User Manual:

Solar Spectral Irradiance Meter

SolarSIM-D2

User information

Spectrafy Inc. strongly recommends reading this instruction manual prior to installation and operation of your Solar Spectral Irradiance Meter (SolarSIM-D2).

If you have any comments about this manual or our products, please send them to:

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Spectrafy Inc. reserves the right to make modifications to the user manual without prior notice.

Warranty and liability

Spectrafy Inc. guarantees that the Solar Spectral Irradiance Meter (SolarSIM-D2) has been thoroughly tested to ensure that it meets all of the stated specifications. A two year warranty is provided from date of invoice, subject to correct installation and operation. Spectrafy Inc. accepts no liability for any loss or damages arising from improper usage of this product.

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Introduction

Dear customer, thank you for purchasing the direct Solar Spectral Irradiance Meter (SolarSIM-D2) from Spectrafy Inc. Please become familiar with this instruction manual for a full understanding of the use of your SolarSIM-D2.

The SolarSIM-D2 is designed to be a cost-effective tool for accurately determining the solar spectrum and direct normal irradiance (DNI) as part of on-site solar resource assessments and module performance characterization studies. The instrument uses silicon photodiodes, integrated with hard-coated bandpass filters to measure the solar spectral irradiance in six narrow wavelength bands within a full angle of 5°. The SolarSIM-D2's proprietary software uses these measurements to resolve the direct solar spectrum, in addition to major atmospheric processes, such as air mass, Rayleigh scattering, aerosol extinction, ozone and water vapour absorptions.

If you have any questions, please feel free to contact a Spectrafy representative or e-mail `info@spectrafy.com`

1 Main components

The exploded view of SolarSIM-D2 components is shown in Figure 1, which includes

- a front cap,
- a front window,
- bandpass filters,
- an enclosure,
- a backplate, and
- a connector.

1.1 Front cap

The front cap is used to secure the front window glass to the enclosure via six screws.

1.2 Front glass

The front glass prevents the ingress of moisture and debris.

1.3 Bandpass filters

Six bandpass filters transmit a narrow band of spectral irradiance to the detectors.

1.4 Enclosure

The anodized aluminum enclosure secures SolarSIM-D2 components in place, while providing robust protection from the environment.

1.5 Backplate

The anodized aluminum backplate seals the back of the enclosure with four screws.

1.6 Connector

The connector provides the power and communication to the SolarSIM-D2 electronics.

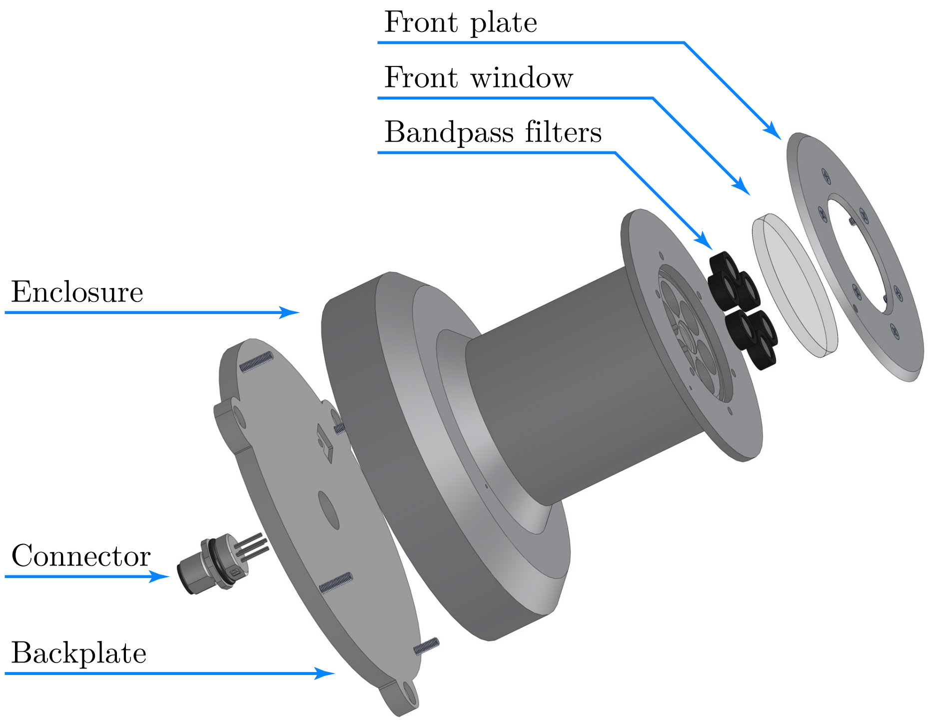

Figure 1: The exploded view of SolarSIM-D2 components.

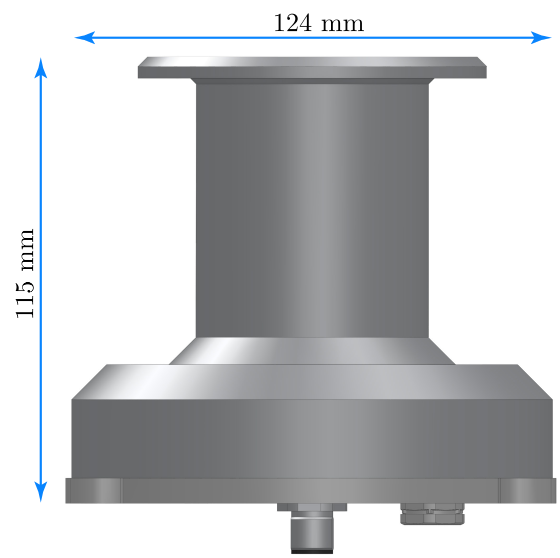

Figure 2: SolarSIM-D2 main dimensions.

2 Installation

2.1 Contents of delivery

Per each ordered SolarSIM-D2 the received package should contain:

- a SolarSIM-D2 ×1,
- a communication cable ×1,
- a SolarSIM-D2 Communication Box ×1 (optional),
- a mounting plate ×1 (optional),
- mounting screws ×3,
- mounting springs ×3, and
- a USB key loaded with the SolarSIM-D2 software.

Please check the contents of the package and note if any damages have occurred during shipment. A claim should be filed with the shipment carrier should this be the case. Additionally, please contact a Spectrafy representative to facilitate the repair or replacement of the instrument and/or its accessories.

2.2 Mechanical installation

The SolarSIM-D2 installation requires fastening it to the 165 mm × 165 mm mounting plate via three M4 screws and springs, as demonstrated in Figure 3. The mounting plate is 4.8 mm thick and has four through holes of 4.5 mm diameter for external fastening, as shown in Figure 4. The screws for external mounting are not provided. The procedure for mechanical installation is described as follows:

1. Place the SolarSIM-D2 on the mounting plate as per Figure 4.
2. Place the spring under the SolarSIM-D2 so that it roughly aligns with one of the mounting holes on the SolarSIM-D2.
3. Insert the mounting screw through the SolarSIM-D2's mounting hole and the spring. Then thread the screw into the mounting plate for a few revolutions, only.
4. Repeat steps 2 and 3 for the remaining two screws and springs.
5. Tighten all screws to compress the springs by about 10 mm..
6. Once the SolarSIM-D2 is on the sun, adjust the mounting screws to align the SolarSIM-D2 to the sun using the alignment pinhole.

