



DATA ACQUISITION GRAPHIC USER INTERFACE (DAQ GUI)

PC APP FOR PROTIUM-1000/3000

USER GUIDE – DAQ GUI V4.1



SAFETY, HANDLING & SUPPORT

The Data Acquisition Graphic User Interface (DAQ GUI) application is specially designed to work only with Spectronik fuel cells – specifically the Protium-1000 and Protium-3000. By using the software, user agrees and acknowledges that he/she has sufficient knowledge in operating a fuel cell system and strictly adheres to the operating instructions listed separately in the fuel cell user guide.

Software license is valid for multiple users within the buyer's organization, and solely for the purpose of usage with Spectronik fuel cells. Software is Spectronik proprietary and any duplication, dissemination and distribution is strictly prohibited.

Note: Software only runs on Windows. Please check for system compatibility.

For technical support, contact: hello@spectronik.com

1 OVERVIEW

The DAQ GUI software transmits live fuel cell performance and captures valuable operating parameters. User can record and analyze the information by connecting a PC/laptop to the fuel cell system via the UART-to-USB cable provided. The data log files saved can be exported to Excel for further analysis.

GETTING STARTED – SOFTWARE INSTALLATION & RUNNING THE PROGRAM

1. Unzip the DAQ GUI zip file. User can also create a shortcut file in desktop `main_plot.exe`.

Note: Do not delete Resource file.



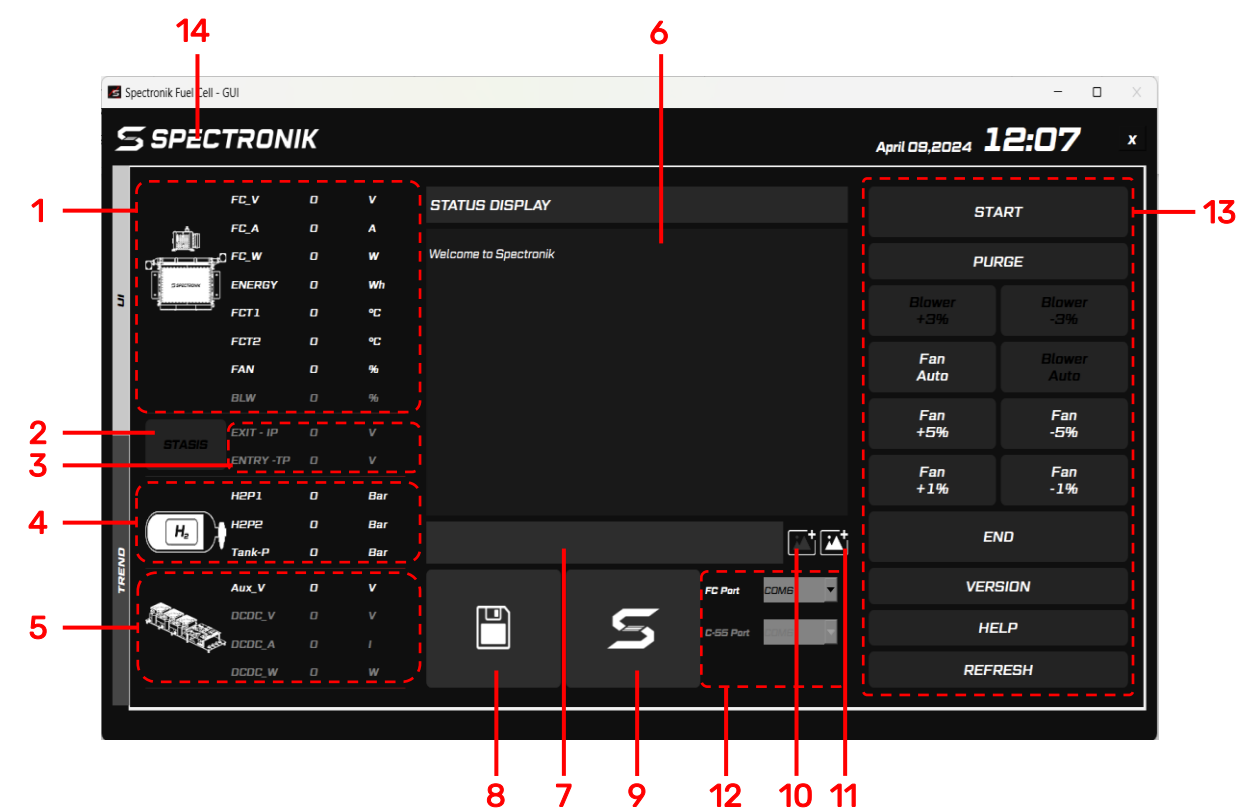
GUI_FEAXL_WLT_BV.rar

2. Double-click on the `main_plot.exe` to run the program. The interface page will appear.



2 INTERFACE

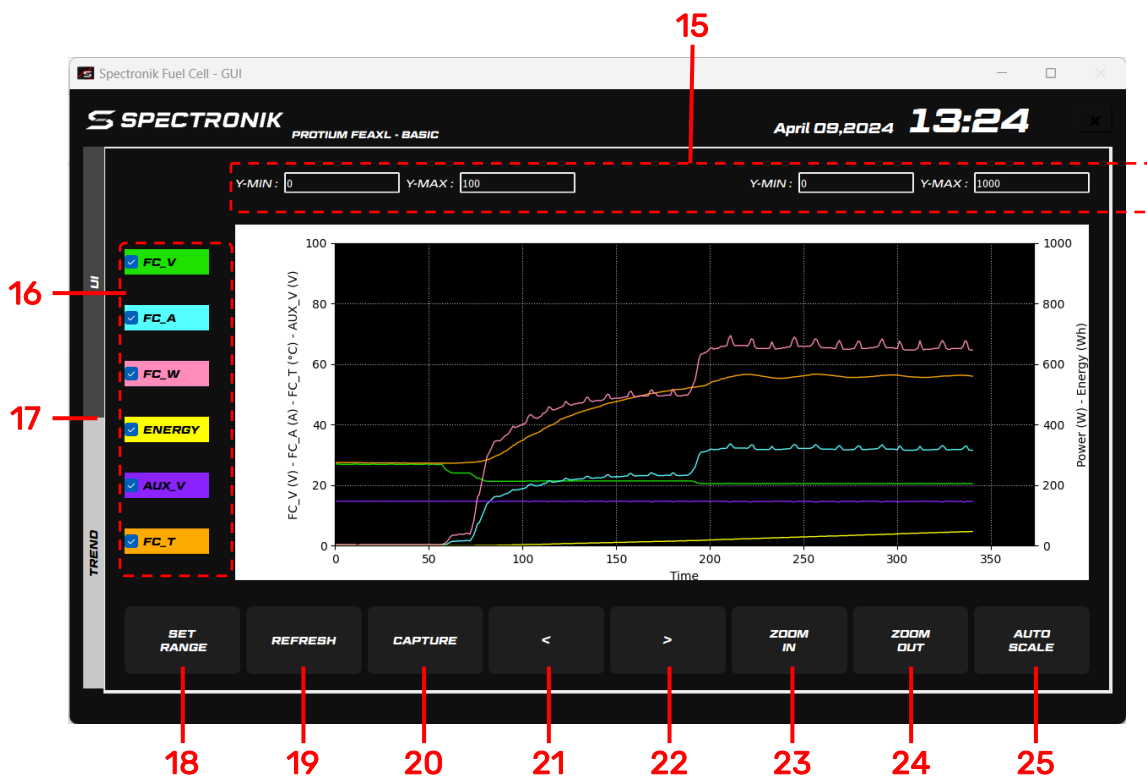
2.1 DIGITAL DISPLAY VIEW



ITEM DESCRIPTION			
1.	Fuel-cell stack parameters	8.	Data logger button
2.	Stasis Mode toggle button	9.	Connect/Disconnect button
3.	Stasis Mode settings	10.	Background image selector – Inactive State
4.	Fuel supply parameters	11.	Background image selector – Active State
5.	External power supply AuxV Voltage	12.	Communication port selector Data log file name
6.	Message display screen	13.	Command panel
7.	Keyboard input	14.	Spectronik logo

