



Sparklike Laser Portable™ 2.1

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NOTIFICATIONS

- ▶ Do not position the equipment in a way that it would be difficult to reach and operate the power cable.
- ▶ If the equipment is used in a manner not specified by the manufacturer, the safety protection of the equipment may be compromised.
- ▶ Do not replace detachable mains supply cords with inadequately rated cords.
- ▶ Always make sure that you are using a safety grounded socket with a safety grounded mains supply cord to connect the mains supply.
- ▶ Never flush the device with a gas flow greater than 3 litres/min (Chapter 5.1.2).
- ▶ To ensure the measurement accuracy device must be calibrated annually.
- ▶ Unauthorized modification or replacement of components is forbidden. This will void the warranty and may cause danger to the user. For maintenance, refer to Sparklike Oy or Sparklike Service Partners

1. SPARKLIKE LASER SPECIFICATIONS

Laser Classification

Sparklike Laser device uses a semiconductor laser as a light source. According to the regulations, the laser is tested by a third party as class 1 laser product (SGS-CSTC Standards Technical Services Co. Ltd., test report GZES150500576331)

Class 1 Laser product

Cannot emit laser radiation at known hazard levels. Users of Class 1 laser products are generally exempt from radiation hazard controls during operations and maintenance. **Class 1 laser is eye-safe under normal operating conditions.**

Laser Specifications

Wavelength:	760 nm
Maximum optical output power:	3 mW
Maximum single mode output power:	0.6 mW
Classification:	Class 3B
Visibility:	NIR (Near Infrared)

Standards & Regulations

IEC 60825-1: 2014 (Third edition)

2. CONNECTIONS

The measuring head is connected with 4 signal cables to the matching sockets on the main unit and with a flushing hose to the flushing gas inlet connector. The signal cables and matching sockets are distinguished by the color and text-markings. The display is connected with an HDMI connector, USB connector, and power cord to the main unit. For connecting or disconnecting the cables, refer to sparklike.com/guidance/lp.



Connector panel:
Connections

3. STARTING UP THE SPARKLIKE LASER

After connecting all the cables and turning the main switch on, turn on the device from the power switch on the main unit. A green light will light up after few seconds around the power switch. After Windows has started, start Laser Software by Sparklike.

When starting the Laser software, the lights at the joint of the handles turns on.

NOTE: When the device is turned on, start the software, and let the device warm-up for 15-30 min. Place the measuring head to the holder at the top of the device. Remember to lock the measuring head in place with a locking knob.

The power switch has an indicator light:

●	Green light continuous	Sparklike device is ON
●	Red light continuous	Battery voltage too low but Sparklike device is ON
●	Blue light blinking slowly	Device on standby
●	Red light blinking	Laser driver temperature too high
●	Red and blue lights blinking alternately	Laser driver temperature too low (sensor error)
○	No light at all	Battery switched OFF



Main switch on the main unit



Locking the knob and Indicator leds on the handles

4. START USING THE EQUIPMENT

4.1 Starting up the device

Remove the protective film from the measurement head window. Leaving the film will interfere measurement.

4.2 Software functionality and pages

The following chapters will discuss each page of the software – Main Page, Settings Page, and Test Page – and their functions.

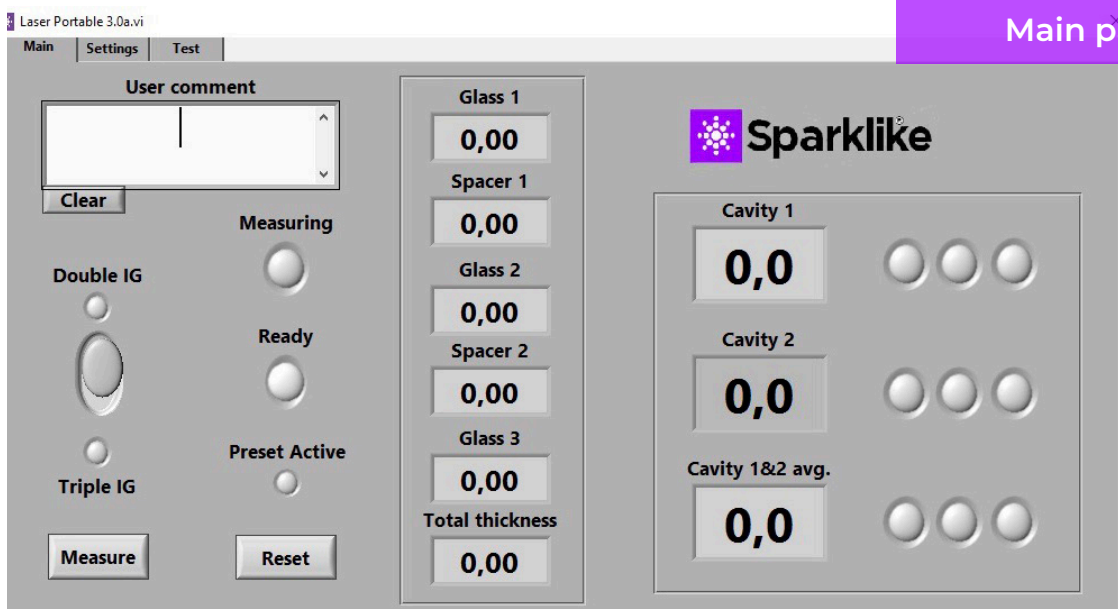
“Measure” button on the Main Page will start the measurement. It is also possible to start the measurement directly by pressing any of the buttons on the measuring head handles. For more information on taking the measurement, read Chapter 5.

