Manual XEN-5320 CAN

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Contents

1   Product Description

The XEN-5320 is an intelligent gas sensor for the measurement of gas composition, such as helium in air (hydrogen mimicking), oxygen (diving applications) or nitrogen; hydrogen in air or nitrogen (fuel cell applications). In addition, it can serve as a thermocouple-vacuum sensor, and it can give a general output signal, useable for other gas compositions.

The sensor is based on the measurement of the thermal conductivity of the ambient gas, using the proven thermal conductivity sensor XEN-TCG3880.

To compensate for the influence of temperature and humidity, these are measured separately and a correction is made for them in the micro-controller. Each device is factory calibrated (zeroed), the customer can re-zero. Gain adjustment is also possible.

1.1   Specific Conditions of Use

- Maximum voltage that can be applied to the non-intrinsically safe connection facilities without invalidating the type of protection Um = 30 Vdc, maximum connected working voltage = 24 Vdc.
- Prospective short circuit current is limited to 50A.
- The XEN-5320-CAN shall be used only with dedicated extension cables and terminators Type XEN-84…
- The connectors, terminators and cables shall be protected from UV light when installed.
- Sensor and connectors comply with low risk for mechanical danger, which means that they shall be protected from any high risk of mechanical danger.
- Do not connect or disconnect connectors when energized.
- Potential electrostatic charging hazard, connectors shall only be cleaned with a damp cloth.
- Tightening torque for the connectors is 0.49 Nm to 0.6 Nm.
- Cable gland is an integral part of the sensor and cannot be replaced.

1.2   Safety references

Devices in hazardous area must be installed, supervised, maintained and kept in good conditions by the owner of the plant. Part of this is an inspection after the transport to identify possible damages caused during the transport.

Only qualified workers are allowed to install and dismount as well as doing maintenance work on the   Intelligent gas sensor XEN-5320-CAN. All universally valid rules and laws and other binding directives for the safety of people and environment must be kept.

WARNING – DO NOT CONNECT OR DISCONNECT CONNECTORS WHEN ENERGIZED

WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – CLEAN ONLY WITH A DAMP CLOTH

1.3   Mounting

The Intelligent gas sensor XEN-5320-CAN must be protected against aggressive and unusual environmental conditions which could cause damages on the equipment. This could be e.g. acids or high and low temperatures other than the allowed ambient temperature range.

For installation, please refer to EN 60079-14 and other valid standards and directivities on the place of erection.

RS PRODUCT SOLUTIONS

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1.4   Installation

The sensor shall be connected with following dedicated extension cable and terminators:

XEN-84005 Cable 0.5 m male M12 - female M12 connector
XEN-84010 Cable 1 m male M12 - female M12 connectors
XEN-84020 Cable 2 m male M12 - female M12 connectors
XEN-84040 Cable 4 m male M12 -female M12 connectors
XEN-84100 Cable 10 m male M12 - femaleM12 connectors
XEN-84200 Terminator set 120 Ohm male M12 and female M12 connectors

- Observe all specific conditions of use above!
- Protect the M12 connectors efficiently against damage.
- The cables must be firmly laid and effectively protected against damage.
- Connectors must always be closed with a counterpart. They may be left open in the field only briefly for servicing purposes.

1.5   Operation, Maintenance and Elimination of Disturbances

Devices in hazardous area must be installed, supervised, maintained and kept in good conditions by the owner of the plant. For information, refer to EN 60079-17. Only skilled workers are allowed to do maintenance and the elimination of disturbance work.

Before doing this work, the safety requirements must be kept!

For elimination of disturbances, only original spare parts after consulting with RS Products Solutions B.V. are allowed to use. Before using them again, the safety requirements must be kept.

For information about operation, maintenance and elimination of disturbances for the internal components, please refer to the individual manuals of these components.

1.6   Maintenance and repair

The sensor or connectors shall not be modified nor can be repaired. In case of a fault please contact the manufacturer.
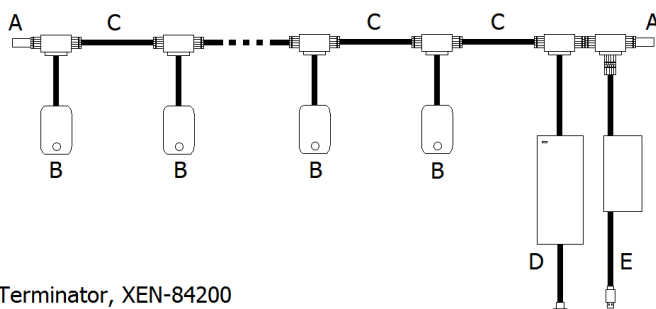
1.7   Service address

RS Products Solutions B.V.
Distributieweg 58
2645 EJ Delfgauw
The Netherlands

2   Installation

The CAN bus network for the XEN-5320 CAN sensors consists of the following items:
- Terminators
- XEN-5320 CAN sensor(s)
- CAN cables (optionally)
- Power supply, 24 V
- Kvaser CAN-USB interface

Connect the system as following:

A: Terminator, XEN-84200
B: Sensor, XEN-5320 CAN
C: CAN cable, (none), XEN-84005, XEN-84010, XEN-84020,
          XEN-84040, XEN-84100
D: Power supply, XEN-84201
E: Kvaser CAN-USB interface, XEN-84202

The CAN bus network consist of a central line (all the cables C), with CAN bus devices connected via T-pieces. The CAN bus line has to be terminated with 120 Ohm Terminators (A) on both ends. It is not allowed to split the central line, into a Y-shaped configuration. Only T sections to the XEN-5320 CAN sensors, power supply and CAN-USB interface (together called CAN bus devices, B) are allowed. The cables to the devices from the T-sections may not be longer than 30 cm.

The CAN-USB devices (B) can be at any location in the CAN bus line, in any order. The length of the cables (C) between the devices can range from zero to hundreds of meters. The total length of the CAN bus line is in general limited to a few hundred meters, also depending on the data rate.

Use the following connections in case the XEN-5320-CAN sensor has a 4 - 20 mA current output:
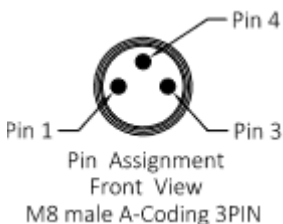
Pin 1: Shield
Pin 3: Current loop + (+ 24 VDC)
Pin 4: Current loop -

Note that the sensor is powered by the power supply through the CAN bus.

3   LabVIEW communication software

3.1   Installation

The LabVIEW software can be downloaded from our website:

https://www.xen5320.com/Downloads/

3.2 The Connection Setup Page

Before starting the XEN-5320-CAN software, make sure the Kvaser CAN-USB interface is installed and connected by an USB port to the computer.

When the XEN-5320-CAN program opens, the Connection Setup page comes up automatically, see Fig. 1.

In the Connection Setup page, the file path for filing the measurement data has to be given.

Then, the button Connect to CAN network can be pressed so a connection is made with the Kvaser CAN-USB interface. If a connection is made the green bulb Connected to CAN bus lights up continuously. Once the connection is made the button Find devices can be pressed to search for any connected XEN-5320-CAN sensors. Maximally 100 sensors can be found with CAN addresses in the range of 0000FF40$_{hex}$ and 0000FFA4$_{hex}$. Searching for sensors will take a few seconds.

The **Enable** button has to be activated (indicated by the green light in the button) to actually measure the device.

The **Start** button at the bottom of the Settings page (and all other pages) starts the measurements, indicated by a green **Running light**.

The **Stop** button stops the measurements.

The **Quit** button exits the program.

The **Delay** window allows to slow up the measurements if they go too rapid. Standard is a data refresh time of 0.3 seconds, for up to about 25 sensors. With more sensors, the data refresh time will rise. The Delay is in seconds. Adding delay will reduce the measurements file size, and avoid eventual slowing down of the measurement refresh time if extreme long experiments are carried out (extending over days).

The **Average measurements** window allows to average measurements.

With the **Select CAN network** window the user can select a CAN network when multiple CAN networks are connected to the PC. Standard this setting should be 1.

When the **Enable remote control** button is enabled and multiple CAN networks are connected to the PC the user can control multiple instances of the software.