DESCRIPTION DETAIL	
	FC_V: FC voltage (V) FC_A: FC current (A) FC_W: FC power (W)
1.	Energy: Energy delivered by the fuel cell during this operation (Wh) FCT1: FC temperature at location 1 (°C) FCT2: FC temperature at location 2 (°C) FAN: Cooling fan duty cycle (%) BLW: Oxidant blower duty cycle (%)
2.	Stasis Mode: toggle button to enable/disable Stasis Mode
3.	EXIT-IP: Initiation Point (IP) Voltage to exit Stasis Mode; ENTRY-TP: Termination Point (TP) Voltage to enter Stasis Mode;
4.	H2P1: H ₂ supply pressure (Barg) H2P2: H ₂ pressure in FC (Barg) Tank-P: Gas tank pressure (Barg)
5.	AuxV: External Power Supply voltage (V)
6.	Display system messages from the fuel cell
7.	Keyboard to input command
8.	Log data: Save data into csv format
9.	Connect/Disconnect: Start/stop live transmission of data
10.	Choose background image for Active State
11.	Choose background image for Inactive State
	Communication port selector: depending on user's PC USB port;
12.	Baud rate selector: default 57600; Data log file name will be displayed in the box.
13.	Start: Start fuel cell system Purge: Perform manual H ₂ purge Blower auto: Set oxidant blower to automatic control Blower +3%: Increase blower duty cycle Blower -3%: Decrease blower duty cycle Fan auto: Set fan to automatic control Fan +5%: Increase fan duty cycle Fan -5%: Decrease fan duty cycle Fan +1%: Increase fan duty cycle Fan -1%: Decrease fan duty cycle END: Shutdown fuel cell system Version: Display firmware version Help: Command panel description
14.	Spectronik logo: Hyperlink to Spectronik website

2.2 GRAPHICAL DISPLAY VIEW



ITEM DESCRIPTION			
15.	Primary and Secondary axes scale	21.	< Left shifter button
16.	Trendline checkboxes	22.	> Right shifter button
17.	UI/TREND tab selector	23.	Zoom In button
18.	Set Range button	24.	Zoom Out button
19.	Refresh button	25.	Auto Scale button
20.	Capture button		

2.2 GRAPHICAL DISPLAY VIEW

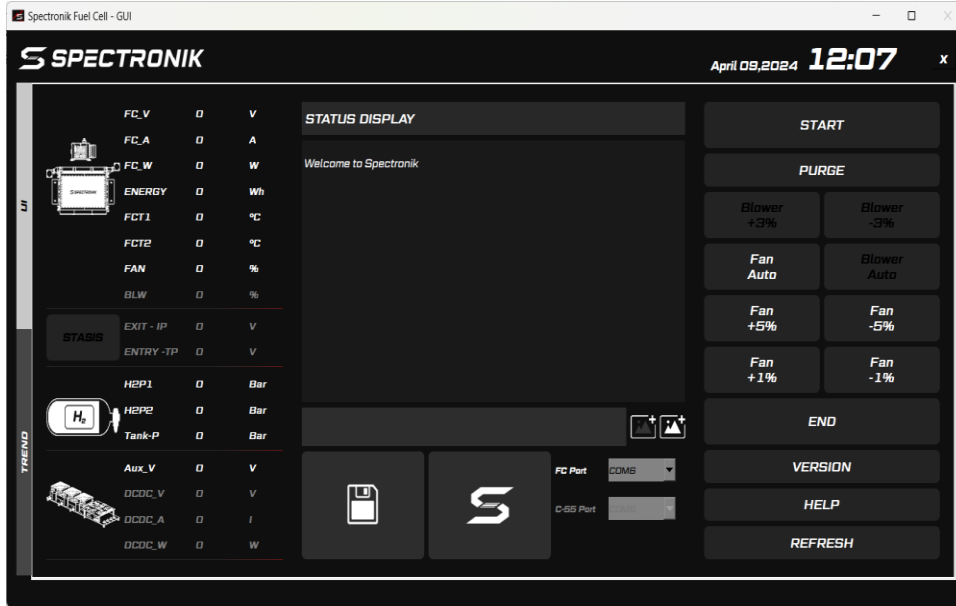
DESCRIPTION DETAIL

- 15. Key in desired minimum and maximum values for primary and secondary vertical axes
- 16. Check the desired parameters to be plotted in the graph
- 17. Toggle between the digital display and graphical display tabs
- 18. After keying in the desired minimum and maximum values for the primary and secondary vertical axes, click on Set Range button to log them in
- 19. Wipe the plotted trendlines and restart the graph
- 20. Screengrab to capture the graph
- 21. Move the graph to the left
- 22. Move the graph to the right
- 23. Zoom in to enlarge the graph
- 24. Zoom out to minimize the graph
- 25. Resize the graph to show the entire data from the beginning of the operation

