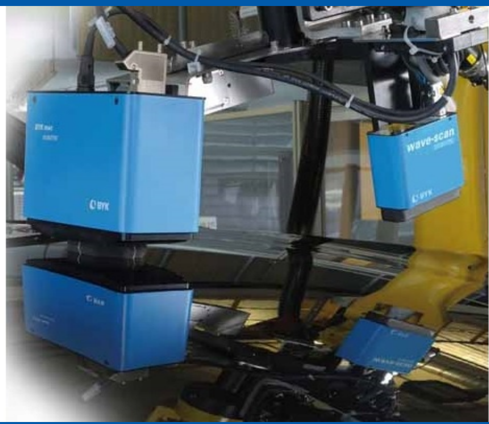
Measure what you see

smart-robotic



Operating Instructions

A member of ALTANA

BYK

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1 Introduction

Dear customer,

thank you for having decided for a BYK-Gardner product. BYK-Gardner is committed to providing you with quality products and services. We offer complete system solutions to solve your problems in areas of color, appearance and physical properties. As the basis of our worldwide business, we strongly believe in total customer satisfaction. Therefore, in addition to our products, we offer VALUE-ADDED services:

- Technical Sales Force
- Technical & Application Support
- Application and Technical Seminars
- Repair & Certification Service

BYK-Gardner is part of the Altana Group and a direct subsidiary of BYK, the worldwide leader of additives for coatings and plastics. Together we offer complete and unique solutions for you, our customer.

Thank you for your trust and confidence. If there is anything we can do better to serve your needs, do not hesitate to let us know.

Your BYK-Gardner Team

www.byk-instruments.com

1.1 Copyright

Specific properties and structural characteristics of the instrument are intellectual property of BYK-Gardner. The copyright of this manual remains with BYK-Gardner.

This document must not be reproduced fully or in party, published or used for any other competitive purposes, no matter whether against payment or not, without prior written authorization from BYK-Gardner.

BYK-Gardner reserves the right to update the instrument, software and written documentation without prior notice.

1.2 Prerequisites

In order to operate the software basic understanding of following topics is required:

- Products from BYK-Gardner:
  - Instrument **BYK-mac i ROBOTIC** to measure effect colors
  - Instrument **wave-scan ROBOTIC** and **wave-scan 3 ROBOTIC** to measure appearance (orange peel)
  - Software **smart-process** to monitor the measurement results
- Third-party products:
  - Instruments for measuring the thickness
  - OPC server for the control of the robot
  - Pre-positioning system for robot moves

NOTICE

The software **smart-process** is a variant of the software **smart-chart**. After a trial period of 30 days the software **smart-chart** has to be registered. During registration the variant **smart-process** has to be selected.

1.3 Requirements

1.3.1 Hardware

- Hardware: Intel Core-i3 2.5 GHz; Core-i7 recommended, or equivalent
- Memory: 8 GB RAM, 16 GB recommended
- Hard-disk capacity: 4 GB during installation
- Monitor resolution: 1920 x 1080 pixel or higher
- Interface: LAN port and free USB port

1.3.2 Software

- Operating system: Windows® 10 1607 or later
- Software smart-chart V7.1 or later
- Runtime: .NET core 3.1.0 or later

2 System Description

The software **smart-robotic** is the interface software for the BYK-Gardner robotic color and appearance measurement instruments and for compatible thickness measurement systems.

It provides all necessary modules for system configuration and monitoring for the BYK-Gardner robotic instruments and for storing the measurement results:

1. Monitoring [▸ 26]: Check the logging of events such as errors, warnings, debug events and info.
2. OPC [▸ 28]: Configure and test connection to the server hosting the interface to the robot.
3. Devices [▸ 35]: Configure and test the physical robotic measurement instruments.
4. Results Management:
   – Without **smart-chart**: Generate Output Files [▸ 67] as CSV / XML.
   – With **smart-chart**: Store results via smart-chart link [▸ 77] in the DB.
5. Robot Simulator [▸ 140]: Test the existing configuration and the physical instruments without the need of a robot.

