IGB GMBH
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the rad pack

Operating Instructions

IGB-sense®

The Mobile Dielectric Spectroscopy

Content

1. General information

1.1 Safety information

Please read the following instructions conscientiously to protect yourself from injury and your equipment from damage.

These operating instructions contain safety instructions, and we use the following symbols:


Caution (general)


Caution against electrical hazards


Caution against hot surfaces


Caution against (UV) radiation


Caution, be sure to wear eye protection

General notes:


Work on the device may only be carried out by qualified and instructed personnel *


Maintenance and servicing work may only be carried out in a de-energized state..


The general rules of technology apply to the use of the device.

The IGB-sense® is built according to the currently valid rules of technology and is safe to operate. Improper handling by insufficiently qualified personnel* may result in hazards. These are generated less by the device itself than by its use in production machines, conveyor belts and UV radiation equipment. Thorough instruction of the operating personnel is then absolutely necessary.

1.2 Modifications to hardware and software


Repairs and hardware modifications may only be carried out by the manufacturer! (Service address see below in this manual).

Failure to comply with these safety instructions may result in limitation or complete loss of liability by the manufacturer.

* Qualified personnel are persons who, due to their training, experience and instruction as well as their knowledge of relevant standards, regulations, accident prevention rules and operating conditions, have been authorized by the person responsible for the safety of the installation to carry out the required activities and are able to recognize and avoid possible hazards. (Definition for skilled personnel according to VDE 105 or ICE 36).

1.3 Validity of the operating instructions

These operating instructions are valid for IGB-sense® devices from hardware release Transmitter V16, Receiver V9 and software release 3.7.

The software release data can be found at the top left of the user interface.

The hardware versions and S/N can be found on the housings (laser label).

1.4 Warranty

These operating instructions do not contain any warranty promises. The warranty for products of the company IGB-tech GmbH is exclusively based on the General Terms and Conditions in the current version. Prerequisite for the warranty is the intended use of the device in compliance with the specified operating conditions.

No liability is assumed for consequential damage of any kind that could result from failure or malfunction of the device.

1.5 Intended use

The IGB-sense® is a piece of equipment for use in the laboratory or in industrial plants.

It is used to evaluate curing processes during the processing of reactive materials, in particular adhesives, potting compounds or paints. Based on dielectric spectroscopy, ion/dipole mobilities are measured, evaluated and graphically displayed. Switching signals can be generated on the basis of adjustable limit values in order to influence running processes.

To ensure proper functioning, long service life and compliance with the intended use, the operating conditions specified in these operating instructions and the listed operating notes must be observed.

1.6 Terms

For the sake of simplicity, the following names are used in this manual:

RECEIVER = stationary receiver or data logger

TRANSMITTER = mobile data transmitter incl. temperature and UV detector

SENSOR = sensor board for measuring polymer properties and temperature

ACCU = energy source of the IGB-sense® transmitter and the additional extension module. The energy source are capacitors (SuperCaps).

2. Description

2.1 Technical data

Housing

Material	Alu (powder coating)
Dimensions Receiver W x D x H	113 x 106 x 32 mm
Dimensions Transmitter incl. sensor W x D x H	57 x 115 x 32 mm
Dimensions Sensor W x D x H	60 x 28 x 1,5 mm
Weight Receiver	240 g
Weight Transmitter incl. Sensor	125 g
Weight Sensor	5 g
Operating temperature	+10-70° C
Storage temperature	0-40° C
rel. humidity (operating)	max. 80 %
Electrical data	
Power supply receiver	24 V DC, 3 A, ca. 60W
Charging voltage transmitter	24 V DC, 3 A
Operating time transmitter mode	6 min
Operating time transmitter mode plus extender	30 min
Charging time of capacitors	15 resp. 30 s for complete set
Switching capacity of relay outputs I-III (normally open)	24 V 0,5 A (PLC

Electrical connections

Data connection to PC	USB 2.0
Supply voltage Charging function	24 V DC 3A ODU mini snap Size.0
Charging of the handset (transmitter)	(supply also during a running measurement) via receiver, alternatively use of additional battery pack

Operation

Operating mode	Intermittent operation / accu
Operation	Continuous operation / mains connection
Input parameters	ICONS / English
Internal memory	Via PC
Status displays of relay switching states	non-volatile (EEPROM)
Charge function indicators (receiver) and charge status indicator (transmitter)	3 LED (red, yellow and green)

2.2 Approvals

- The IGB-sense® is approved for operation with 24V DC voltage and complies with the EMC directive
- The device carries the CE mark
- The device is classified according to IP 20

2.3 Assignment of the connection sockets and signal level

2.3.1 Receiver

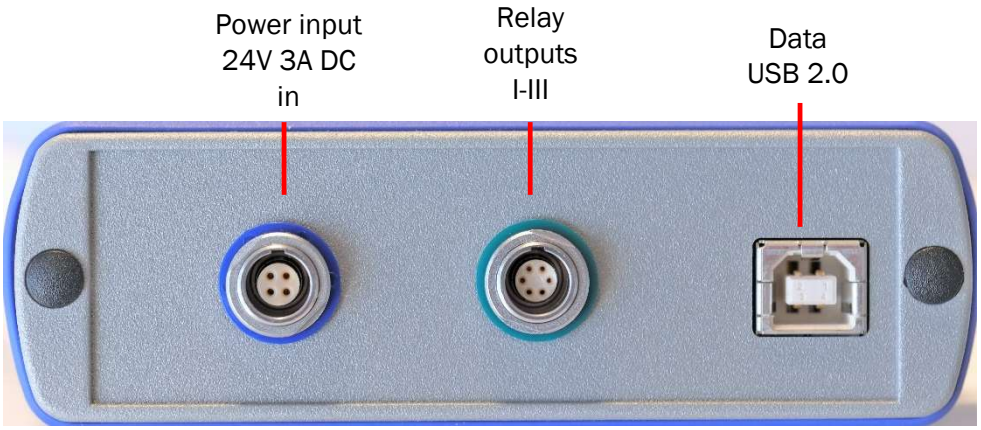
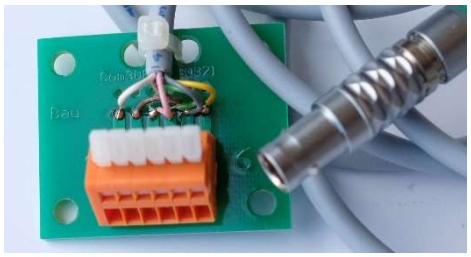


Fig. 2.3.1a Receiver, connection sockets on the left side of the device

Fig. 2.3.1b Receiver, connection sockets on the right side of the device



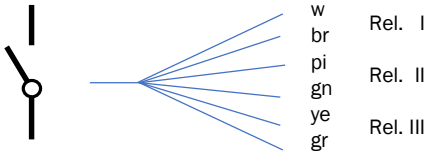


Fig. 2.3.1c Relay connection cable & terminal assignment / cable colour coding

2.3.2 Transmitter

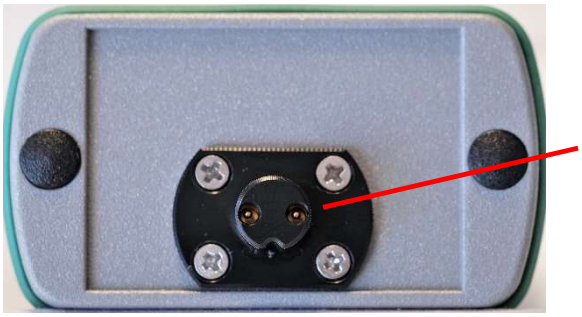


Fig. 2.3.2a Transmitter, left side

Fig. 2.3.2b Transmitter, right side

3. Commissioning

3.1 Unpacking and inspection

After unpacking, please check the delivery for completeness and for compliance of your operating conditions with the specifications in this manual.