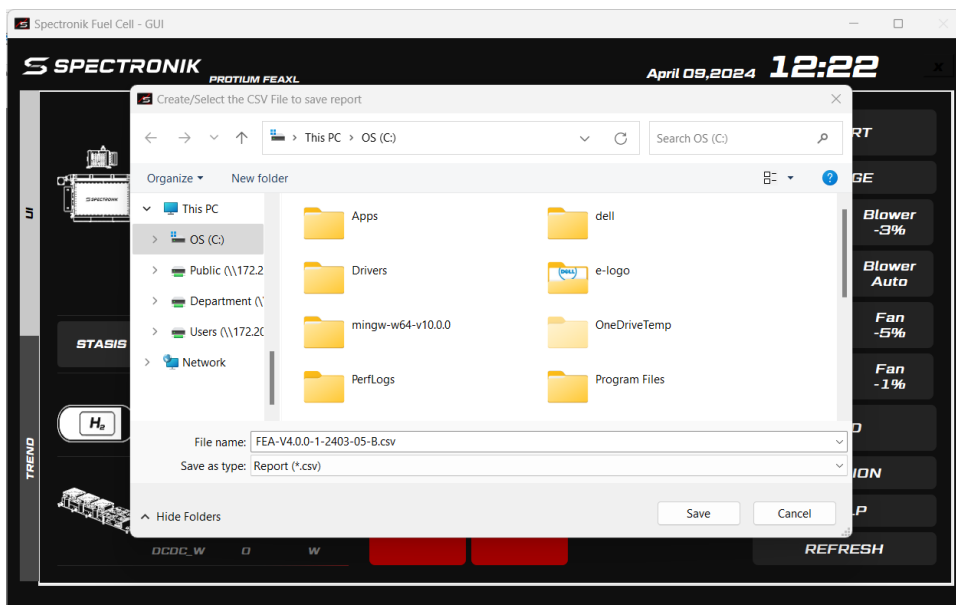
3 OPERATING PROCEDURES

3.1 DAQ GUI – LINK-UP

1. Connect the USB cable and open the Spectronik DAQ GUI PC app.

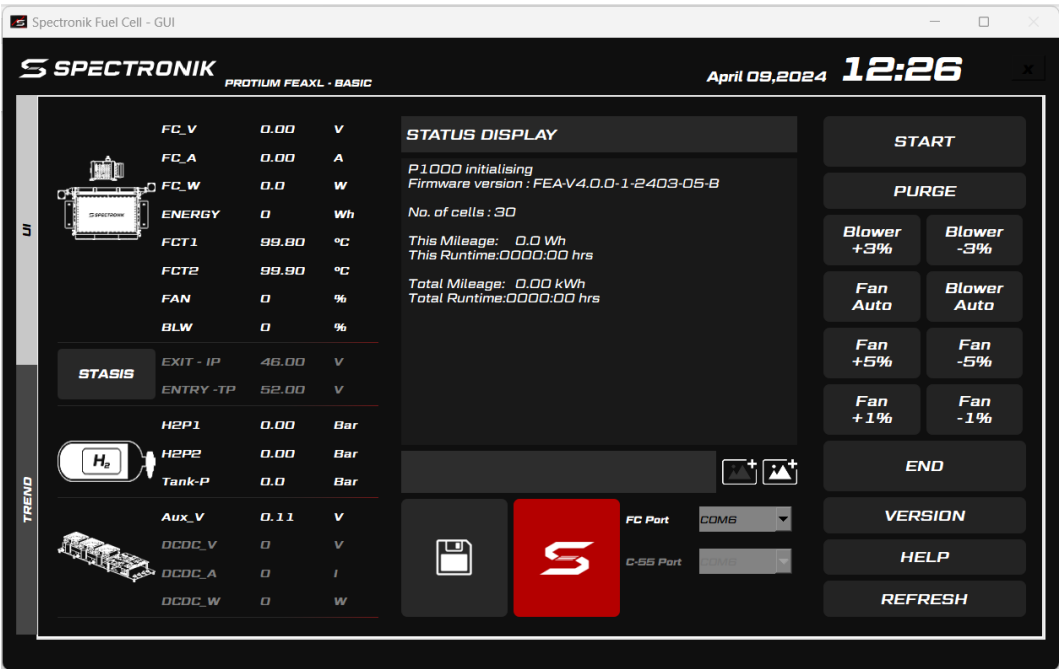


2. Select the correct 'Com Port'.
3. Click the Connect/Disconnect button to connect to the fuel cell Electronic Controller. The button should light up and a welcome header appears in the **Status Display** box.
4. Fuel cell will enter its **Standby Phase**, indicated by the message "P1000/P3000 Initializing".
5. After reading the product information, the user interface determines whether to enable or disable a feature, such as the blower.

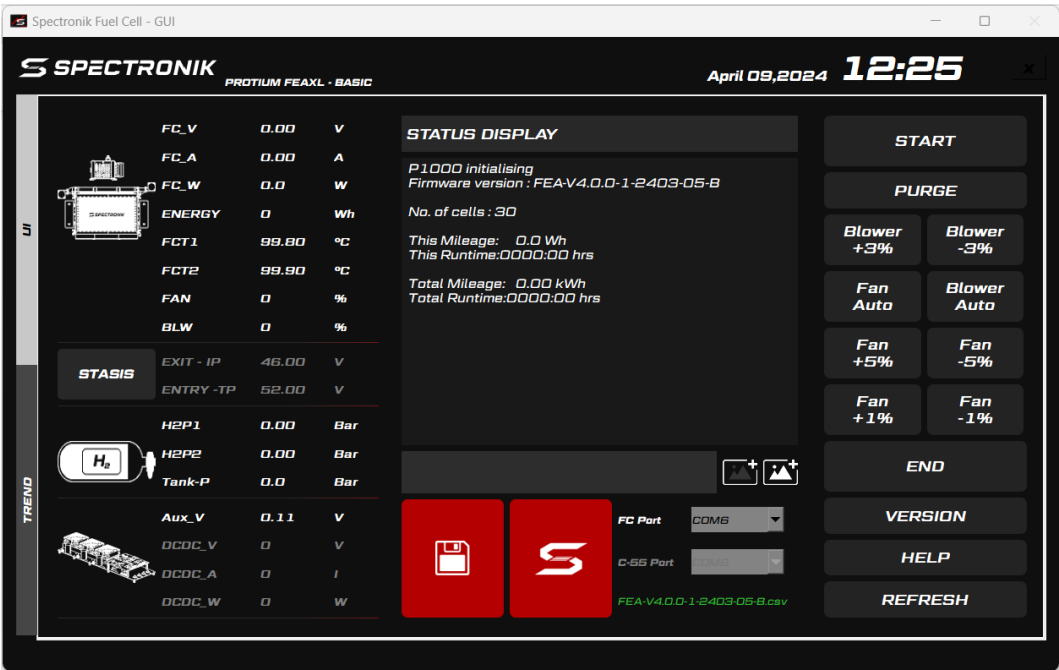


3.2 CONFIGURE STASIS MODE (PRO VERSION ONLY)

6. As a default, the system will prompt you to log data. Key in your desired file name and save location. If you do not wish to log data, click 'cancel'.



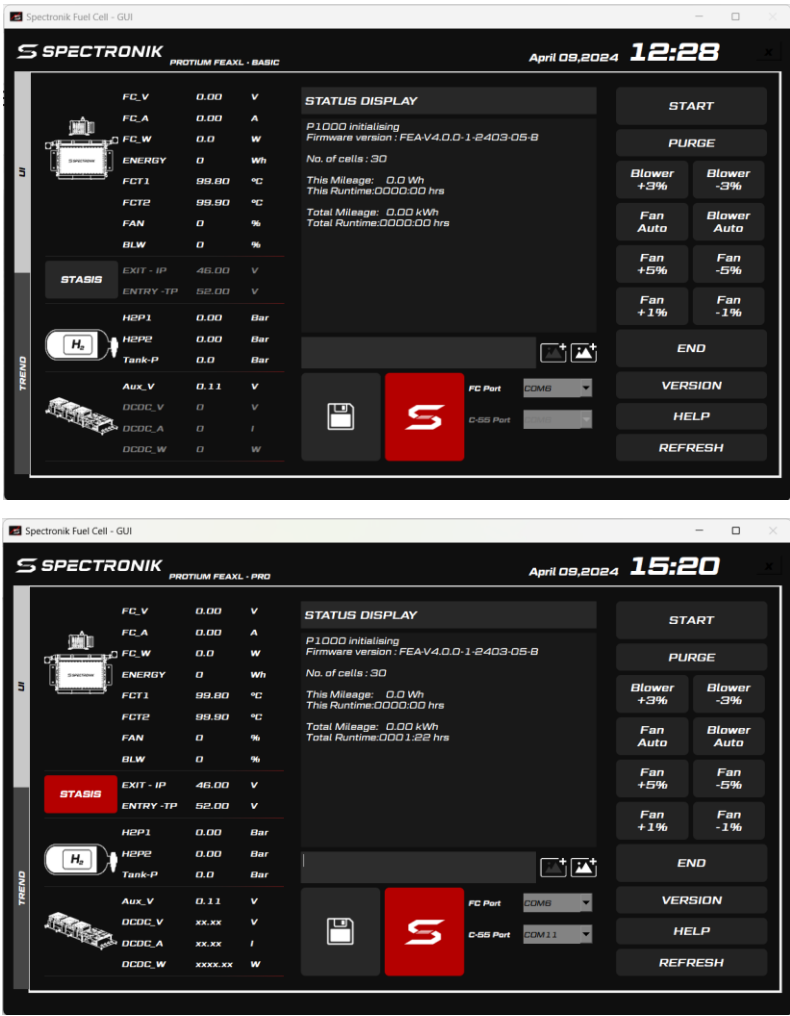
7. If you choose to log data, the file name can be seen below the COM Port selector.