2.1 Overview

The software can control following robotic measuring instruments:

- Color meter for effect colors: BYK-Gardner **BYK-mac i ROBOTIC**
- Appearance measurement:
  – BYK-Gardner **wave-scan ROBOTIC**
  – BYK-Gardner **wave-scan 3 ROBOTIC**
- Thickness measurement: **Fisher** or **PELT**

Illustration 1: Car body in robot cell with two robots

The measuring instruments mounted to a robot arm are providing measurement raw data.

Illustration 2: Instrument wave-scan ROBOTIC on robot arm

The raw data are received and evaluated by smart-robotic and stored in CSV / XML files or in the database of the BYK-Gardner software **smart-chart** for further processing.

2.2 Mounting

The measurement instruments and a pre-positioning system are mounted to a robot arm. Via the pre-positioning system the target position is reached. The robot arm rotates to bring the required instrument into measurement position. Afterwards the measurement is started. The measurement data are transferred immediately to **smart-robotic** and evaluated there.

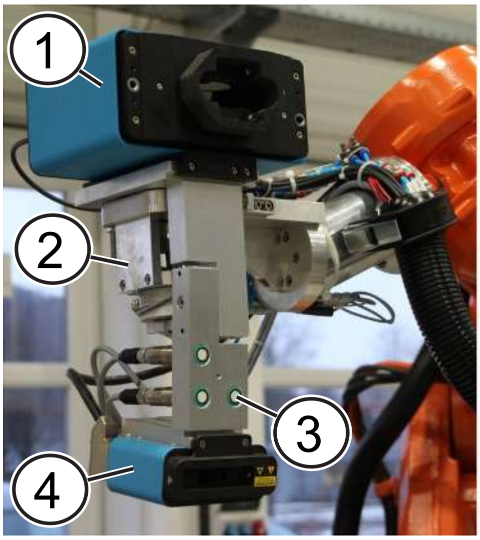


Illustration 3: BYK-Gardner instruments mounted to robot arm

1	BYK-mac i ROBOTIC: Color & Effect Measurement
2	Rotatable Adapter: 0°, 90°, 180°
3	Pre-Positioning System: Ultrasonic or Vision
4	Wave-Scan ROBOTIC: Appearance Measurement

After successful measurement the procedure is repeated for the next measurement point / check point.

2.3 Integration

Following figure shows the basic integration principle of smart-robotic.