4.2.1 Software – Main Page

The Main Page of the software entails the following functions: A place to add user comments, the choice between measuring double or triple glazed units and showing obtained results.

1. In the box labelled “User Comment” the user can write text to be added with the measurement result using the on-screen keyboard found in the Windows Taskbar. This information is saved to the file together with the results. This box can be filled automatically using the barcode reader.
2. Double glass measurement is set as a default for Sparklike Laser analyser, this can be observed from the “Double IG” indicator being green. It is possible to measure also triple glazed products. To measure triple glazed units, slide down the button on the left-hand side of the Main Page. Once this is done, the “Triple IG” indicator lights up. The default settings can be found in the image representing the Main Page with the default setting.
3. Pressing the “Measure” button will initiate the measurement. During the measurement, the “Measuring” indicator is blinking. After the measurement has been completed, the “Ready” indicator is lit, and the measurement results can be seen on the right-hand side of the screen.

(continues on next page)



Main page

4. In the middle of the page, the user is able to observe the results on the thickness of the glass and the space between the glasses as well as the total thickness of the IGU. This reading is available whilst your gas concentration measurement is measured.
5. To return all the values back to default values, press the “Reset” button or change the values back manually. When pressing the “Reset” button it takes a few seconds to return all the values back to default.

The results are displayed once the measurement is finished. When the gas measurement results are over the high limit value, the green indicator will light up on the Main Page next to the measured gas concentration results. The limits for color indicators can be defined on the Setting Page and the indicators, green, yellow, or red, will light up accordingly (instructions in the following chapter labelled Software - Settings Page).

4.2.2 User interface – Settings Page

The Settings Page of the software entails the following functions: defining glass and spacer thicknesses (preset), setting measurement time, setting the device for multiple sequential measurements, setting the measurement result indicator limits, measurement head inner oxygen concentration check, and opening the daily measurement results.

Adding (1) pre-set values with “Glass” and “Spacer” drop down boxes assists the software to identify the correct glass and spacer thickness values and to enable the measurement of glass and spacer thicknesses outside the software default values. It is recommended to use pre-set values if it seems that the glass thicknesses are measured wrong. This may happen, e.g., in the case of certain coated or laminated glasses. As a default software identifies glass thicknesses between 2 and 13 mm and spacer thicknesses from 6 to 25 mm. The device user can set glass thicknesses from 2 to 23 mm and spacer

thicknesses from 4 to 40 mm. When using the pre-set values via the drop-down boxes, the software identifies the glass and cavities thicknesses in the ± 1 mm range from each given value. The glass and spacer closest to the measurement device are “Glass 1” and “Spacer 1”, the further glasses and spacer being sequentially “Glass 2”, “Spacer 2”, and “Glass 3”.

“Measurement time” (2) drop-down box indicates the time to collect data from one cavity. This can be adjusted between 2–5 seconds. The default time is 5 seconds. Longer measurement time is advised for greater accuracy.

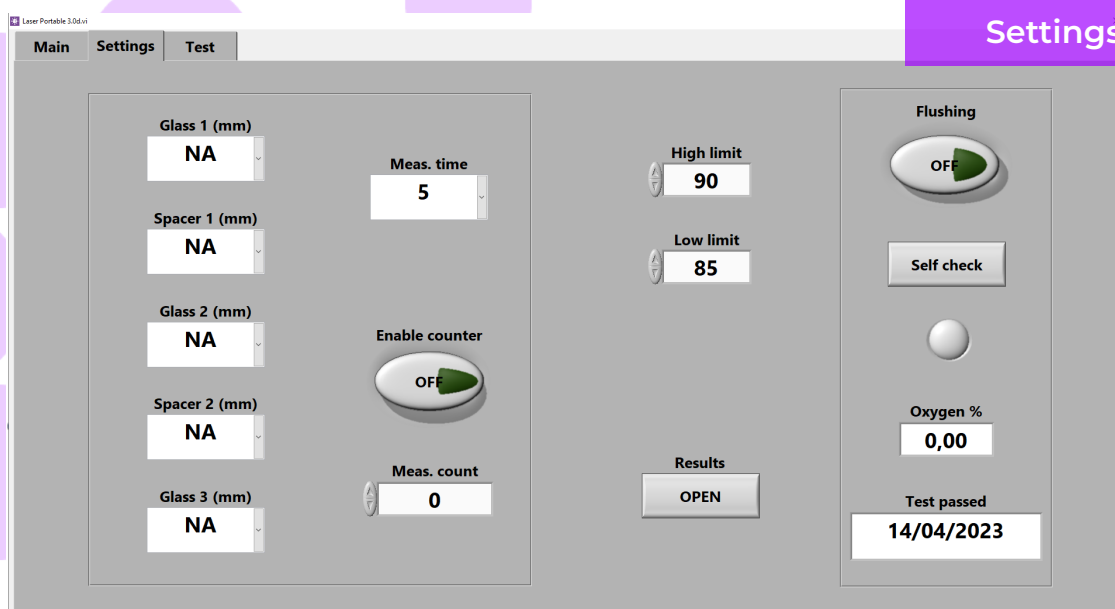
“Enable counter” and “Meas. count” (3) refer to settings for making multiple measurements (discussed below in Section 5.3.1).

