heat sink and cooling fans Applicable for battery charging (voltage output droop while maintaining set Current output)
Product Code	C-55-1590-75-S
<b>Electrical Specifications</b>	
Isolation <sup>(1)</sup>	Non-isolated DCDC
Input V <sup>(2)(3)</sup>	15 to 90 V
Input I max	75 A
Output V range <sup>(4)(5)</sup>	12 to 90 V
Output I limit range <sup>(4)</sup>	2 to 75 A
Output current ramping <sup>(4)</sup>	1 to 20 A/s
Rated max Power <sup>(6)</sup>	5500 W
Efficiency	94 - 98 %
Start-up Duration <sup>(7)</sup>	< 1700 ms
<b>Mechanical Specifications</b>	
Mass with Heatsink & fan	1460 g
Size L x W x H	360 x 100 x 90 mm (with spacers)
Power Cables Connections	Lug connection for M5 male with Nut
Mounting	10 x Ø3.2mm or M3 spacers
Advised ambient temperature	-15 to 60 °C
Advised temperature threshold <sup>(6)(8)</sup>	< 80 °C on converter
<b>Converter Safety Features</b>	
CAN/CSA-C22.2 No.60950-1:2007/A2:2014	
UL 60950-1:2007/A2:2014	
EN 60950-1:2006/A2:2013	

[1] UART communication port is isolated.

[2] Non-operating Input max 99V.

[3] Input Over-Voltage shutdown during operation, if > 90V.

[4] Programmable settings through GUI during start-up via comm port with PC.

[5] Might require a minimum load of 0.5A for tighter tolerance at Output V.

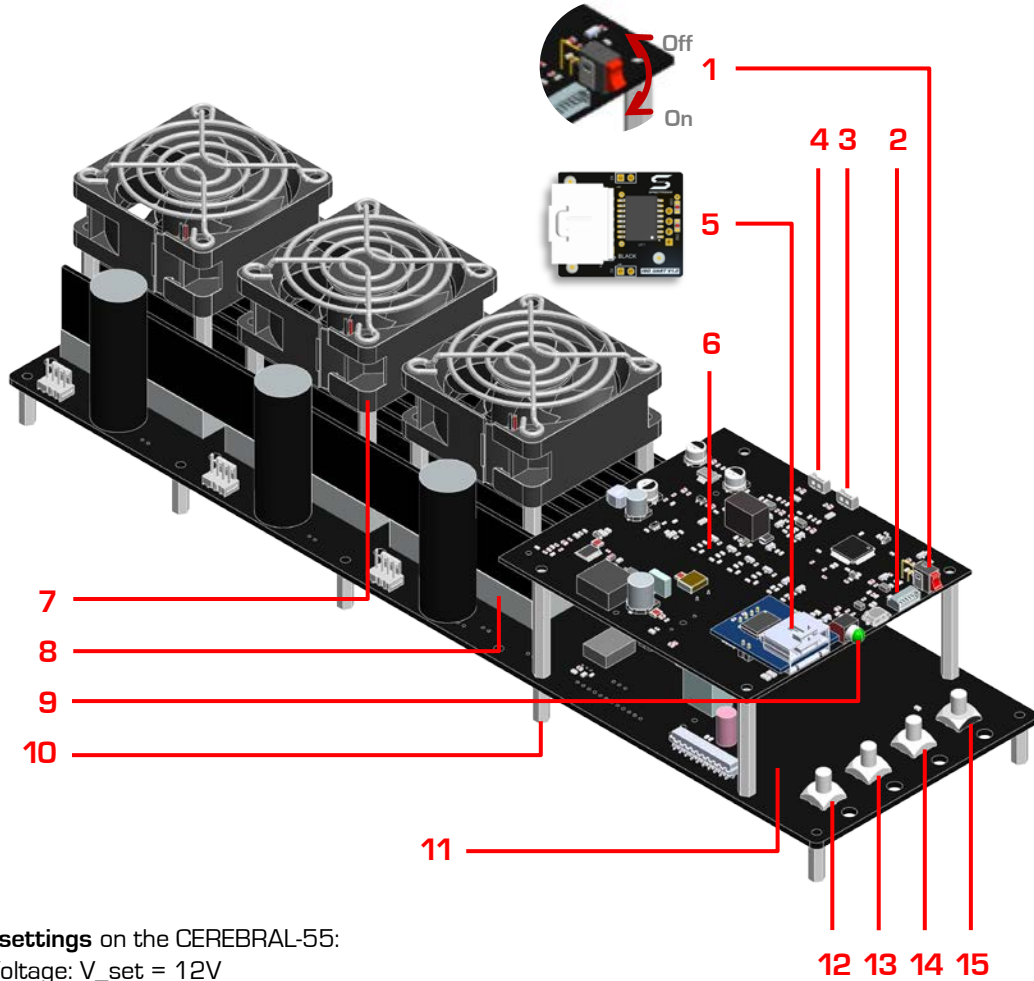
[6] Output current derates when > 80 °C.

[7] System boot-up in 1200ms automatically when there is input power. Max power output in about 500ms after switch is turned on.

[8] High-Temperature shutdown, if > 105 °C.

# 2 OVERVIEW

## 2.1 CEREBRAL-55 SYSTEM OVERVIEW



### Factory settings on the CEREBRAL-55:

Output Voltage:  $V_{set} = 12V$

Output Current:  $I_{set} = 2A$  (the minimum Current Limit value)

Output Current Ramping = Deactivated (displayed as 0, 1.0 A/s)

**Configure new  $V_{set}$  /  $I_{set}$  / Ramping settings through Spectronik Cerebral DCDC GUI.**

**$V_{set}$  and  $I_{set}$  are limited such that their product does not exceed 5600W.**

This allows the full 5.5kW to the load end despite in-line voltage drops from conduction losses.

### ITEM DESCRIPTION

1. Output On/Off Switch	6. Control board	11. Converter Board
2. Programming Port	7. Fans x3	12. GND M5 stud
3. Load VI sensing	8. DCDC Converters x3	13. V_in M5 stud
4. Supply/Battery VI sensing	9. Status LED	14. V_out M5 stud
5. UART Port	10. Mounting M3 Spacers x10	15. GND M5 stud

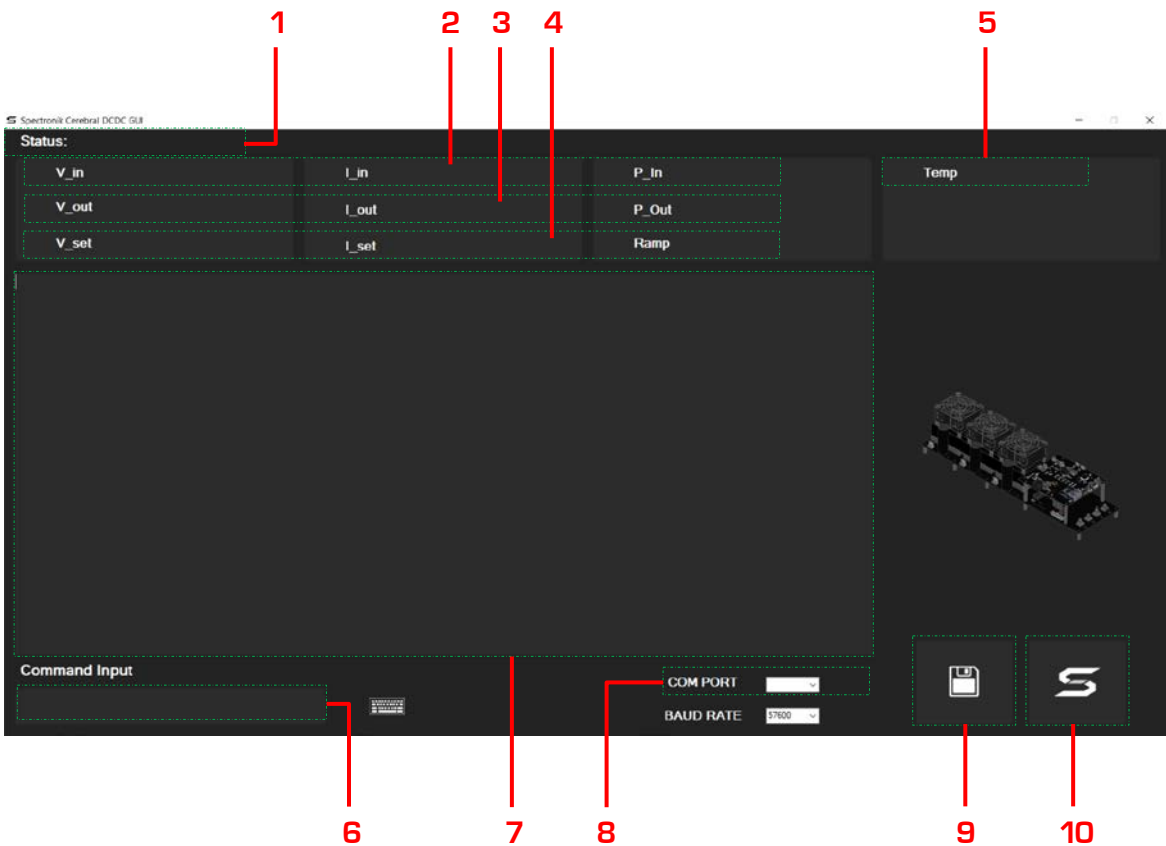
## 2.2 GRAPHIC USER INTERFACE (GUI) OVERVIEW

Configure CEREBRAL-55 output settings through the “**Spectronik Cerebral DCDC GUI**” PC app using the USB-to-UART cable.

**Tip:** A terminal emulation program on a computer, such as a HyperTerminal, is an alternative. Use com port settings: 57600 bps | 8 Data Bit | No Parity Bit | 1 Stop Bit | No Flow Control

The GUI has the following features:

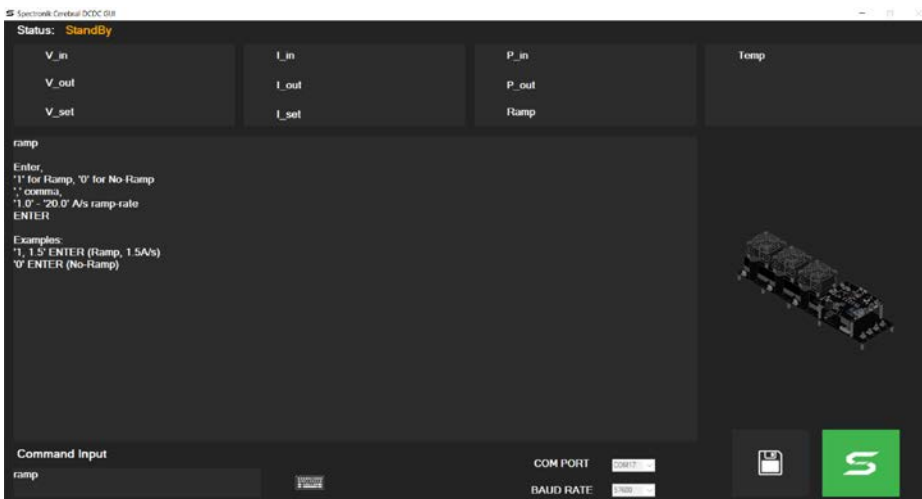
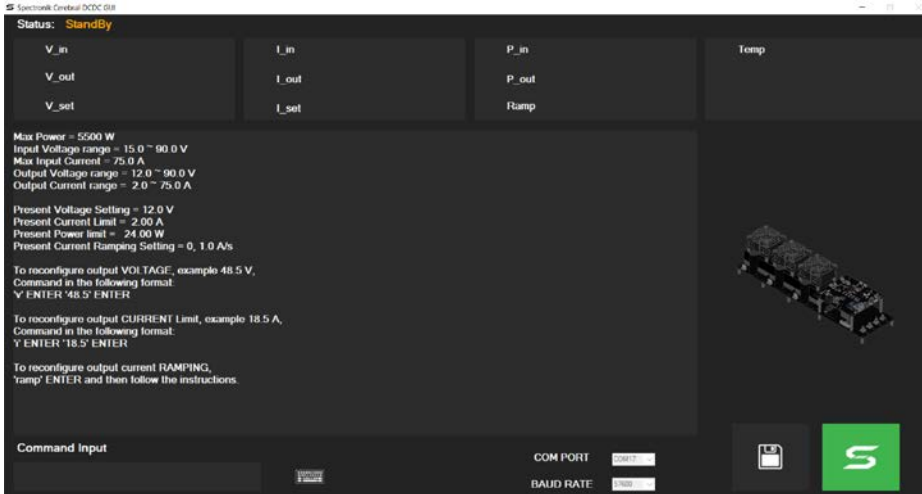
- I. Display input and output values.
- II. Display CEREBRAL-55’s settings.
- III. Display CEREBRAL-55’s operational status.
- IV. Clear step-by-step user guide on how to configure settings.
- V. Data-logging into CSV file.