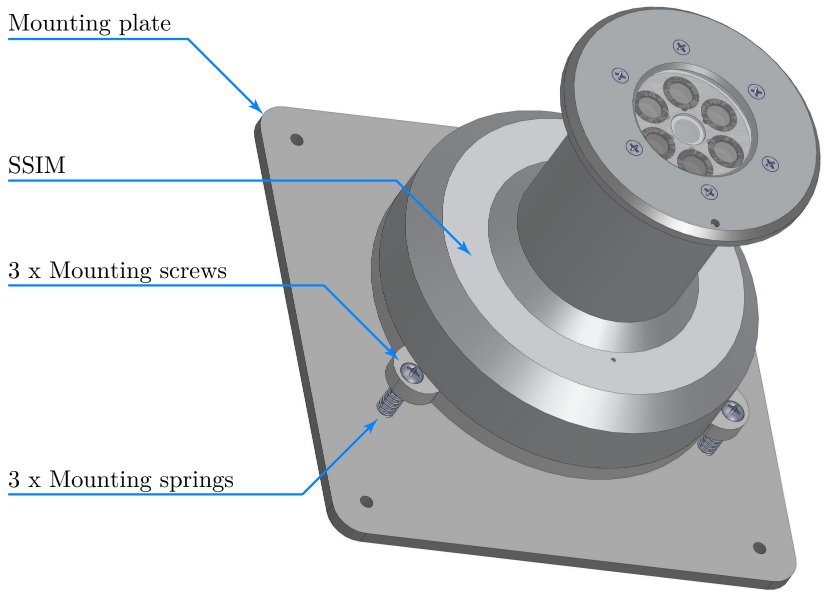

Figure 3: Assembled SolarSIM-D2 on a mounting plate.

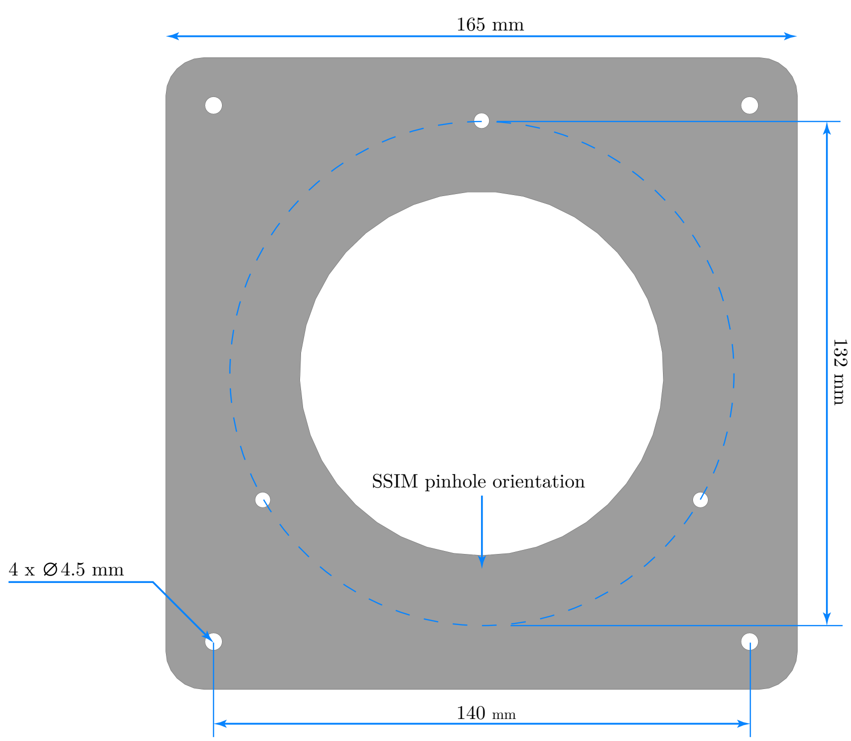

Figure 4: Dimensional drawing of a mounting plate.

3 Maintenance

The SolarSIM-D2 needs very little maintenance. The most important task is to make sure that the front window of the SolarSIM-D2 is clean at all times, as the accumulation of dirt can lead to misrepresented data. Furthermore, the alignment of the SolarSIM-D2 should be checked regularly.

3.1 Cleaning

As a general rule, we recommend cleaning the SolarSIM-D2's front glass with a dry, non-abrasive cloth, or paper towel, once per week, in order to maintain optimum performance. This frequency can be altered depending on your local climatic conditions.

3.2 Alignment

With each cleaning, it is also advised to check the alignment of the instrument using the pinhole, provided it is sunny. If the sun's spot size is not centred within the pinhole, adjust the appropriate mounting screws to re-align the SolarSIM-D2.

3.3 Desiccant

The desiccant is used to maintain an appropriate humidity level within the SolarSIM-D2. It should appear blue to begin with, as visible through the front window. Once the desiccant is saturated, it will turn red. The colour of the desiccant should be checked regularly as part of the cleaning procedure. The lifetime of the desiccant is expected to exceed two years, although it may vary based on the local climatic conditions. The desiccant can be replaced as part of the SolarSIM-D2's re-calibration procedure.

3.4 Recalibration

We recommend that the SolarSIM-D2 is returned to Spectrafy for recalibration **every two years** in order to maintain the SolarSIM's specified accuracy.

4 Connectivity

The SolarSIM-D2 offers unparallelled connectivity options suitable for most use case scenarios. The connectivity solutions include

1. A SolarSIM-D2 Communication Box,
2. A serial-over-Ethernet converter, or
3. A datalogger.

Option 1 uses the SolarSIM-D2 Communication Box (COMBOX) - a seamless link between a PC and the SolarSIM-D2, as shown in Figure 5. A standard 6 ft USB cable is connected from the COMBOX to a PC. On the other side, a 10 m RS-485 communication cable is connected from the COMBOX to the SolarSIM-D2. This option is ideal for test sites and locations where one has the access to a personal computer (PC) or when quick, in-field spectral measurements are necessary with a laptop.

Option 2 allows to interface with the SolarSIM-D2 via serial-over-Ethernet converter, provided there is Internet access. For this option the user must manually connect the power and communication wires to the SolarSIM-D2 by following the wiring guide in Section 4.2. This option is ideal for test sites and locations which have Internet access, but no PC nearby. Both options 1 and 2 make the use of the SolarSIM DAQ graphical user interface, which must be installed on a Windows-based PC or a server, as explained in Section 5.

Option 3 uses a datalogger to acquire raw data from the SolarSIM-D2. This raw data must be specifically formatted by the user into a .csv file, which is then fed into the SolarSG software to generate a complete SolarSIM-D2 data set, as further eluded to in Section 6.3. This option is ideal for remote test sites and locations with existing datalogger systems.

Figure 5: The COMBOX is necessary to interface the SolarSIM-D2 wih a PC.

4.1 SolarSIM-D2 Communication Box

The COMBOX is the best option for stable communication between a PC and the SolarSIM-D2. Please follow these steps to install the COMBOX:

1. Connect one end of the communication cable to the SolarSIM-D2.
2. Connect the other end to the COMBOX.
3. Connect one end of a male-to-male USB cable to the COMBOX.
4. Connect the other end of a male-to-male USB cable to a PC. A blue LED on the top of the COMBOX indicates power to the SolarSIM-D2.
5. Wait for the PC install the FTDI drivers, which may take a few minutes.
6. Once the FTDI drivers are installed, restart the PC.