- The scope of delivery includes:

  - 1x IGB-sense® Receiver
  - 1x IGB-sense® Transmitter
  - 1x plug-in power supply (24V DC, 60W)
  - 1x package of IGB-sense® sensors in container (content: 20 pieces)
  - 1x user manual and operating software (on USB stick)
  - 1x USB cable flat/0,8m
  - 1x plug relay connections with cable and terminal connection board
  - 1 case

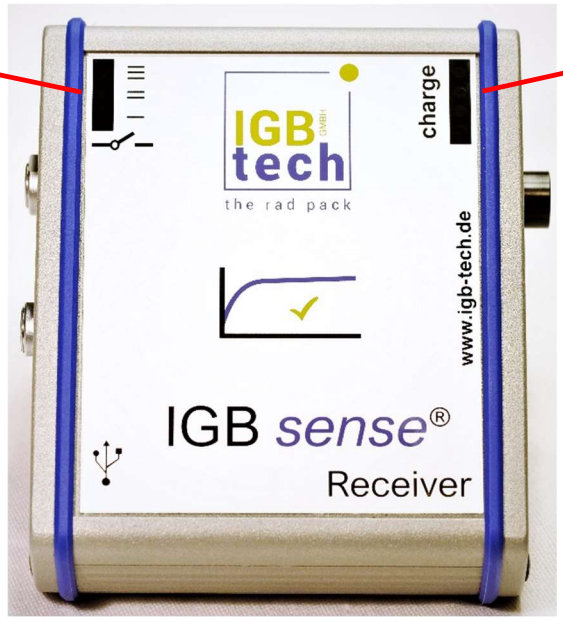
  as well as for the complete set

  - 1x battery extension module
  - Application accessories (application squeegee, cover glasses)
  - 3 pcs. pattern spacer rings for 1, 2 and 3mm layer thickness (dam & fill)

3.2 Device views and controls

3.2.1 Receiver

LED Relay-Status



LED
State of charge of transmitter and, if applicable, accu

Fig. 3.2.1 Top view receiver

3.2.2 Transmitter

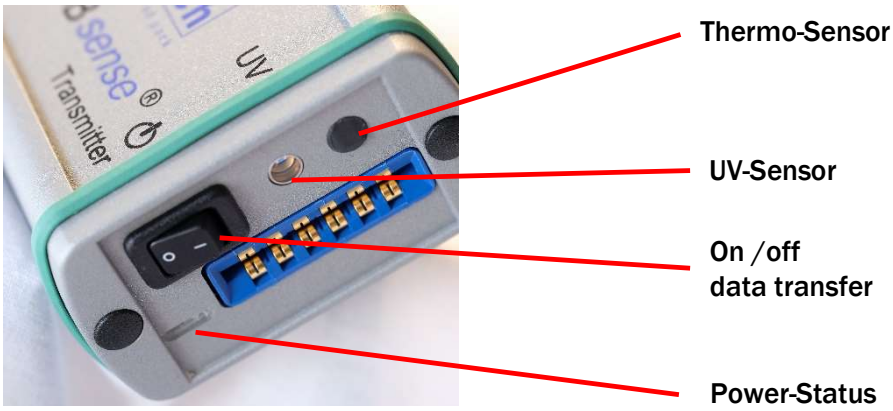


Fig. 3.2.2 Transmitter

3.2.3 Sensor

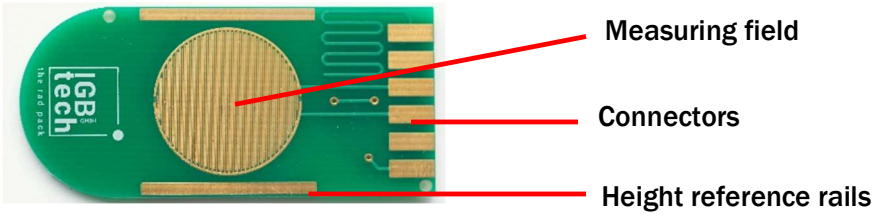


Fig. 3.2.3 Sensor

3.2.4 Accu-Extension-Modul

Fig. 3.2.4 Top View Accu Expansion

3.3 Charging the accu pack

The IGB-sense® was designed to be extremely energy-saving and can therefore do without classic batteries or accumulators. It therefore uses capacitors (SuperCaps) as an energy source in its basic configuration in the transmitter and expansion module.

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The advantages are:

- an extremely short charging time, shorter than 1 minute even when the device has been stored for a longer period of time or is completely discharged
- an almost unlimited number of charging cycles and storage stability
- better temperature resistance than NiCd or LiPo batteries
- unrestricted transportation by air

To charge the capacitors, connect the receiver to your mains supply (110-230 VAC) using the supplied plug-in power supply. Then plug the transmitter into the receiver charging socket on the right side.

The LED display on the top of the receiver informs you about the progress of the charging process:

green (when switched on without components connected) Receiver receives power from the power supply unit

- red (after connecting components) status empty, charging process starts
- yellow 1 charging status 50%
- yellow 2 charges status 75%,
- green flashing charging status 90%
- green 100% charged and ready.

After disconnecting the transmitter from the receiver, the LEDs on the side of the transmitter provide information about the charging status. For this purpose a sensor must be plugged in and the transmit mode must be switched on (on/off switch).

To extend the mains-independent operation time there is an extension battery, which increases the transmission time from 6 to approx. 30min. It is charged like the transmitter at the receiving unit separately or together with it.

This battery extension module does not have its own charge indicator. After connection to the transmitter, the available operating time is displayed by the transmitter for both batteries together.

3.4 Initial installation on your PC

If you are using a PC with the Windows 7/10 operating system, no additional driver is required. If you are using a different system, please contact our technical service department.

Important: Be sure to perform the installation as a logged-in administrator !

- Create a new folder for the IGB-sense® software and another one for IGB-sense® measured values and screenshots.
- Now load the software from the supplied USB stick onto your computer in the software folder you just set up and unzip the zip file there.
- Select the SetUp.exe program.
- After installation the ICON of the IGB-sense® appears on your desktop
- Connect the receiver to a free USB port on your PC using the USB cable supplied.

- Clicking on the icon opens the user interface of the program.
- - In the upper left corner you will find the control panel Communication-Status, which now lights up red and shows a question mark.
- - By clicking on it, the program automatically searches for a free COM port and displays its number with a message that has to be acknowledged by closing the window.
- This initializes the data connection.

3.5 Checklist

- Is the supply voltage applied to the receiver and is the communication port status indicator on the screen green (Connected)?
- Is the transmitter sufficiently charged (charge level indicator LEDs) green?
- Is there a new sensor in the transmitter unit?
- (Alternatively, you can also start with a sensor that is already charged with material).

Start: If all conditions are met, you can start with the first measurement. But first, let's look how the measurement works and explain some basics.