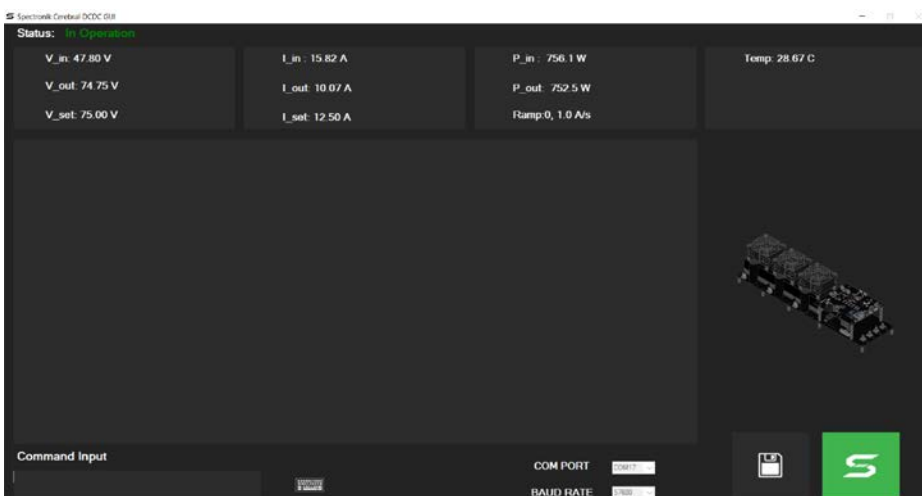
### ITEM DESCRIPTION

- |    |                       |     |  |
|----|-----------------------|-----|--|
| 1. | Operational Status    | 6.  | User input text box                    |
| 2. | Values of Inputs      | 7.  | System messages output box             |
| 3. | Values of Outputs     | 8.  | Communications port drag-down selector |
| 4. | Output Settings       | 9.  | Data-logging “Save” button             |
| 5. | Converter Temperature | 10. | System “Connect” button                |

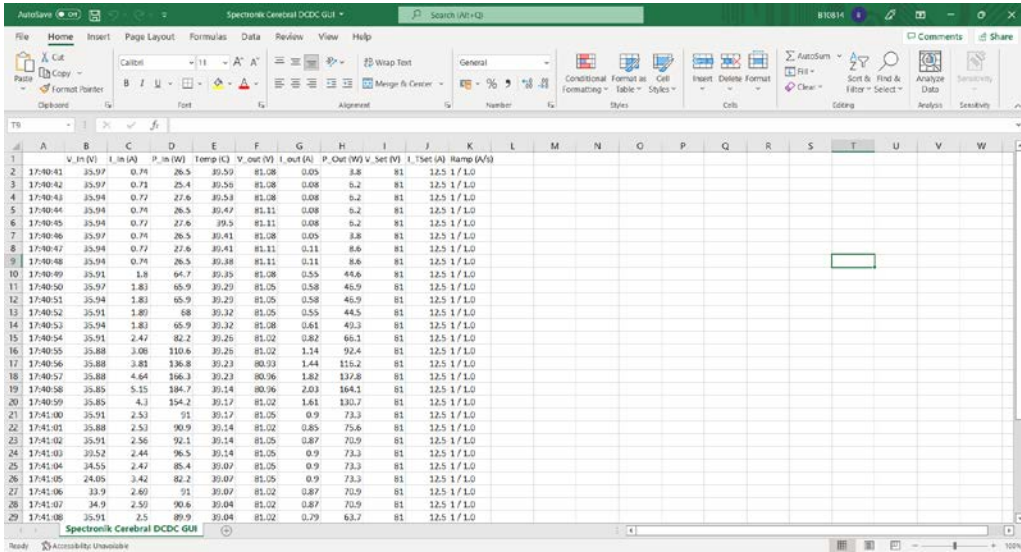
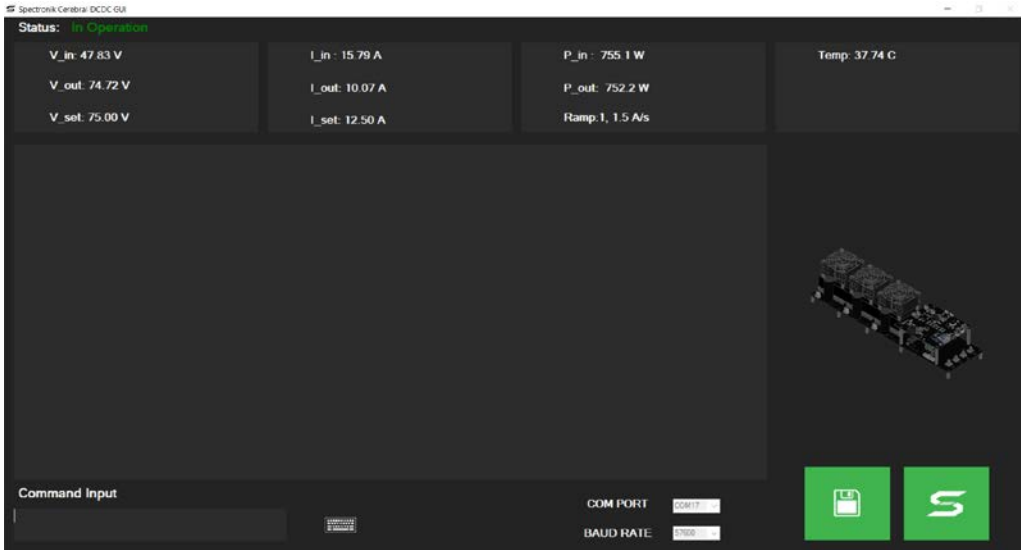
GUI displays output configurations and instructions for new settings.



GUI displays live status when the output Switch is turned on.

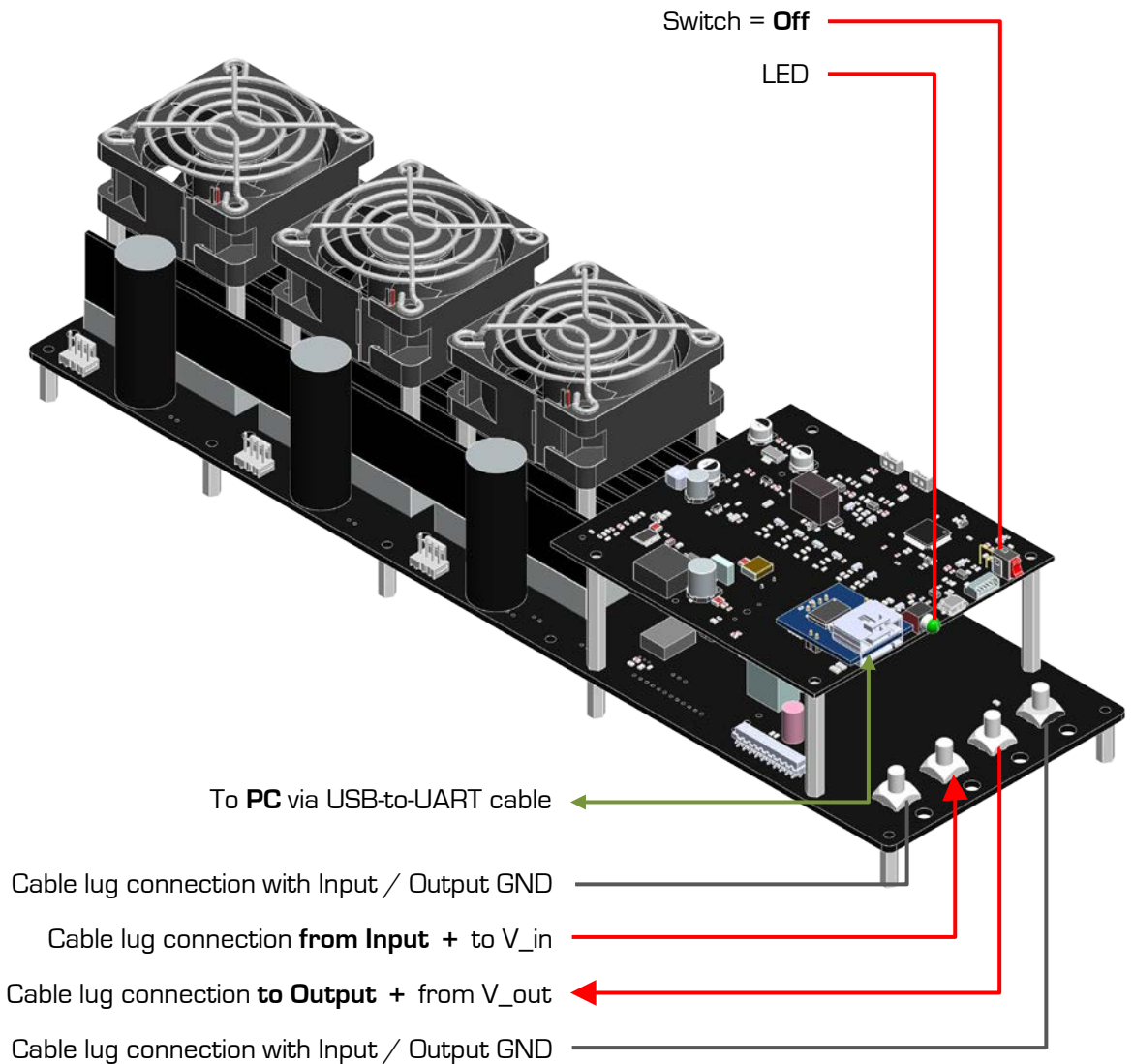
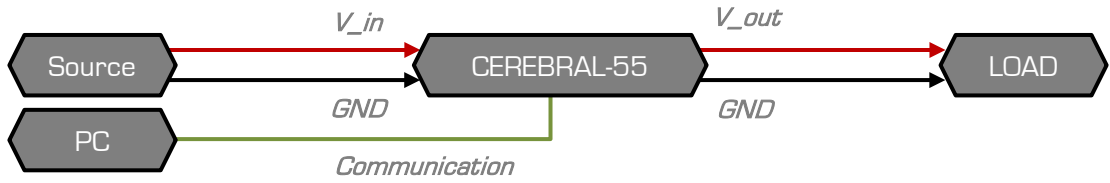


Live data-logging is available and will be saved in a CSV format.



# 3 OPERATING CEREBRAL-55

## 3.1 GETTING STARTED (SYSTEM CONNECTIONS)



Turn **on** the power at **source**. System will boot up.

Turn **Switch** to **ON** to **allow output** at  **$V_{out}$**  (to load). (Output settings are set to last used configuration. If in doubt, connect to GUI to verify output settings.)

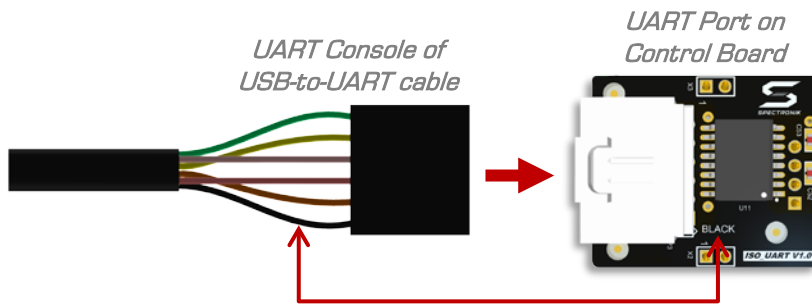


## 3.2 GETTING STARTED (GUI SETUP)

Install “**Spectronik Cerebral DCDC GUI**” on a PC.  
The GUI loader icon will be on desktop screen after installation.  
(Software can be downloaded from Spectronik website.)



**Connect** the CEREBRAL-55 **UART-Port** to the **PC** using the **USB-to-UART** cable.  
At the UART connection, ensure correct orientation,  
Black wire to “BLACK” locator.