In the **Select directory for saving measurement data** window the file name for storing the data shown the Reception History can be given by the user. Each measurement is immediately stored in the file, there is no need for any further action to save data. A file for each sensor is made. For the first measurement of the day, a new file is created. Subsequent measurements on the same day are appended to the existing file.
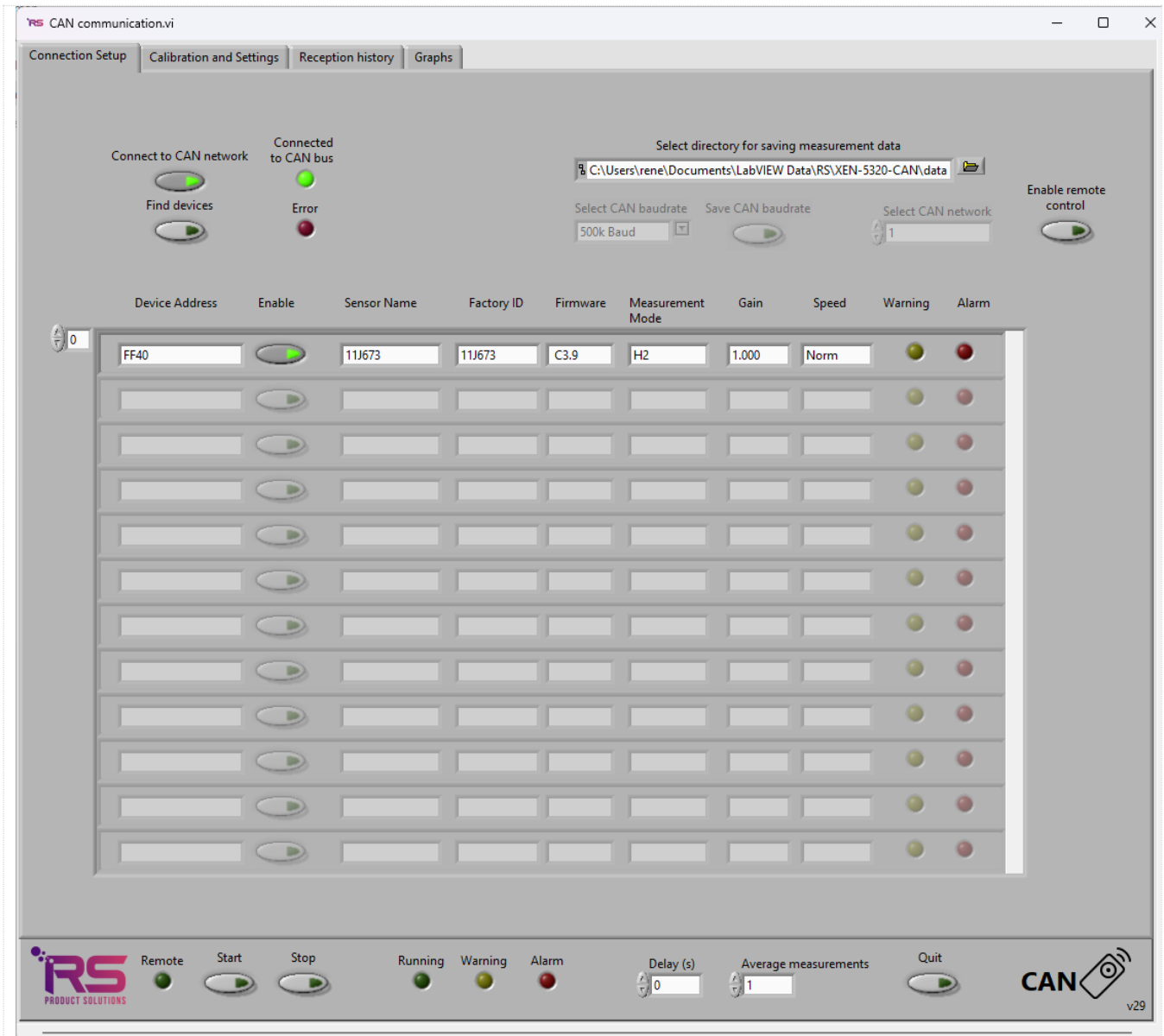
Figure 1: The Connection Setup page

Before the connection to the CAN network is made the user can select the desired baudrate with the **Select CAN baudrate** drop down menu. Connected sensors should all have the same baudrate to be able to work properly.

The selected CAN baudrate can be saved by pressing the **Save CAN baudrate** button.

The **Warning** and **Alarm** lights on the right will light up at the appropriate sensor if a warning or alarm has been issued. The codes are listed on the Reception history page of the sensor in question, and the code will also be written into the file of that sensor. See the Par. on Alarm Page data for the codes, and consult the data sheet for background information.

A general **Warning** and **Alarm** light is at the bottom of all pages. This page indicates for which sensor(s) the warning or alarm is given.

3.3   The Measurement Mode page

Fig. 2 shows the measurement mode page. On this page the curve used to calculate the output signal is chosen.

If **H2** or **HE** is chosen, a look-up table will be used to convert the change in transfer (the deviation of the Corrected Transfer from unity) into the output signal.

For **GEN** the change in corrected transfer is simply displayed.

When the **Custom Curve** is chosen, a user provided 23-point look up Table will be used to calculate the output (%) signal.
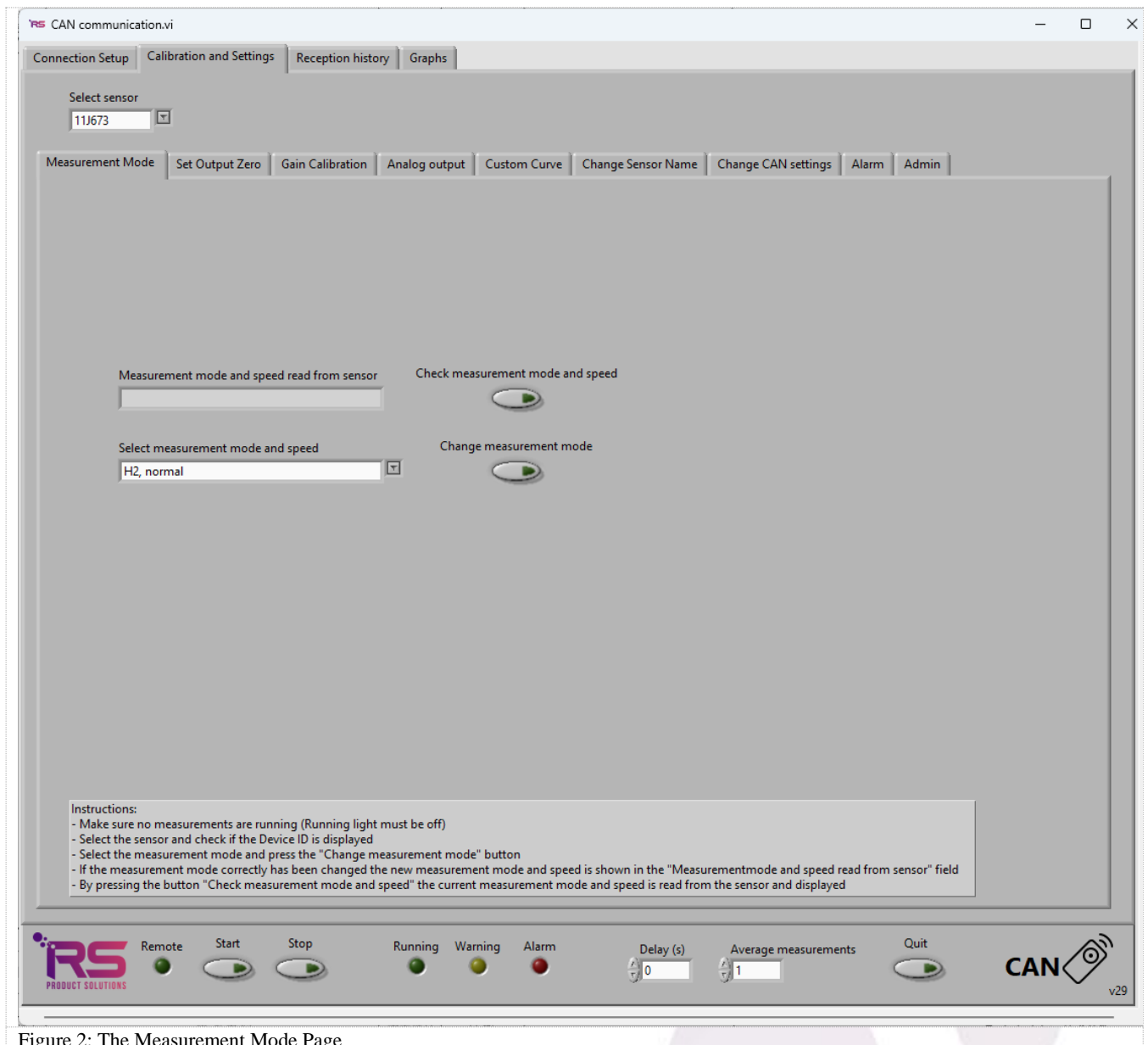

Figure 2: The Measurement Mode Page

Be sure to stop the measurement first, before checking or changing the measurement mode. If there is still a measurement running (green light below Running), then nothing will happen.