4. The measurement of reaction kinetics

4.1 The measuring principle

The measuring principle is based on dielectric spectroscopy. In the case of unhardened materials, freely movable dipole elements are in the sample to be examined. A high-frequency alternating current field is introduced into the sensor and the capacitance is measured. With increasing hardening, this mobility of the dipoles decreases to a standstill and thus the dielectric constant of the material changes. The capacitance of the measuring capacitor decreases. This can happen very quickly (e.g. UV/light-initiated curing) or take many hours (e.g. during room temperature curing).

The measured values can be saved as raw data or graphically visualised as a curve and stored and exported in various formats (e.g. as *. csv for spreadsheets or *. jpg).

4.2 Preparation of the measurement

Please take into account that the measuring system already starts recording at the moment you insert the sensor into the transmitter unit and switch the on/off switch to "I".

Before the measurement, ensure that the transmitter is sufficiently charged and, if longer measurement intervals are planned, that an additional battery module is charged and installed. Therefore, prepare all necessary materials, prepare the dosing of the material sample onto the sensor and, if necessary, ensure the performance of the UV lamp (e.g. heat-up phase for discharge lamps, such as mercury HD lamps).


When using UV radiation, be sure to use suitable protection for skin and eyes!

4.3 Applying the sample

To prepare the sensor for medium to higher viscosity samples, the complete set includes a universal application squeegee for different layer thicknesses. By positioning the squeegee accordingly, layer thicknesses of 100µm-1,000µm can be set.

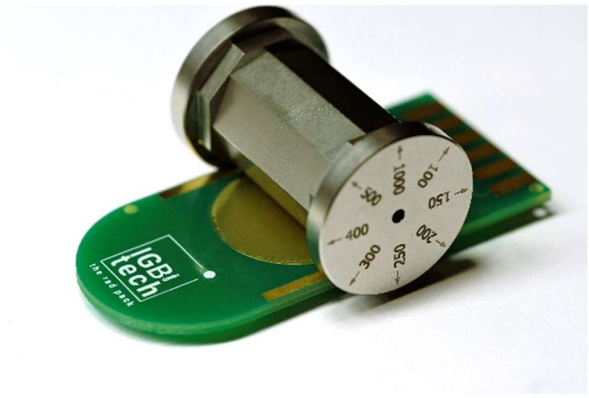


Fig. 4.3 a Polymer application using a squeegee (here 250µm)

For layer thicknesses greater than 1mm or for media that are not suitable for being applied by squeegee, we recommend the use of spacers. Precision rings made of POM are suitable for this purpose and can usually be reused.

You can get rings in different thicknesses and matching cover glasses including application aid from us in a starter set or refill pack.

Fig. 4.3 b Spacer rings in different thicknesses

5. Program and controls

5.1 Start screen

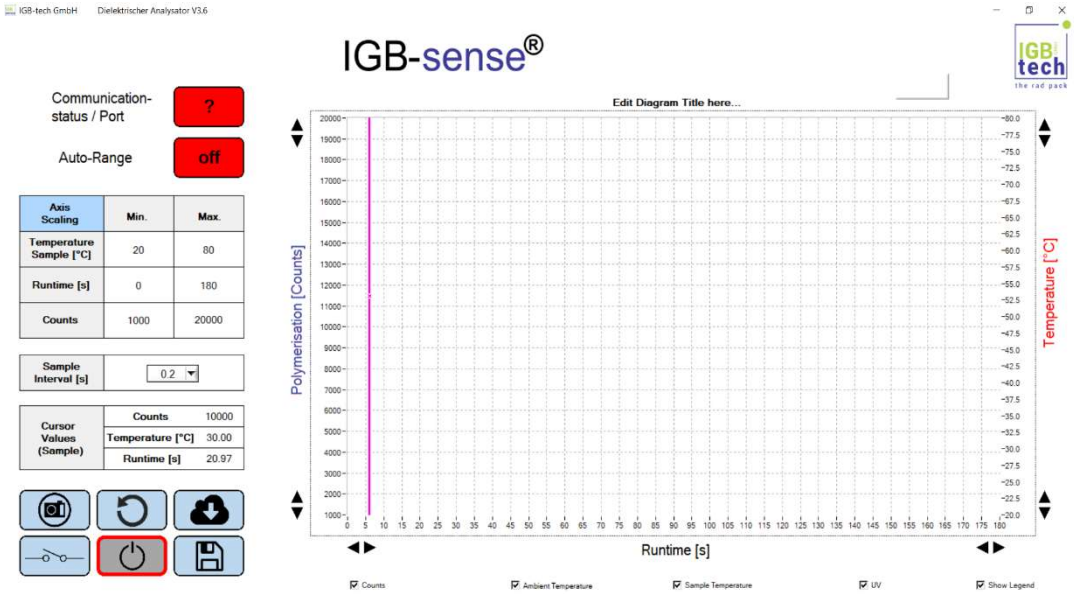


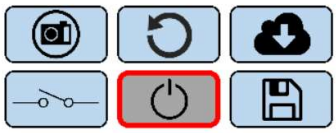
Fig. Start5.1 screen when calling up the program

5.1.1 Buttons (SF) and table values (T)

- **(SF 1) "Communication Status / Port"**
  If this field is highlighted in red, there is not yet a data connection to the PC.
  By clicking on this field, the program determines the next free COM port and reserves it for data transmission. After notification and confirmation, the assigned number of the COM port is automatically entered here.
  The colour signal also shows during operation whether the connection is active (green) or not (red).
- **(SF 2) "Autorange"**
  When "Autorange" is clicked, the program continuously adjusts the scaling of the Y axes so that all incoming measured values can be graphically displayed within the diagram area. If the autorange function is active, the field is highlighted in green and shows "on", otherwise "off" in the red field.
- **(T) "Axis Scaling"**
  In the table "Axis Scaling" the min and max values of the axis scaling can be entered manually. Alternatively, you can click the UP/DOWN arrows at the respective scale end points and change the scales in increments.
  Please note that the following scale resolution limits (difference between min and max values) must be observed, otherwise an error message appears:

  - Difference between min and max of the temperature scale : >= 10K-
  - Difference between min and max value of the counts: >= 1000

- **(T) "Sample Interval"**
  This value determines the speed/frequency at which the program reads out the measured values and can output them graphically. The program selects the corresponding data from the data stream (f=approx. 10 Hz) and combines them into packets. The transmission frequency of these packets for screen updating can be set separately. For more information, see "Practical hints for parameterisation" (chap. 5.2.2).
- **(T) "Cursor Values"**
  If a count or temperature curve is selected by the mouse pointer, the vertical cursor (pink line) jumps to the curve, the program searches for the next available data set in time and displays its values numerically here. The display of the cursor values only works with an active measurement.



Buttons 3 – 8 (below the table clockwise)

- **(SF 3) "ScreenPrint"**
  Clicking saves the pure curve graphic, without the tables that are on the left of the image.
  Note: The screen content is saved here as a JPEG file, NOT as a data set of the measured values.

- **(SF 4) "Refresh"**
  Clicking during the measurement deletes the screen curves and restarts the display of the incoming measurement data.

- **(SF 5) "Load"**
  Loads one or more curves from existing saved files (see supplementary information in chapter 6 "Graphical evaluation of test results"

- **(SF 6) "Save"**
  A new dialogue window opens for saving curves including the corresponding data sets. (see additional information in chapter 6 "Graphical evaluation of the test results").

- **(SF 7) "Quit Program"**
  This closes the program and deletes unsaved data.
  For safety's sake, the request must be confirmed.

- **(SF 8) "Relay Settings"**
  This opens an input table in which the switching points of three relays can be stored. (See additional information in the chapter "Using the Relay Functions".