“High limit” and “Low limit” (4) refer to the desired result range. For easy interpretation of the results, there are three indicator lights next to the results, featured on the Main Page of the software. To suit their local requirements, the user can set these values via the Setting Page by adjusting the “High limit” and “Low limit” values by clicking up or down or by using the on-screen keyboard to type the desired value. i) when the gas measurement results are over the high limit value, the green indicator will light up, ii) if the result is between high and low limit, the yellow indicator is lit, iii) and if the result is below the low limit, the red indicator turns on.

To access the daily measurement results, click on the Results “Open” button (5).

NOTE: Measurement results are shown on the screen, but are simultaneously saved on the device, and can be accessed at Windows Explorer: Computer\Local Disc(C:)\Temp\Results

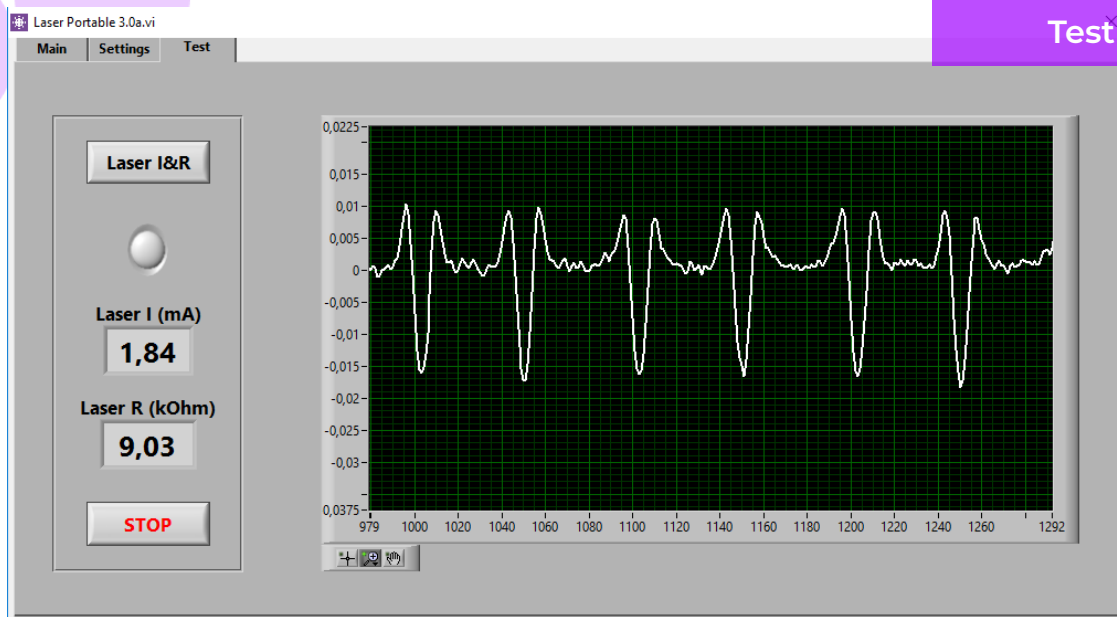
“Flushing”, “Self check”, “Oxygen%”, and “Test passed” (6) refer to purging oxygen from the measurement head (discussed below in Section 5.1.2). “Oxygen %” tells the measured O₂ concentration inside the measurement head in percent. “Test passed” shows the last date the self-check has been passed.



4.2.3 Software – Test Page

The Test Page of the software provides the laser temperature and current check function. The laser component needs to be operated at the correct temperature to yield highly accurate measurement

results. Incorrect temperature adjustment may crash the software. This is discussed below in Section 5.1.1.



5. TAKING A MEASUREMENT

5.1 Daily operations for temperature check and gas fill

AT EVERY STARTUP: The user should check for temperature and oxygen concentration. This ensures the correct operation of Sparklike Laser. To ensure the quality of the measurements it is recommendable that the user checks the oxygen concentration every two hours. Also, always make sure the measuring head's window surface is clean. Clean the surface with a detergent made for windows.

5.1.1 Temperature check

The laser component needs to be operated at the correct temperature to yield highly accurate measurement results. Let the device warm-up with software running for 15-30 min. Incorrect temperature adjustment might result in incorrect measurement results or unexpected functions. Take the following actions to test the temperature adjustment whenever starting up the device.

Choose the "Test" page from the upper left corner of the software. Press the "Laser I&R" button (the indicator below the button starts blinking) and see the following:

- ▶ "Laser I (mA)" should be 1,7–5,9 mA and "Laser R (kOhm)" should be 5–17 kOhm). The values are specific for each device, depending on the laser source.
- ▶ Figures on the graph should be equally spaced and between 30-70 points spacing approximately. See test menu picture.

If these are correct, press STOP. The indicator below the "Laser I&R" button stops blinking. If these do not apply, see the troubleshooting section in Chapter 6.6.

NOTE: remember always to press STOP before starting to use the laser or checking the oxygen level in the measuring head.