3.4   Set Output Zero Page

The Set Output Zero Page (see Fig. 3) allows zeroing of the device. The zeroing data are stored in the memory of the XEN-5320 CAN, and zeroing can be carried out when so desired. First **Select sensor** to be zeroed (left top), then select if the zeroing should be performed on only the connected sensor or on all connected sensors. Start zeroing by pushing the **Start set output zero** button (after stopping the measurements). The zeroing takes a number of seconds, and takes longer when multiple sensors are zeroed at the same time. The busy light is flashing green and yellow.
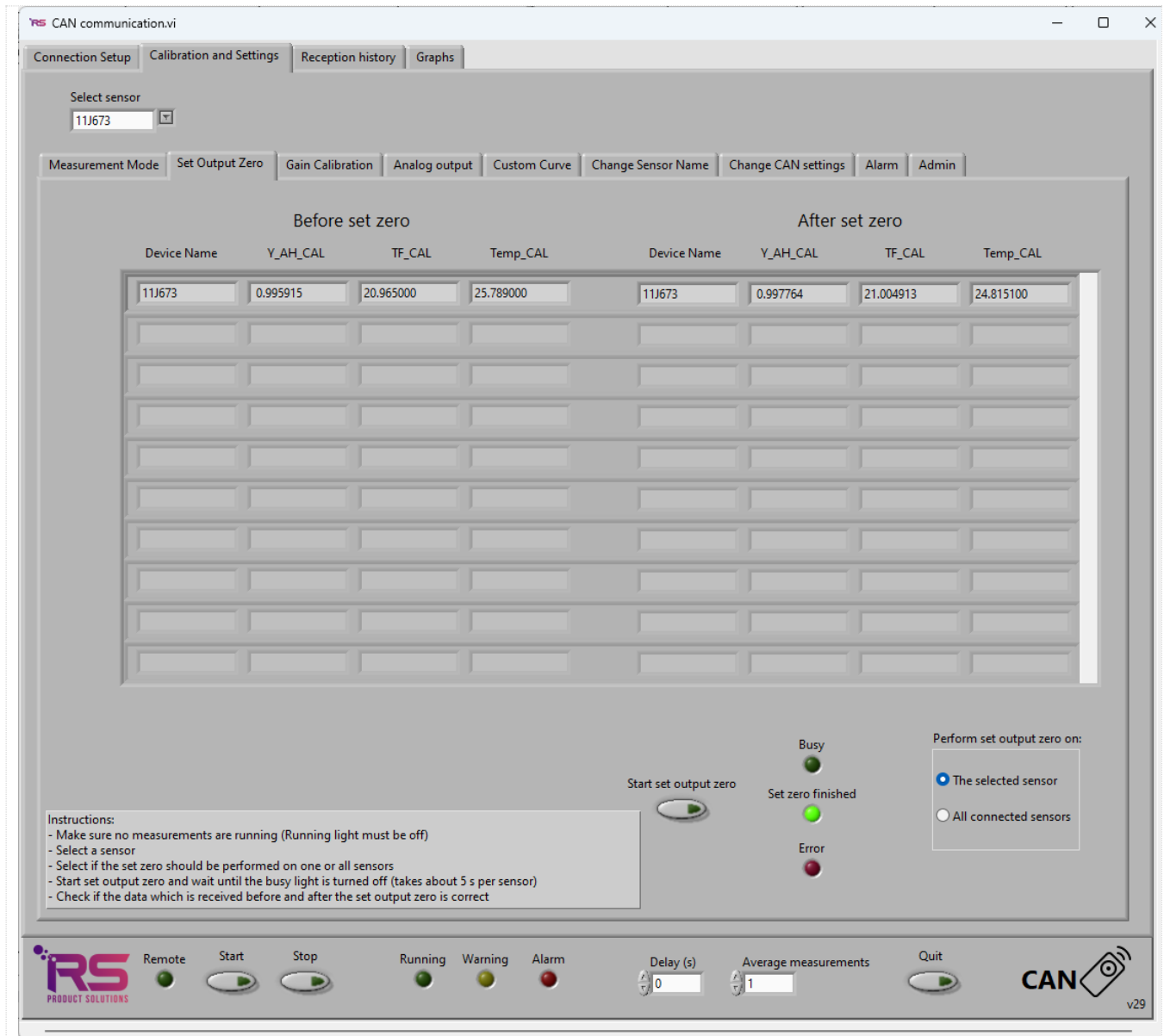

Figure 3: The Set output zero Page, with data of the device before and after zeroing.

3.5   Gain Calibration Page

The Gain Calibration page allows for calibration of the 100% value for the helium or hydrogen signal in the helium or hydrogen measurement modes (see Fig. 4).

There should be no measurement running.

In HE measurement mode, 100% helium should be present around the sensor head, in H2 mode 100% hydrogen. First **Select sensor** (top left) then push the **Start set gain** button, and the program will perform a measurement, calculate the output and calculate a gain factor to adjust the output to 100%.

If the adjustment that is required is more than 3 percent, for instance in air, the error light will shine and a gain factor of unity is returned. This is also the method to reset the gain factor. The gain factor is stored in the memory of the XEN-5320 CAN.