4.2 Serial-over-Ethernet converter

For remote test site applications the SolarSIM-D2 can be connected to a networked PC via a suitable serial-over-Ethernet (SOE) converter - such as the ICP DAS I-7188-E2[1]. The user must connect the SolarSIM-D2 communication cable wires as per Table 1. More specifically, the D+ and D− lines, brown and black wires, respectively, must be connected to the corresponding terminal block inputs on the SOE device, while the blue and white wires - to the positive and common ground sides of the 12 VDC power supply, respectively. The SOE converter and the power supply must have a common ground. Note, supplying the SolarSIM-D2 with the voltage higher than **12 VDC** will damage the SolarSIM-D2 electronics.

The network must assign a static IP address to the SOE converter. Afterwards, a virtual communication link can be established via the VxComm software[2]. The latter must be configured as per Figures 6 and 7. Once properly configured, the VxComm software creates a virtual serial port on the networked PC, which the SolarSIM DAQ application uses to communicate to the SolarSIM-D2.

[1] https://www.icpdas-usa.com/i_7188e2.html
[2] http://ftp.icpdas.com/pub/cd/8000cd/napdos/driver/vxcomm_driver/windows/

Table 1: Wiring guide for the SolarSIM-D2.

Colour	Label	Function
Blue	V_{in}	Input voltage (+12 VDC)
White	GND	Common ground
Black	D−	Negative RS-485 input
Brown	D+	Positive RS-485 input

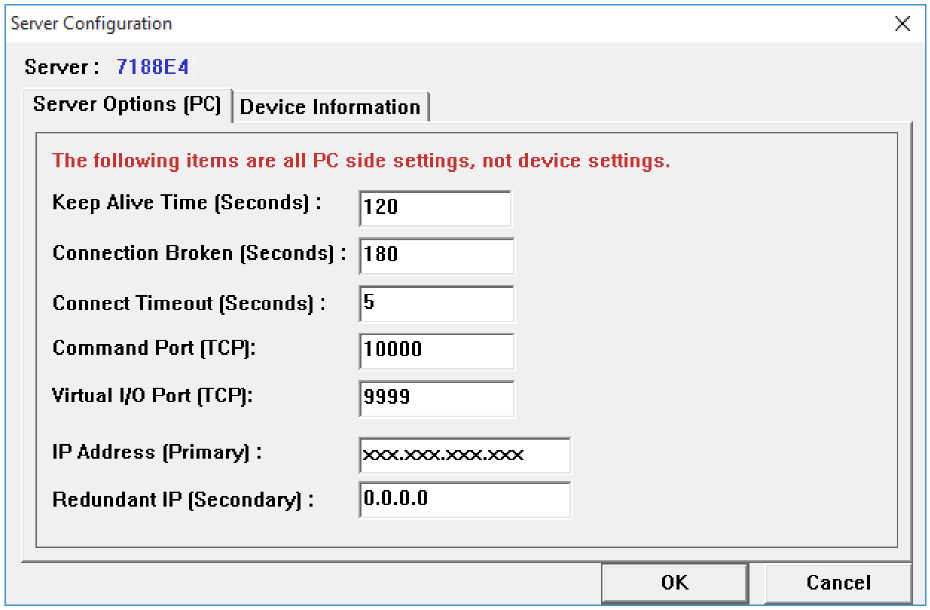

Figure 6: Server configuration for VxComm software. Note, the SolarSIM-D2 supports only the ASCII RS-485 communication mode.

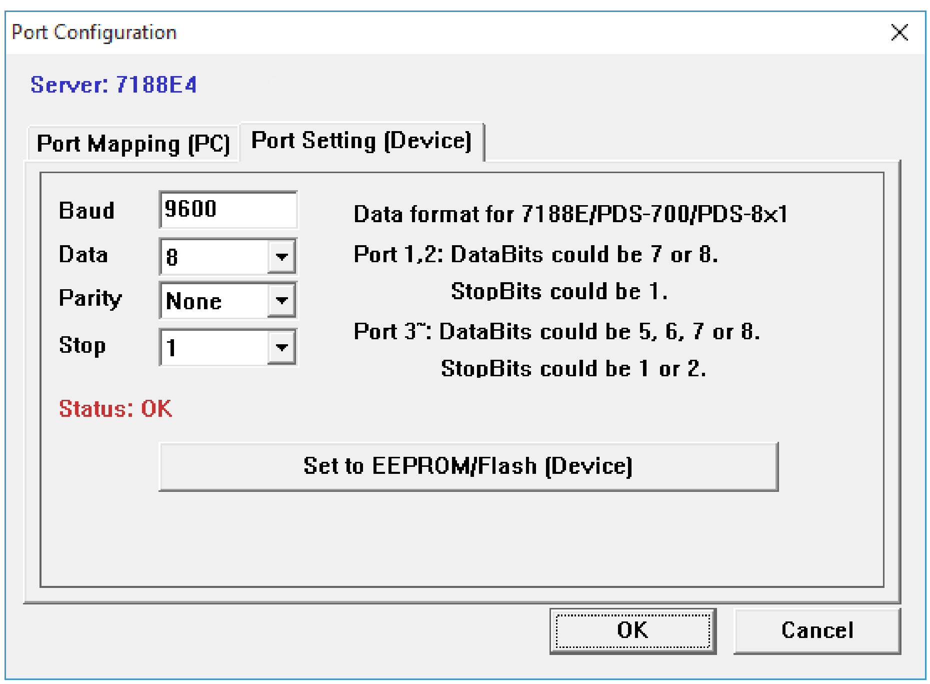

Figure 7: Port configuration for VxComm software. Note, the SolarSIM-D2 supports only the ASCII RS-485 communication mode.

4.3 Datalogger

The connectivity with a datalogger is similar to the SolarSIM-D2's integration with the SOE converter. The SolarSIM-D2 communication cable is connected to the corresponding datalogger inputs as per Section 4.2. The datalogger must have a spare RS-485 port.

5 SolarSIM DAQ Application

The SolarSIM DAQ application provides the user with the real-time status of the instrument, data acquisition and storage, and daily data plots. The SolarSIM DAQ communicates via a serial port and thus can be used with either a COMBOX or a SOE converter. This section will go over the software installation, the program settings, and the general know-how for using the SolarSIM DAQ.

5.1 Software installation

The software installation is performed by executing the `setup.exe` inside the `SolarSIM setup` folder located on the provided USB key, as shown in Figure 8. The user should follow the installation instructions as prompted by the software.