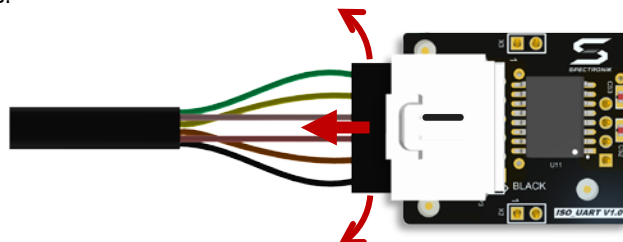


### Caution

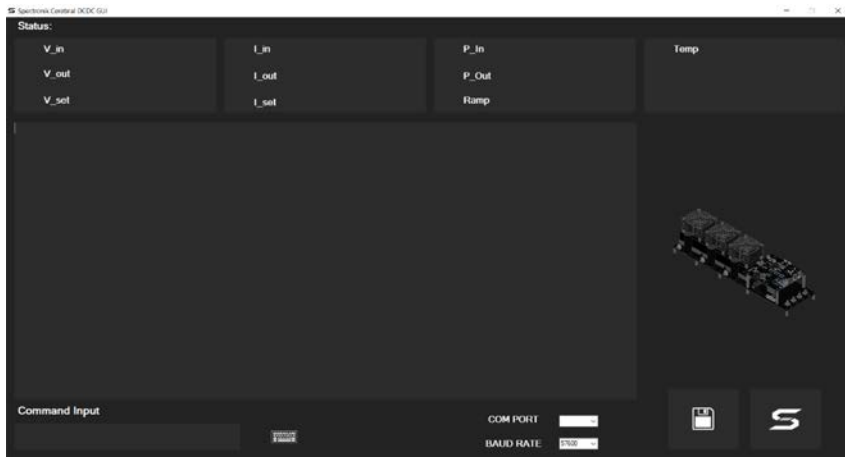
The UART connector has a tight fit to provide a robust connection.

When connecting, ensure the UART console is fully inserted into the receiving port.

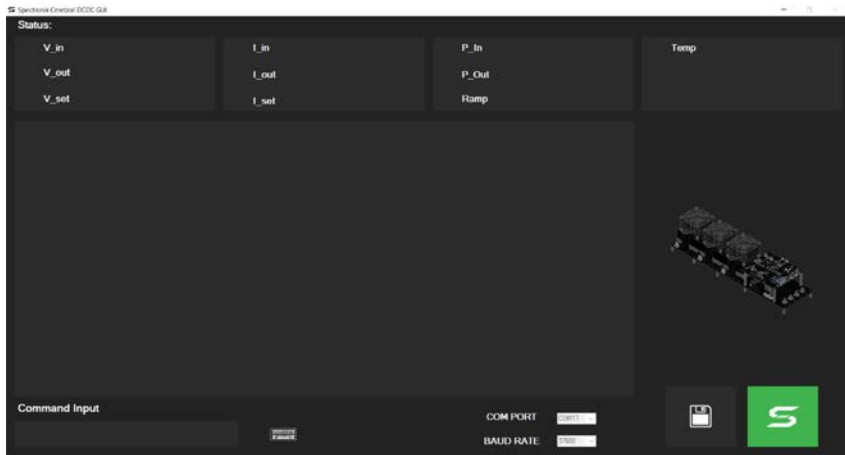
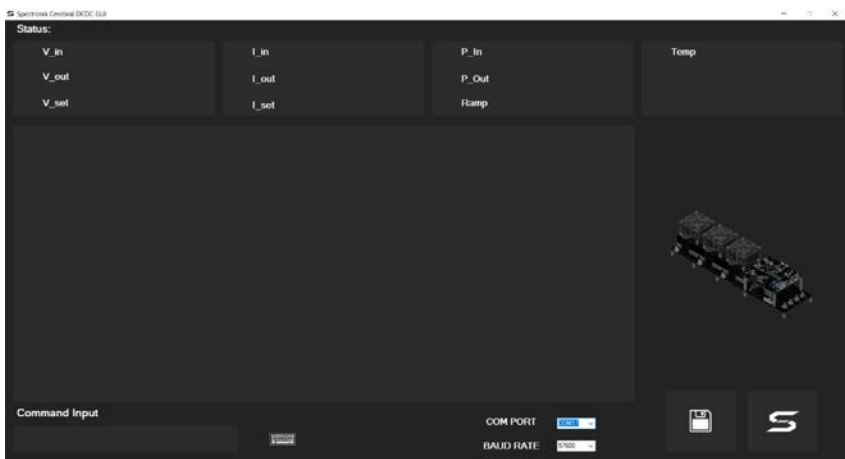
When disconnecting, firmly grip the sides of the console head and pull out.  
You may jiggle it sideways but not up-down.  
Do not pull by the wires.



When the CEREBRAL-55 and the PC are connected,  
**Run the GUI.**  
The program windows shown below would appear.



Select the correct **communication port** and click on the **S** (Connect) button.



The GUI is now connected to the CEREBRAL-55.  
GUI will respond once there is power into the CEREBRAL-55.

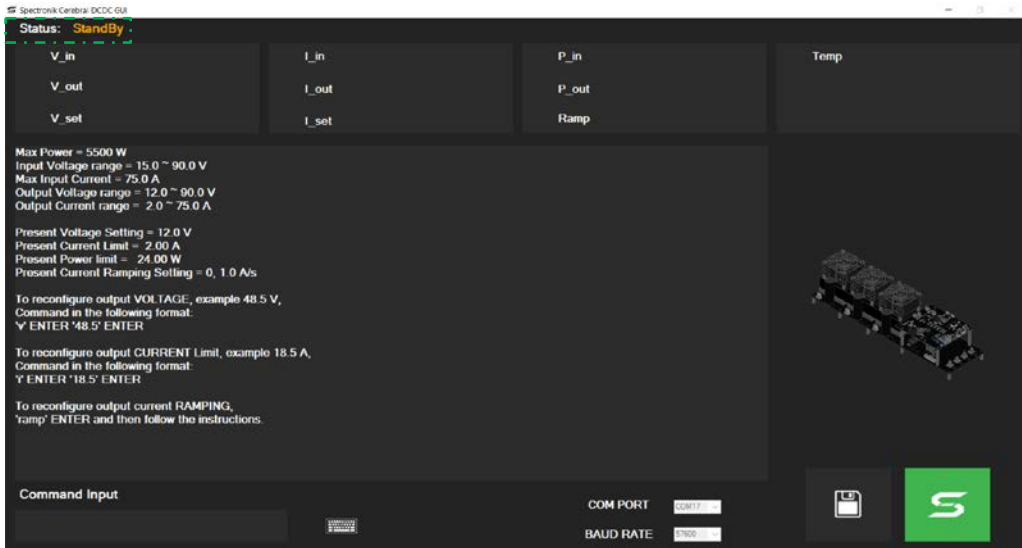
**Note**

GUI is not needed to turn on the CEREBRAL-55.  
GUI is only needed for output setting(s) reconfigurations.  
The GUI may remain connected for monitoring and datalogging.

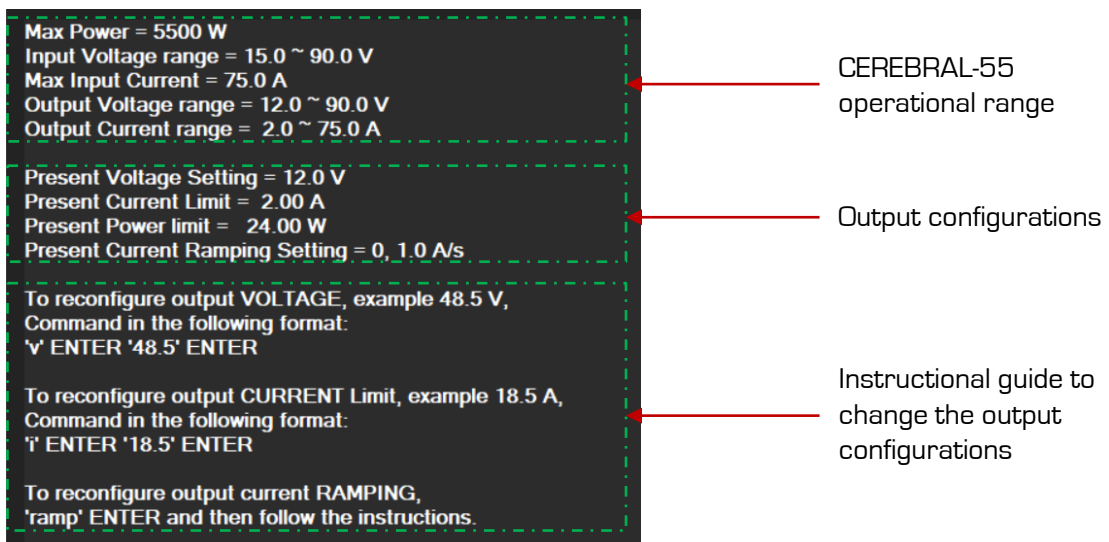
### 3.3 GETTING STARTED (SYSTEM CONFIGURATION)

Turn on the input power (at Input +) to the CEREBRAL-55.  
Input power automatically activates the system.)

The CEREBRAL-55 has entered “Standby” status, as shown on the GUI.  
(If the GUI screen remains unchanged (blank), it is likely that the com port is incorrect.)

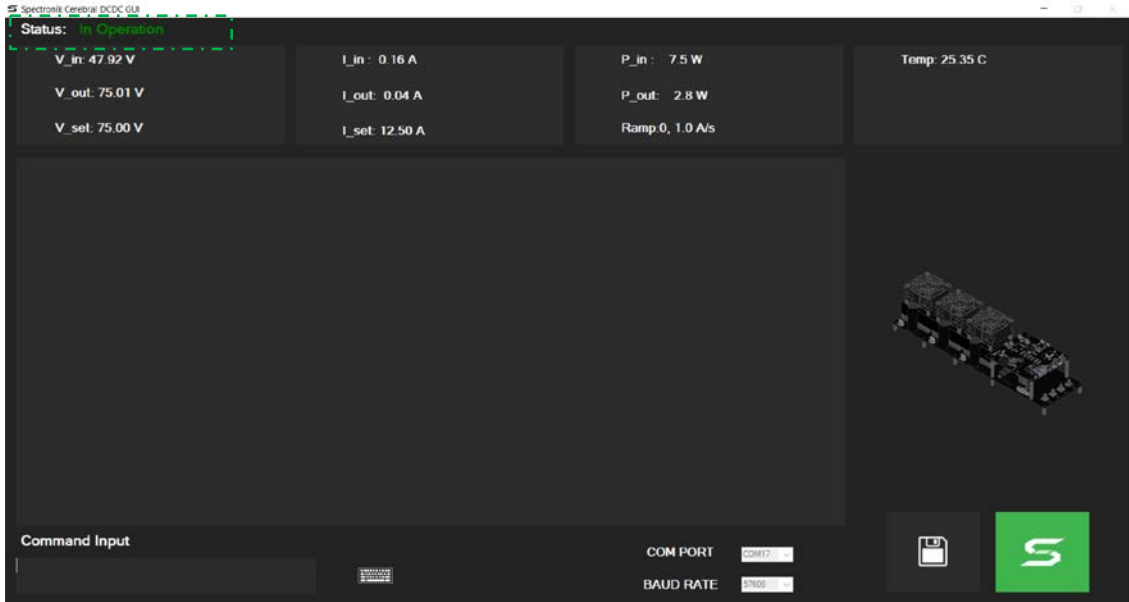


Keep the **Switch** at **Off** to make changes to the output settings.  
Refer to the guide printed in the message box,  
Follow the relevant steps to change the output setting(s).  
Illustrations are available in the appendix.



CEREBRAL-55 is now **ready**.  
(Ensure output settings are configured correctly.)

Turn **Switch** to **On**, to allow power **output**.  
GUI will show that the system has entered “**In Operation**” status.