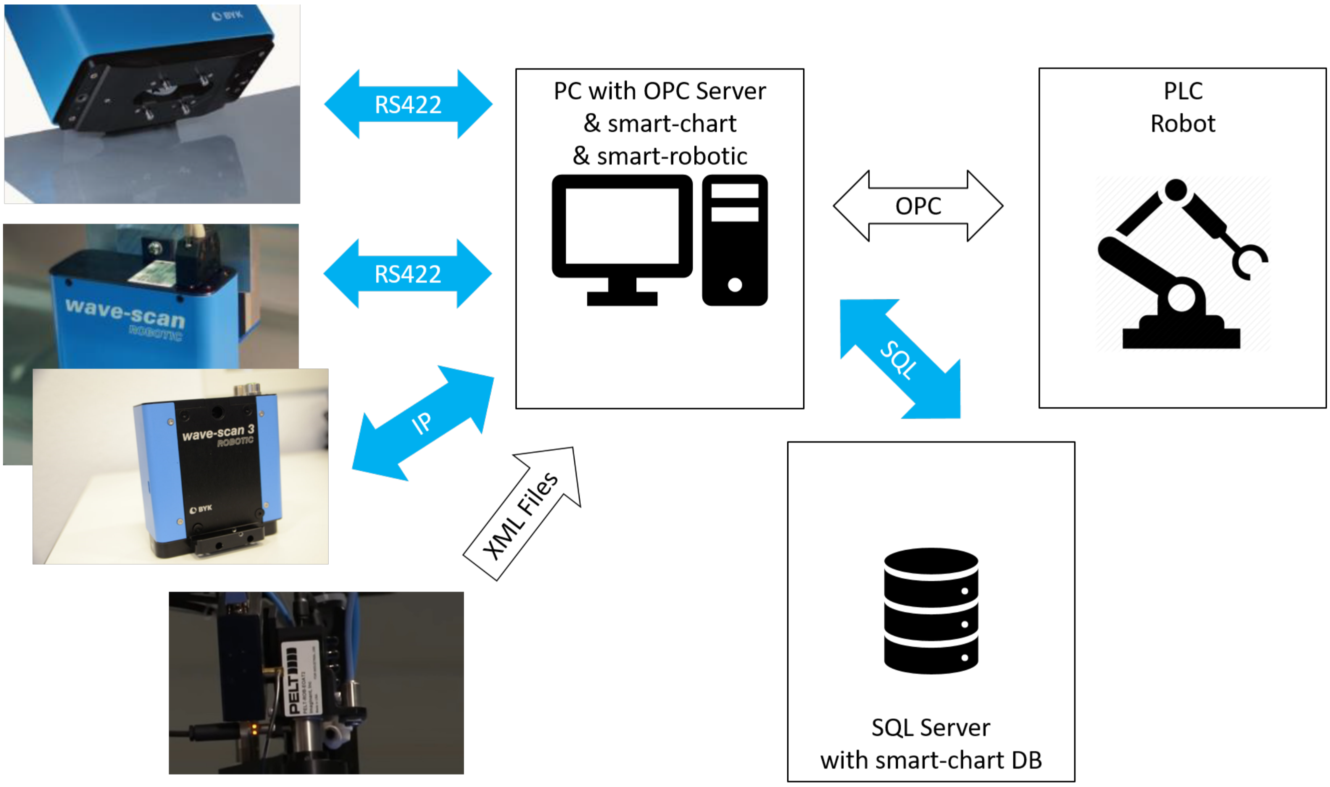


Illustration 4: Integration of smart-robotic with instruments and robot

The products connected with blue arrows are delivered by BYK-Gardner. The products connected with white arrows are delivered by third parties.

The software **smart-robotic** is designed to fulfill following tasks:

- Provide the interfaces to the measurement instruments mounted on the robot.
- Process and store measurement data in the **smart-chart** database or in CSV / XML files.
- Communicate via Open Platform Communications (OPC) with the Programmable Logic Controller (PLC).

NOTICE

The thickness measuring instruments are not controlled by **smart-robotic**. The supported instruments create XML files (in a predefined format) which can be read by **smart-robotic** and processed in **smart-chart**. Details see Thickness Measurement [▸ 107] and PELT Measurement [▸ 122].

3 System Installation

Install and configure following components:

1. OPC Server (3rd Party) [▶ 12]
2. Software smart-chart [▶ 17]
3. Robotic Instruments [▶ 21]

3.1 OPC Server (3rd Party)

The OPC server is required to communicate with the PLC robot. It is a 3rd party software and thus not in the scope of this documentation. Perform following steps:

1. Install the OPC server
2. Configure the OPC server

Step 1 depends on the OPC server and is described in the documentation for this product. Step 2 is smart-robotic specific and described below.

OPC Signals / Items

The OPC server communicates with the robot via “OPC signals” – sometimes also called “OPC items”. These signals have to be configured in **smart-robotic**. Following signals are mandatory:

1. Common Control Signals [▶ 12]
2. Control Signals for BYK-mac i ROBOTIC [▶ 13]
3. Control Signals for wave-scan ROBOTIC [▶ 13]

These signals / items must meet following requirements. For the creation of this documentation the OPC signals have been used as described in Example List of OPC Signals [▶ 14].

NOTICE

The suggested refresh rate for each signal on the server is 10 ms.

3.1.1 Common Control Signals

Following common OPC signals are required in **smart-robotic**.