5.2 Software settings

Once the SolarSIM-D2 software is installed, the user must define the location-specific geographic settings for the SolarSIM-D2 to work properly. This process can be accomplished in

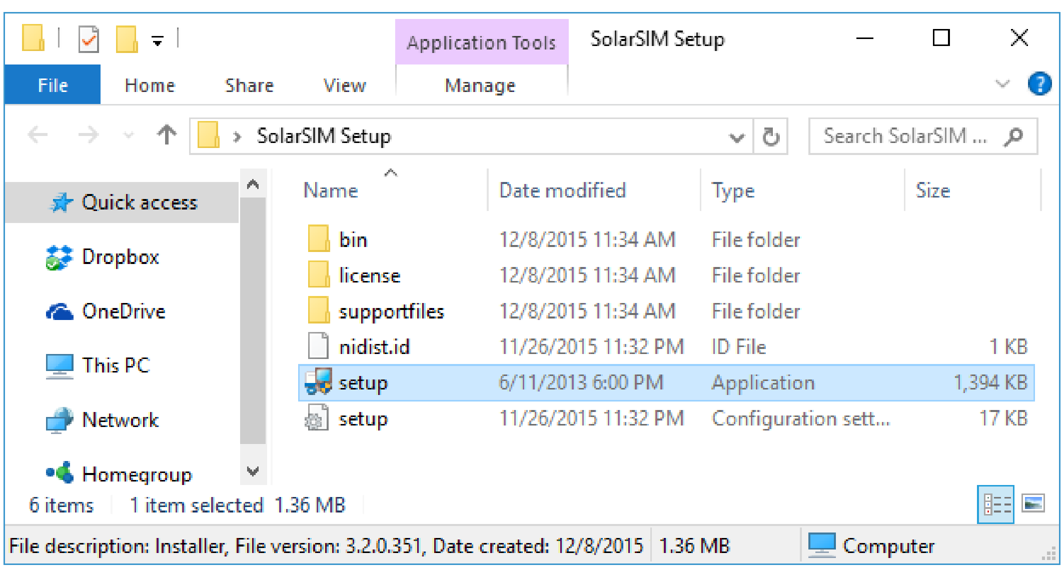

Figure 8: Installation of the SolarSIM-D2 software

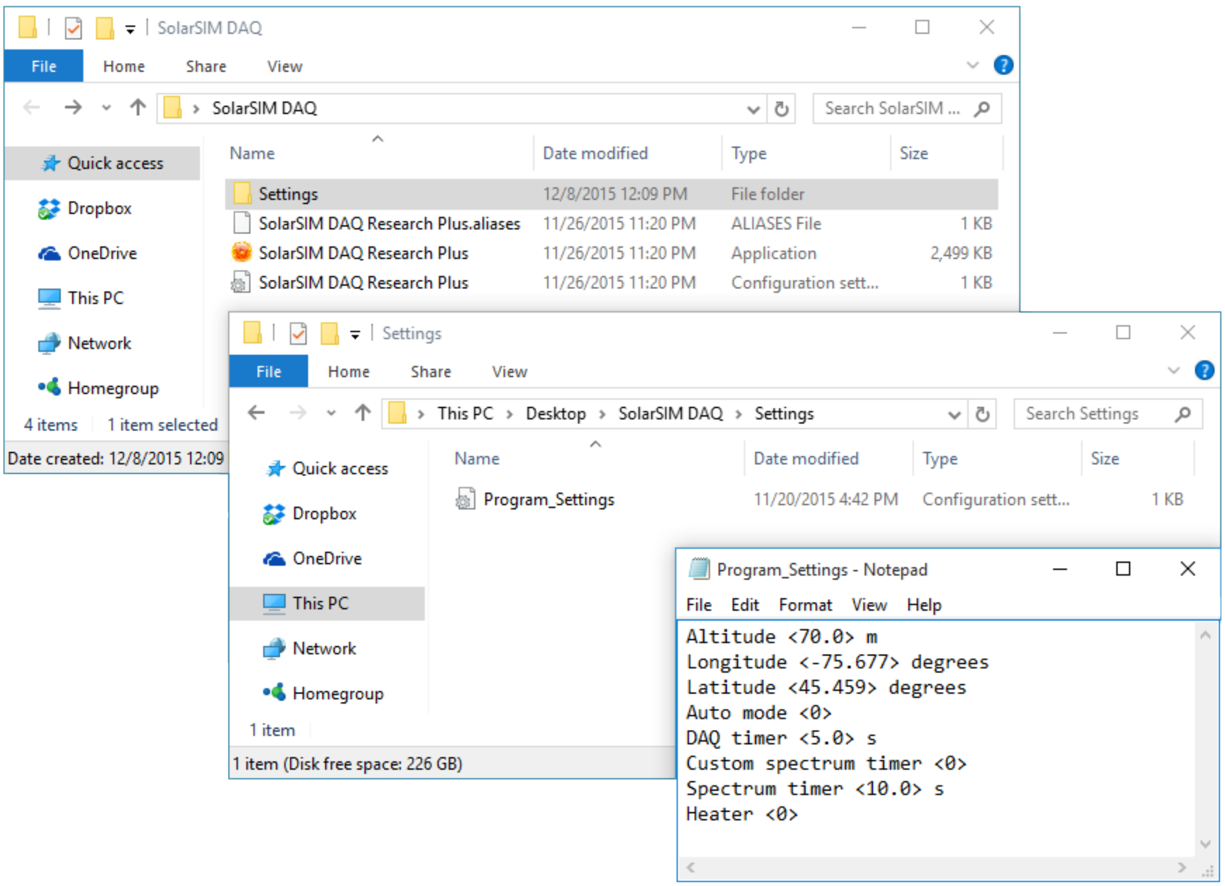

Figure 9: Adjustment of the SolarSIM-D2 program settings.

two ways. The first option is for the user to change the values for altitude, longitude, and latitude in the Program_Settings.ini file, located in the Settings folder of the installation directory, as shown in Figure 9. The second option is to modify these parameters when automatically prompted by the software, as will be explained in Section 5.3. The modifications of the remaining parameters is optional. If Auto mode is ON, upon launching, the application does not interact with the user and begins the data collection automatically. The DAQ timer sets the data acquisition rate for the entire SolarSIM-D2 data set. If it is desired to have a separate data rate for the spectral data, the user can turn ON the Custom spectrum timer and change the spectral data acquisition to a desired rate via the Spectrum timer. Please refer to Table 2 for the summary of the program settings. Note, in order to modify the Program_Settings.ini file the user may have to change their user account control settings in Windows by following Control Panel→ Action Centre→ Change User Account Control Settings→ Never notify.

5.3 Using the software

The SolarSIM-D2 software is launched by double-clicking the SolarSIM DAQ.exe in the installation directory. It should be noted that it is required to run this application in the **administrator mode** (right click on the application icon, then select Run as administrator). Once launched, the program automatically searches for the SolarSIM-D2 calibration file. If none is found, the SolarSIM DAQ will prompt the user to browse to the calibration file's directory, as shown in Figure 10. Browse to the Calibration_File folder on the provided USB key, and select the appropriate calibration file. The application will then copy this file to the Settings folder and will not ask for it again. If the SolarSIM DAQ detects multiple calibration files, the application will prompt the user to select the desired SolarSIM-D2, as shown in Figure 11.

Once the calibration file is loaded, the SolarSIM DAQ software searches for the serial port to which the SolarSIM-D2 is connected. If the SolarSIM-D2 is not detected, the program displays the message as shown in Figure 12 and exits. In this case, please ensure that your PC detects the serial port by viewing the available serial or COM ports in the Device manager. If similar problem arises with the SOE converter, please double-check the setup procedure as explained in Section 4.2.