5.1.2 Oxygen concentration check

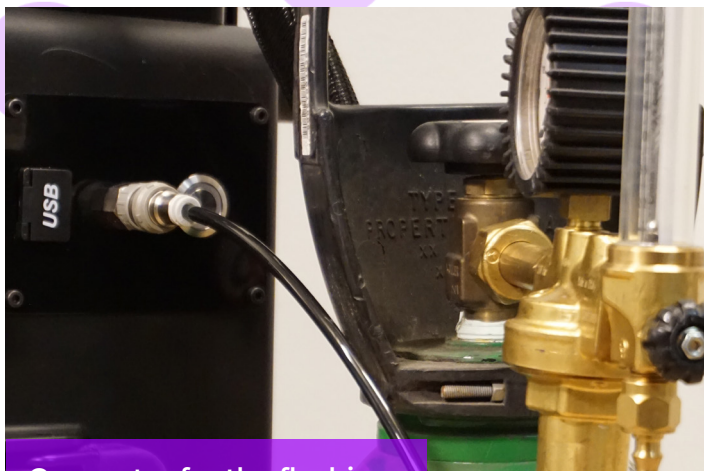
Sparklike Laser is a gas fill analyser; however, it measures the oxygen absorption from the insulating glass unit. For correct readings, oxygen inside the measuring head needs to be removed as well as possible. This is done by flushing the measuring head with e.g., argon, or nitrogen. These gases are later referred as flushing gases.

NOTE: Separate flushing gas cylinder, gas hose, regulator and flowmeter are needed in order to complete the oxygen concentration check. These equipment do not come with the device.

On the Settings Page, press “Self check” button. The indicator below the button starts blinking and the indicator light on the measurement head turns yellow. The self-check will measure the oxygen concentration inside the measuring head and show the result on the box below the button. The operator can begin to use the device if the result is below 0.1 %. If the oxygen concentration is higher than this, the software gives a “Oxygen concentration > 0,1%.” Please flush the device (See manual for details)” warning message and the indicator lights on the measurement head turns red. The date for the last successful self-check can be found in the “Test passed” box on the Settings Page. If the result is over 0.1%, there is too much oxygen inside the measuring head, and the user should flush the device.

Flushing the oxygen from the measurement head

- ▶ Place the measuring head facing down on the holder on the top of the case.
- ▶ The gas fill inlet is next to the power switch. Attach the connector for the flushing gas hose to the main unit. Join the flushing gas hose (6x4mm).
- ▶ Apply dry and pure (> 99.99%) flushing gas flow of 1-3 l/min (max 3 l/min and 1 bar) to the hose.



Connector for the flushing gas hose and the hose

- ▶ Press the “Flushing” button on the software (light on the button will turn on). This will open the internal valves and guide the flushing gas flow through the measuring head. During the filling, press “Self check” button to check the concentration. On each check, the user should see the concentration to decrease. Continue filling as long as the concentration does not go any lower, and the selfcheck result is < 0,1 %. The device can be used while the measuring head is being flushed with a flushing gas. After the oxygen from the measuring head have been successfully removed and replaced it with flushing gas, press the “Flushing” button again to close the valves (indicator turns off), and disconnect the gas flow.

NOTE: Internal oxygen concentration can be tested anytime via Settings Page by pressing the “Self check” button. It is recommended to do this check every two hours, or every time when suspecting incorrect readings. For any problems, see the troubleshooting section in Chapter 6.7.

5.2 Basic measurement

Choose “Double IG” or “Triple IG” from the Main Page depending on which type of IGU is measured.

Place the measuring head front cushion firmly against the window. It is possible to start the device in two alternative ways:

- ▶ Press the “Start” button directly on any of the handles of the measuring head (see picture below).
- ▶ Press the “Measure” button on the Main Page of the software. Use only when the device is resting on a horizontal surface (see picture: Main page).

The vacuum pump evacuates the air between the measuring head and the glass to attach them tightly together. If the vacuum is poor, the software will



Start button on the handle

give a warning message. When the measurement is started the “measuring” led starts to blink on the software. The indicator leds on the measuring head will turn blue. Keep your hands on the handles (if the device is not used on a horizontal surface).

The measurement takes about 18–28 seconds depending on the settings and the window to be measured.

Measuring head indicator lights:

●	Purple light continuous	Device in stand by
●	Blue light continuous	Measuring
●	Blue light blinking	Vacuum missing
●	Green	Measurement about to end/ done
●	Blue	Self-check in progress
●	Yellow	Gas fill valves open
●	Red	Error

Once the measurement is ready, the vacuum pump stops, and the measuring head is released from the glass. “Ready” led turns green and the results are displayed on the Main Page.

5.3 Advanced measurement

5.3.1 Enable Counter

If the user have enabled counter (Settings Page), signal how many measurements are liked to taken in a row. First, select a number for the “Meas. count” box by clicking up or down arrows, or by typing a value with the onscreen keyboard. Use of “Meas. count” is recommended only if measuring is made on horizontal surfaces.

Then, if “Enable counter” button is pressed, multiple measurements are done in a sequence. A green indicator is switched on.

NOTE: If the user has changed any of the following default values: i) glass or spacer thickness ii) measurement time or iii) counter state, the “Pre-set Active” indicator on the Main Page turns red when measuring. This reminds the user that the measurement settings are different from the default values. To return all the values back to default values, press the “Reset” button on the Main Page or change the values back manually. When pressing the “Reset” button it takes a few seconds to return all the values back to default.

5.3.2 Editing the default settings

The default values can be edited with normal Windows editing applications such as Notepad. Please note that editing the default settings is on the user’s own responsibility and Sparklike cannot assure the measurement results.