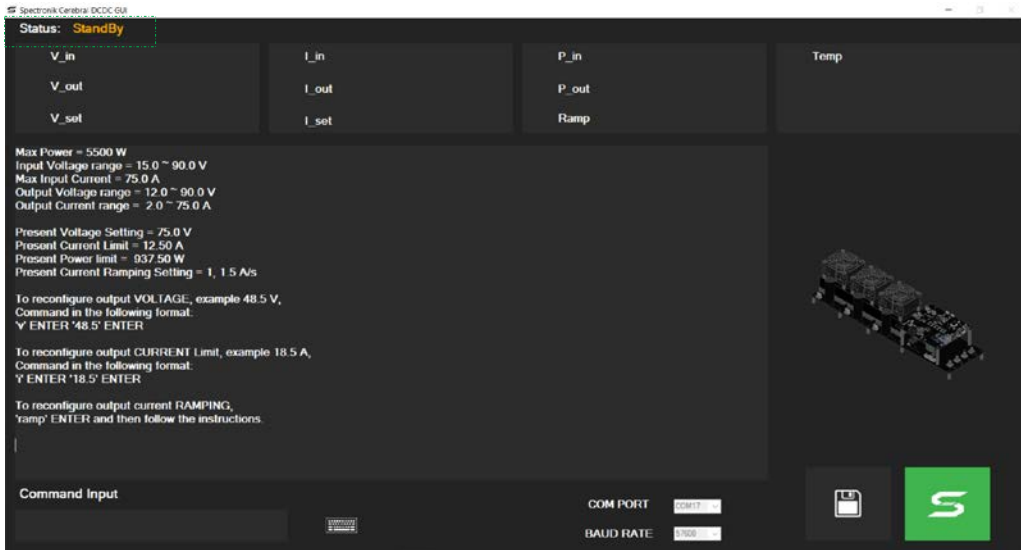


## 3.4 SHUTTING DOWN

### Turning off output

To disable output power from the CEREBRAL-55, turn **Switch** to **Off**.  
The system will return to “**Standby**” status.


Note: CEREBRAL-55 will automatically shut down if there is no Input power.

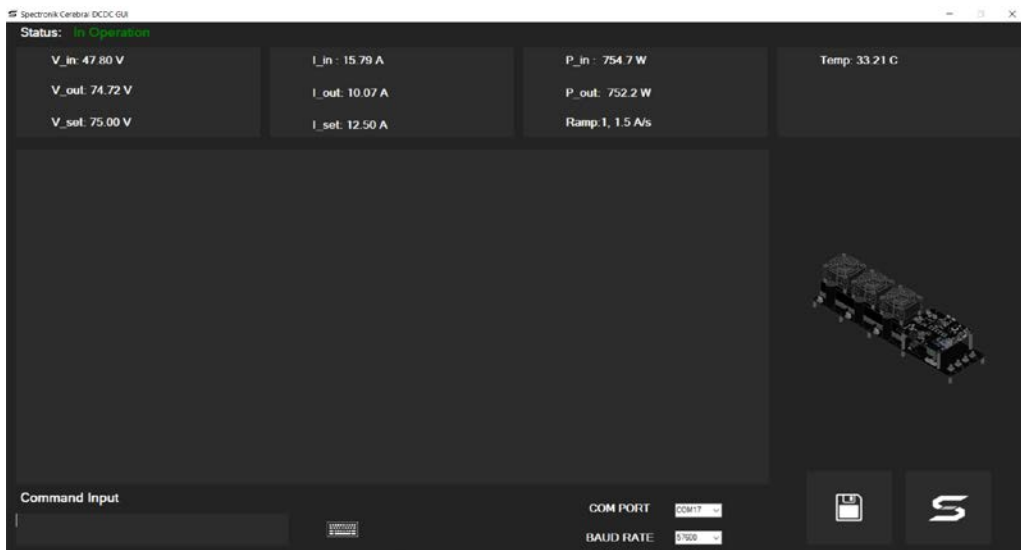


### Aborting the GUI program

The GUI can be disconnected or terminated at anytime.

Click on the  (Connect) button to end GUI.

The  (Save) button must be at 'off' in order to end the GUI.



The “x” button on  is now permitted.

### 3.5 CURRENT-RAMPING

“Current-Ramping” is a process to control the current increase slew rate, in a stepwise manner.

This feature is pragmatic for application where the power source prior to the DCDC converter might not be able to provide/discharge its full power instantaneously (such as fuel cells) and requires time to meet that capacity. This also support smoothing the transition between multiple power sources.

The current ramping rate is configurable,

Ramping function can be set to **Active** or **Non-active** (configurable through setting)

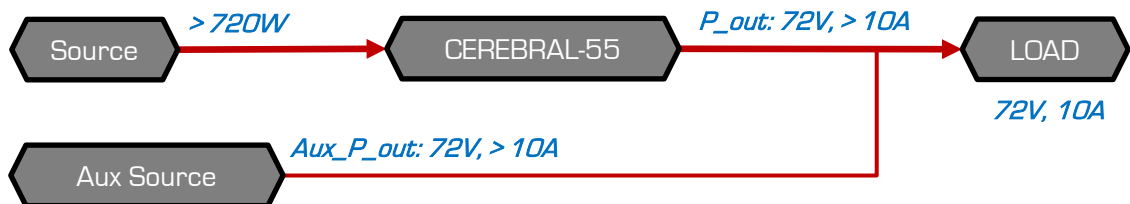
Step length resolution = **500ms** (fixed)

Step height resolution = **500mA ~ 10000mA** / 500ms (configurable through setting)  
(Range given as 1A/s to 20A/s)

Refer to “Output Current Ramping Setting (active & non-active)” in the appendix for setup guide.

When operating with an active Current-Ramping program, it is necessary to have an **auxiliary power source** (*Aux\_P\_out*), in parallel to the Cerebral-55 output (*P\_out*).

The auxiliary power must be there to support the full power demand from the load, while the Cerebral-55 ramps up its power output.



See example on next slide.

## An example

### Cerebral-55 Settings:

**I\_Set:** 12.5 A, (Output I Limit)

**Ramp:** 1, 1.5 A/s

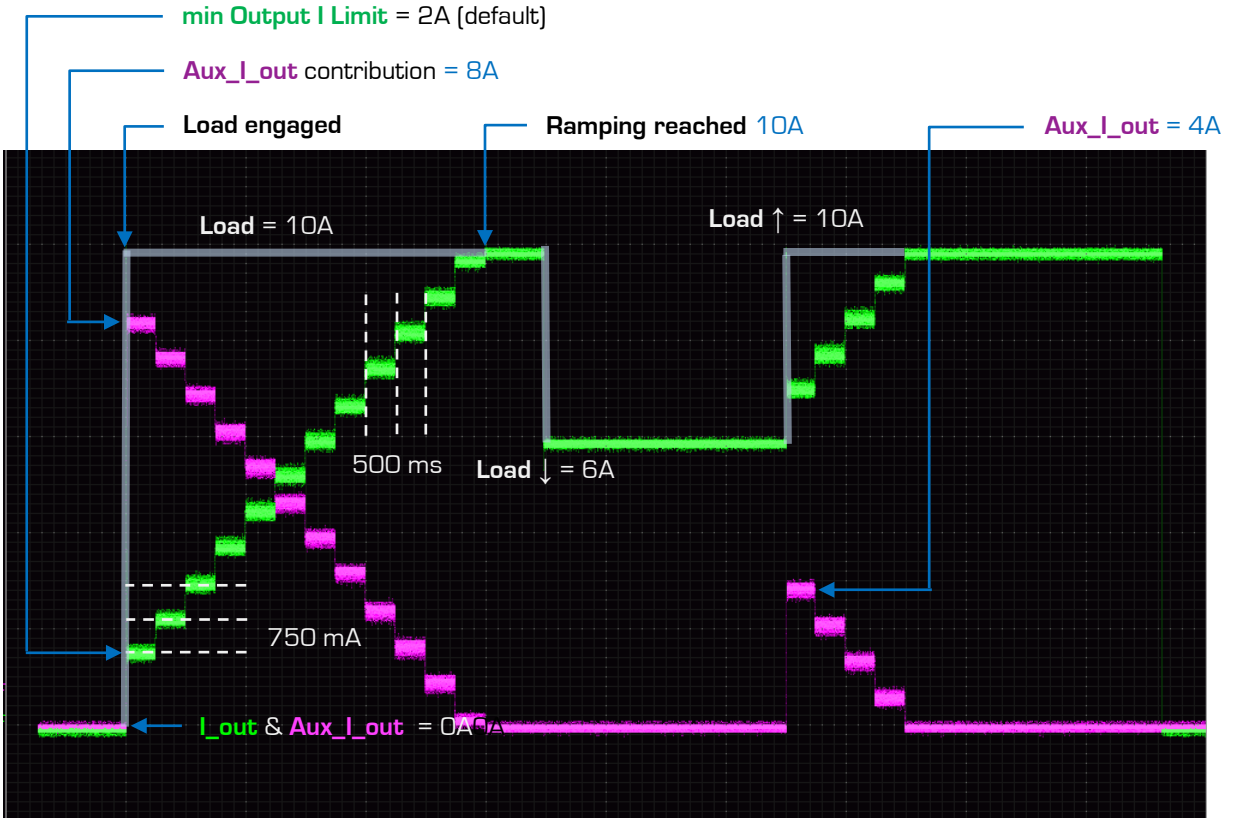
$\therefore$  step resolution  $\rightarrow$  750mA/500ms

### Electronic-Load:

**Mode:** Constant-Current

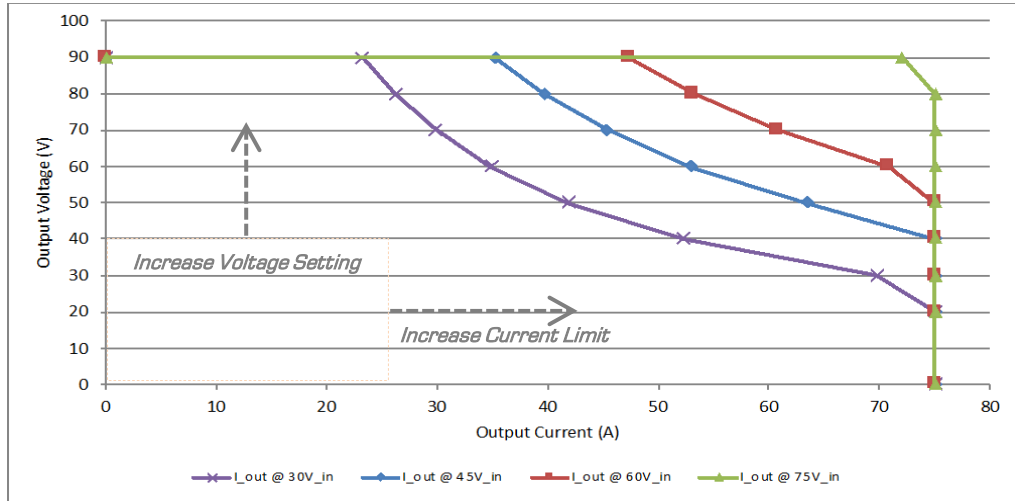
(For steady current demonstration)

**Load:** 10 A



### 3.6 PERFORMANCE GRAPHS & TABLES

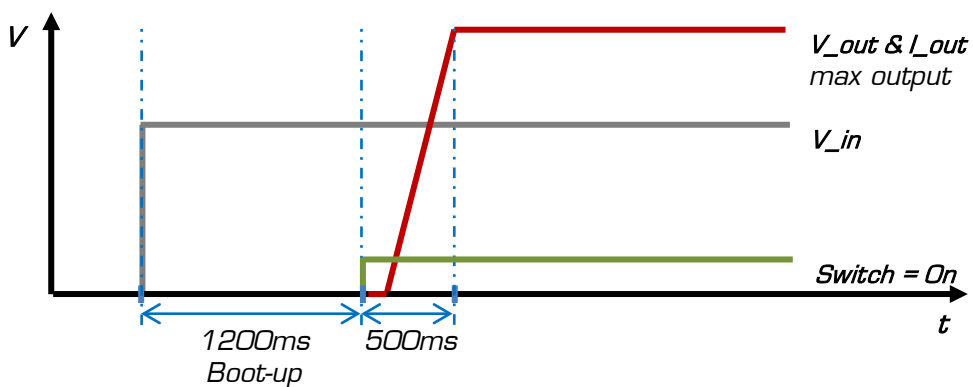
#### VI Characteristic of Input & Output relations Graph



#### Efficiency reference Table

V <sub>in</sub>	V <sub>set</sub>	V <sub>out</sub>	I <sub>in</sub>	I <sub>out</sub>	P <sub>in</sub>	P <sub>out</sub>	Effi	Notes
15	24	24.04	71.80	40.99	1077.00	985.40	91.49	Low-low buck
24	15	15.00	50.70	74.49	1216.80	1117.35	91.83	Low-low boost
24	48	47.68	75.10	35.39	1802.40	1687.40	93.62	Low-mid boost
48	24	23.81	38.90	73.99	1867.20	1761.70	94.35	Mid-low buck
48	48	47.19	75.00	73.29	3600.00	3458.56	96.07	Mid-mid buck/boost
15	90	89.60	75.40	10.89	1131.00	975.74	86.27	Low-high boost
90	15	15.05	14.00	73.99	1260.00	1113.55	88.38	High-low buck
48	80	79.10	75.50	43.99	3624.00	3479.61	96.02	Mid-high boost
80	48	47.14	45.30	73.99	3624.00	3487.89	96.24	High-mid buck
80	80	78.50	67.30	66.99	5384.00	5258.72	97.67	High-high buck/boost