5.1.2 Data export

The measurement data is stored in the desired formats in the previously selected file directories. Subsequent editing of the .csv and .jpg files can be done with spreadsheet and image editing programs.

During the measurement, the polymerization process (blue curve), the product temperature (red curve), the ambient temperature (yellow curve) and UV light on or off (pink curve) are displayed and recorded. The display of the respective curves as well as the legend can be selected and deselected (also during the measurement using switch symbols below the diagram).

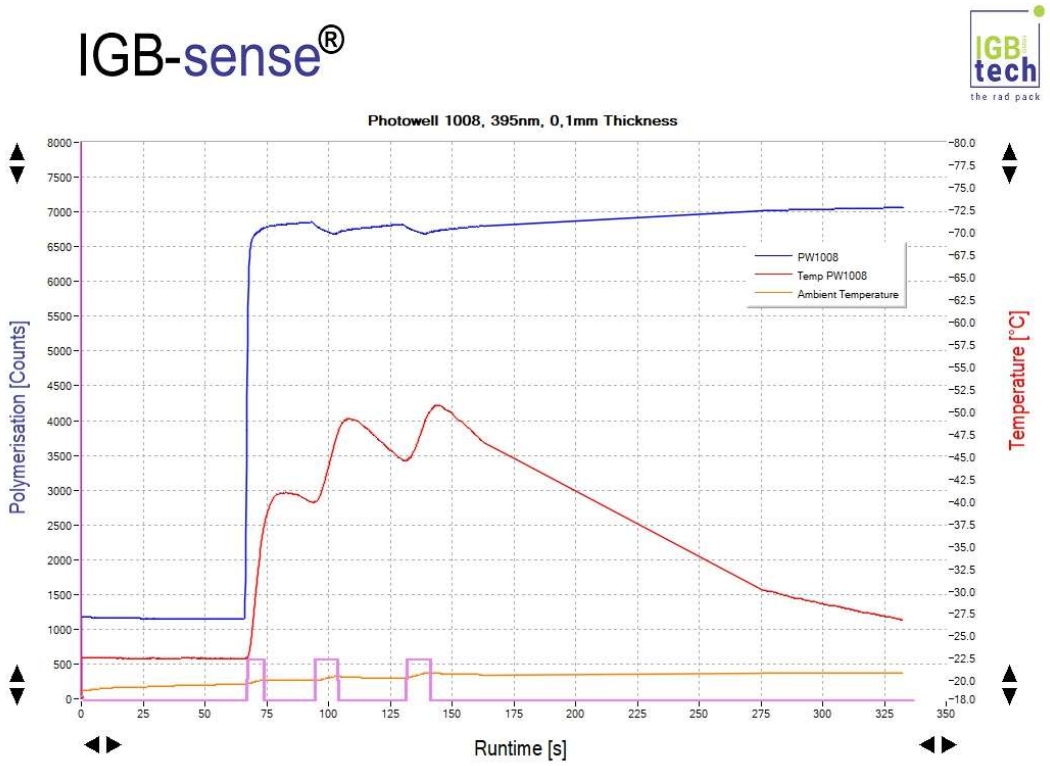


Fig.5.2 Graphical representation of the measured values during the measurement (see also chap. 6)

5.2. Parameterization of the graphic

In addition to the displays and buttons already described in chapter 5.1 .1, there are the following fields to adapt the graphic to your own requirements:

- **Arrows on y-axis left "Polymerization" (Min. Counts and Max. Counts).**
  This adjusts the resolution of the **left** y-axis to the incoming polymerisation data and thus optimises the display. The values are relative units, i.e., they have a purely qualitative meaning and are referred to as "counts". In "Autorange" mode, this is done automatically.
- **Arrows on y-axis right "Temperature" (Min.°C and Max.°C)**
  With these arrows the temperature scale can be changed. The temperature curve is shifted vertically. In auto-range mode, the scale adjusts automatically.

Please note regarding the temperature:

*The maximum permissible temperature of the transmitter electronics in the transmitter is limited to **80 °C**. If, in special cases, curing of the adhesive above this temperature is to be monitored continuously over a longer period of time (e.g. in a curing oven), the sensor must be thermally separated from the transmitter unit during tempering. Please contact our technical service for such applications.*

- **Arrows on x-axis "Runtime [s]".**
  The scaling of the x-axis (in s) defines the start time and duration of the graphical display of measured values from the running data stream.

  The left arrows define the start time of the graphical representation of the measured values as a curve.
  Example:
  If x-value = 0, the display starts immediately at the beginning of the measurement. If the value is 10, the first 10 s are recorded in the data set but not displayed (delay). These values can still be changed during the ongoing measurement. The right arrows are used to set the maximum expected measurement time. If the polymerisation times turn out to be different than expected, the axis can still be changed during the measurement in order to display further values or to optimise the display.
- **(SF 9) "Counts"**
  Selecting this field activates the display of the polymerisation curve.
- **(SF 10) "Ambient-Temperature"**
  Selecting this field activates the display of the ambient temperature, measured on the right side of the transmitter's housing.
- **(SF 11) "Sample-Temperature"**
  Selecting this field activates the display of the sensor temperature.
  The measurement is made by a temperature sensor attached to the back of the sensor and thus shows the product temperature with sufficient accuracy.
- **(SF 12) "UV"**
  Selecting the field activates the display of the UV irradiation (internal sensor).
- **(SF 13) "Show Legend"**
  Here the display of the legend can be activated/deactivated.

5.2.1 Practical tips for setting the parameters

The electrical properties of the sensor are calibrated before delivery to compensate for manufacturing tolerances and to be able to carry out comparative measurements with different sensors. When you insert a new sensor into the transmitter unit for the first time, the "empty" sensor normally shows a count value of 10.000. The lower count value shown after adhesive application depends on various parameters, especially the dielectric properties of the sample itself, the layer thickness of the sample and the occupied contact area of the sensor.

For unknown materials, it is recommended to leave the graphical representation to the "Autorange" function at first.

This function ensures that the scaling of the Y-axis is continuously adapted to the incoming data and that its curve remains visible in any case. If you have experience with the polymerisation behaviour of your sample, you can switch off this function and parameterize it manually. The temperature curve is also scaled automatically. However, the X-axis (time scale) is NOT scaled. Therefore, pay attention to the start value 0 sec and scale the time manually when the curves reach the right end of the display area.

The recording of the raw data is independent of the graphical evaluation. The raw data must be saved via the “Save” button. Saved curves can be reloaded and compared with each other by overlaying them. Equal scaling simplifies the work when first assessing the curves. (More on this later in chapter "6.3 Comparative measurements").

5.2.2 The image refresh rate

As mentioned in 5.1.1, the image resolution is defined on the user interface in the field "sample interval". The transmission of this data can take place at different speeds (rates can be selected in the drop-down menu sample interval).
Please note that at maximum transmission speed, the graphics build-up must happen very quickly and places corresponding demands on the hardware. In addition, the fast flickering can be perceived as disturbing.
We therefore recommend reducing the image refresh rate if a fast rate is not required.
Regardless of the display, the raw data is saved with the settings of the Plot Settings (see following image).

To set the data rate, click with the right mouse button on the IGB-tech logo in the upper right corner of the picture; the following input field will then open:

Fig. 5.2.2. data rate

In the example the computer will try to update with 10 Hz. If you set this value to 500 or 1000, then measurements are made or2 taken 1per second. In case of very slow reactions, measurements only every 5 s may be useful.