3.2 CONFIGURE STASIS MODE (PRO VERSION ONLY)

The **Stasis Mode** function allows autonomous transition for the fuel cell to enter a temporary hibernation. The primary function is to save Hydrogen fuel. The Trigger Points to enter/exit Stasis Mode is purely dependent on the AuxV Voltage.

Stasis Mode function can be set active/inactive via the DAQ GUI only during Standby Phase. Toggle the STASIS MODE button on/off as desired.



NOTES

- **Stasis Mode** is intended to work only in the recommended configuration as per Section 3.4 in Protium-1000/3000 user guides. It is also only available in Pro Version of DAQ GUI and with the purchase of Spectronik Cerebral-55 Smart DC-DC Converter.
- The fuel cell will autonomously enter hibernation when AuxV reaches Termination Point (TP) - defined as the voltage where the battery load is deemed to be full.
- The fuel cell will autonomously exit hibernation when AuxV drops to Initiation Point (IP) - defined as the voltage where the battery load is deemed to be depleted and requires fuel cell recharging.

Trigger points reference:

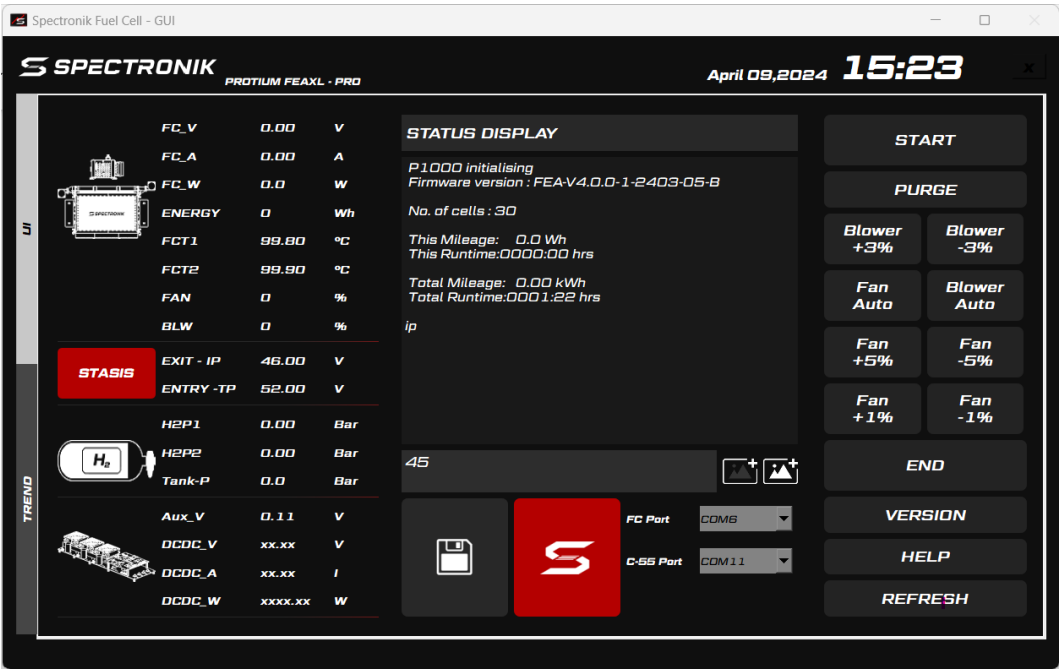
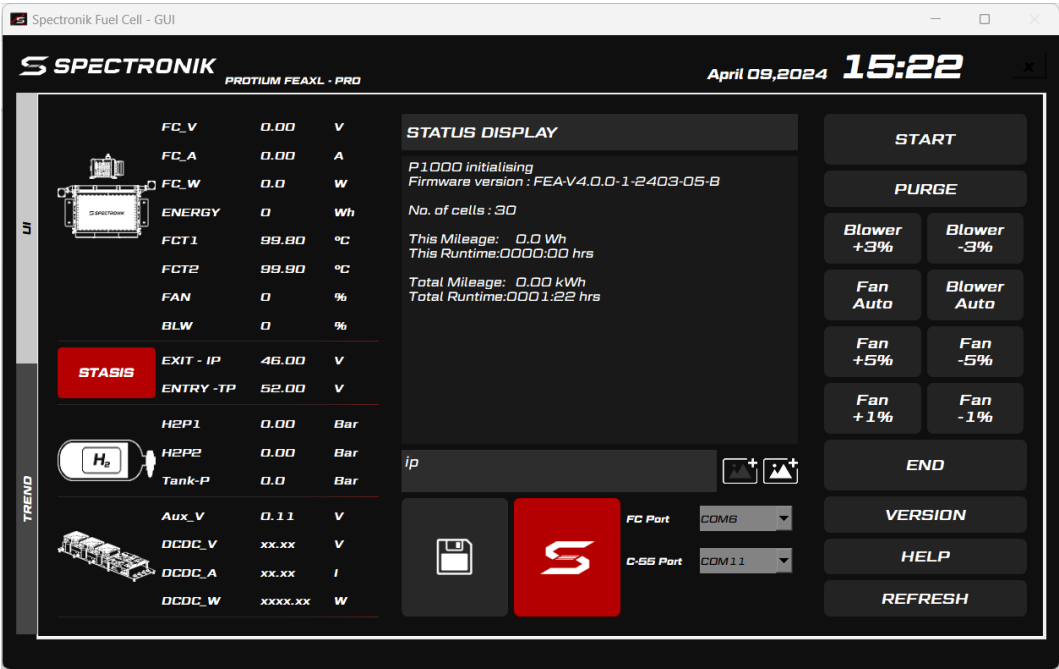
Enters Stasis Mode when Termination Point (TP) is reached.
Exits Stasis Mode Initiation Point (IP) is reached.

3.3 CONFIGURE IP

- 1. Initiation Point (IP) can be set via DAQ GUI only during Standby Phase.
- 2. Type the following command into the message box:

'ip' <enter> 'ip_set value' <enter> (ip_set value allows one decimal place.)