The gain calibration can be performed on only the selected sensor or on all connected sensors by selecting the desired setting in the **Perform gain calibration on** menu.
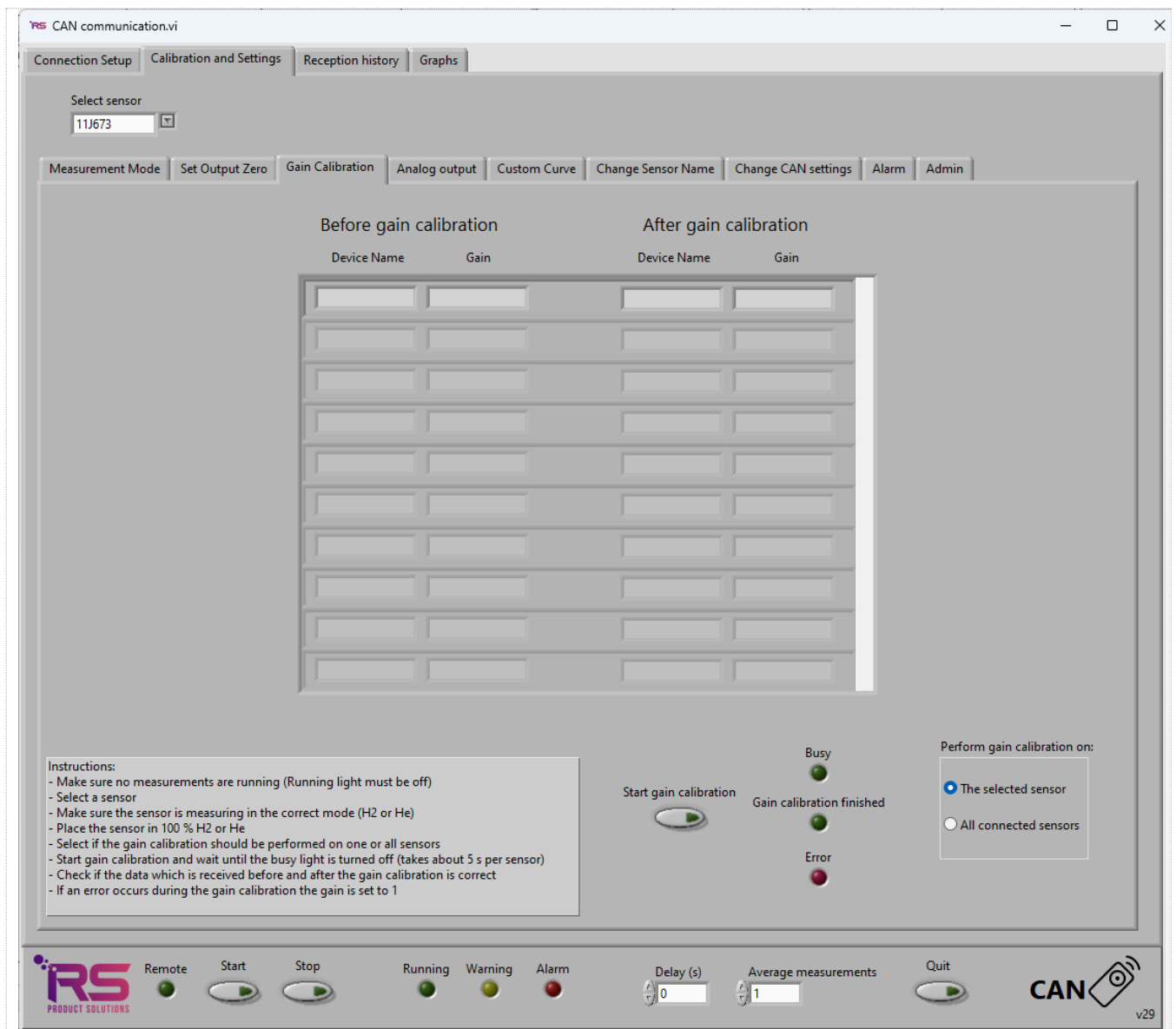

Figure 4: The Gain Calibration page.

3.6   Analog output Page

The analog output page is only relevant for sensors which are equipped with a 4 – 20 mA current output. In this page it is possible to check the current analog output range and to change the analog output range of the sensor. First **Select sensor** (top left) then push the **Check analog output range** button, and the program will read the current analog output range from the sensor. To change the analog output range the desired output range can be selected from the pull down menu and the then press the button **Change analog output range**.
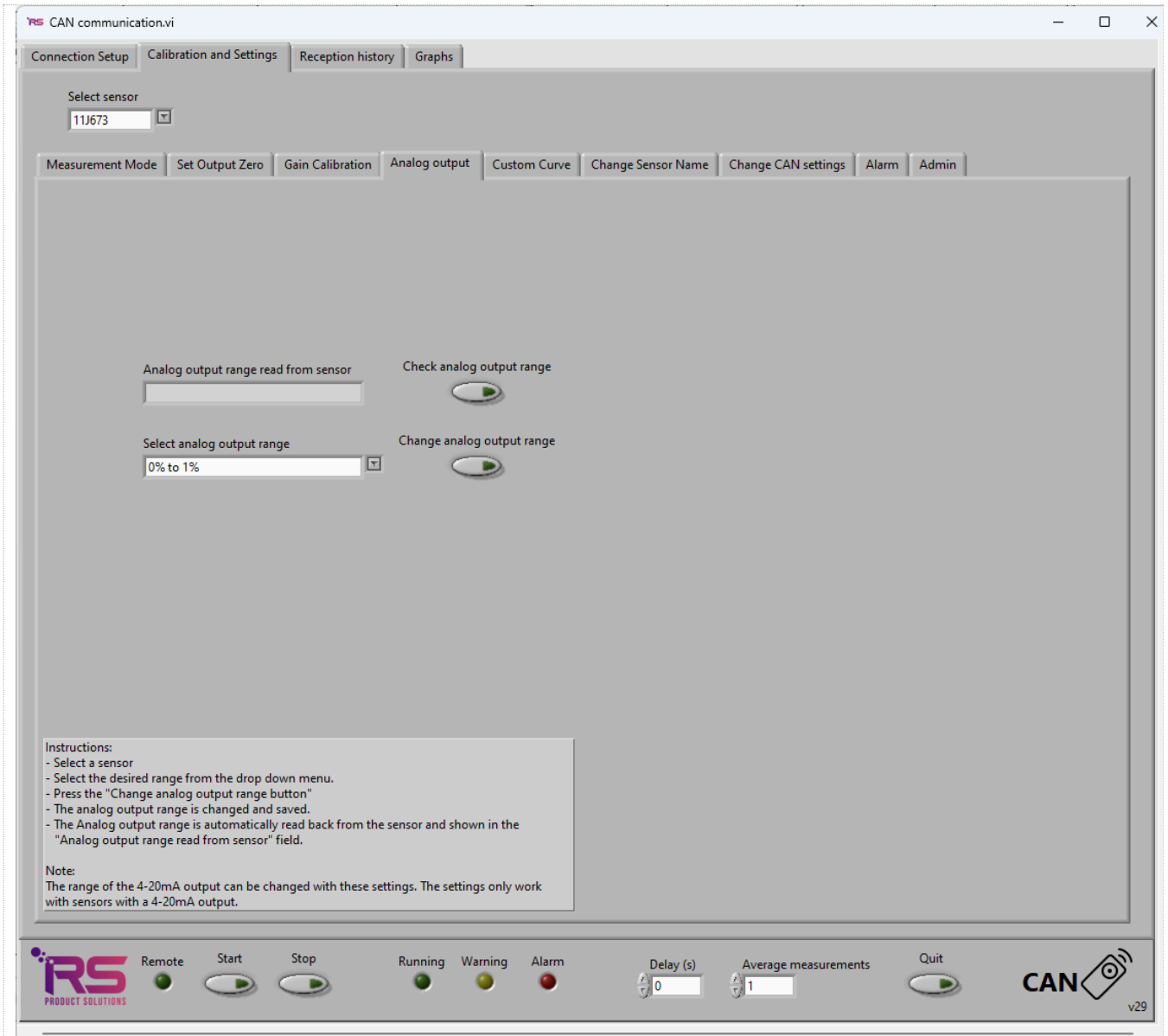
Figure 4: The Analog output page.

3.7   Custom Curve Page

The Custom Curve page allows uploading (and checking by downloading) of a 23-point look up Table into the XEN-5320. Fig. 5 shows a custom helium curve. The points of such a curve may be generated, for instance, using EXCEL. The points do not need to be equidistant. Fig. 6 shows an example of the custom-curve txt file.
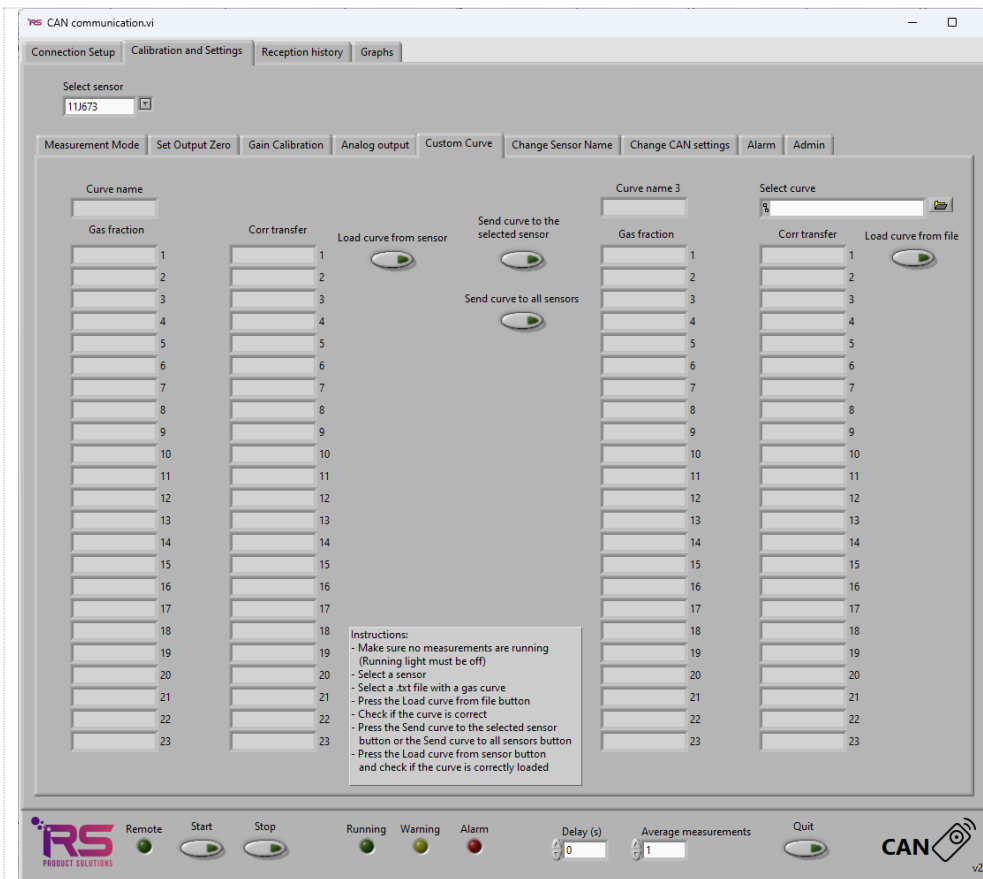