#### Startup Duration Graph

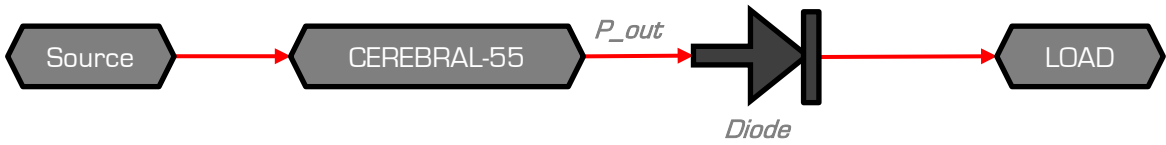




### 3.7 SYSTEM INTEGRATIONS

#### Stand-Alone Power Source

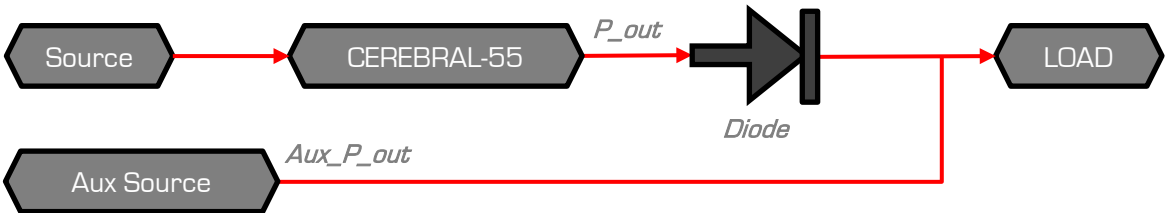
If the load is capable of generating a potential, A **Diode** at the converter output must be in place.



#### With Parallel Power Source(s)

When integrating with another source of power in parallel to the converter output, A **Diode** at the converter output must be in place.

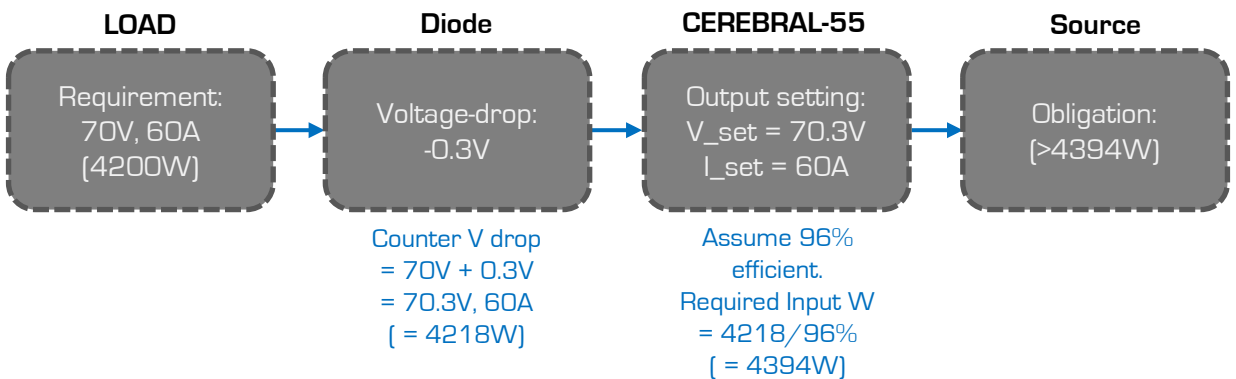
\*And depending on the type and function of the parallel source, it may require a diode as well.



#### Sizing up Power Requirements in an Integration

Work backwards to determine power requirements and obligations on respective segments.

An example:



#### Recommended Diode

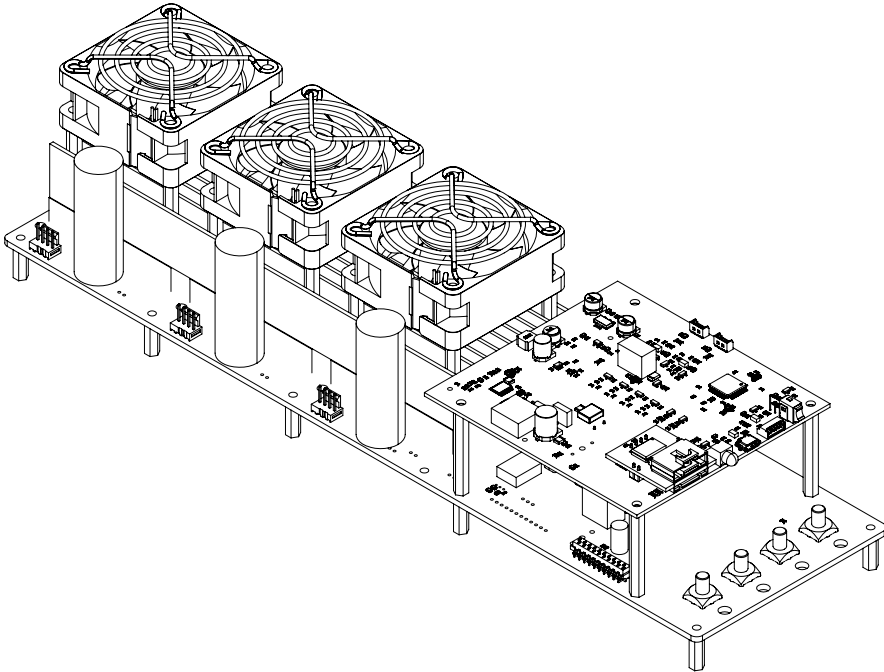
Peak Reverse Voltage: 170V

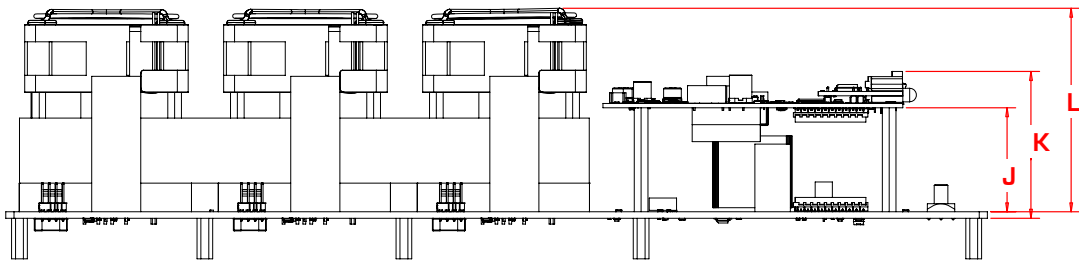
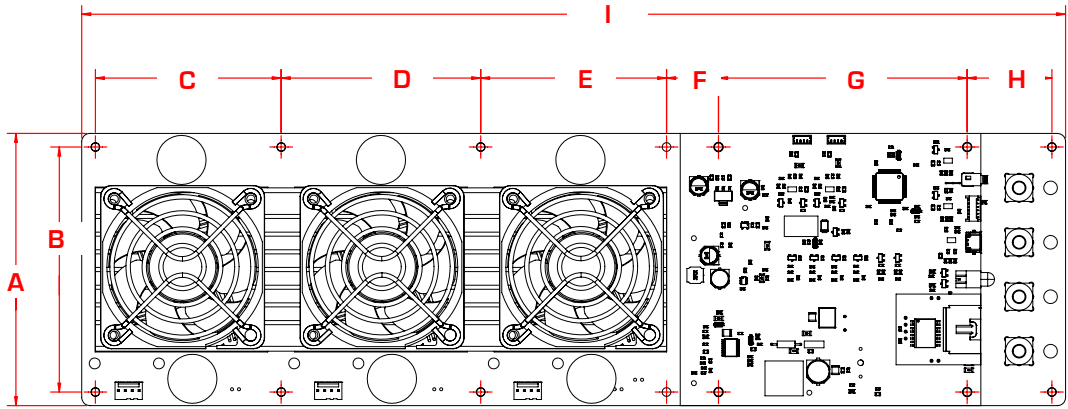
Max Forward Current: 100A

Reference diode model: STPS200170

# 4 MECHANICAL DRAWINGS

## 4.1 MECHANICAL DRAWINGS - CEREBRAL-55





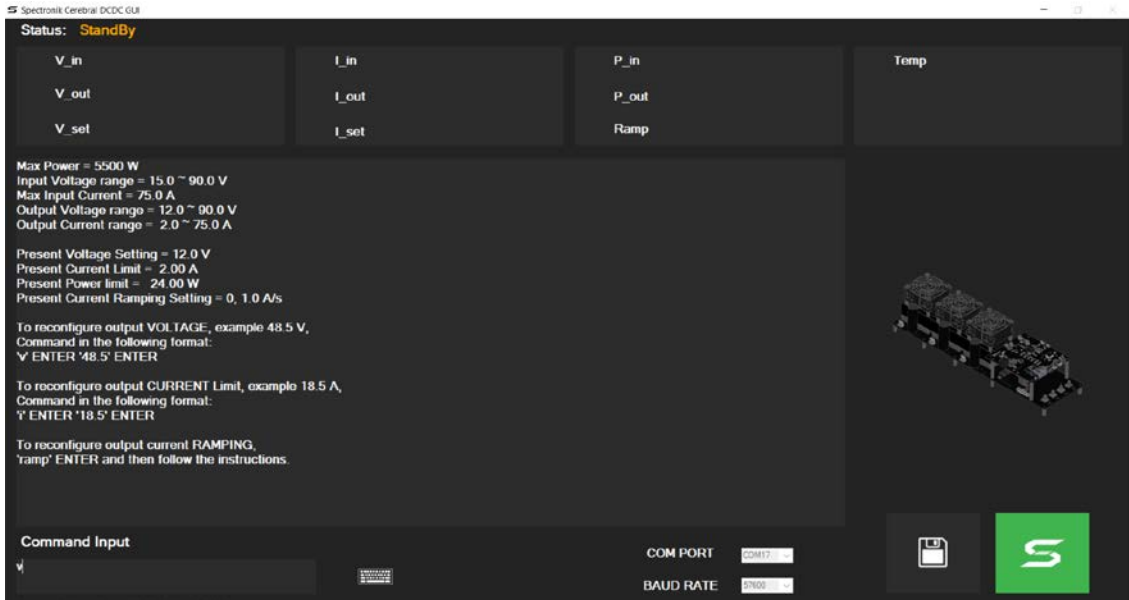
**All dimensions in mm**

<b>A</b>	100.00	<b>G</b>	91.00
<b>B</b>	90.00	<b>H</b>	31.00
<b>C</b>	68.00	<b>I</b>	360.00
<b>D</b>	73.00	<b>J</b>	40.00
<b>E</b>	68.00	<b>K</b>	54.30
<b>F</b>	19.00	<b>L</b>	75.20