5.3 Long-term studies

5.3.1 Measuring frequency

The measuring frequency of the raw data can be set in a range from a minimum of 1 measurement /minute to a maximum of 10 Hz (default: 10 Hz). The frequency of the measurements should be adapted to the reaction kinetics in order to neither omit information (in the case of fast reactions) nor to generate undesirably large data sets without usable information.

Normally, e.g., for UV reactions, a sampling rate of measurements 5/**second** will be sufficient. For long-term measurements over hours, 5-10 measurements /**minute** are often sufficient. Only very reactive systems require the highest resolution.

5.3.2 Long-term measurements

Long-term measurements with reduced sampling rate should be discussed with our application technology, especially for thermal curing. We will program the sampling rate into the unit according to your needs. However, further precautions may need to be taken to protect the sensor and transmitter from damage.

For this application, connect the transmitter to a suitable power source, e.g. the acccu pack for measurements up to 30 minutes or leave it connected to the receiver for longer measurements. Supply your PC and the receiver with uninterrupted power for the planned measurement duration.

Select **Min. Time / sec:** 0 and Max. Time /: as 9999 parameters and prepare the sample as already described under Chap 4.3.

From the moment the sensor is plugged into the transmitter and switched on with the on/off switch, the measurement and the graphical representation starts.

Note: Furthermore, in addition to the automated fixed measuring frequency, there is also the option of removing the sensor board during a running measurement (after intermediate storage of the data) and reinserting it after a longer waiting time or after thermal curing and reading out further measurement data. This data can be added manually to the previous values.

6. Evaluation of the measurement data and graphical representation

6.1 Display of the different curves

Due to several integrated sensors in the IGB-sense® measuring device, various influences on the polymerization (temperature, UV irradiation) are displayed simultaneously with the reaction curve (see Fig.5.2).

Especially the combination of UV irradiation time and the changing dielectricity in connection with the reaction temperature enables the interpretation of the polymerization kinetics from the liquid monomer to the solid polymer.

Depending on the task, parameters can be displayed or suppressed by selecting the checkboxes located below the graph.

6.1.1 The dielectric values "Counts"

The data transmitted to the receiver are transferred live in the form of packets to the PC, which displays it as a running data record or in the form of a constantly updating graphic. All other information is omitted in the following graphic for the sake of clarity.

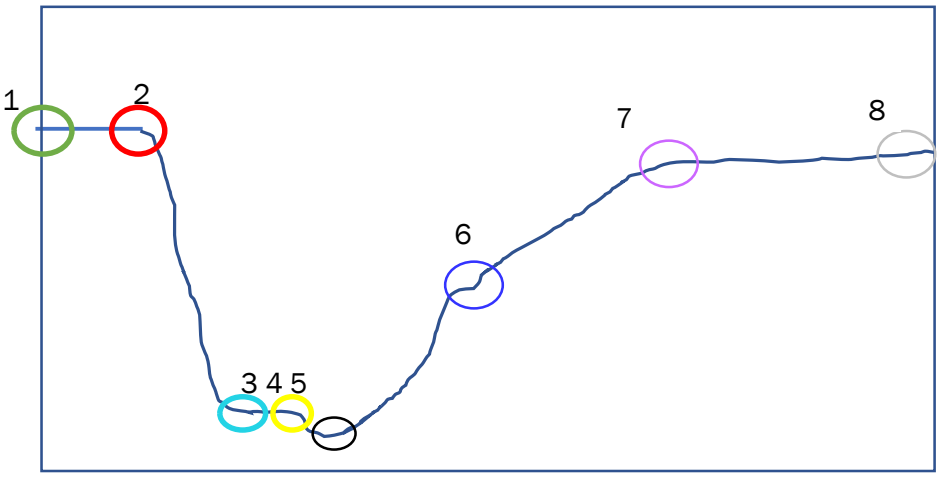


Fig. 6.1.1 Typical evaluation points of polymerization (counts)

Here, the type of representation can be adapted (see chap. 3) and at the same time various points can be recognized that contribute to the understanding of the reaction kinetics:

- **Point 1**
  Conductivity reference point of the new/empty sensor (default 10.000)
- **Point 2**
  Start dosing
- **Point 3**
  End of dosing. For comparative measurements, this point is an important indicator and shows whether a defined application quantity/coating thickness has been reached. The curve should be horizontal at this point, as only then the flow of liquid has stopped and conditions are stable for further proceeding.
- **Point 4**
  This is where the irradiation starts. Sometimes the dielectricity increases briefly due to the increasing (reaction) temperature, before it drops and the curve rises due to the beginning polymerization and solidification of the dipole elements.
- **Point 5**
  The maximum dipole mobility is reached. Then polymerization starts and the dipole activity decreases.
- **Point 6**
  Possibly occurring area in which the dipole activity increases again due to the influence of temperature.
- **Point 7**
  End point of primary polymerization
- **Point 8**
  End point after post-polymerization, if applicable

6.1.2 The Sample-Temperature Curve

A thermal-sensor is located on the back of the sensor. This records the temperature of the sample applied to the front side with an accuracy of 1-2 °C. The temperature curve is a very important indicator of the cross-linking process. The temperature curve is a very important indicator of the cross-linking process. Phase changes in the network become visible in relation to the count curve. Risks such as possible material damage due to excessive temperatures during curing can also be reliably identified.

6.1.3 The Ambient-Temperature Curve

On the right side of the transmitter housing, close to the sample to be measured, there is a temperature sensor that measures the ambient air resp. housing temperature. If the sample is cured e.g. by means of a hot air stream or in a heating cabinet, this temperature can be measured and displayed simultaneously with the sample temperature as an additional graph. This makes it easier to classify changes in the measured value of the polymerization temperature, i.e. whether they are due to external temperature influences or, for example, exothermic processes in the material itself.

6.1.4 The UV irradiation interval

A special feature is the automatic detection of UV exposure by the integrated sensor. It is located on the right side of the transmitter and is triggered by stray light during UV exposures. The sensitivity can be adjusted to attenuate influences from ambient light and to achieve a correct signal.

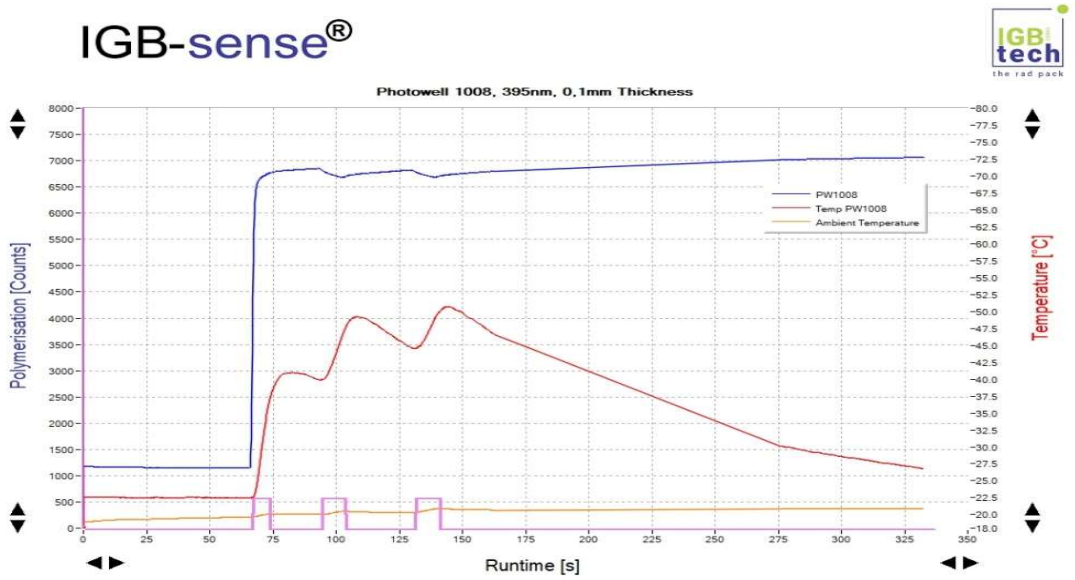


Fig. 6.1.4 a Measurement curves (polymerization (blue), product temperature (red), ambient temperature (yellow) & UV signal (pink))

The recording of the UV signal is purely qualitative, i.e. the temporal course is registered.
To record the intensity or the dose, it is necessary to use a separate UV meter.