Once the SolarSIM-D2 is found, the SolarSIM DAQ prompts the user to verify and/or change the geographic settings, which include altitude, longitude and latitude, as shown in Figure 13. If these parameters are incorrect, the user can change them by modifying the appropriate values in the pop-up window. When ready, press Apply, and the program will save these settings permanently by writing them to the Program_Settings.ini file. Please note that the latitude and longitude must be negative for southern and western hemispheres, respectively.

The SolarSIM DAQ is depicted in Figure 14. The software displays the daily plots of

Table 2: SolarSIM DAQ program settings.

Setting	Value range	Units
Altitude	0.0 to 9000.0	metres
Longitude	0.00 to 180.00*	degrees
Latitude	0.00 to 90.00**	degrees
Auto mode	0 or 1	OFF or ON
DAQ timer	1.0 to 3600.0	seconds
Custom spectrum timer	0 or 1	OFF or ON
Spectrum timer	0 or 1	OFF or ON
Heater	0 or 1	OFF or ON

*longitude is negative for western hemisphere
**latitude is negative for southern hemisphere

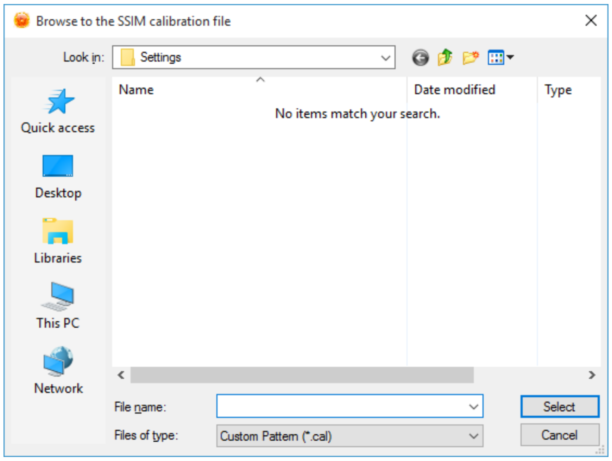

Figure 10: Browsing to the calibration file.

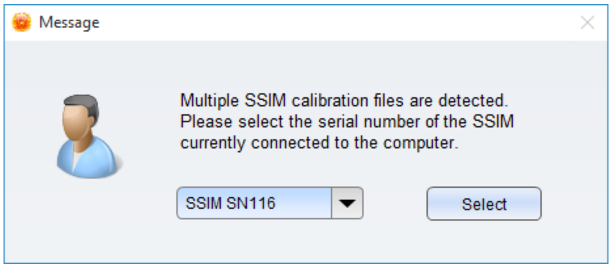

Figure 11: Selecting multiple calibration files.

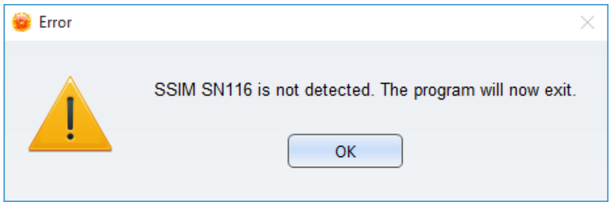

Figure 12: Failing to detect the SolarSIM-D2.

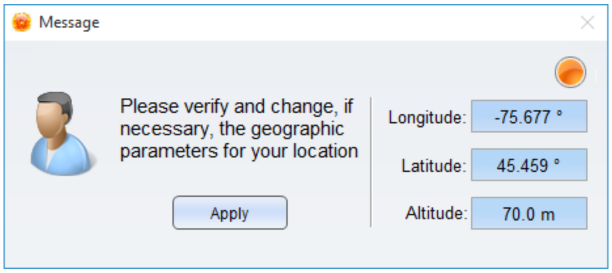

Figure 13: Changing and verifying geographic settings.

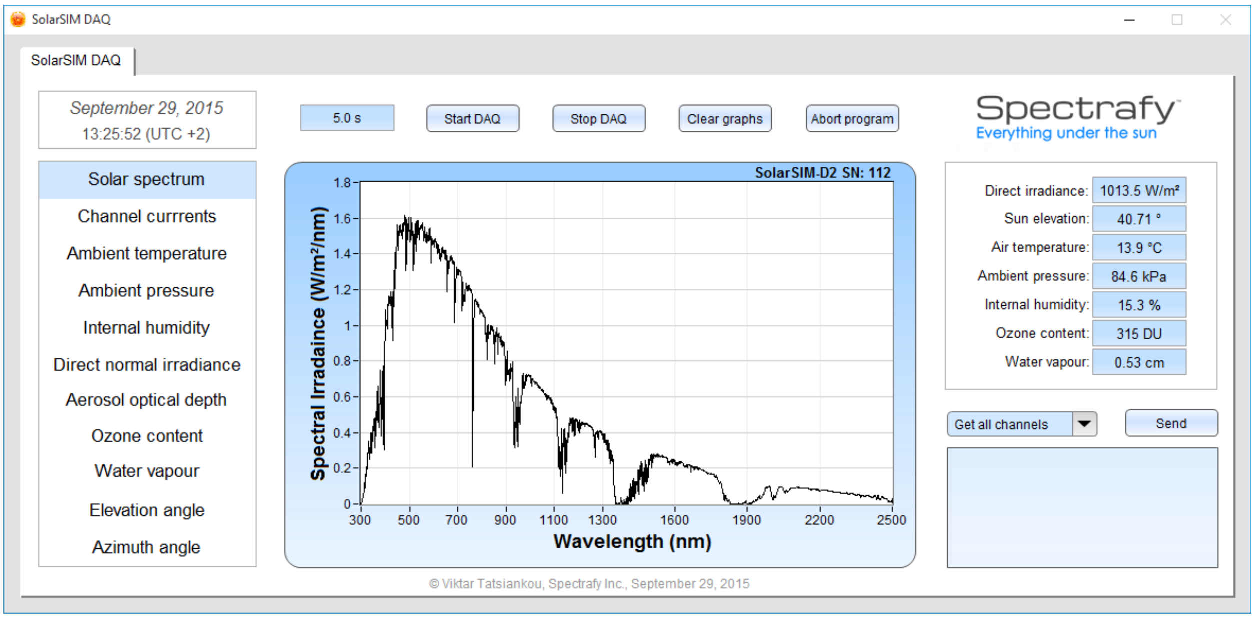

Figure 14: SolarSIM-D2 control software main page

the photodiode currents, the ambient temperature and pressure, the DNI in the 350–1830 nm and the 280–4000 nm ranges, the aerosol optical depth, the ozone content, the water vapour amount, and, elevation and azimuth angles. Data for all plots, other than the ambient temperature and pressure, is recorded between the sunrise and the sunset. Furthermore, the real-time plot of the solar spectrum is provided.

The desired DAQ timer rate (left of the Start DAQ button) should be set before beginning the data acquisition. It has a default value of 5 s, but it can be changed by modifying the Program_Settings.ini file. The DAQ timer value can be set between 1.0 s and 3600 s (1 hr) with 0.1 s resolution. Begin the data collection by pressing the Start DAQ button.