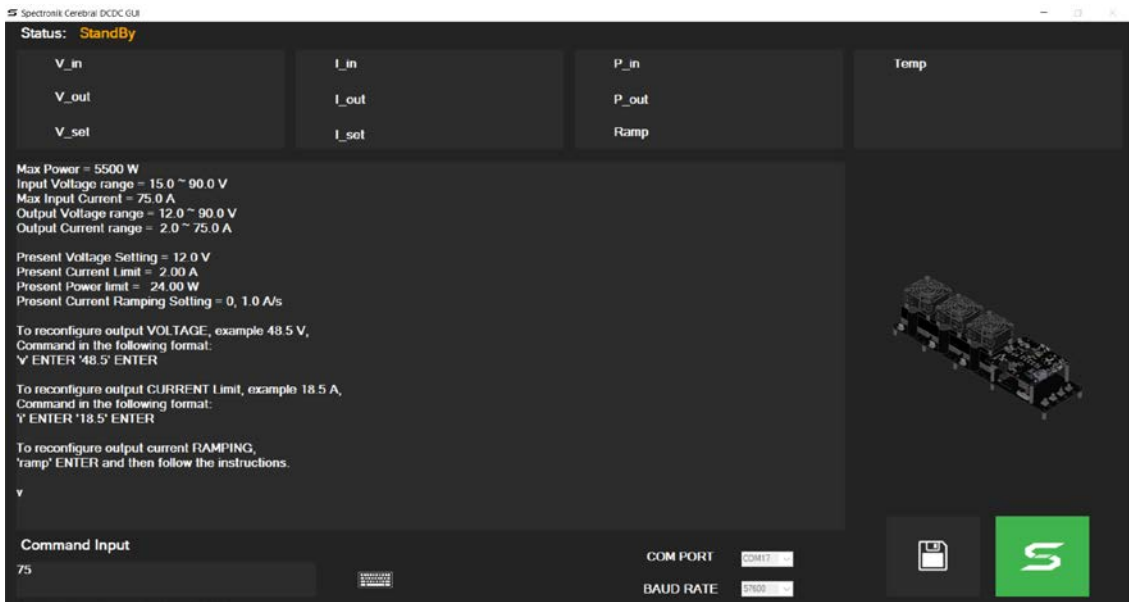
# 5 APPENDIX

## 5.1 APPENDIX – OUTPUT VOLTAGE SETTING

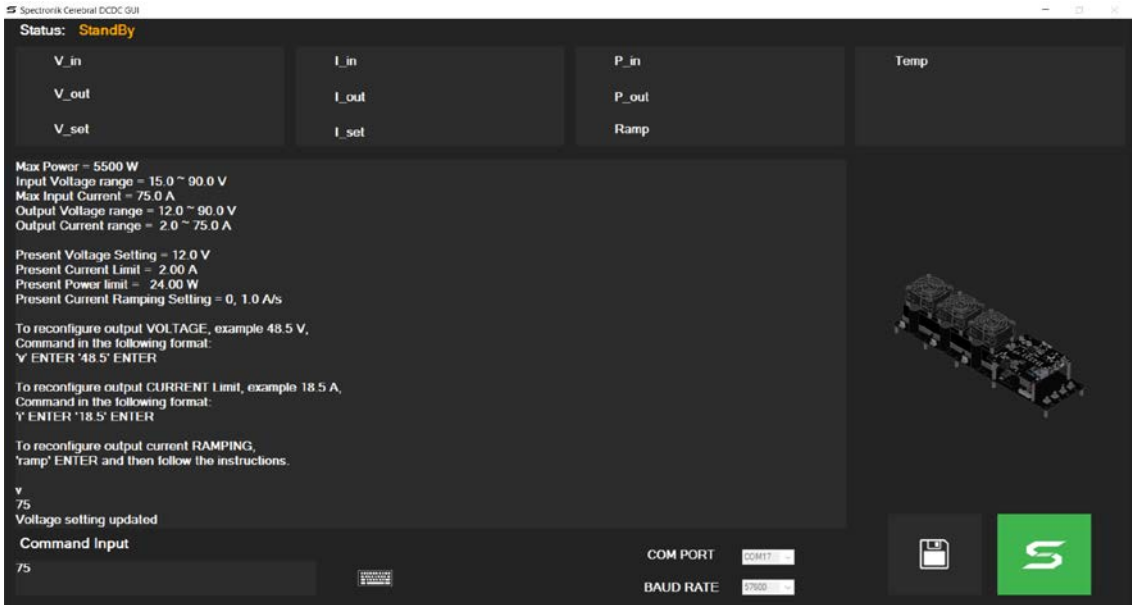
Type in “v” into the input text box, followed by the “enter” key.



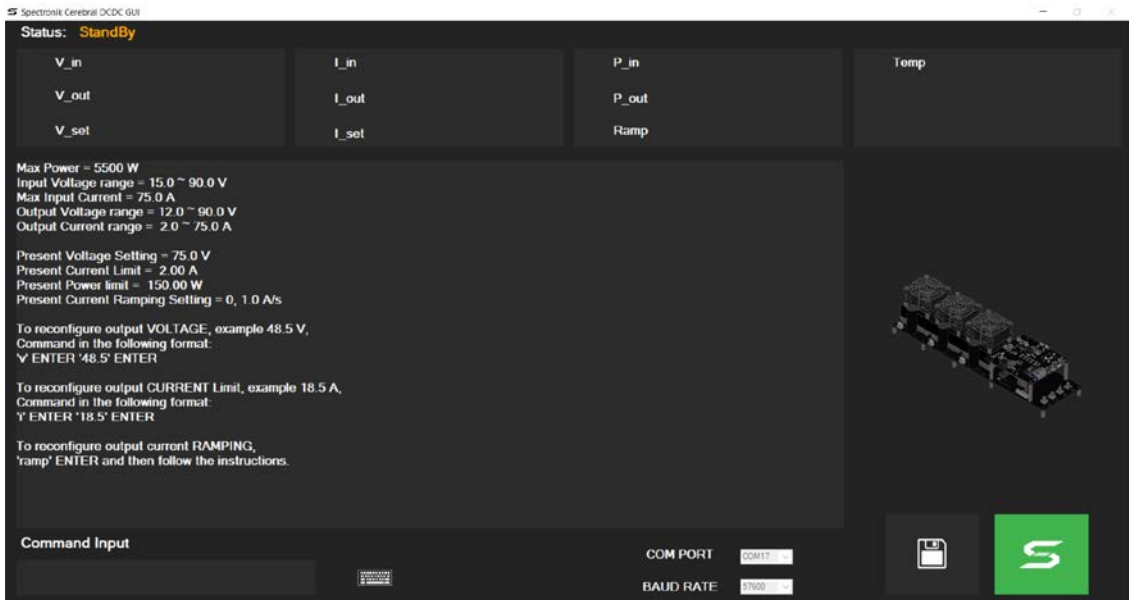
Type in desired voltage, e.g. “75”, and “enter”.



Acknowledgement to the voltage change is printed.

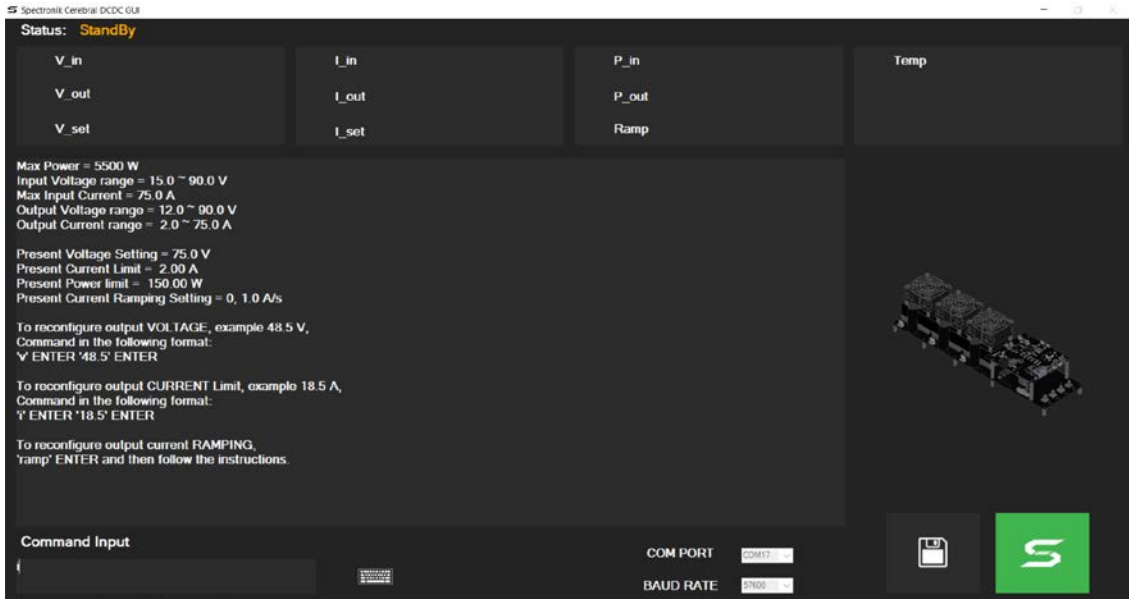


Values on output configuration is updated and displayed.

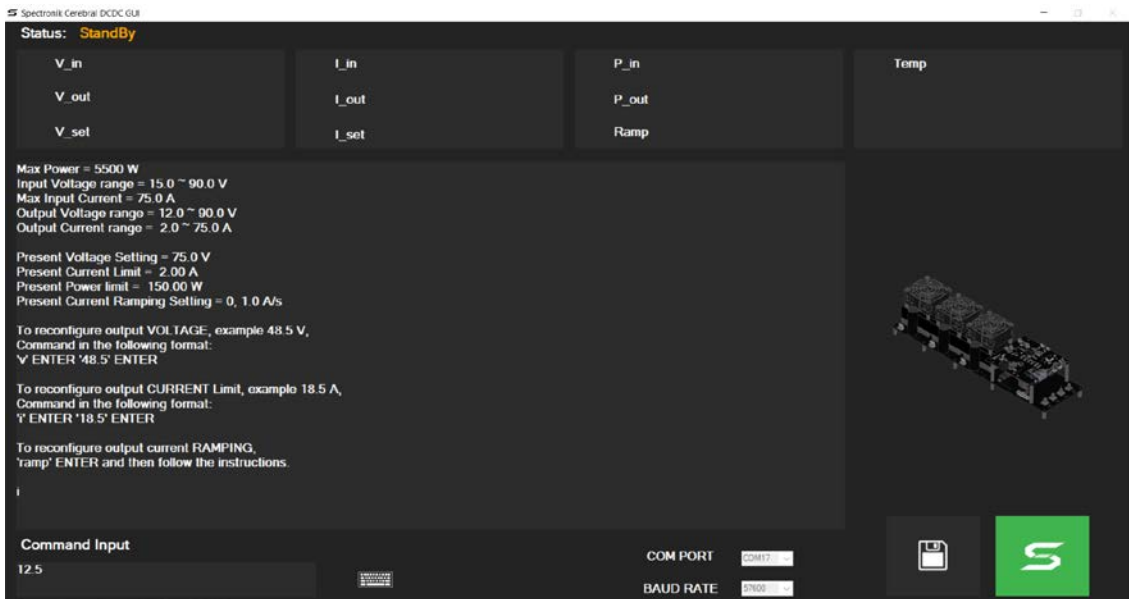


## 5.2 APPENDIX – OUTPUT CURRENT LIMIT SETTING

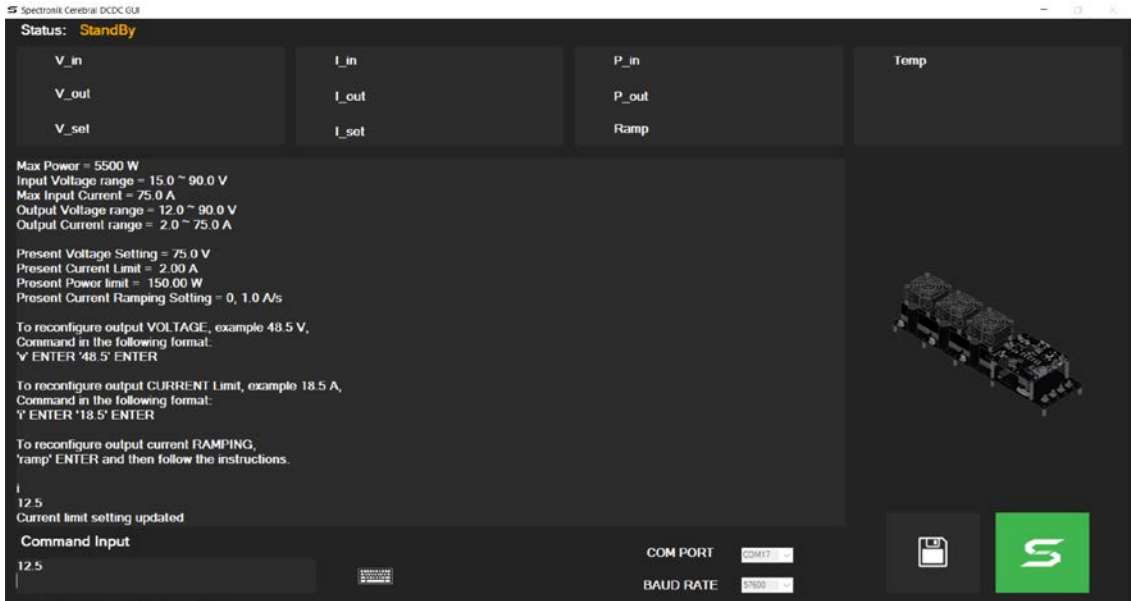
Type in “I” into the input text box, followed by the “enter” key.