IGB-tech has various UV measuring devices in its product range for both broadband spectra and LED applications.

Our specialists will be happy to advise you if required.

To set the UV signal switching threshold, click with the right mouse button on the IGB-tech logo in the upper right corner of the image, then the following input field opens:

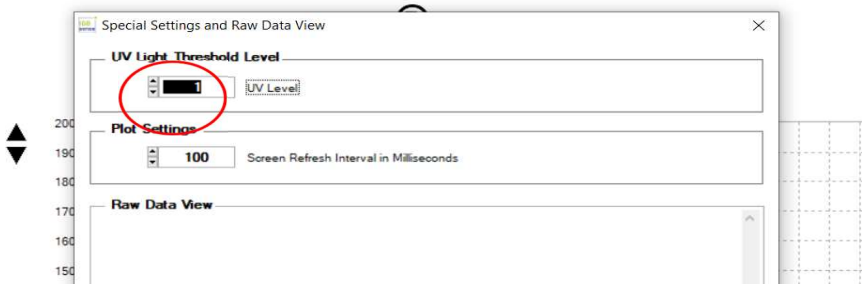


Fig. 6.4.1. b Setting the UV switching threshold

The higher the set value, the stronger the damping (recommended start value in normal environments = 5).

6.2 Saving the measurement data

The program offers the possibility to save the determined raw data and the finished processed curves. You can give the graph above the curve a title and also rename it during saving and add further information.

Edit the graphic as desired (especially with regard to the axis scaling, see also 6.3) and save it as follows:

Select the corresponding ICON SF 6 “Save" on the user interface. The following input field appears:

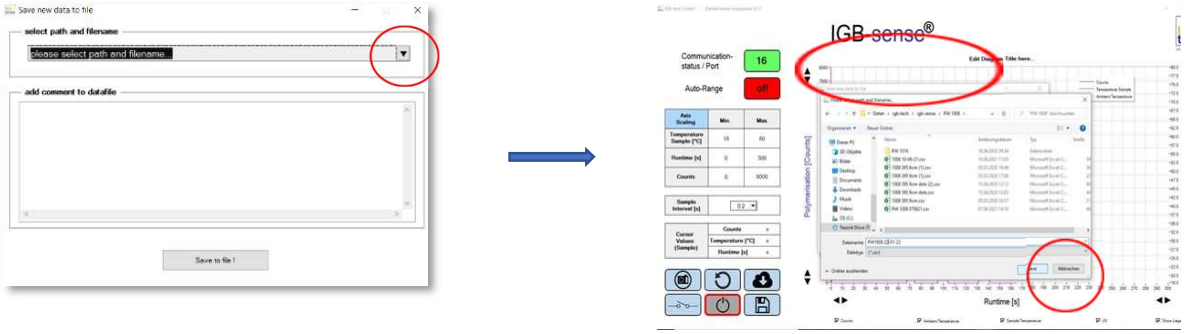


Fig. 6.2 Saving measurement data

First determine the storage location! (The drop-down arrow opens your file structure)
Ideally, you will have created file folders for your data during the installation, as recommended in Chap 3.4.

Now name the graphic according to your wishes and finally save it by clicking on "Save to file".

6.3 Recalling stored data

You can recall saved data sets and curves by using the "Load" function of the "SF 5" button. The following selection menu appears:

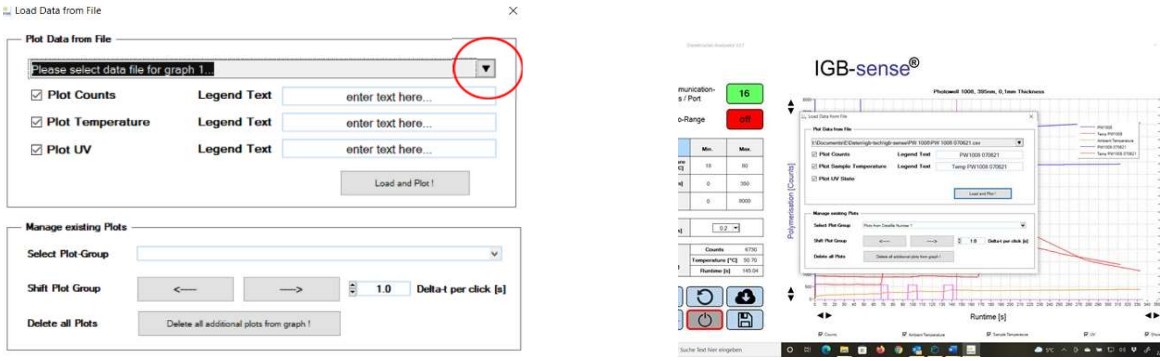


Fig. 6.3.1 Loading measurement data /1

Use the drop-down function to find your file again.

Select the curves you want to view and place the ticks in the corresponding fields. To label your graph in the legend, enter the designation in the text fields. Then confirm with "Load and Plot".

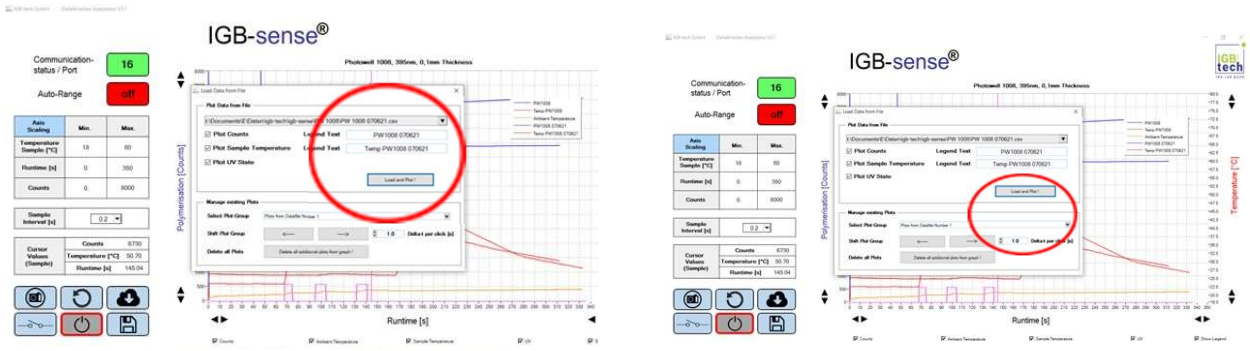


Fig. 6.3.2 loading measurement data /2 labelling the graph

Note: You can add already saved measurement data to your current graph, but it is clearer to prepare all graphs to be combined beforehand, save them and combine them offline. To do this, clean up the screen beforehand with the function "Delete all existing plots from graph".