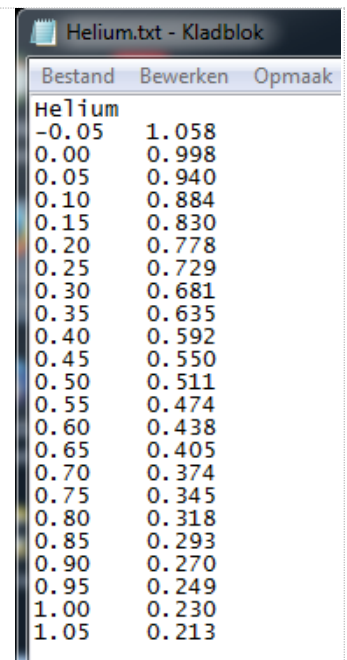
Figure 5: The Custom Curve page.

Figure 6: The helium.txt custom curve text file.

To use a Custom curve, first **Select sensor**. Then **Select curve** from the directory where the custom curves are stored (user chosen). Then push **Load curve from file**, the curve should now appear in the right columns. Upload this curve to the selected sensor by pushing **Send curve to sensor**. By pushing **Load curve from sensor** the curve currently stored in the sensor's memory will appear in the left columns.

There should be no measurement running.

3.8   Change Sensor Name

The Change Sensor Name page allows changing the device name of the XEN-5320 CAN. The device name can store a min of 1 and a max of 10 characters and can be used to give each device a customized name, see Fig. 7.

First **Select sensor**, then enter the new name in the **Give new device name** field, and by pressing the button **Give new device name** the name is transferred to the XEN-5320 memory. Once the transfer is complete the new name is read back from the XEN-5320 and shown in the **New Device name read from sensor** field. The **Incorrect name** light burns when the field **Give new device name** is empty or contains more than 10 characters. There is no check for duplicate names.

There should be no measurement running.
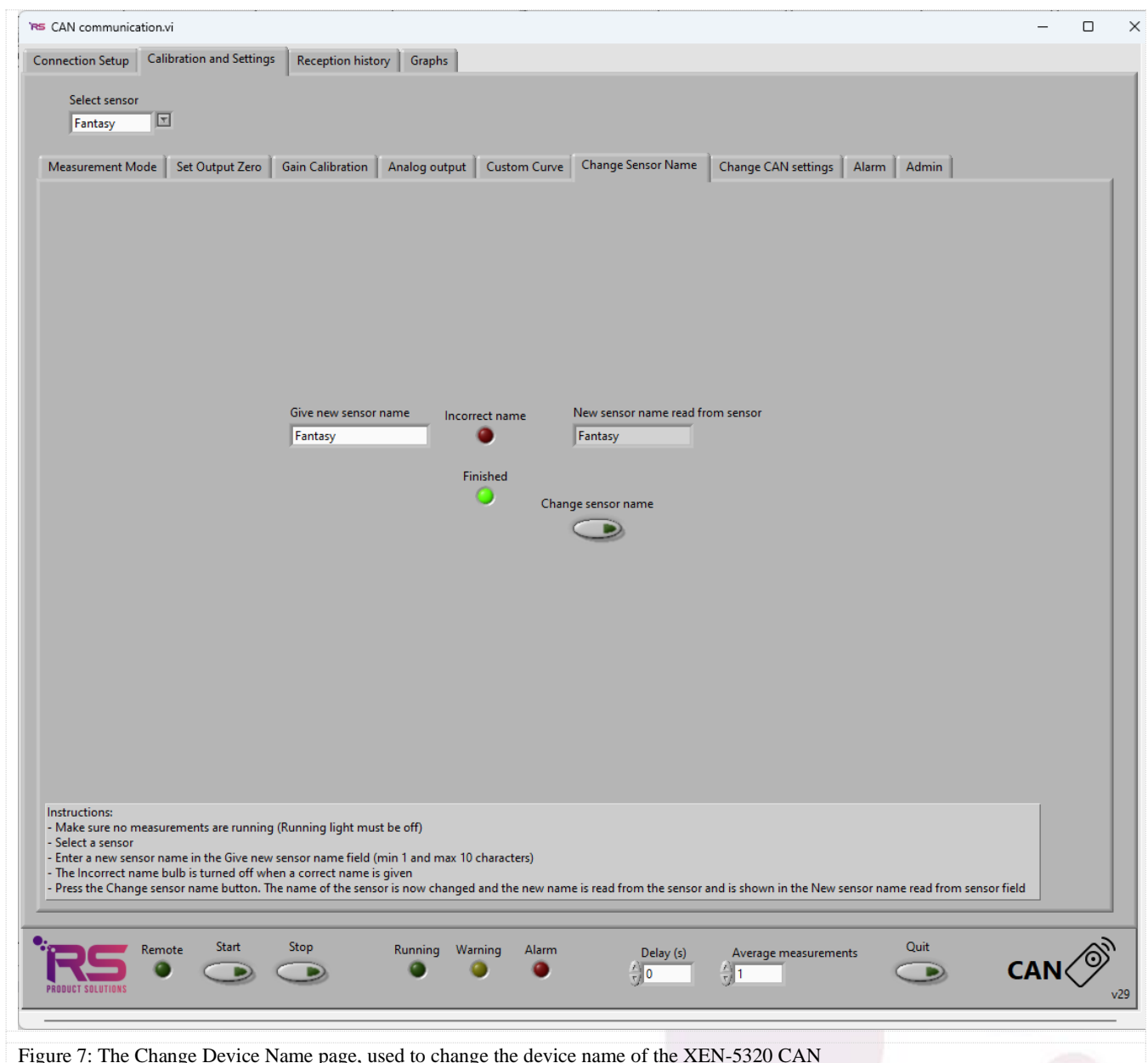
Figure 7: The Change Device Name page, used to change the device name of the XEN-5320 CAN

3.9 Change CAN settings Page

For the CAN bus to work properly, each XEN-5320-CAN device needs an unique CAN address in the CAN network. The page that can be used to change the CAN address is shown in Fig. 8. Be sure that no measurement is running. If two devices have the same address, one of the two needs to be disconnected in order to change the address of the other one.

Figure 8: Change CAN settings page.