5.4 Data type and storage

The SolarSIM DAQ stores the SolarSIM-D2 data in the Data folder, located in the installation directory. The software outputs two data files types: the solar spectral files and the daily summary data files. The spectral data is stored in the Data\Spectra\yyyymmdd directory, where yyyy, mm, and dd correspond to the year, month, and day, respectively. A snippet of the SolarSIM-D2 spectrum file is presented in Figure 15. As shown, the wavelength column is not included to minimize the file size. Rather the 3721 values of the spectral irradiance in units of $W/m^2/nm$ are presented in a single column format. The value in row 2 corresponds to the spectral irradiance at 280 nm, while the value in row 3722 corresponds to the spectral irradiance at 4000 nm. The spectral ozone absorption, water vapour absorption and aerosols transmission are also recorded in this file, as show in Figure 15.

The daily summary data files are stored in the Data folder. A snippet of the SolarSIM-D2 data file is shown in Figure 16. It contains the values for the elevation and azimuth angles, the ambient temperature, the ambient pressure, the internal humidity, the DNI in the 350–1830 nm and the 280–4000 nm ranges, the aerosol optical depth at 500 nm, the ozone content, the water vapour amount, and the currents from the detectors for each timestamp.

5.5 Data collection size

At 5 s data acquisition resolution the daily summary file's size is ~4 MB or ~230 bytes per measurement. The spectral file size is ~37 KB per measurement. The size of the entire spectral file data set depends on the amount of daily sunlight, but with 5 s data acquisition

	A	B	C	D
1	Spectral irradiance from 280-4000nm (W/m2/nm)	Aerosol transmission	Ozone transmission	Water vapour transmission
2	2.14E-24	7.82E-01	5.78E-22	1.00E+00
3	4.12E-22	7.84E-01	4.81E-20	1.00E+00
4	1.10E-19	7.86E-01	7.18E-18	1.00E+00
5	2.03E-18	7.87E-01	1.08E-16	1.00E+00
6	9.68E-17	7.89E-01	5.26E-15	1.00E+00
7	8.34E-16	7.90E-01	1.18E-13	1.00E+00
8	3.13E-14	7.91E-01	1.67E-12	1.00E+00
9	6.15E-13	7.93E-01	2.53E-11	1.00E+00
10	1.28E-11	7.94E-01	7.59E-10	1.00E+00

Figure 15: SolarSIM-D2 spectrum data file snippet.

	A	B	C	D	E	F	G
1	Time stamp	Time zone	Elevation (deg)	Azimuth (deg)	Ambient temperature (C)	Ambient pressure (kPa)	Inside temperature (C)
2	2015-12-07 11:02:30	-7	31.245	159.609	23.33	96.88	22.37
3	2015-12-07 11:03:00	-7	31.281	159.737	23.36	96.88	22.46
4	2015-12-07 11:03:30	-7	31.317	159.865	23.39	96.88	22.36
5	2015-12-07 11:04:00	-7	31.353	159.994	23.4	96.88	22.44
6	2015-12-07 11:04:30	-7	31.388	160.122	23.43	96.87	22.46
7	2015-12-07 11:05:00	-7	31.423	160.251	23.47	96.87	22.46
8	2015-12-07 11:05:30	-7	31.459	160.379	23.51	96.88	22.5
9	2015-12-07 11:06:00	-7	31.493	160.508	23.52	96.87	22.52
10	2015-12-07 11:06:30	-7	31.528	160.637	23.52	96.87	22.53

H	I	J	K	L	M	N	O	P	Q	R
Inside humidity (%)	DNI (280-4000nm)	O3 (cm)	H2O (cm)	AOD 500nm	V1 (mV)	V2 (mV)	V3 (mV)	V4 (mV)	V5 (mV)	V6 (mV)
20.56	984.096	0.29	0.274	0.035	817.175	2057.13	2941.546	2720.985	2670.353	1453.519
20.66	985.317	0.277	0.28	0.037	816.631	2056.377	2933.9	2703.443	2668.867	1451.888
20.46	986.113	0.285	0.277	0.036	818.133	2059.579	2940.307	2714.741	2672.348	1455.057
20.55	986.464	0.268	0.277	0.036	819.414	2061.906	2939.837	2699.993	2666.163	1457.512
20.72	989.938	0.284	0.279	0.035	820.36	2064.393	2948.22	2719.624	2681.692	1461.713
20.72	988.875	0.287	0.28	0.035	820.167	2062.857	2947.004	2720.699	2680.38	1457.469
20.54	989.303	0.269	0.277	0.035	820.627	2065.787	2944.794	2703.841	2673.915	1463.289
20.54	988.713	0.278	0.277	0.035	822.125	2064.922	2946.787	2712.822	2674.262	1460.66
20.53	985.642	0.283	0.278	0.037	820.203	2060.061	2943.578	2715.502	2669.203	1453.996

Figure 16: SolarSIM-D2 daily summary file snippet.

resolution and with 8 hr of continuous sunshine, it adds up to ~210 MB. The user is advised to use the Custom spectrum timer and Spectrum timer options in the Program_Settings.ini file to reduce the daily spectral data set size as desired. With the Research Plus Total package the SolarSIM DAQ provides the aerosol, ozone and water vapour transmissions in the spectral file. In this case, the file size is ~146 KB per measurement.

5.6 Changing default language for non-Unicode characters

For users of computers with non-Latin based languages, such as Chinese, the SolarSIM-D2 DAQ may improperly display non-Unicode characters. To solve this problem, the user must change the default language for non-Unicode programs to English. To do so, first locate the Clock, Language, and Region settings in the Control Panel, then click on Region settings, as show in Figure 17. Then navigate to the Administrative tab and select Change system locale..., as demonstrated in Figure 18. Lastly, change the language to English from the drop down menu, as shown in Figure 19, and press OK.

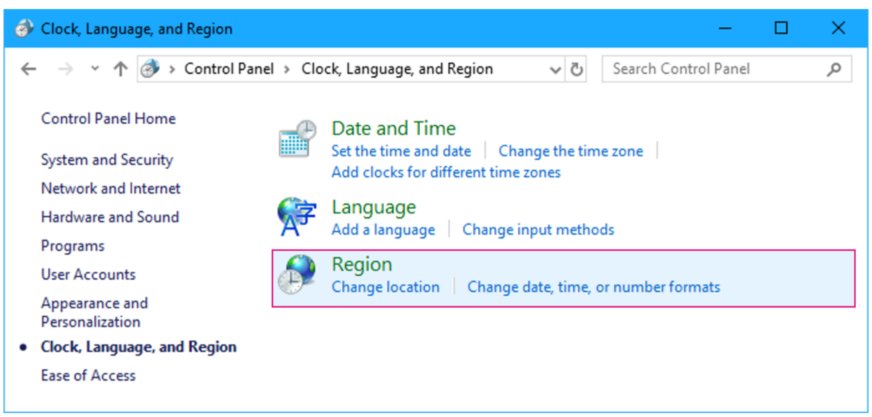

Figure 17: Clock, Language, and Region settings in the Control Panel.