6.4 Comparative investigation of polymerization processes

In order to be able to compare different polymerization curves (maximum 10) with each other, you should observe a few rules that will make your work easier:

- Storage in the same location or subfolder
- Ideally, all time axes and the temperature axis of the different graphs should have the same scale to simplify overlaying.
- Superimposing the curves on the x-axis by selecting a characteristic point (e.g. exposure start) and shifting horizontally.
- Assignment of different colours for the individual curves for better differentiation.
- Labelling of the curves in the legend
- Saving the new, combined graphic under a new name

6.4.1 Overlaying measurement data

After loading the data or curves to be combined, they can be shifted horizontally, i.e. in their chronological sequence. With this function, important process points (such as the start of the polymerization reaction) can be brought into agreement in order to evaluate the curve comparatively.

Note:
*A graphic consisting of superimposed curves can only be saved as a common **new** image graphic (*. jpg).*

To do this, select the data set you want to move:
(The drop-down arrow opens the available, loaded cures) and move the curves with the arrow keys.

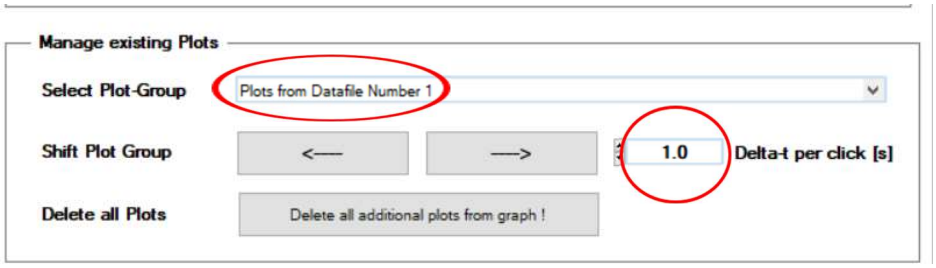


Fig. 6.4.1 Shifting the overlayed graph

If necessary, set an increment to speed up the shift per click (default=1).

The open loading window can be moved by mouse drag if it blocks the view of the curves.

The labels in the legend as well as the colour of the curves can be changed by right-clicking on the respective curve in the legend.

Subsequently, the combination graph is saved like a single curve.

7. Use of the programmable switching functions for process control

If the measurement results are to be used to influence a machine, three independent, programmable switching thresholds are available.
The three relays built into the unit can be used to control devices and thus, for example, to start or interrupt a UV LED exposure at the appropriate time.
As the integrated relays are only designed for low switching capacities, the signals are further processed in a PLC and corresponding load relays/contactors are controlled via this (see technical data: Chap. 2.1).

7.1 Programming the switching functions

7.1.1 Overview of terms and switching thresholds

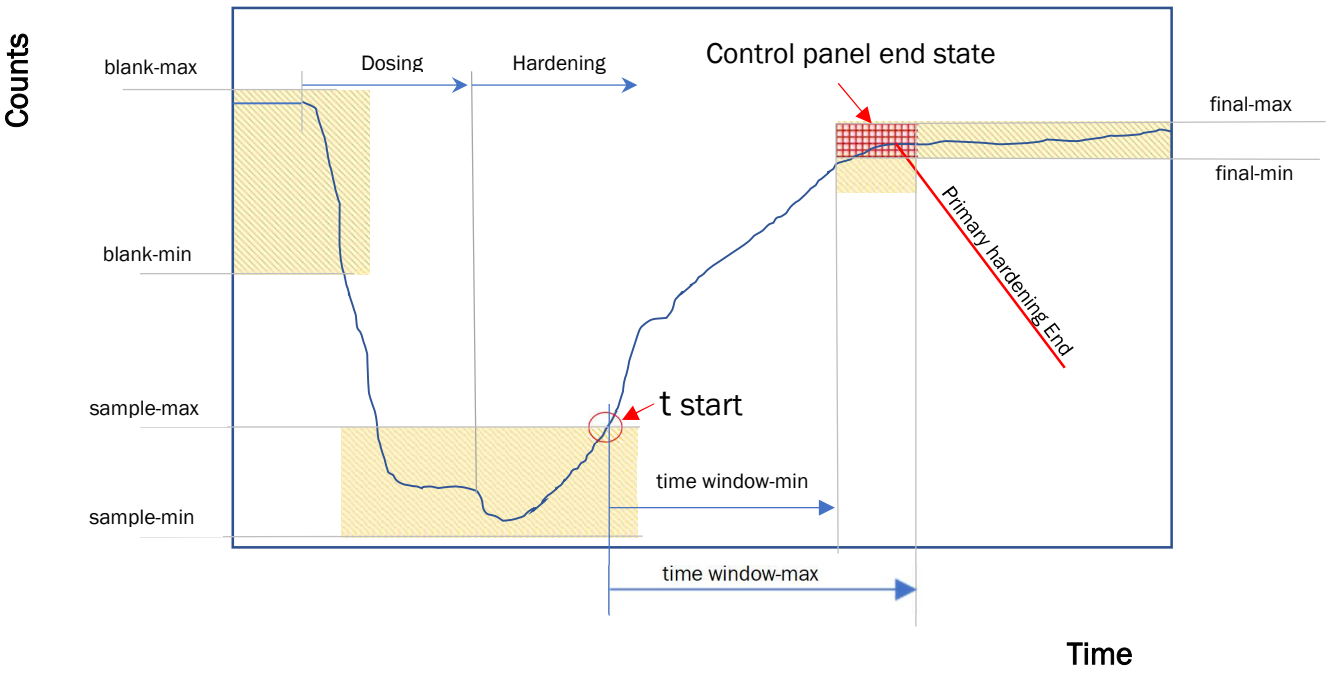


Fig. 7.1.1 Threshold values

The integrated relays can be programmed freely and independently of each other.
According to the switching states, the LEDs on the top of the receiver light up in red/yellow/green (for switching diagram, see chapter 2.3).

7.1.2 Switching logic and display

Counts	Relay contacts closed& LED status	Relay contacts closed& LED status	Relay contacts closed& LED status
Blank-min < Counts > Blank-max	1-2 & (red)		
sample-min < Counts > sample-max		3-4 & (yellow)	
final-min < Counts > final-max ***& simultaneously within the selected time window:*** Time window min < Counts > Time window max.			5-6 & (green)

7.1.3 Input mask for configuring the switching points

The following picture shows the input mask for the switching thresholds. Make sure that the transmitter is not active and no diagnosis is running. Click the button **(SF 8) "Relay parameterisation"** (Chap. 5.1.1.). The following picture now appears on the left:

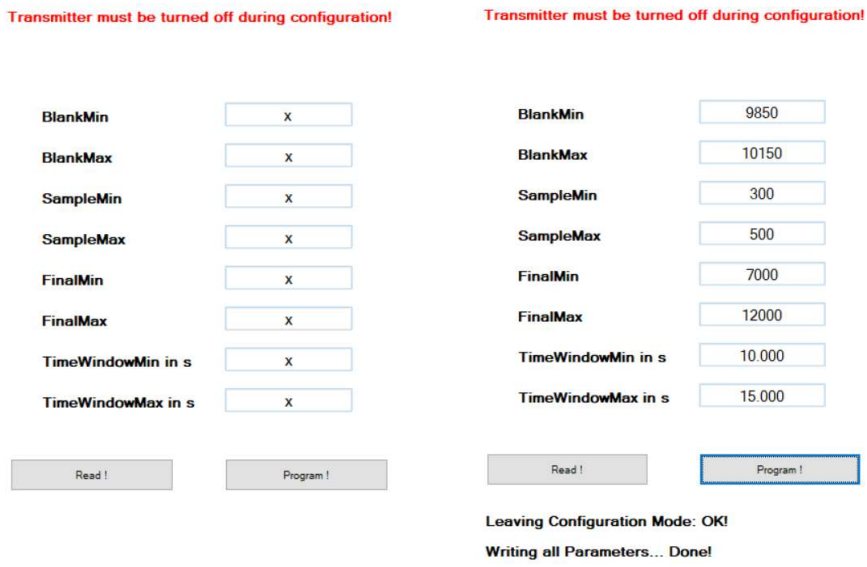


Fig. 7.1.3a Input masks for relay switching values

and after entering the values via “Program!” the right picture appears with x replaced by values.