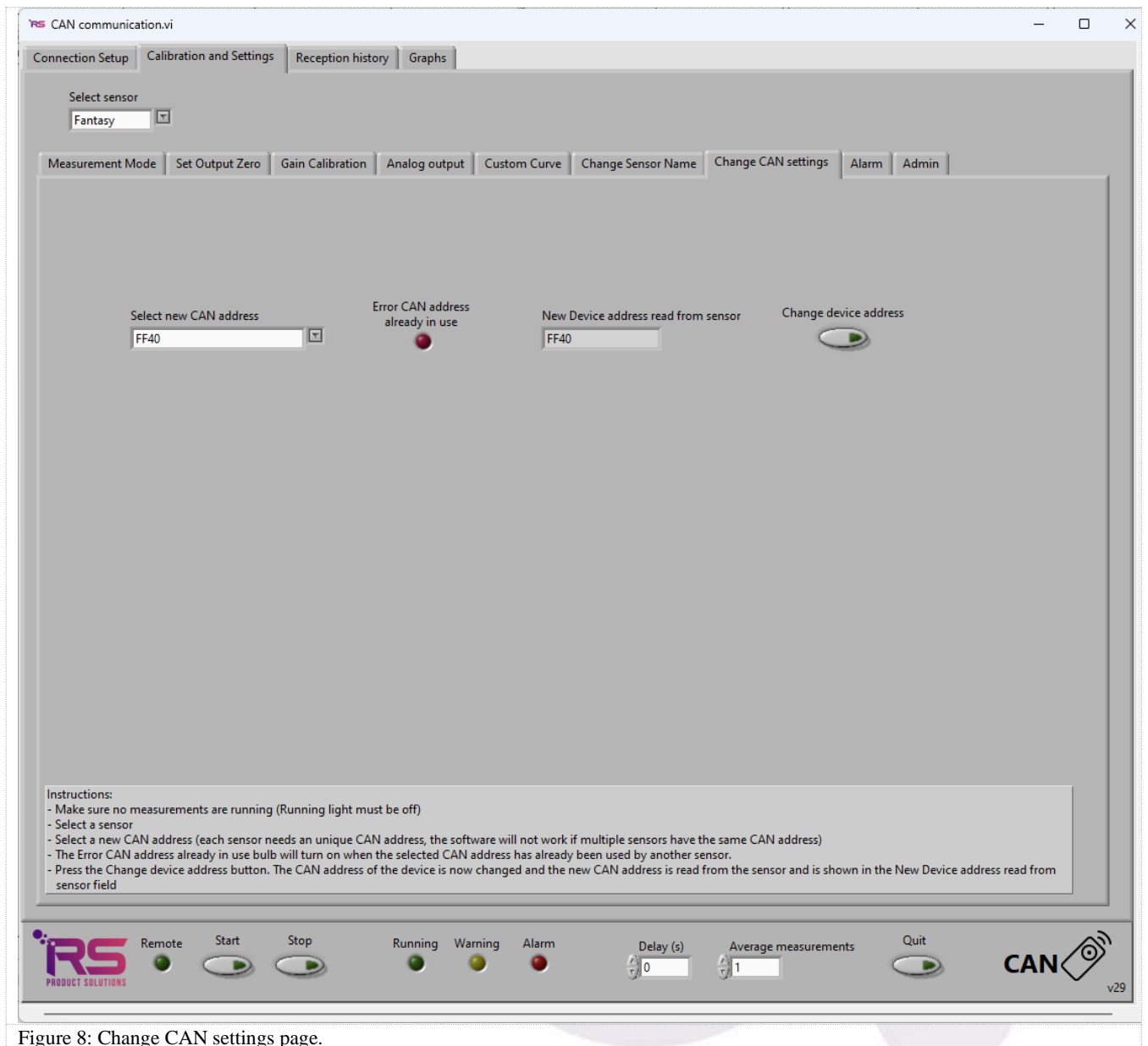## 3.9.1   Instructions

- Make sure no measurements are running (Running light must be off)

- Select the XEN-5320 CAN device for which the settings needs to change. This is done by selecting the XEN-5320 CAN device in the Select sensor drop down menu.

- Select a new CAN address in the Select new CAN address drop down menu.

- Press the Change device address button

If the selected CAN address already exists in the CAN network the Error CAN address already in use bulb will light up and no changes will be made. When the selected CAN address not already exists in the CAN network the CAN address will be changed. When the CAN address is successfully changed the new device address is shown in the New Device address read from sensor field.

Note: The software does not work correctly if multiple XEN-5320 CAN devices have the same CAN address.

3.10   Alarm Page

The Alarm page shows the cumulative codes of a selected group of warnings and errors, calculated by the LabView program, see Fig. 9. The code is stored at each measurement, and warns if anything is out of the ordinary or even wrong. For each sensor a light will shine on the Connection Setup Page to indicate for which sensor the alarm is going off. On the sensor's Reception History Page, or in the file, the codes can then be found and checked. The higher the code, the more serious the problem.
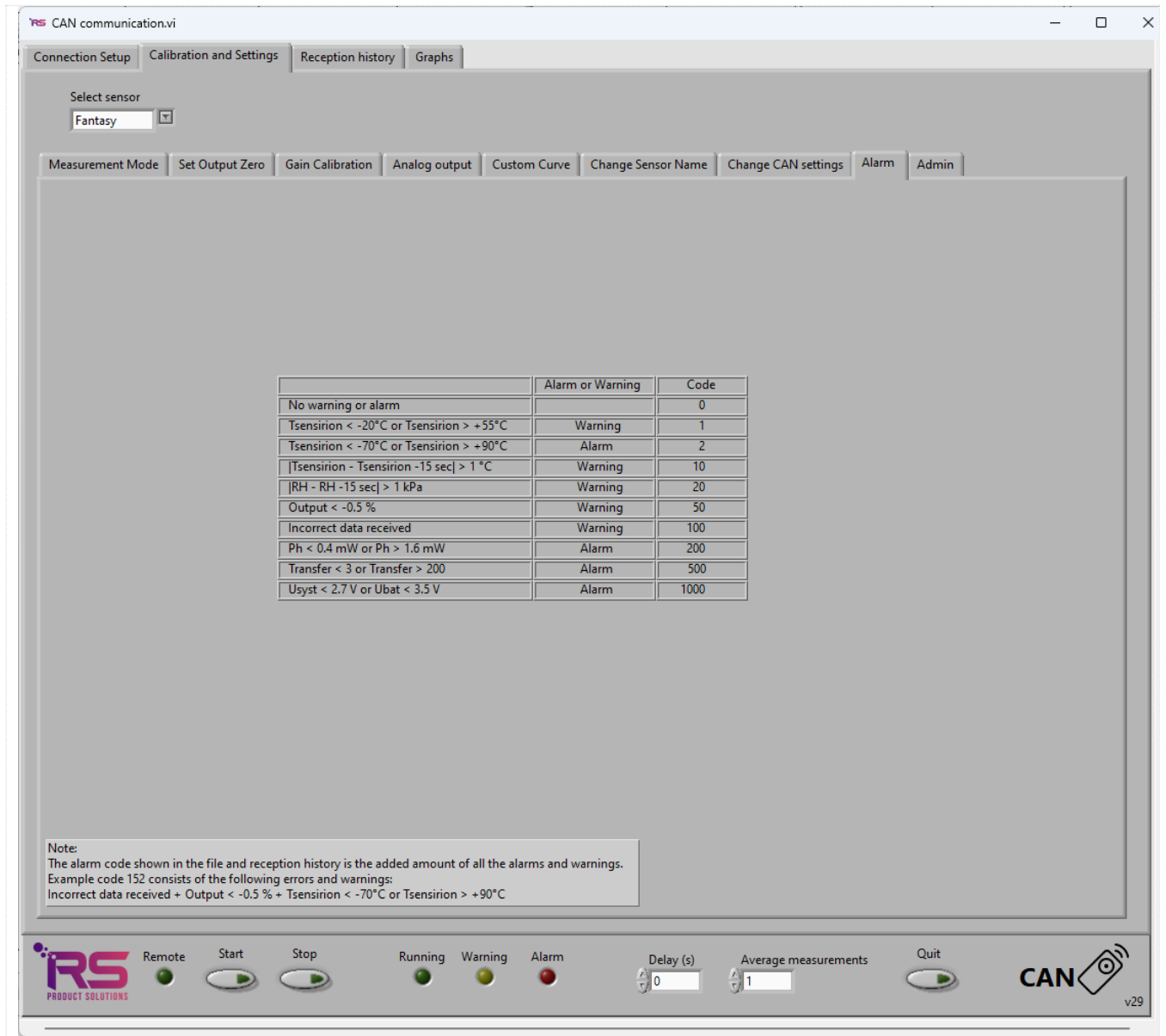