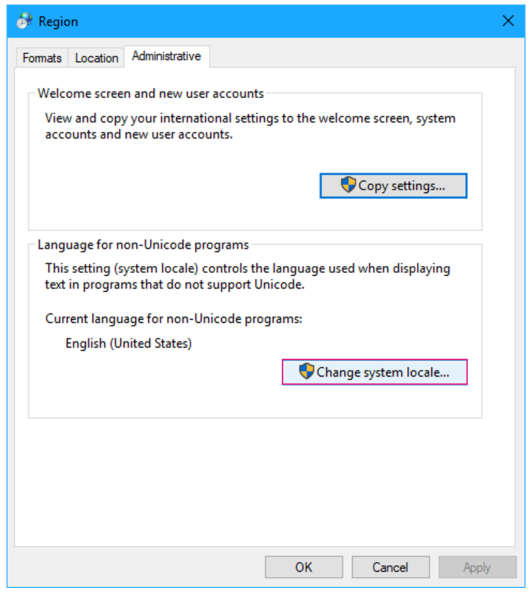

Figure 18: Changing the system locale in the Administrative tab of the Region settings.

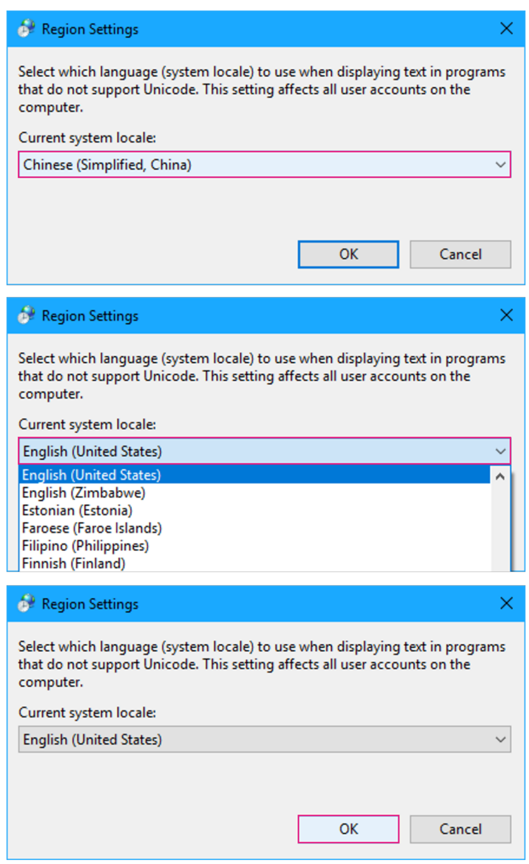

Figure 19: Changing the default language for non-Unicode characters..

6 Datalogger setup

The SolarSIM-D2 can be interfaced with any datalogger, provided the latter has the RS-485 functionality. However, compared to other SolarSIM-D2 connectivity options, this approach is slightly more involved. In a nutshell, the user must execute the following steps to process the data from the SolarSIM-D2:

1. Setup the serial communication between the datalogger and the SolarSIM-D2.
2. Send the serial command from the datalogger to the SolarSIM-D2.
3. Retrieve the raw data from the datalogger.
4. Format the raw data into a specific format.
5. Place the formatted raw data files into the SolarSG software's directory and run the application.

This section discusses in detail how to proceed with each step, including the serial port configuration, sending and parsing the serial command, formatting the SolarSIM-D2 raw data into a required format, and how to use the SolarSG software.

6.1 Serial port configuration

Prior to configuring the serial port on a datalogger, the user must wire the SolarSIM-D2 by following instructions from Section 4.2. The serial port is then configured with standard serial parameters as per Table 3.

6.2 Serial commands

There is only one serial command that one needs to use to acquire the SolarSIM-D2 data:

`Nxxx_E`

where `xxx` corresponds to the 3-digit serial number of your SolarSIM-D2. In return, the SolarSIM-D2 sends an ASCII string with the ambient pressure, external temperature, internal temperature, relative humidity, and six voltages from the detectors. The following ASCII

Table 3: SolarSIM-D2 serial port configuration.

Parameter	Value
Baud rate	9600
Parity	None
Data bits	8
Stop bits	1

string is a sample output:

N115_1013.120,2500.000,2700.000,1530.000,2500.032,4999.999,
0000.001,1274.004,2746.321,3291.214/r/n

The aforementioned string can be parsed as:

N"serial number"_"$P_{\text{out}} \times 10$","$(T_{\text{out}} + 50) \times 75$","$(T_{\text{in}} + 50) \times 75$","$H_{\text{in}} \times 100$",
"V_1","V_2","V_3","V_4","V_5","V_6","end of line character"

where P_{out}, T_{out}, T_{in}, H_{in}, and V_{1-6} are the ambient pressure, the ambient temperature, the internal temperature, the internal humidity, and the six voltages from the detectors, respectively. The aforementioned example string is parsed in Table 4. Please note, this string structure applies to the SolarSIM-D2 with the serial number 112 and above.

The user has an option to control the SolarSIM-D2's internal heater, which is designed to keep the instrument a few degrees above the ambient temperature to avoid condensation on the front window. The commands Nxxx_W1 and Nxxx_W0 are used to turn ON and OFF the heater, respectively, where xxx corresponds to the serial number of your SolarSIM-D2. The device replies back with Nxxx_OK if the operation was successfully completed.

Table 4: Processed output example for Nxxx_E command.

Parameter	Symbol	Value	Units
Ambient pressure	P_{out}	101.312	kPa
Ambient temperature	T_{out}	-16.67	°C
Internal temperature	T_{in}	-14.00	°C
Relative humidity	H_{in}	15.3	%
Voltage channel 1	V_1	2500.032	mV
Voltage channel 2	V_2	4999.999	mV
Voltage channel 3	V_3	0000.001	mV
Voltage channel 4	V_4	1274.004	mV
Voltage channel 5	V_5	2746.321	mV
Voltage channel 6	V_6	3291.214	mV

6.3 Raw data file format

The SolarSG software requires a .csv file in a specific format based on the SolarSIM-D2 raw data output. The file must have the following headings with the corresponding data: `Timestamp`, `Time zone (hr)`, `Ambient temperature (C)`, `Ambient pressure (kPa)`, `Inside temperature (C)`, `Humidity (%)`, `V1 (mV)`, `V2 (mV)`, `V3 (mV)`, `V4 (mV)`, `V5 (mV)`, and `V6 (mV)`. Each data row must consists of comma separated values only, with no spaces in between. The timestamp must be strictly in the yyyy-mm-dd HH:MM:SS format, where yyyy, mm, dd, HH, MM, and SS is the year, month, day, hour, minute, and second, respectively. The SolarSG software uses the time stamp and the timezone from the raw data file to determine the UTC time, which is necessary for the solar position algorithm. Therefore, the user must ensure that each time stamp plus the timezone corresponds to the UTC time. The snippet of the raw data file is presented in Figure 20. The raw data file must be named as yyyy-mm-dd_SSIM_Raw_Data_SNxxx.csv, where yyyy, mm, dd correspond to the year, month, and day when the raw SolarSIM-D2 data was generated, while xxx is the 3-digit serial number of your SolarSIM-D2.

Time stamp	Time zone (hr)	Ambient temperature (C)	Ambient pressure (kPa)	Inside temperature (C)	Humidity (%)	V1 (mV)	V2 (mV)	V3 (mV)	V4 (mV)	V5 (mV)	V6 (mV)
2015-12-07 11:02:30	-7	23.33	96.88	26.20	20.56	817.175	2057.130	2941.546	2720.985	2670.353	1453.519
2015-12-07 11:03:00	-7	23.36	96.88	26.31	20.66	816.631	2056.377	2933.900	2703.443	2668.867	1451.888
2015-12-07 11:03:30	-7	23.39	96.88	26.19	20.46	818.133	2059.579	2940.307	2714.741	2672.348	1455.057
2015-12-07 11:04:00	-7	23.40	96.88	26.28	20.55	819.414	2061.906	2939.837	2699.993	2666.163	1457.512

Figure 20: SolarSG input file snippet.