1. Open the c:\temp\Settings.ini file
2. Change the corresponding values. Do this with discretion to not interfere with the operation of the device. Safe values to edit are, e.g. High_limit and Low_limit for the indicator lights on the Main page of Sparklike Application. It is not recommended to edit other values without consulting Sparklike product support.
3. Save and close the file
4. Stop and restart the Sparklike Application to use the new settings values.

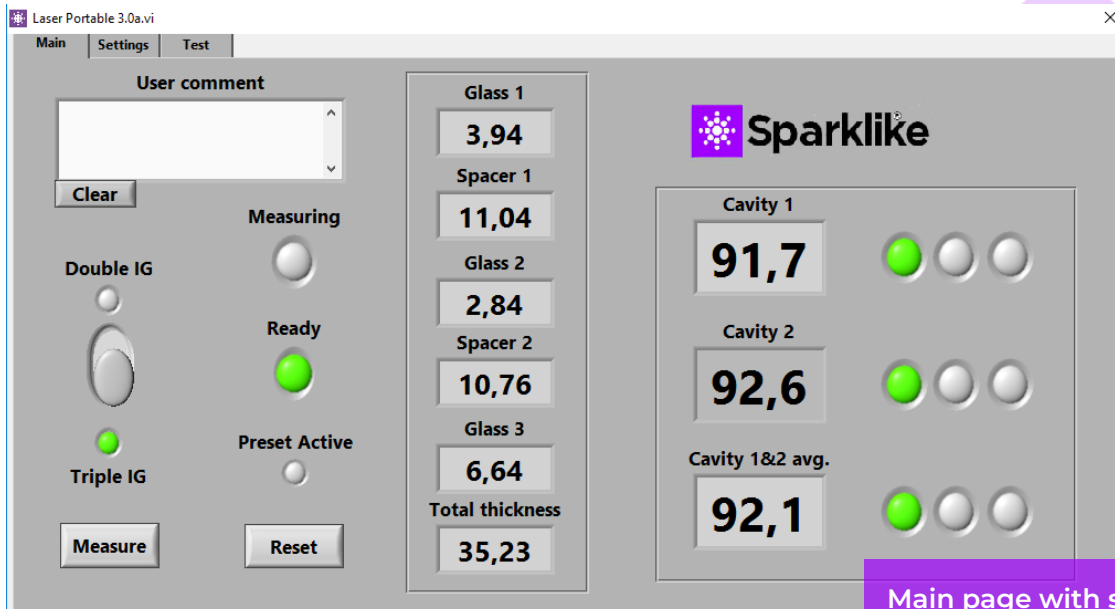
5.4 Understanding the results

For triple glass units, the device measures first the overall value of both cavities, then the 1st cavity, and then based on these measured results, calculates the gas content of the 2nd cavity. Therefore, the results of the 2nd cavity can be considered as indicative of what complements the information of each cavity.

- ▶ See the insulating gas (such as argon, krypton, or xenon) concentration on the result boxes on the Main Page Press the “Measure” button on the Main Page of the software.
- ▶ For a double glazed unit, only the “Cavity 1” result is shown.
- ▶ For a triple glazed unit, all three results are shown.
- ▶ “Cavity 1” is measured, and “Cavity 2” is a calculated
- ▶ “Cavity 1&2 avg” is the average of overall gas fill and it considers the thicknesses of both cavities (weighted average).

Check that the glass and cavity dimensions are what they should be. If they are not, see the troubleshooting section in Chapter 6.8.

REMINDER: Measurement results are shown on the screen, but are simultaneously saved on the device: Disc (C:)\Temp\Results



Main page with sample measurement results for triple glass

5.5 Factors to consider when measuring

Here is a list of factors that might impact the measuring. Please read the whole manual carefully to understand how the Laser device functions.

- Ensure the cleanliness of measured glass and device window surfaces.
- Note that the maximum thickness is 51 mm (DGU from surface 1 to 3 and TGU 1 to 5).
- Self-check is below 0,1 % of Oxygen.
- Let the device warm-up with software running for 15-30 minutes and do not use the device. The laser component needs to be operated at the correct temperature to yield accurate measurement results.
- Make sure vacuum suction holds the measuring head tightly against the insulating glass to be measured.
- Perform several measurements on the same IGU and to the same spot and compare the results. If most of the measurements are consistent but there are exceptional results, repeat the measurement. The exceptional results might be measurement errors.
- If measured a glass with a special reflective coating (e.g., Low-E), try measuring from the non-coated side to get a better signal to the sensor and more accurate results.
- Try to measure close to the spacer to avoid glass arching because vacuum gripping can be more difficult on arched glass. The user can try to help the vacuum by pressing the measuring head against the glass firmly once the measurement has started. If this does not help, firstly clean the vacuum with a dry cloth. If that does not help, secondly replace the vacuum seal to new one which can be found from the spare parts.
- Ensure that measured results of glass and spacer thicknesses are approximately according to the expected thicknesses of the measured IGU.
- Note that over 97 % gas filling might be difficult to ensure due to extremely low concentration of residual Oxygen to be detected.