For example: 'ip' <enter> '45' <enter>

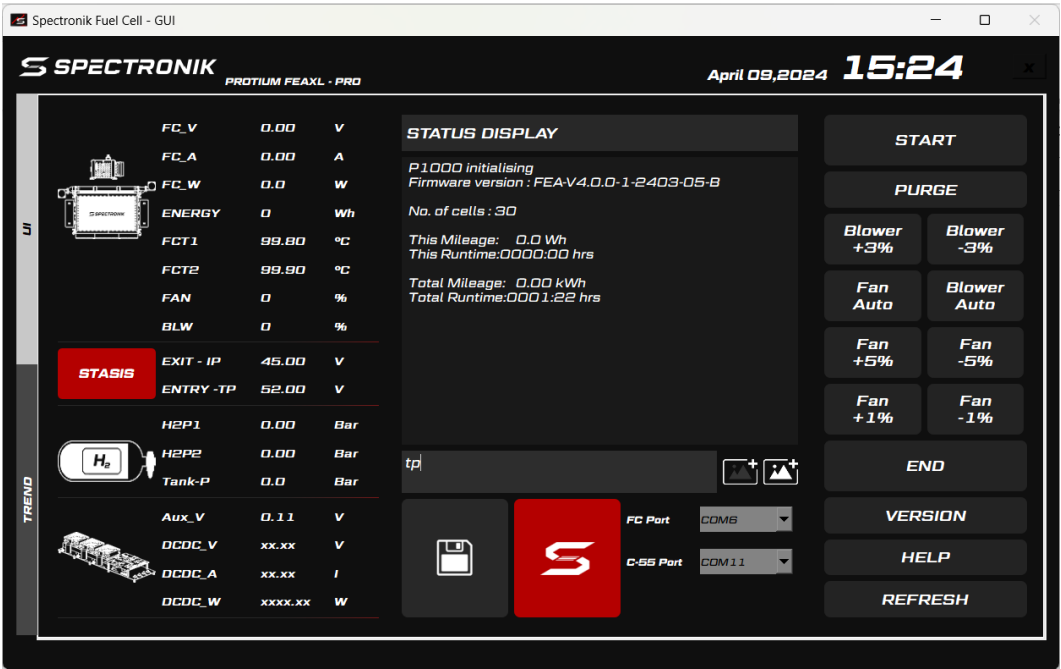


3.4 CONFIGURE TP

- 1. Termination Point (TP) can be set via DAQ GUI only during Standby Phase.
- 2. Type the following command into the message box:

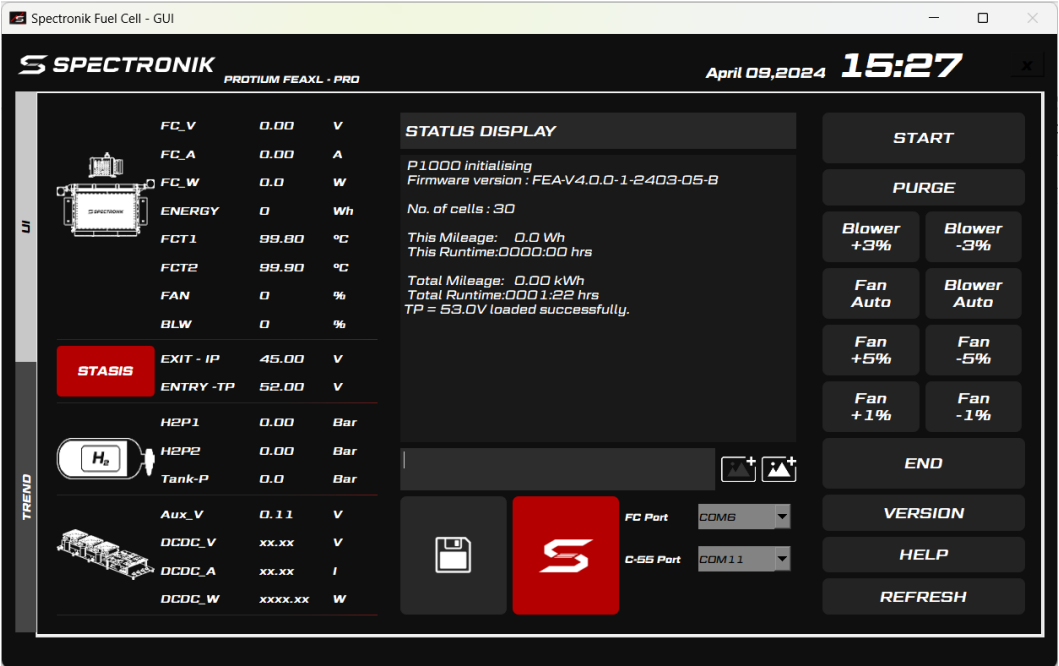
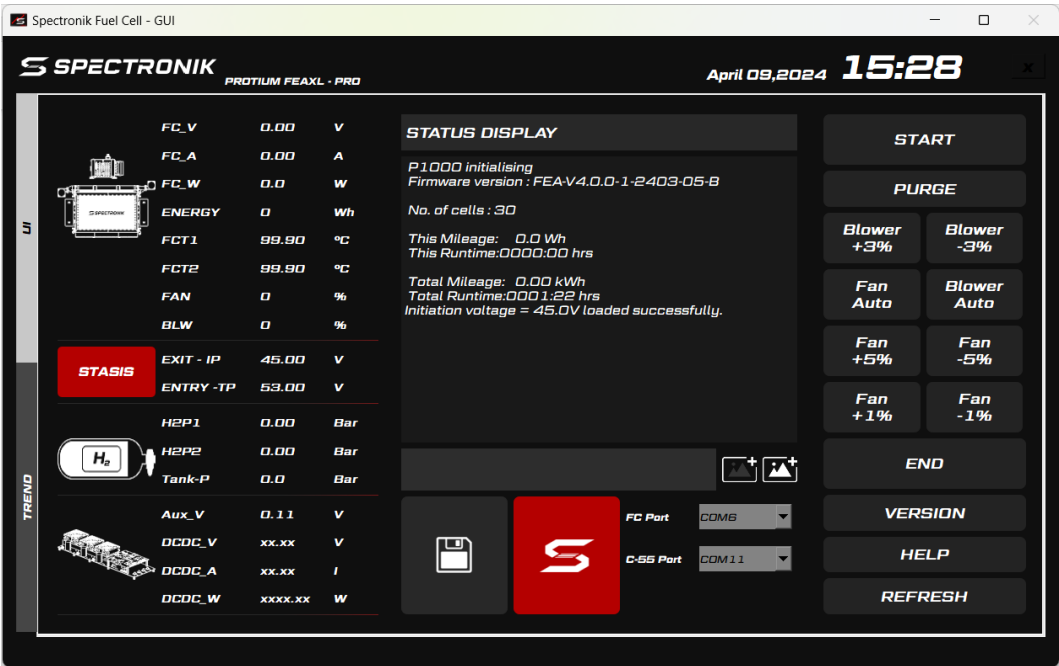
'tp' <enter> 'tp_set value' <enter> (tp_set value allows one decimal place.)

For example: 'tp' <enter> 52' <enter>



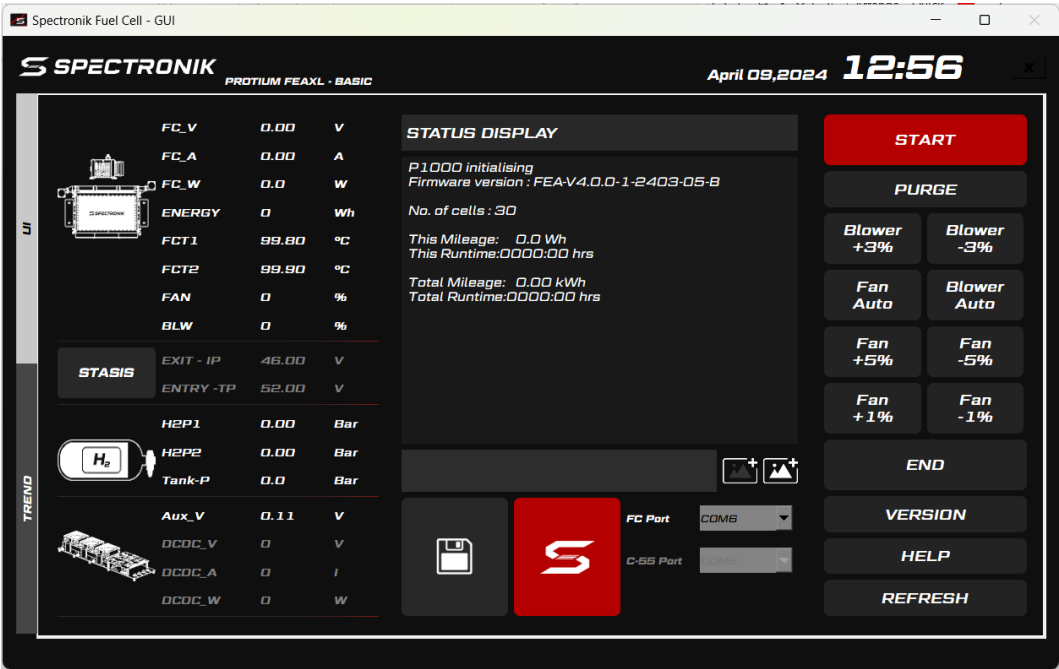
3.5 IP & TP SET ACKNOWLEDGEMENTS

Successful IP & TP entries will get acknowledgements “Initiation Voltage loaded successfully” and “Termination Voltage loaded successfully”.