6.4 SolarSG application

The SolarSG application is an executable that the user must run to process the raw data from the SolarSIM-D2 into the spectral data. This software is located on the provided USB key inside a folder with contents as per Figure 21, which initially include:

1. atmParam.data
2. SolarSG.exe
3. SSIM_Calibration_SNxxx.json
4. user_settings.ini

Pleas note, the calibration file for the SolarSG application is in a .json format, in contrast to the .cal file format used by the SolarSIM DAQ. Prior to running the SolarSG application the user must configure the local geographic settings in the user_settings.ini file, by modifying the altitude, longitude, and latitude, corresponding to the location of your SolarSIM-D2, as shown in Figure 21. Please refer to Table 2 for the allowed ranges and the positive/negative convention of these parameters. Finally, place the raw data .csv file(s) formatted as per Section 6.3 in the SolarSG directory and launch the application.

Once launched, the SolarSG application scans the directory for new raw data files. If found, the software processes each file line-by-line, as shown in Figure 22. The SolarSG application creates three folders in the working directory. The daily_summary_files and spectrum folders contain identical data to that which SolarSIM DAQ generates as explained in Section 5.4. The archive folder contains all processed raw data files.

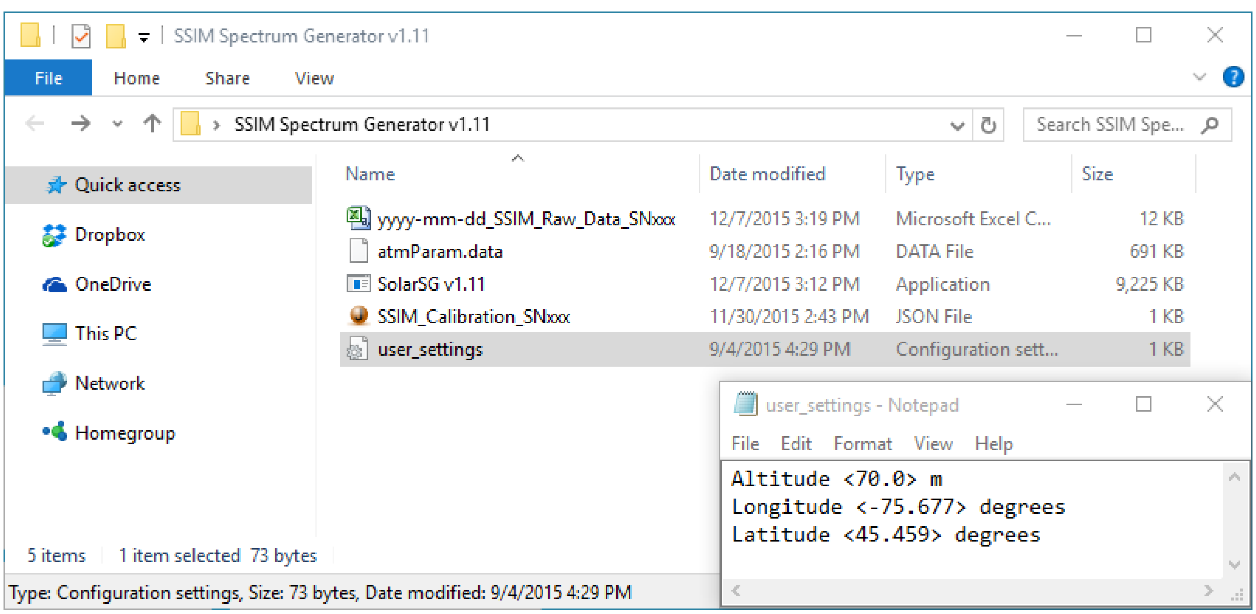

Figure 21: Modifying geographic settings for the SolarSG application.

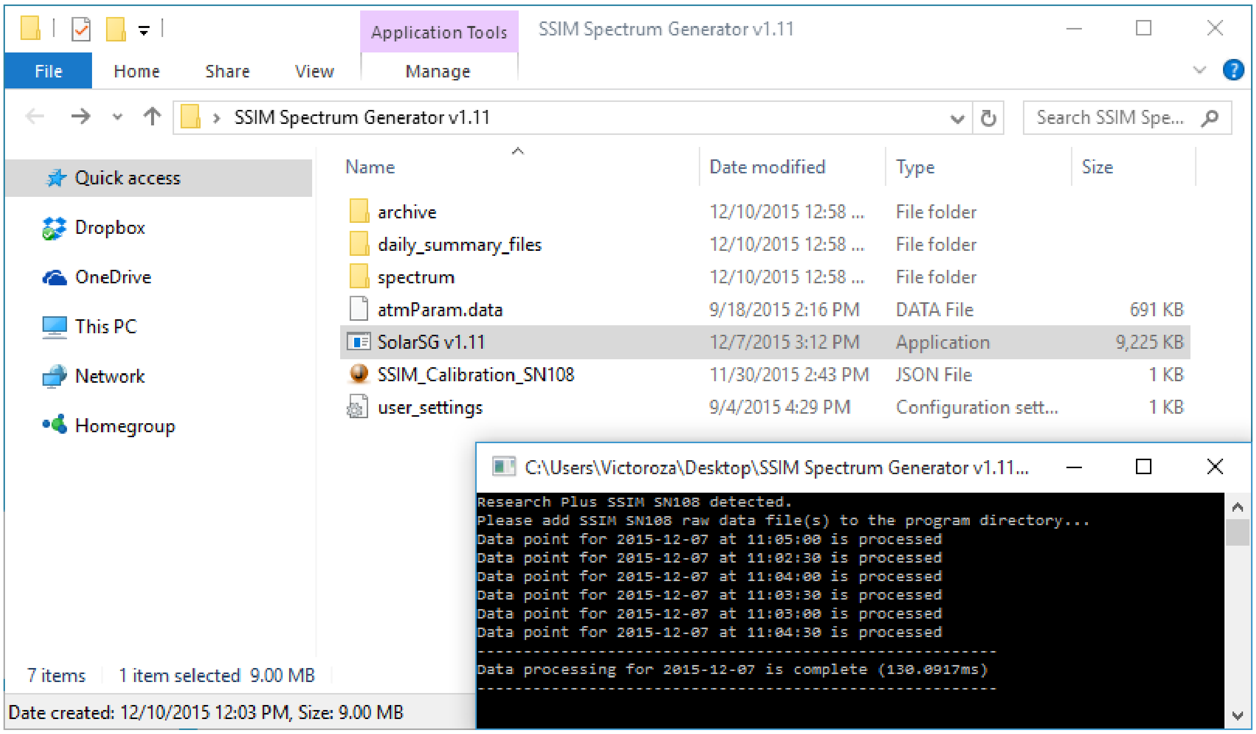

Figure 22: SolarSG application processes the SolarSIM-D2 raw data file.