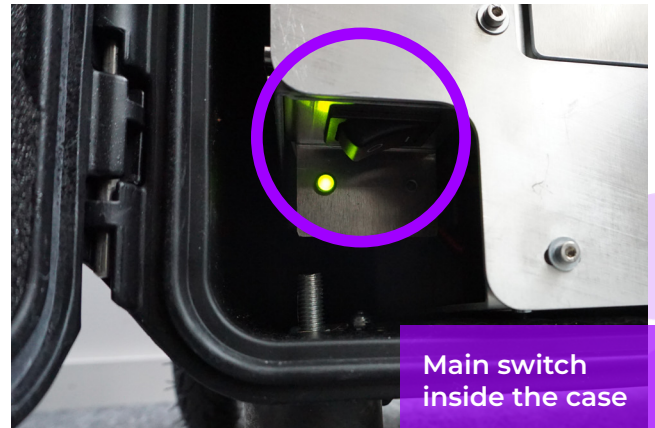
6. TROUBLESHOOTING

6.1 Restarting the program

When starting the system, if the indicator leds on the handles of the measuring head do not light up (Chapter 3), restart the program by closing the window from the upper right corner.

Start the program by double-clicking the Laser software icon on your desktop.

If the Windows freezes and you are unable to shut down the device, press the power switch continuously for a few seconds to force shut down the device. If this does not help, open the trolley case and turn OFF the main switch inside the case, see picture.



6.2 DAQ identification error message

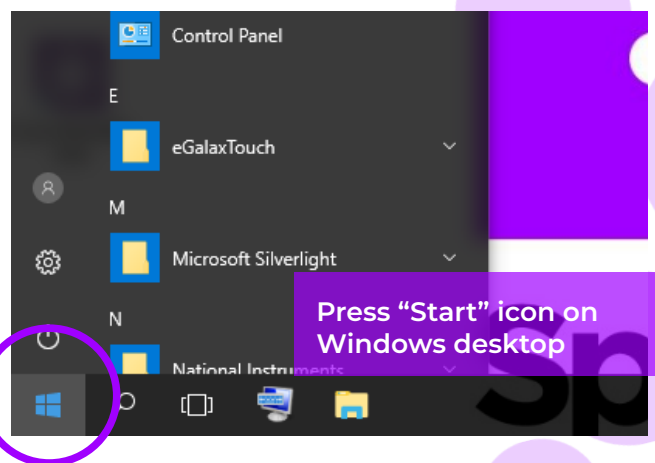
Check that Windows has a connection to the DAQ: From Windows desktop press the "Start" icon >> Windows System >> Control Panel >> Device Manager. There should be Data Acquisition Devices >> USB DAQ.

1. If the USB DAQ is found (This device is working properly): Run the ResetNICConfig at C:\Program Files (x86)\National Instruments\Shared\Reset NI Config. After running ResetNICConfig it will show a warning message to which select YES. Then the program asks to restart the computer, select No and turn off the computer from the windows operation system and then turn it on from the power switch.

2. If the USB DAQ is not found: the device is inactive. Check that the DAQ led on the connector panel inside the case is on.

- 2.1 If DAQ led is on: the power supply for the DAQ card is working. Then shut down windows and after that, restart the device. If this does not solve the problem, contact the product support at Sparklike for instructions.

- 2.2 If DAQ led is off, contact the product support at Sparklike for instructions.



6.3 Laser temp or current out of range

Check from the connector panel that the green-labelled circular multipin connector is firmly connected to the connector panel. Shut down the Windows, wait 20 seconds before restarting the device.

6.4 Drive error

Check from the connector panel that all the circular multipin connectors are firmly attached. Shut down the Windows, wait 20 seconds before restarting the device.



6.5 Glass detection error message

If the "Glass Detection Error" message appears, check that the pre-set glass and spacer values are correct, the device is firmly against the glass, and the device is not tilted. In these cases, the device window may need to be cleaned. If that does not help, shut down the Windows, and wait 20 seconds before restarting the device.

If the above-mentioned actions do not work error message is caused by the lack of the laser signal on the detector. This is due to insufficient amount of laser light passing the surfaces 1 or 2 on the IGU due to coatings. Try measuring from another side.

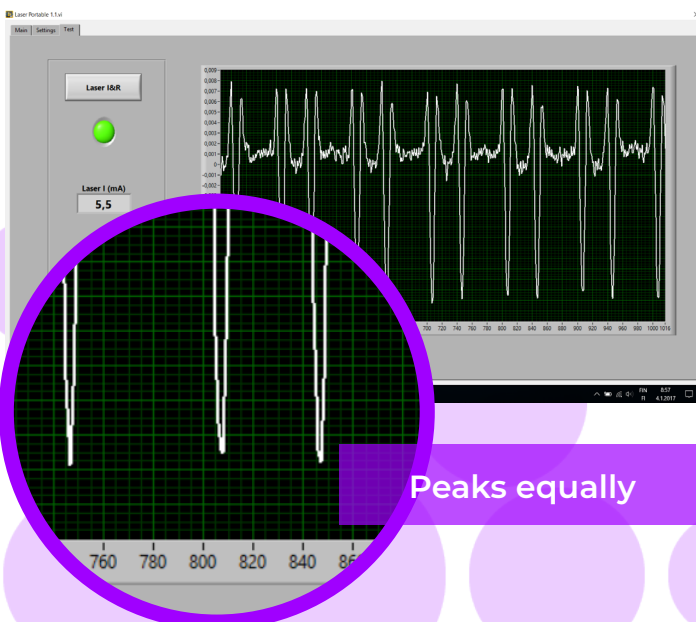
6.6 Adjusting the laser temperature

If the parameters and the graph on the daily operations (Chapter 4.2) are incorrect, please try the following actions:

- ▶ Let the device warm up for 15 minutes
- ▶ Press the "Stop" button and then "Laser I&R" button on the Test page again to restart the test process (see picture Test Page, Chapter 4.2.3.). If the readings or the graph are still incorrect, restart the program (see Chapter 6.1. Restarting the program) and press "Laser I&R" button again. See picture A for reference.
- ▶ If this does not help, and the graph is still not correct (between 30-70 dots equal spacing), it means that the laser temperature is incorrect and needs to be adjusted: Try the self check function on Settings Page. You will have an info screen about laser temperature adjustment. See the picture Peaks equally for the reference.

If the temperature of the laser has changed so much that one cannot see the peaks in the Test page "Laser I&R" test, one can fine-tune the temperature as follows (Sparklike technical support can help with this).

1. Open the c:\temp\Settings.ini file with Windows Notepad.
2. Change the value of the "T_fine_tune" variable. Changing the value from 0 to 0,01 will move the peaks to about 5 data points. Using a negative value (-0,01) will move the peaks to the opposite direction.
3. Save and close the file.
4. Open the laser software and run the "Laser I&R" test from the "Test" page. The peaks should have moved according to the value set to the variable.
5. Increase the value as much as needed and try to find a value where the peak spacing is close to around 50 data points.
6. Check that the final "Laser R" value is close (inside couple of hundred Ohms) to the "Rvalue" mentioned in the "Settings.ini" -file. If not, there could be another oxygen peak closer to the original value but to the "other direction" (negative or positive adjustment value).



6.7 Internal oxygen concentration problems

Sparklike Laser is a gas fill analyser that works by measuring the oxygen inside the glazing unit. To ensure correct readings, oxygen needs to be removed from inside the measuring head by replacing it with argon or other flushing gas such as xenon or nitrogen.

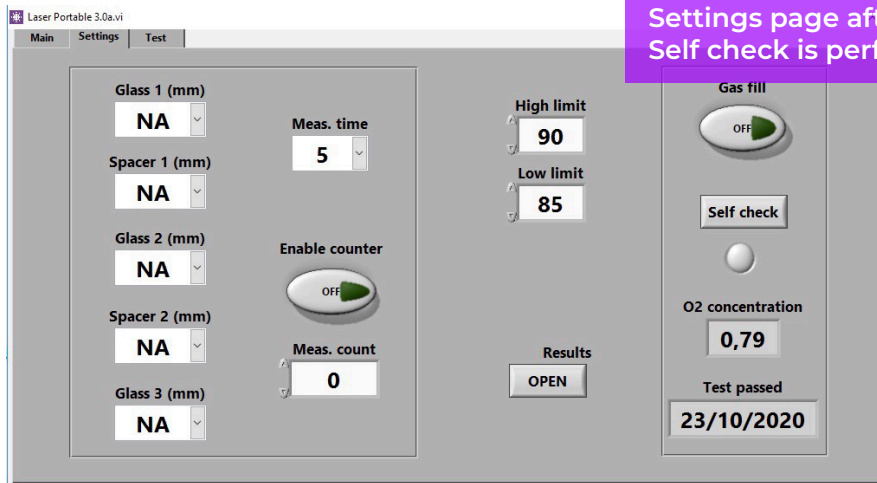
Internal oxygen concentration is tested from the Settings Page on the software by pressing the “Self check” button. When testing the internal oxygen level or making the argon fill, the operator might run into the following situations:

Internal oxygen concentration result does not go below 0.1 %, as required. Normally the internal oxygen concentration level should drop below 0.1% within about 20 min of flushing time. If the oxygen level settles to a value over 0.1% and does not go any lower, please check that:

- ▶ the flushing gas is pure (>99.99% Argon)
- ▶ there is pressure and the flow rate is 1–3 l/min (maximum 3 l/min!)

- ▶ “Flushing” button is enabled on the software’s Settings Page
- ▶ turn the measuring head slowly upside down a few times to help remove oxygen (otherwise keep the measuring head vertically on the holder)
- ▶ If all of these are OK, but the problem persists, please contact service@sparklike.com for further assistance.

Internal oxygen concentration result drops below 0.1%, but there is considerable variation in “Self check” results. Once the result is very low, around 0.01–0.05%, the operator might see some variation in the “Self check” readings so that some readings might be even > 0.1%. This is normal, as the concentration is so low, that sometimes the measurement noise can cause variation. Important thing is that most of the “Self check” measurements are < 0.1%, as required.



6.8 Measurement problems

If unexpected inconsistent readings are received, please check the following things:

- ▶ Laser temperature
- ▶ Internal oxygen concentration
- ▶ Vacuum suction holds the measuring head tightly against the insulating glass to be measured
- ▶ Glass and spacer thicknesses are approximately according to the correct expected thicknesses
- ▶ Try to measure close to the spacer.
- ▶ Do several measurements on the same IGU and compare the results. If most of the measurements are consistent but there are exceptional results, repeat the measurement. The exceptional results might be measurement errors.
- ▶ If there is a special reflective coating (e.g., Low-E), try measuring from the non-coated side to get a better signal to the sensor and more accurate results.