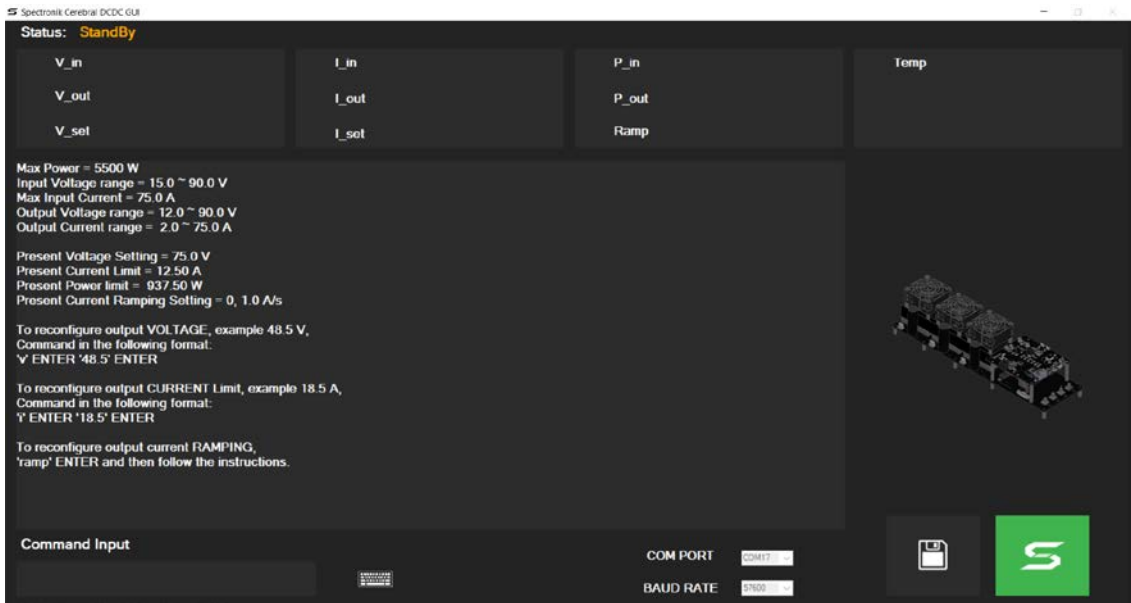
Type in desired current limit, e.g. “12.5”, and “enter”.



Acknowledgement to the current change is printed.

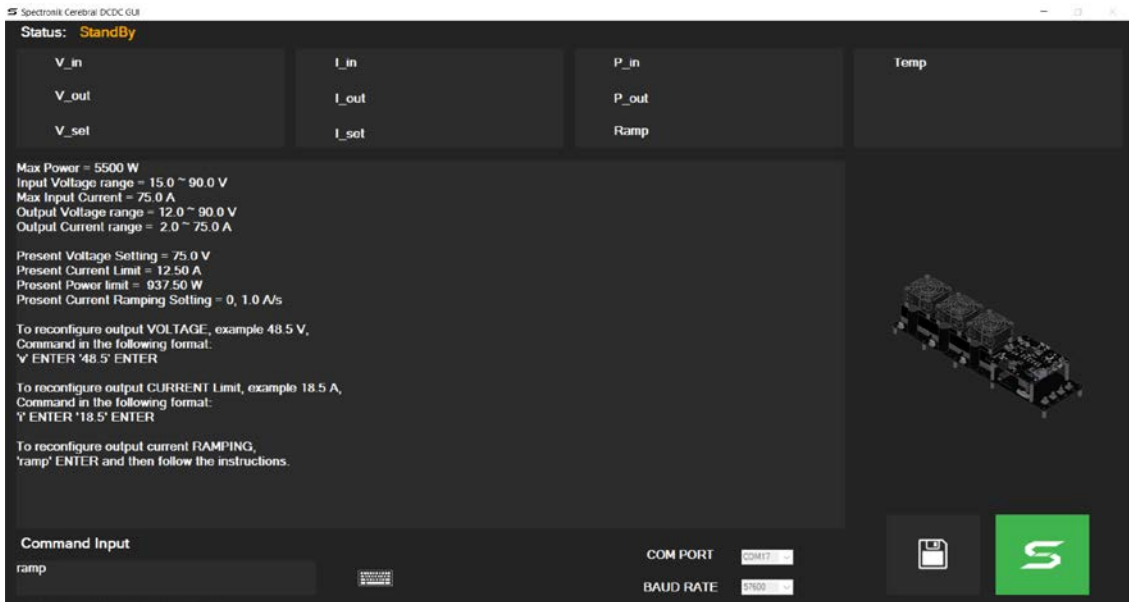


Values on output configuration is updated and displayed.



## 5.3 APPENDIX – OUTPUT CURRENT RAMPING SETTING (ACTIVE & NON-ACTIVE)

Type in “ramp” into the input text box, followed by the “enter” key.



Type in selection for ramping function to be **active** and the desired ramp rate, e.g. “1, 1.5” and “enter”.

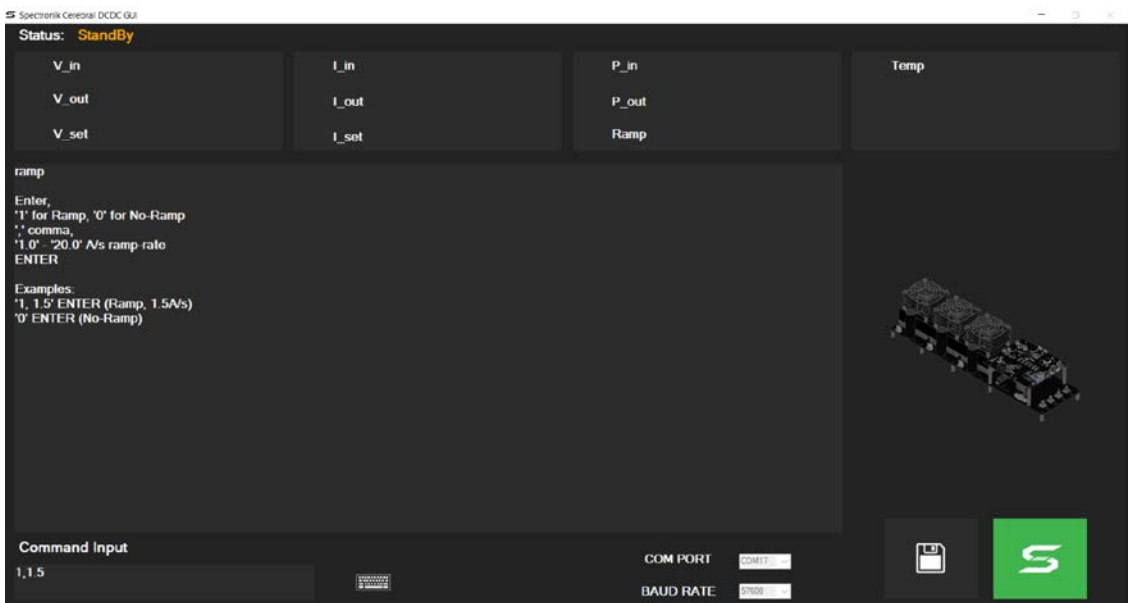
1<sup>st</sup> value

“1” = ramping activated

“0” = ramping not activated

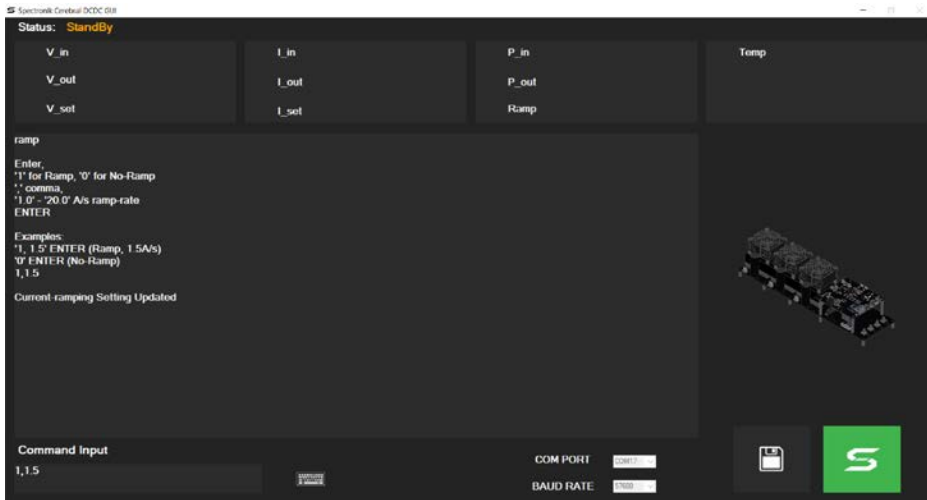
2<sup>nd</sup> value

“1.5” = ramp rate of 1.5A/sec

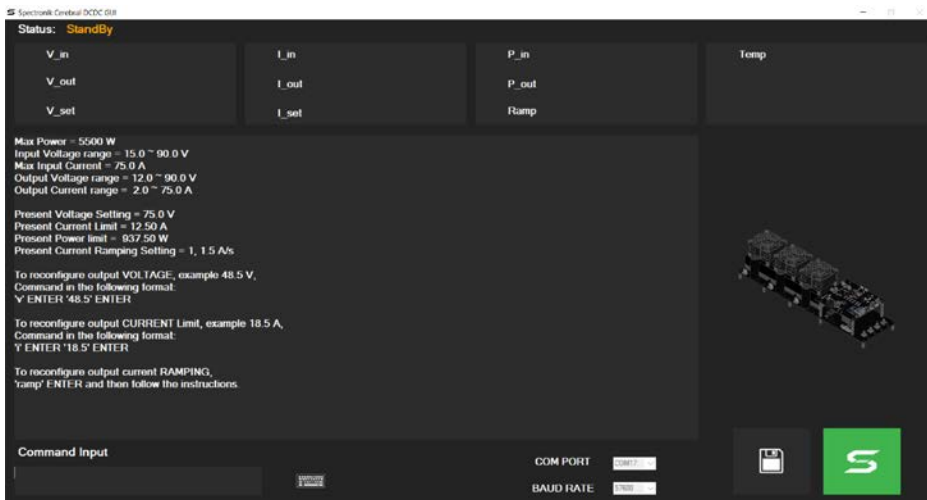




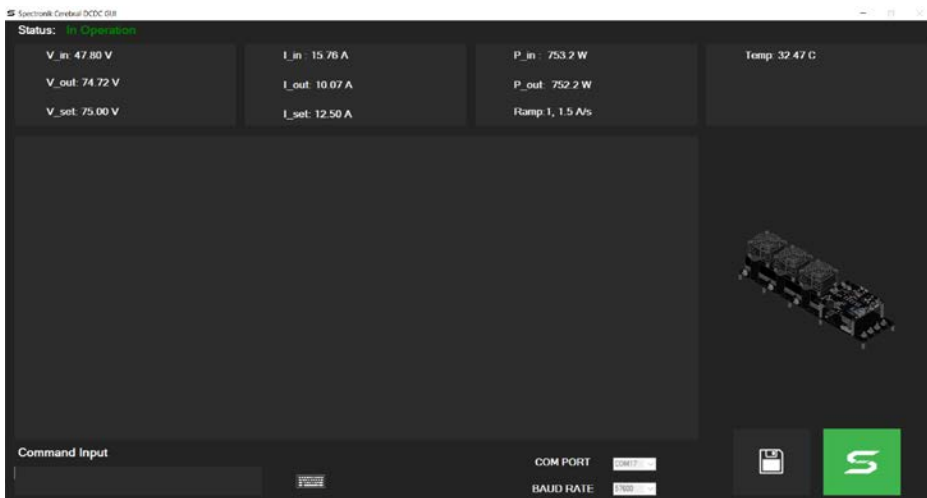
Acknowledgement to the ramping change is printed.



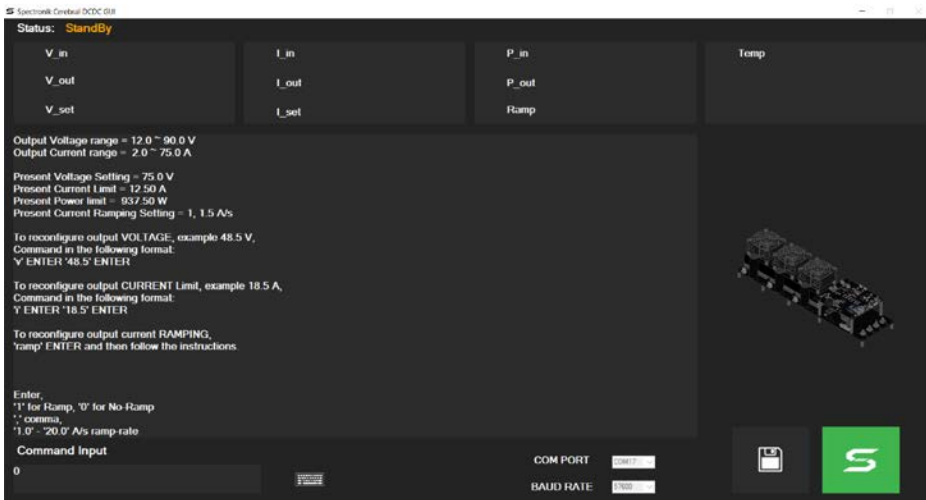
Values on output configuration is updated and displayed.