Figure 9: The Alarm page, which shows the different types of alarms and warnings

3.11   The Reception History Page

3.11.1   The displayed data

On the Reception history page, the measurement data are shown as numbers, see Fig. 10. The reception history can be shown for one sensor at a time, by selecting the desired sensor from the **Select Sensor** drop down menu. At the top of each page, the **Sensor ID**entification is shown, the **Firmware version** of the sensor, the **Measurement mode**, i.e., the conversion curve used to calculate the output in %. This can be altered on the Measurement mode page. And finally the **Gain** is shown, the gain can be calibrated on the Gain Calibration page. The output values are multiplied with the gain to get a 100% output when 100% of the second gas type is present. For instance, for an air-helium curve, gain calibration is performed in 100% helium. The gain factor is calculated to get the displayed output also to 100%. If the calculated value deviates too much (more than a few percent), for instance, when a wrong gas mixture is present, the gain is set to unity instead.
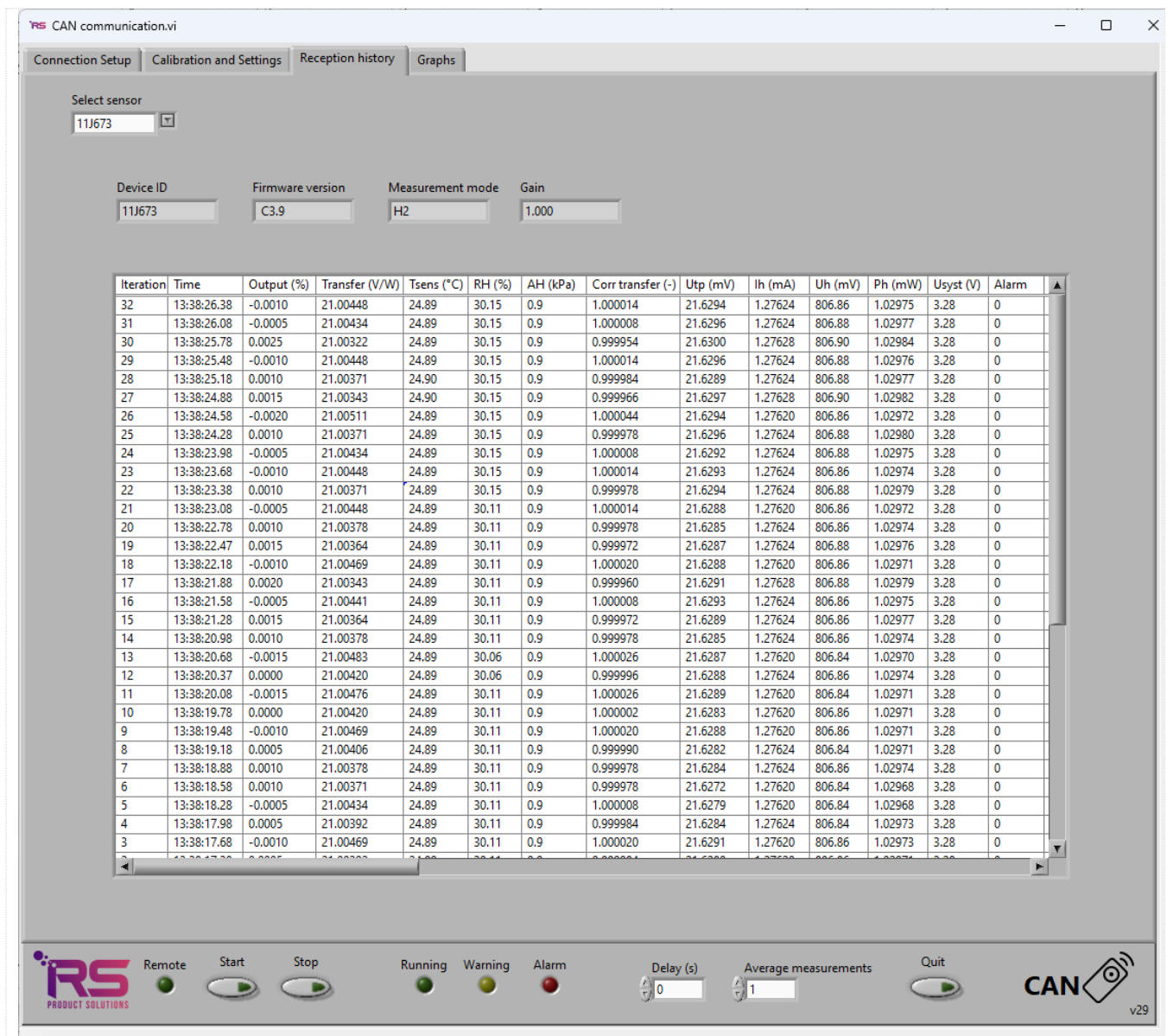

Figure 10: The Reception History Page

3.11.2   Explanation of the columns.

Iteration is the number of the measurement, this is counted per device and starts at 0. The iteration restarts at 0 after a stop and (re)start of the measurements.

Time is the computer time of the measurement. It is given in increments of 10 ms. However, when importing the data into EXCEL, the time is displayed only in full seconds, unless the notation is changed into an adjusted notation (go to cell properties, and use an adjusted notation as u:mm:ss.00).

Output in % is the deviation of the corrected transfer with respect to the calibration transfer.

In case the **Measurement mode** is H2 for hydrogen, the output is given as % H2 concentration.

In case the **Measurement mode** is He for helium, the output is given as %helium.

In case the **Measurement mode** is GEN, a general output is given as % of the difference between the calibration transfer and the corrected transfer.

Transfer in V/W (output voltage of the thermocouple sensing element divided by the heater power) is what has been measured.

Tsens in ºC is the temperature measured with the Sensirion humidity sensor, which is located in the thermal conductivity sensing-element housing.

RH (Relative Humidity in %) is the RH measured by the Sensirion RH sensor, which is located in the thermal conductivity sensing-element housing.

AH shows the absolute humidity pressure in kPa. It equals the RH times the saturation water vapor pressure at **Tsens**.

Corr_transfer, the corrected transfer gives the nominal transfer (but not in V/W, but normalized to the transfer in the base gas) as calculated after correcting for the differences between the temperature and humidity during calibration and during measurement. The remaining difference from unity is then ascribed to the parameter to be measured.

Utp in mV is the output voltage of the thermopile measuring the temperature elevation of the heater element.

Ih in mA is the current through the heater element on the sensing element's membrane.

Uh in mV is the voltage across the heater element on the sensing element's membrane.

Ph in mW, the multiplication of **Ih** and **Uh** is the power dissipated in the membrane. The Thermocouple voltage **Utp** divided by the Heater Power **Ph** gives the measured **Transfer**.

USyst in V gives the power supply voltage of the XEN-5320 after stabilization. This should normally read as about 3.3 V.

Alarm shows a code for a selected number of warnings and errors. Se the Alarm Chapter for the codes.

3.12   The filed data

All data are stored in a text file, with a name starting with the date (yyyy-mm-dd), followed by the device name. If no file for the current date exists, a new file will be made. Otherwise, the data are appended to the existing file.

For each device and day, a new file is made. The file starts with some general data on the device, with subsequently all the measurement data. If the measurement is stopped and then started again, the header data are repeated.