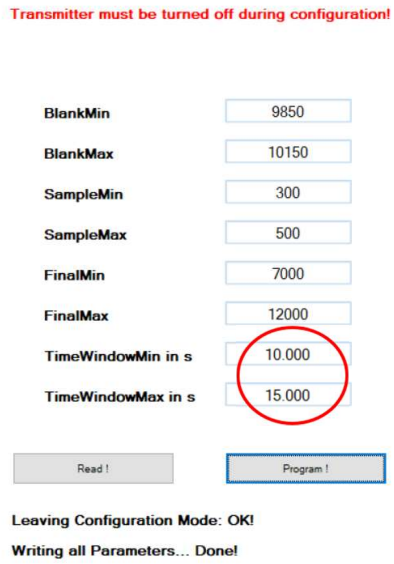


Fig. 7.1.3b Input masks for time window

Please note that the respective *min. values must always be smaller than the max. values and that the times must be given with 3 decimal places.

7.1.4 Application examples

The switching functions are most useful when using the unit to monitor a process and check whether the dosage and the curing process are within the set specifications. This applies both to the absolute curing result and to the timing of the polymerization.

Task:

A certain amount of adhesive required for a bonded joint is to be exposed by means of UV lamps until it is completely cured. The first thing to do is to determine this dose (time x intensity) After this result is found a reference exists which can be compared with the monitored values during the production process.

7.1.5 Parameter determination

We determine the max. layer thickness of an already made adhesive bond by measuring from the surface to the point of contact with the substrate surface.
Next, we prepare a sample quantity that gives the same layer thickness on the sensor as the previously determined thickness of the real adhesive bond. In the following step, the filled up and prepared sensor is exposed to the UV radiation source (or, if necessary, to other radiation such as IR), using the same values (wavelength, power and distance - i.e. intensity) as in the subsequent production facility.

Now the measurement is carried out as described in chap. 4.3 and 4.4.

The results are - if necessary - narrowed down by repeated measurements, i.e. iterated until reproducible results and best possible values for representation of the Y-axis (counts) and the duration of curing on the x-axis are found.
This data is now used to define the tolerance limits for the following use as a monitoring device.

7.2 Parameter monitoring by means of limit values

7.2.1 Switching range "blank" (Relay I)

The min and max limits of the "blank" value can be used, for example, to monitor the correct sensor blank value and the time course of the dosing. This first range is normally adjusted to include the range from the sensor blank value (e.g. 10,000 counts) to about 1000 counts above the lowest expected count value after dosing.
During dosing, the capacitance of the sensor changes due to the impinging new dielectric (e.g. adhesive). Therefore, the count value initially drops to a first minimum (on the curve from value 2 to 3) (see Fig. 6.1.1), directly proportional to the coverage of the sensor measuring surface by adhesive and (non-linearly) to the applied mass. The passage of this interval leads to a response of relay I and the lighting up of the red LED I in the receiver housing. The contact closed during this time can be used by a PLC, e.g. to confirm the time of dosing.

7.2.2 Switching range "sample" (relay II)

Between points 3 and 4 the adhesive flows if it is thin enough. When a horizontal plateau of the curve is reached, the process is complete. If this point is narrowed down as precisely as possible, e.g. by selecting the value sample max. very slightly above this plateau and liquid min. below the lowest count value to be expected, the evaluation of the signal "sample" shows not only whether the correct quantity has been applied, but also whether the viscosity or the wetting behaviour is the same as the underlying reference measurement. This thus confirms the quality of the dosing up to this point and from this point the curing/exposure can be started.

When leaving interval II (repeated crossing of the sample-max-value) the internal timer starts at point t_{start} and counts the polymerization time from then on.

This time measurement is the basis for the evaluation of the polymerization in field 3 "final".

7.2.3 Switching range "final" (Relay III)

If polymerization is started4 at point, the curve runs via points 5 and 6 to 7, the preliminary end point of primary curing, and finally to 8, the end of the reaction.

The interval III for checking the reaction result is delimited by two conditions and must fulfil **both in order** for relay III to switch and the green LED to light up at the same time.

a) The count value must be between "sample-min" and "sample-max".
and
b) The values must be reached **within the time window** defined by "time window-min" and "time window-max".

The start time (t_{start}) required for this is determined when leaving interval II, i.e. when repeatedly passing the "sample-max" value, as described in 7.2.2.

By selecting suitable parameters (intersection, see Fig. 6.1.1), this field is monitored and provides information on the compliance with the specified degree of cure within the expected time.
If curing does NOT occur within the expected time, this indicates possible problems with the adhesive or the curing initiation (e.g. UV source).

After the end of the measurement, the switching state of relay III remains until a new measurement (minimum waiting time 5s) triggers a reset or a reset is triggered manually by the SF 4 ”Refresh screen” or via switch on the transmitter.

8. Maintenance and cleaning

The external cleaning of the aluminum housing parts of **the receiver and transmitter** should only be done with a soft cloth and, if necessary, with a mild cleaner. You can use e.g. isopropyl alcohol or ethanol if necessary, but not acetone or strong acids or alkalis.

Use only slightly damp cloths and prevent liquid from entering the unit in any case!

The sensor itself is intended for single use due to its structure!

As experience has shown that mechanical cleaning cannot be carried out without damaging the conductors or at least impairing them, it is not recommended.

A reliable, reproducible result can only be achieved when using the disposable sensors calibrated at delivery for the first time.

The device should be sent in for inspection and, if necessary, calibration (annually) to permanently ensure operational readiness and measurement precision.

The service address can be found on the last page of the document.

9. Faults and remedies

Malfunction	Possible cause	Measure
Receiver gets no voltage	Power supply unit not plugged in	Check the power supply unit for correct connection
Receiver does not communicate with PC	USB cable not connected	Check USB cable
	Wrong COM port selected	Determine and enter the correct COM port
Transmitter does not transmit data	Accu empty or defective or sensor defective	Charge battery 30s otherwise send unit for service (battery exchange) Clean contacts to sensor board, insert new Sensor if necessary.
Sensor is not recognised (LED on transmitter side flashes red despite full battery)	Contacts dirty or sensor board defective	Clean the contact tongues with ISO propanol or replace the sensor board.
	Sensor board not calibrated	

10. Service contact details

You can obtain advice, adresse:

IGB-tech GmbH

Hauptstrasse 71

D-67159 Friedelsheim

Tel. +49 (0) 6322 949 5787
Fax: +49 (0) 6322 949 5786
info@igb-tech.de
www.igb-tech.de