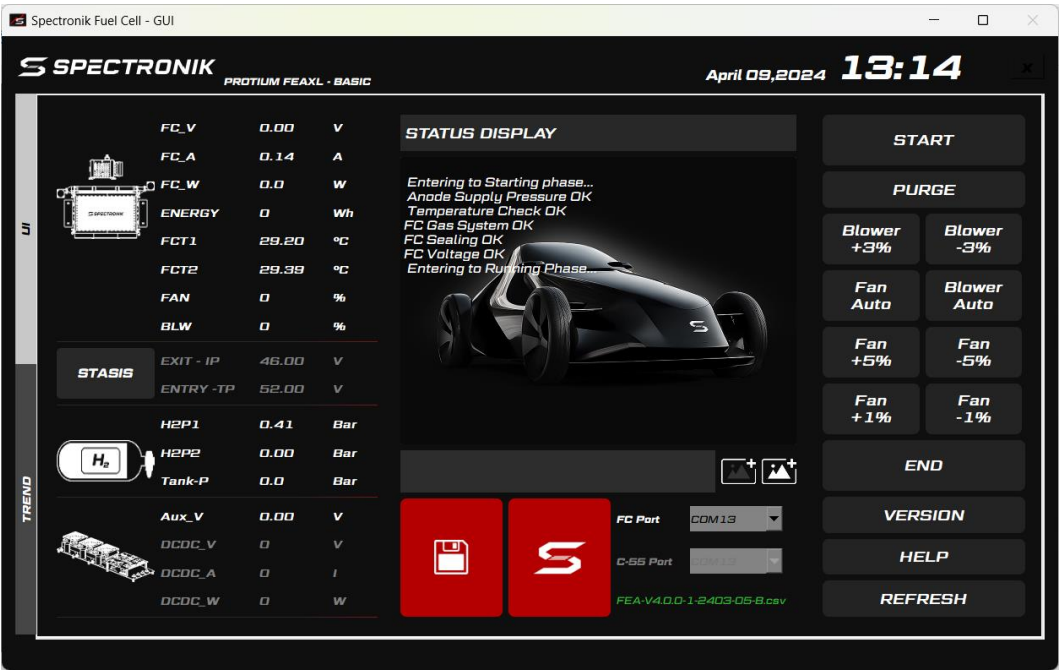


3.6 SYSTEM STARTING PHASE

1. To start the fuel cell, click the **START** button on DAQ GUI or press and hold the *ON/OFF push button* of the Electronic Controller for 3 seconds.
2. The fuel cell will enter **Starting Phase**. And the **START** button would fade away.



3. During the **Starting Phase**, the fuel cell will do a series of internal checks to ensure that all parameters are in good working conditions before entering **Running Phase**.



3.7 SYSTEM RUNNING PHASE

During the **Running Phase**, all controls are managed by the electronics controller.

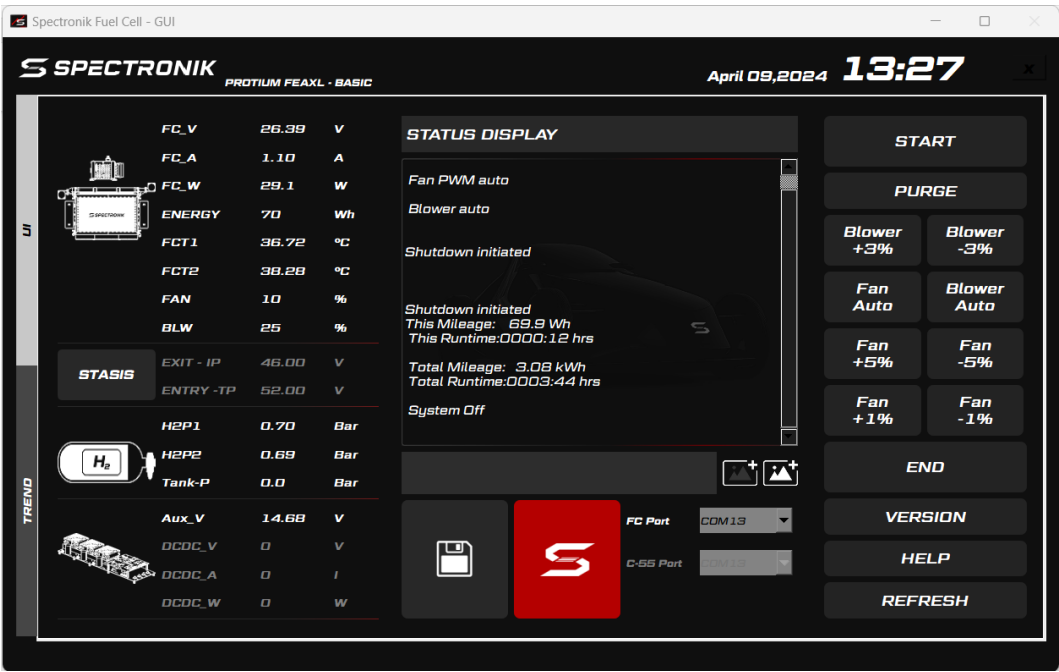


NOTES

- The fuel cell has pre-programmed fan/blower control based on Current output and cell target temperature. Advanced users can manually adjust the cooling fans and oxidant blowers by pressing the respective Fan and Blower buttons' different pwm resolutions (+/- 1%, 3%, 5%). To return to the default program, press FAN AUTO and BLOWER AUTO.
- The fuel cell also has pre-programmed purge control based on optimizing fuel saving and cell performance. You can do additional water removal and Hydrogen line flushing by manually pressing the PURGE button.