The header resembles the data shown in Fig. 11 below (with some long numbers reduced in length):

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Device address	Device ID	Factory Device ID	Firmware	Measurement mode	Gain	Speed	Y_AH_Cal (-)	TF_Cal (V/W)	Temp_Cal (°C)				
2	FF42	04DC25	04DC25	C1.3	H2	1.004	Norm	0.996501	21.471613	30.401989				
3	Iteration	Time	Output (%)	Transfer (V/W)	Tsens (°C)	RH (%)	AH (kPa)	Corr transfer (-)	Utp (mV)	Ih (mA)	Uh (mV)	Ph (mW)	Usyst (V)	Alarm
4	0	03:39.6	0	21.466	30.09	38.69	1.6	1	19.945	1.24	748	0.929	3.26	0
5	1	03:40.0	-0.004	21.468	30.07	38.65	1.6	1.0001	19.948	1.24	748	0.929	3.26	0
6	2	03:40.6	-0.004	21.468	30.1	38.69	1.6	1.0001	19.95	1.24	748	0.929	3.26	0
7	3	03:40.9	-0.012	21.471	30.06	38.69	1.6	1.0002	19.949	1.24	748	0.929	3.26	0
8	4	03:41.2	0.016	21.46	30.09	38.68	1.6	0.9997	19.944	1.24	748	0.929	3.26	0
9	5	03:41.5	0.004	21.465	30.06	38.68	1.6	0.9999	19.943	1.24	748	0.929	3.26	0
10	6	03:41.8	-0.004	21.468	30.05	38.69	1.6	1.0001	19.95	1.24	748	0.929	3.26	0
11	7	03:42.1	0.004	21.465	30.09	38.7	1.6	0.9999	19.949	1.24	748	0.929	3.26	0
12	8	03:42.4	-0.624	21.716	30.12	38.74	1.7	1.0117	20.186	1.24	748	0.929	3.26	50

Blad1 Blad2 Blad3

Figure 11: The Filed data.

The **Device address** is the CAN bus address of the XEN-5320 CAN device.

The **Device ID** is a unique coding for each XEN-5320 CAN.

The **Factory Device ID** is the name given to the device by the manufacturer.

The **Firmware** is the version of the microcontroller program.

The **Measurement mode** is the mode the XEN-5320 CAN is using to measure.

The **Gain** is the factor by which the output is multiplied to get a 100% output value for 100% second gas.

The **Speed** is the measurement speed.

Y_AH_Cal (-) is the correction factor used for humidity during calibration.

TF_Cal (V/W) is the transfer during calibration.

Temp_Cal (ºC) is the temperature during calibration.

These three factors give the XEN-5320 measurement data during calibration. It is possible to update these calibration data by performing a new calibration using the Calibration Page.

These data are used, together with subsequent temperature and humidity measurement to first calculate the corrected transfer at the subsequent measurement. Then difference between the corrected and actually measured transfer is used to calculate the output signal with a look-up Table.

Then the same data are given as displayed in the reception page.

Each measurement data line occupies about 0.1 kB of file size.

Thus, a file with 500 000 measurements is about 50 MB large.

3.13   The Graphs Page

On the Graphs Page, one of all the parameters that are shown in the reception can be displayed against the iteration number. Time cannot be displayed.

There are 5 pages with displays and each page has 5 displays per sub-page. Each display can show one parameter from one sensor. So it is possible to use 5 displays to show 5 parameters from 1 sensor, but it is also possible to use 5 displays to show 1 parameter of 5 sensors.

Fig. 12. shows several data of sensor 07H034: output (%), Transfer (V/W), RH (%RH), AH (kPa) and Corrected transfer (-), for some 520 measurements. The graph shows the effect of breathing in and out over the XEN-5320 CAN.
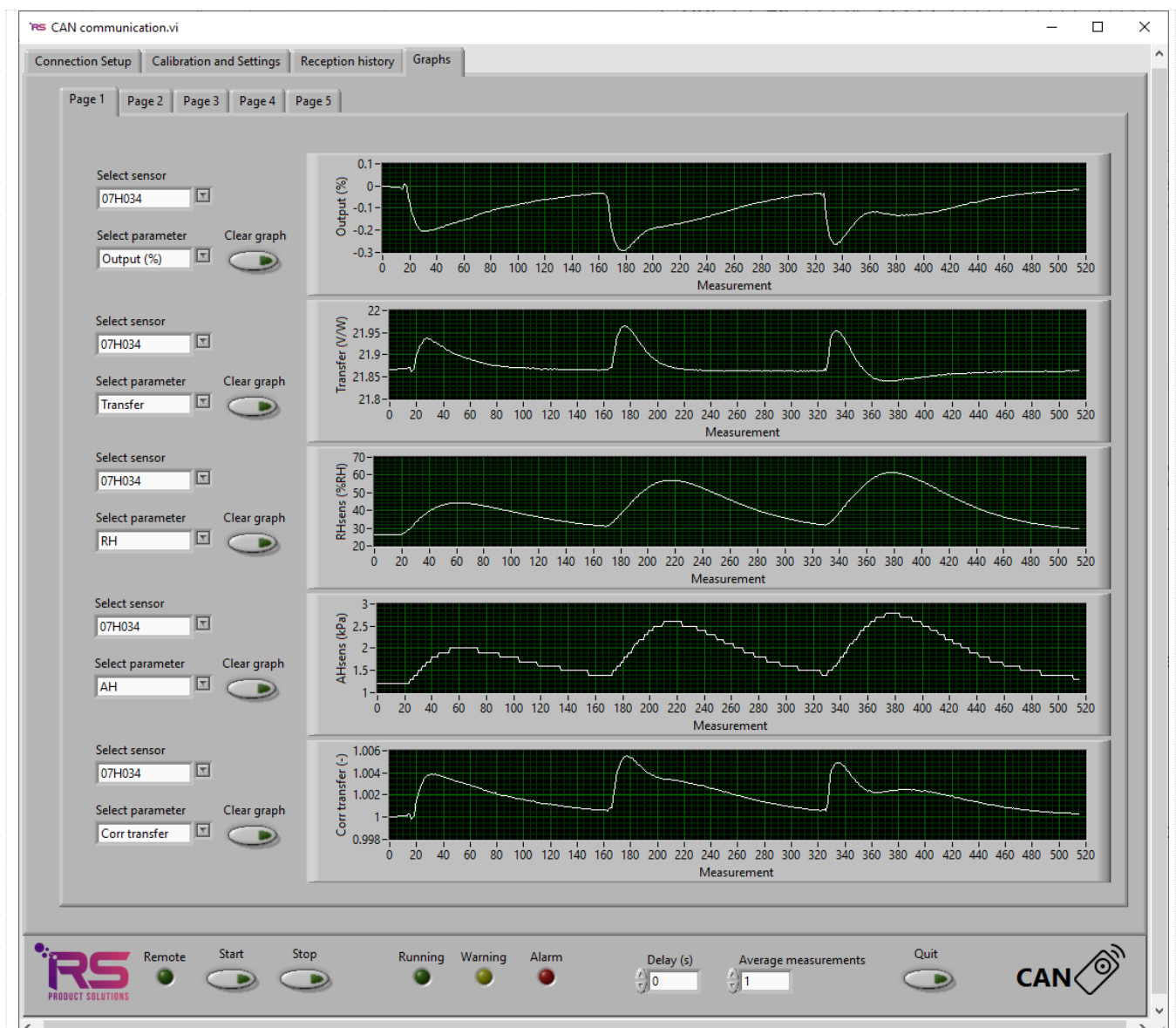

Figure 12: The Graphs Page

3.14   Trouble shooting

The measurement data show a lot of zero's instead of real data.	It can be that your computer shows only zeros after the decimal separator, if this separator is a comma. This separator should be changed into a point(.), and then, correct trailing digits will appear. This can be done in the Country & Language part of the configuration screen of your PC.
The time data are wrong when importing the measurement file into EXCEL.	Be sure to define the time data column as u:mm:ss.00 in the cell properties, adjusted format.
When importing the measurement data into EXCEL they are of an incorrect magnitude.	This is a point/comma settings result. When importing the data in EXCEL, use the advanced settings to exchange the designation of a point and a comma.
The connected to CAN bus bulb is flashing.	Make sure the Kvaser CAN-USB interface is installed and connected to a USB port before the LabView software is started.
The bulb Error burns at the Connection setup page and the devices are not correctly shown after finding devices.	Two or more XEN-5320 CAN devices have the same CAN bus address. Remove one or more XEN-5320 CAN devices with duplicate addresses from the CAN bus network and appoint a different CAN bus address for each XEN-5320 CAN device.
Commands in the Calibration and Settings Page do not work.	Stop the measurement before performing these actions.

For any further questions, problems or remarks, please contact RS Product Solutions BV or search the website for updated information:

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Web   www.xen5320.com