- ▶ If the vacuum does not hold the measuring head tightly against the glass, make sure that the IG surface is not too bent to avoid proper contact. The user can try to help the vacuum by pressing the measuring head against the glass firmly once the measurement has started. If this does not help, replace the vacuum to new one which can be found from the spare parts
- ▶ If glass or spacer thicknesses are shown incorrectly, the measurement is taken from the incorrect location and the results are not correct. The device user can try to help the analysis by providing the pre-set values to the drop-down menus for glass and spacer thicknesses on the Settings Page. When the user provides this information, the software can locate the correct measurement locations more easily.

If the problems persist, please contact service@sparklike.com. Also, please be prepared to have the IG structure information, coating characteristics available, and the measurements data file.

7. SERVICE AND MAINTENANCE

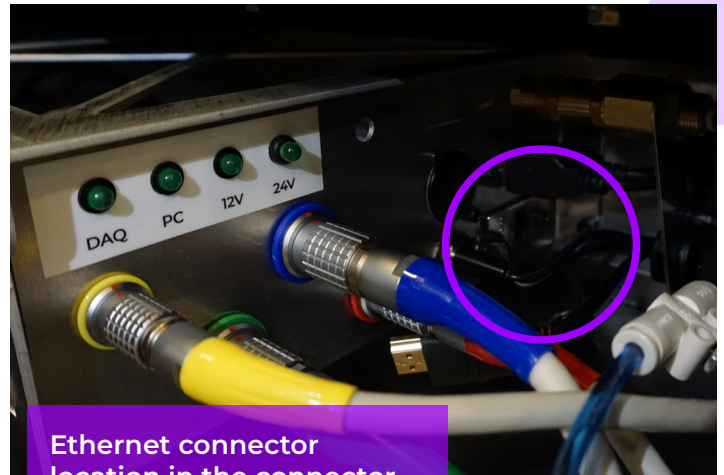
7.1 Calibration

To ensure the measurement accuracy Sparklike Laser Portable 2.1 must be calibrated and maintained annually.

To request calibration and/or maintenance, please contact Sparklike Service Center sparklike.com/en/maintenance-and-calibration/.

7.2 Technical support using remote connection

Sparklike can offer remote technical support using TeamViewer application. Connect the device to the Internet using an Ethernet cable. The Ethernet connector is located in the connector panel inside the trolley case. Please contact Sparklike service@sparklike.com to open the remote connection for technical support.



Ethernet connector location in the connector panel inside the trolley

7.3 Packing and shipping

Sparklike Laser Portable 2.1 is sensitive measuring device and the device must be packed appropriately to ensure safe shipping. When the device have been sent, the user have received transportation box and two packing foams. Set the first foam to the bottom of the transportation box and the main unit on it. After that set the second foam and place measuring head, 12" touch screen display and display holder with other parts. Go to sparklike.com/guidance/lp to get instructions how to pack the device for transportation.

The window of the measurement head is sensitive to scratches. If the window of the measurement head requires cleaning, use materials and solvents made for delicate optical instruments.

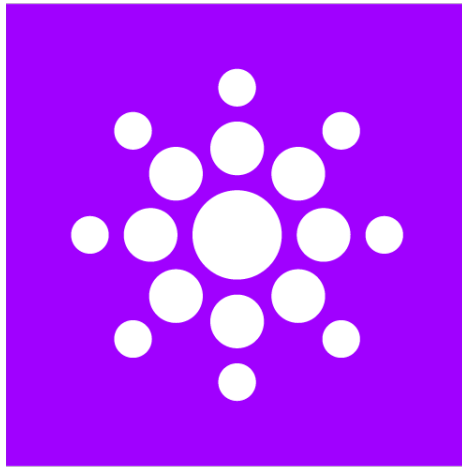


8. TECHNICAL SPECIFICATION

Overall dimensions (LxHxW)	Main unit	420 x 585 x 325 mm	
	Measuring head	320 x 310 x 195 mm	
	Device in operation	420 x 1300 x 390 mm	
	Measuring head cable	1,8 m	
Supply voltage and frequency (refer to product label on mains connector)	Input	110-120 VAC, 220-240 VAC / 50-60 Hz	± 10 %
	<i>OR (if needed)</i>	<i>100-240 VAC / 50-60 Hz</i>	
Power consumption	Max 250 W		
Power cord	5 m		
Weight	Main unit	22 kg	
	Measuring head	6 kg	
Operating conditions	+5 – +40 °C, indoor use only		
Humidity	20–80%		
Altitude	up to 2000 m		
Thickness measurement accuracy	± 50 µm *		
Repeatability of the gas measurements	± 2 % **, **		
Measurement time	18–28 s (depends on the settings and IG structure)		
Maximum IG thickness	51 mm (from surface 1 to surface 3 with DGU, from surface 1 to 5 with TGU)		
Minimum panel thickness	2 mm		
Connectors	4x circular multipin connector, RJ-45, 2x USB 2.0, VAC Power (C14), HDMI, Display Power output		
Display	12" HD Touch Screen		
Software	Windows 10, Laser Software by Sparklike (all included)		
Data logging capability	SSD Storage (232 GB), USB/Network transfer		

* Typical construction of the insulating glass unit

** At least 30 measurements are needed that 95 % confidence interval is valid



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