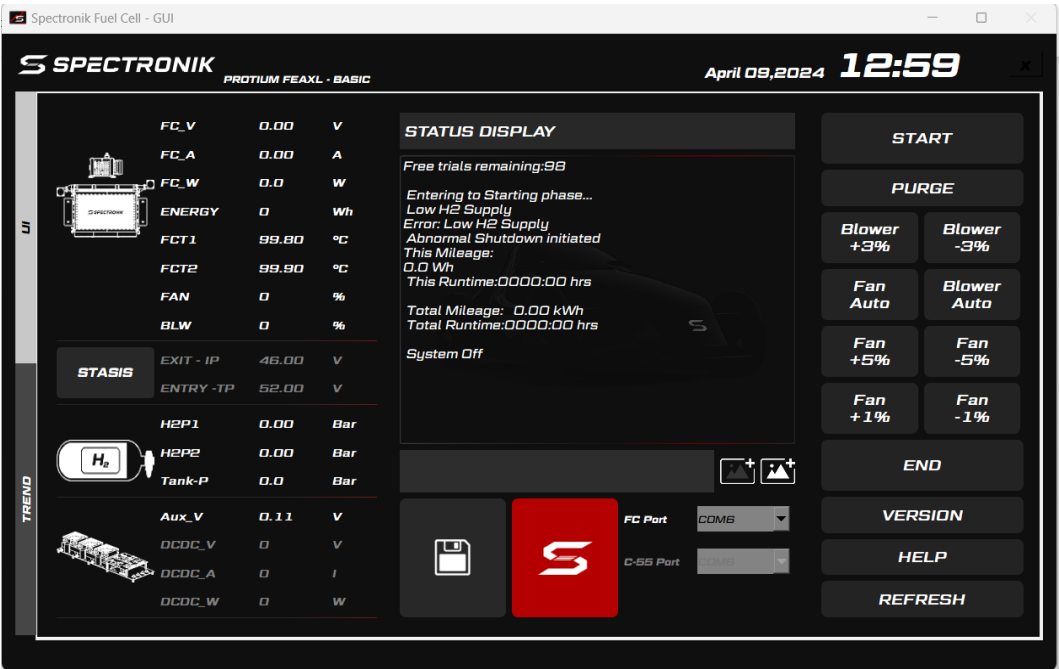
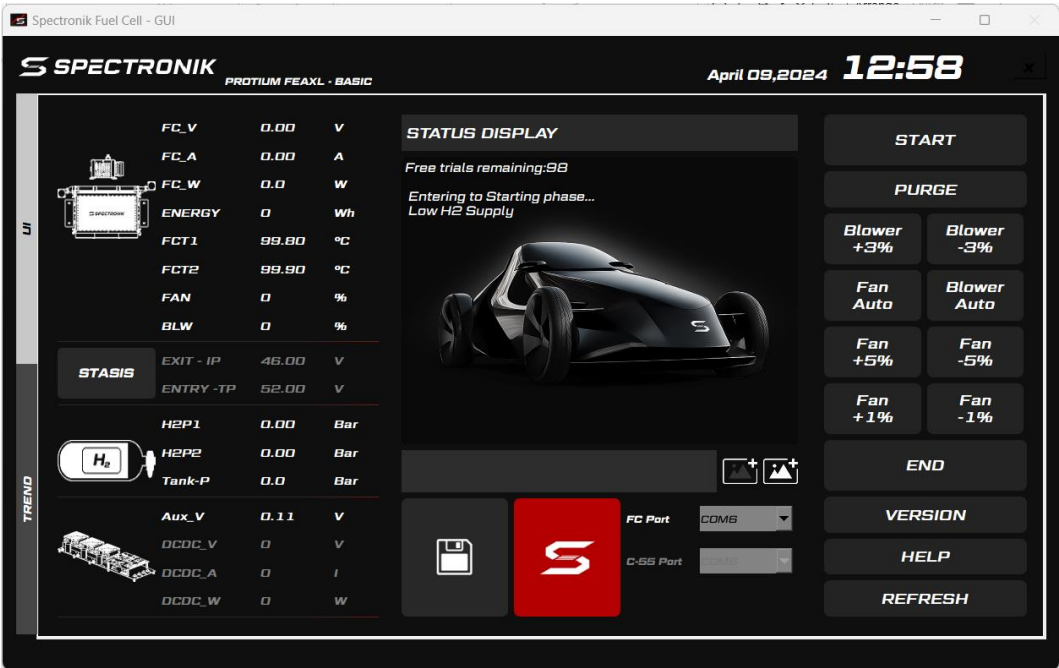
3.8 SYSTEM SHUTDOWN PHASE

- 1. To shutdown the system, click the END button on the GUI or press and hold the *ON/OFF push button* of the Electronic Controller for 3 seconds.
- 2. The system enters **Shutdown Phase** to properly end the fuel cell system operations. After the complete shutdown, the START button would reappear as it returns to **Standby Phase**.



3.9 ABNORMAL SHUTDOWN PHASE

1. During **Starting Phase** and **Running Phase**, in case of any serious erroneous conditions, the fuel cell will immediately enter **Abnormal Shutdown Phase**.
2. The fuel cell will return to **Standby Phase** and can only be restarted after the problem has been resolved. Refer to section 4 of its user guide for a complete list of possible errors and the recommended corrective actions.

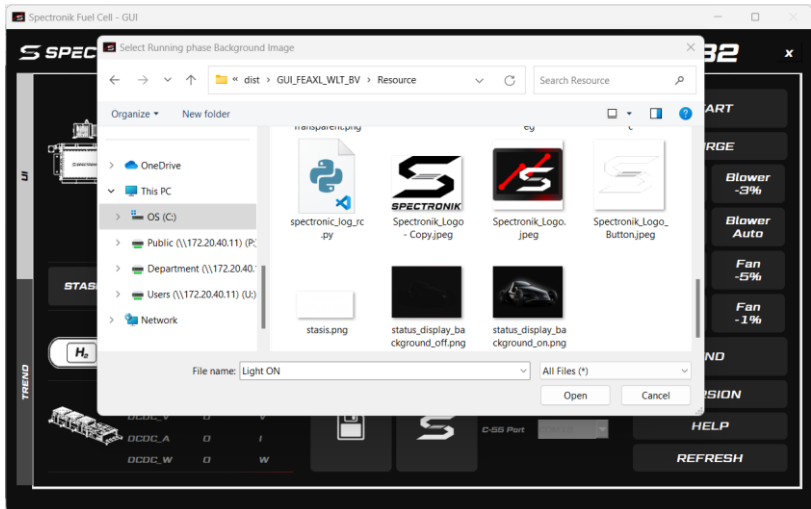
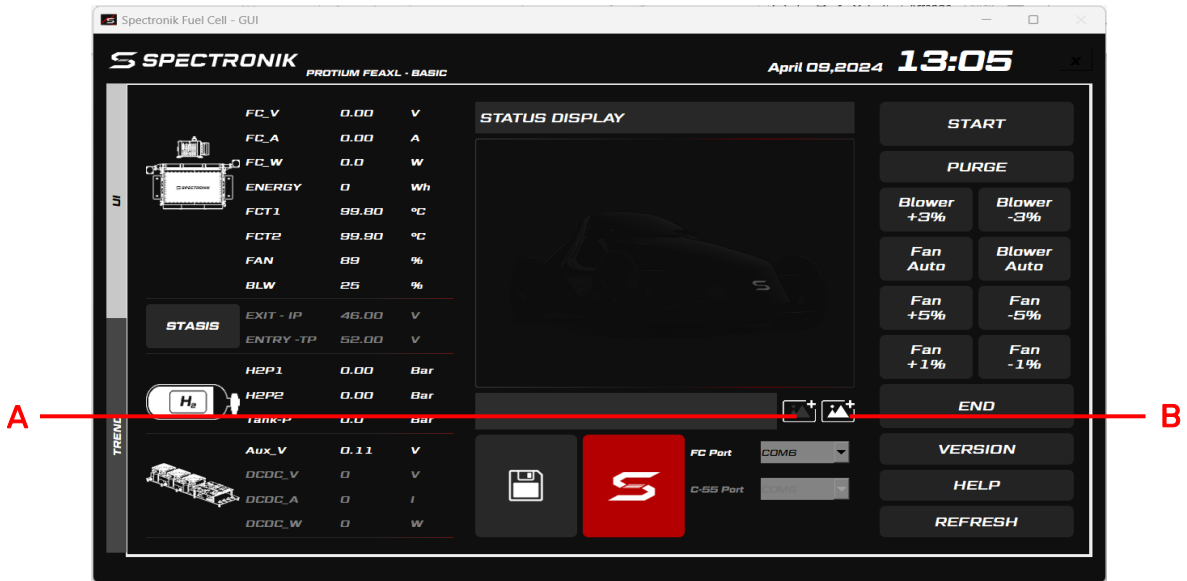


3.10 BACKGROUND PHOTO

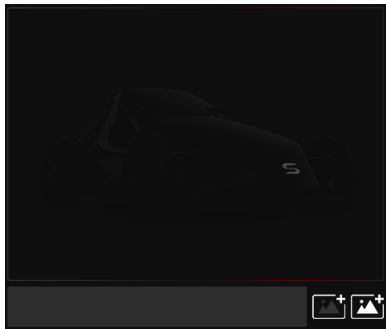
Click on “A” or “B” to change background images.