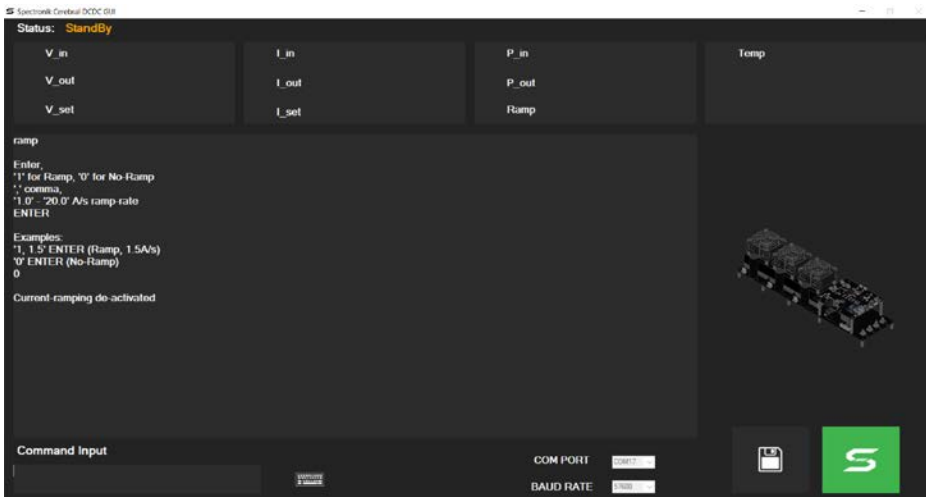
When "In Operation" with above current ramping setting, "Ramp" = "1, 1.5 A/s"



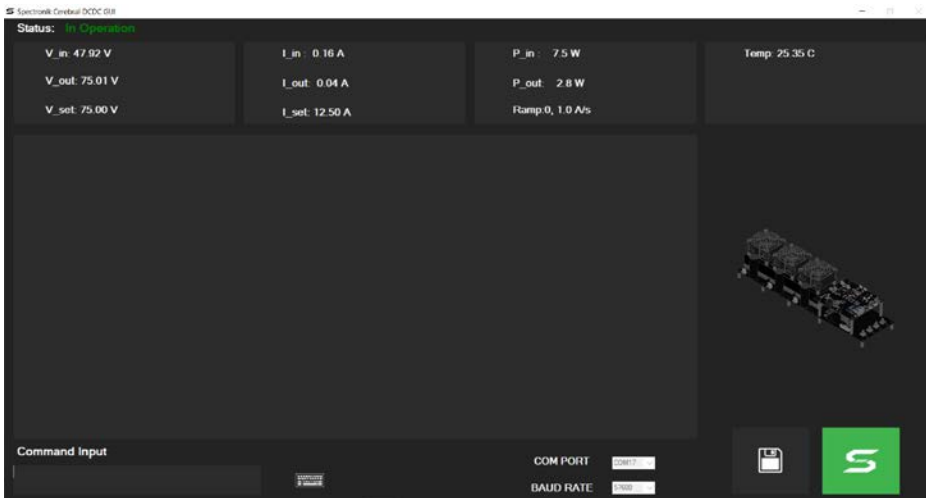
Selection for ramping function to be **non-active**,  
[ramp rate value is irrelevant] e.g. "0" and "enter".




Acknowledgement to the ramping deactivation is printed.

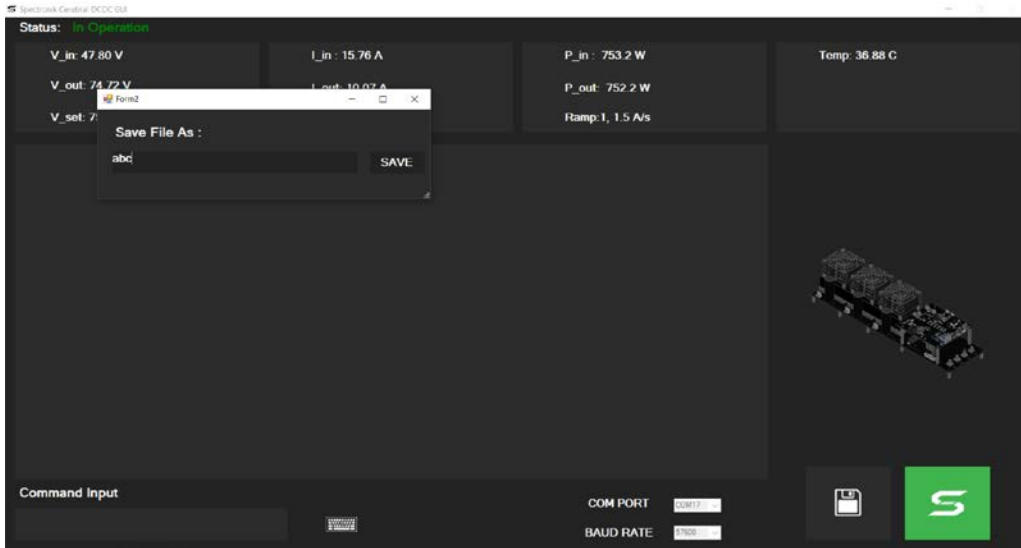


When "In Operation" with above current ramping setting,  
"Ramp" = "0, 1.0 A/s"



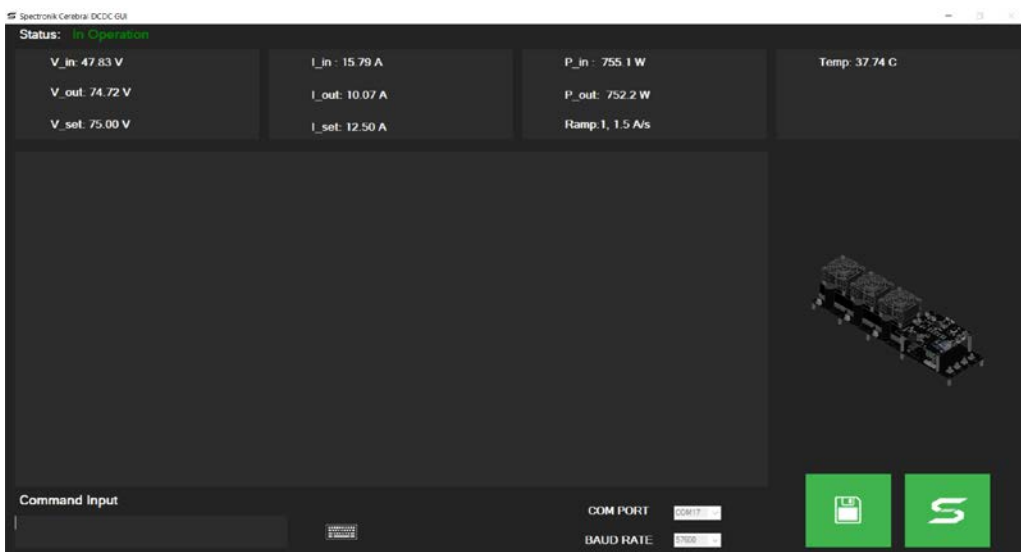
## 5.4 APPENDIX – DATA LOGGING

Click on the  (Save) button. Name the file in the pop-up box. E.g. “abc”. (if the box is cancelled, the default name would be given, “Spectronik Cerebral DCDC GUI”, and can be edited later)

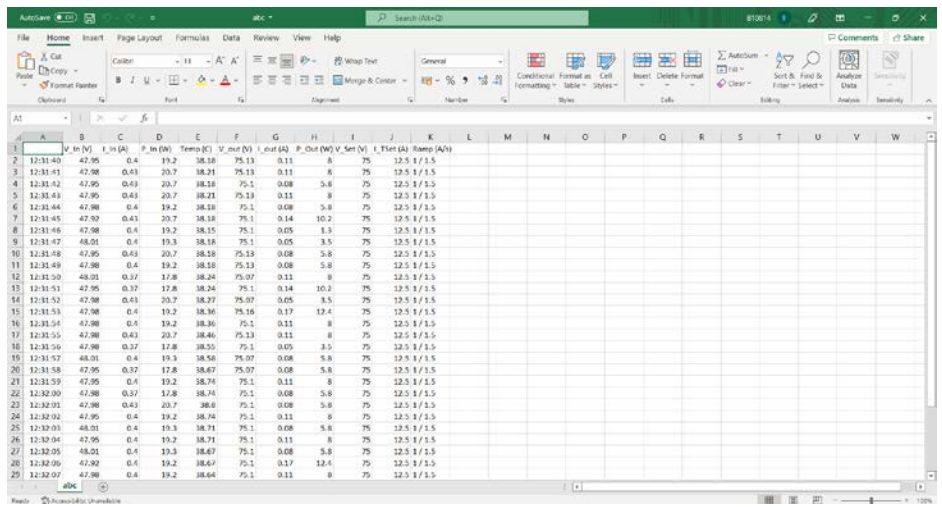



Hereafter, all values would be recorded live into the csv file. Do not open the file while on “save” mode, as it would terminate the recording.

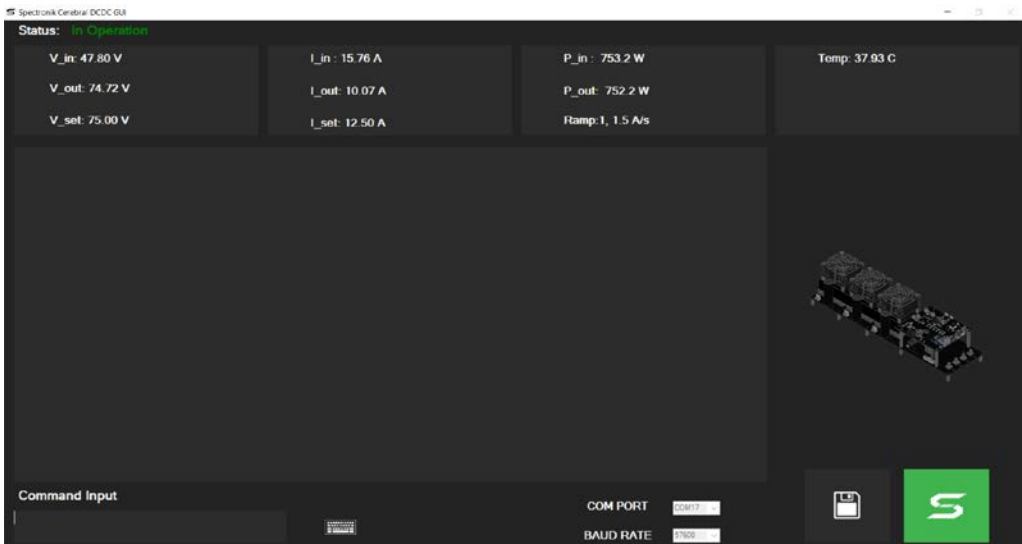
You may save your recording under the same name, and the new recordings would be saved below the previous data lines.



Files will be saved on desktop.



To terminate data-logging, click on the  (Save) again.



## 5.5 APPENDIX – LED OUTPUTS AND CRITICAL ERROR SHUTDOWNS

### LED Output

Critical Error SHUTDOWN message		LED
Power ON	Green	Short Blinking
In Operation	Green	Solid
High Temperature Warning	Orange	Long Blinking
Fan Tacho Lost	Red	Short Blinking
Critical Error SHUTDOWN	Red	Solid

### Critical Error Shutdowns Identifications

Critical Error SHUTDOWN message	Corrective Action
Sys Over-Temperature SHUTDOWN	Check ventilation system/layout
Input Over-Voltage SHUTDOWN	Verify possible 90V exceedance at input
Input Under-Voltage SHUTDOWN	Check possible short-circuit at input
Input Over-Current SHUTDOWN	Verify that supply is adequate for load demand
Output Under-Voltage SHUTDOWN	Verify that supply is adequate for load demand
Output Over-Current SHUTDOWN	Check possible short-circuit at output

### GUI notification message for Critical Error Shutdowns

An example:



The error code message