- A: Background image for fuel cell in inactive state. During Standby Phase, Starting Phase, and Stasis Mode.
- B: Background image when fuel cell is in active state. During Running Phase.

It will prompt for your file location.



Example:

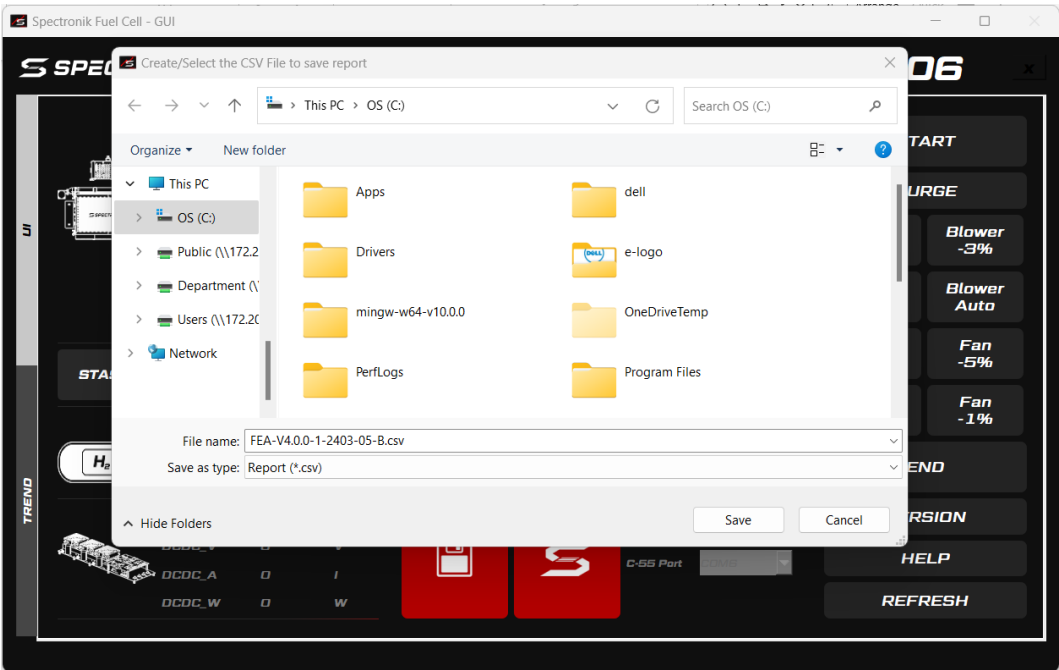


3.11 SAVING A DATA FILE (DATA ACQUISITION)

Even though the software is 'live', it does not record the values unless instructed to do so. To start saving data:

Click on the log data button, a pop-up window will appear. Key in the desired file name, otherwise the default name consisting the fuel cell version will be used. Press enter. The log data button should now be turned ON. The software starts recording data. The file will be saved in desktop (default) or the user's specified location.

The software will continue recording data until the log data button is clicked again. The button color will turn OFF. The software is now no longer recording value.



3.12 DATA REVIEW AND ANALYSIS

After the fuel cell system is turned off, you can review the collected data and print-screens for further analysis.

- i. Go to the specified file location to find the log file.
- ii. Data is saved in csv format, open the file with Microsoft Excel. You should see the following:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	Date-Time	FC_V (V)	FCT1 (C)	H2P1 (B)	DCDCV (V)	FC_A (A)	FCT2 (C)	H2P2 (B)	DCDCA (A)	FC_W (W)	FAN (%)	Tank-P (B)	DCDCW (V)	ENERGY (V)	BLW (%)	Tank-T (C)	BattV (V)	STASIS MC	IP (V)	TP (V)	Remark
2																					
3	02/13/24-	58.2	36.72	0.69	XX.X	8.07	37.11	0.69	XX.X	469.8	16	0	XXXX.X	105	31	0	15.02	0	45	52	80
4	02/13/24-	58.2	36.72	0.69	XX.X	8.07	37.11	0.69	XX.X	469.8	16	0	XXXX.X	105	31	0	15.02	0	45	52	80
5	02/13/24-	58.2	36.72	0.69	XX.X	8.07	37.11	0.69	XX.X	469.8	16	0	XXXX.X	106	31	0	15.02	0	45	52	80
6	02/13/24-	58.2	36.72	0.69	XX.X	8.07	37.11	0.69	XX.X	469.8	16	0	XXXX.X	106	31	0	15.02	0	45	52	80
7	02/13/24-	58.2	36.72	0.69	XX.X	8.07	37.11	0.69	XX.X	469.8	16	0	XXXX.X	106	31	0	15.02	0	45	52	80
8	02/13/24-	58.2	36.72	0.69	XX.X	8.07	37.11	0.69	XX.X	469.8	16	0	XXXX.X	106	31	0	15.02	0	45	52	80
9	02/13/24-	58.2	36.72	0.69	XX.X	8.07	37.11	0.69	XX.X	469.8	16	0	XXXX.X	106	31	0	15.13	0	45	52	80
10	02/13/24-	58.2	36.62	0.57	XX.X	7.95	37.01	0.52	XX.X	462.9	16	0	XXXX.X	106	31	0	15.02	0	45	52	80
11	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	106	31	0	15.02	0	45	52	80
12	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	106	78	0	15.02	0	45	52	80
13	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	106	78	0	15.02	0	45	52	80
14	02/13/24-	58.2	36.62	0.7	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
15	02/13/24-	58.2	36.62	0.7	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
16	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
17	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
18	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
19	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
20	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
21	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	107	31	0	15.02	0	45	52	80
22	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	108	31	0	15.02	0	45	52	80
23	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	108	31	0	15.02	0	45	52	80
24	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	108	31	0	15.02	0	45	52	80
25	02/13/24-	58.2	36.52	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	108	78	0	15.02	0	45	52	80
26	02/13/24-	58.2	36.62	0.69	XX.X	8.07	37.01	0.69	XX.X	469.8	16	0	XXXX.X	108	78	0	15.02	0	45	52	80

Column A is the time of a particular data point while columns B to U show the respective parameters’ values that are recorded. Using this Excel spreadsheet, any graphs can be created for more in-depth analysis and data scrutiny.

4 TROUBLESHOOTING

IF THE SOFTWARE DOES NOT WORK, PERFORM THE FOLLOWING CHECKS:

- Make sure the fuel cell system is running normally and check that the USB cable connection is properly secured.
- Plug the USB cable into the PC port before running the software. Otherwise, close the program and restart it.
- Remember to click the connect button, it should turn green when clicked on.
- If the software still does not work, restart everything and try using another USB port.

If the error persists, contact Spectronik's technical support at hello@spectronik.com