Group	Symbol name	Symbol type	Direction
ALL_CTRL	IN_HEARTBEAT	Boolean	PLC to SR
ALL_CTRL	IN_ERR_ACK	Boolean	PLC to SR
ALL_CTRL	IN_JOB_START	Boolean	PLC to SR
ALL_CTRL	IN_JOB_STOP	Boolean	PLC to SR
ALL_CTRL	IN_REQU_CAL	Boolean	PLC to SR
ALL_CTRL	IN_REQU_MAST	Boolean	PLC to SR
ALL_CTRL	IN_REQU_DAILY_CHECK	Boolean	PLC to SR

Group	Symbol name	Symbol type	Direction
ALL_CTRL	OUT_HEARTBEAT	Boolean	SR to PLC
ALL_CTRL	OUT_JOB_RUN	Boolean	SR to PLC
ALL_CTRL	OUT_JOB_SUCCESS	Boolean	SR to PLC
ALL_CTRL	OUT_ERR_NO	Integer (4 byte)	SR to PLC
ALL_CTRL	OUT_ERR_STROBE	Boolean	SR to PLC

These items are to be created once in the OPC server. Details see Common Control Signals [▸ 31].

3.1.2 Control Signals for BYK-mac i ROBOTIC

In order to address the correct instrument an index is used:

- **BYK-mac i ROBOTIC** on robot 1: MAC1_CTRL
- **BYK-mac i ROBOTIC** on robot 2: MAC2_CTRL

For **BYK-mac i ROBOTIC** with index 1 following OPC signals have to be created. Details see OPC Control Signals [▸ 39].

Group	Symbol name	Symbol type	Direction
MAC1_CTRL	IN_ENABLE	Boolean	PLC to SR
MAC1_CTRL	IN_POINT_POS	Boolean	PLC to SR
MAC1_CTRL	IN_SYS_ERR_ACK	Boolean	PLC to SR
MAC1_CTRL	IN_CURVATURE	Short (2 byte)	PLC to SR
MAC1_CTRL	OUT_SYS_ERR	Boolean	SR to PLC
MAC1_CTRL	OUT_CAL_OK	Boolean	SR to PLC
MAC1_CTRL	OUT_CORR_VAL	Boolean	SR to PLC
MAC1_CTRL	OUT_POINT_READY	Boolean	SR to PLC
MAC1_CTRL	OUT_POINT_RESULT	Boolean	SR to PLC
MAC1_CTRL	OUT_CORR_Z	Short (2 byte)	SR to PLC
MAC1_CTRL	OUT_CORR_K	Short (2 byte)	SR to PLC
MAC1_CTRL	OUT_CORR_Q	Short (2 byte)	SR to PLC
MAC1_CTRL	OUT_ERROR_NR	Integer (4 byte)	SR to PLC
MAC1_CTRL	OUT_ERR_STROBE	Short (2 byte)	SR to PLC

For **BYK-mac i ROBOTIC** with index 2 the same OPC items with prefix MAC2_CTRL have to be created.

3.1.3 Control Signals for wave-scan ROBOTIC

In order to address the correct instrument an index is used:

- **wave-scan ROBOTIC** on robot 1: WAVE1_CTRL
- **wave-scan ROBOTIC** on robot 2: WAVE2_CTRL

For **wave-scan ROBOTIC** with index 1 following OPC signals have to be created. Details see OPC Control Signals [▸ 58].

Group	Symbol name	Symbol type	Direction
WAVE1_CTRL	IN_ENABLE	Boolean	PLC to SR
WAVE1_CTRL	IN_POINT_POS	Boolean	PLC to SR

Group	Symbol name	Symbol type	Direction
WAVE1_CTRL	IN_SYS_ERR_ACK	Boolean	PLC to SR
WAVE1_CTRL	OUT_SYS_ERR	Short (2 byte)	SR to PLC
WAVE1_CTRL	OUT_POINT_READY	Boolean	SR to PLC
WAVE1_CTRL	OUT_POINT_RESULT	Boolean	SR to PLC
WAVE1_CTRL	OUT_ERROR_NR	Integer (4 byte)	SR to PLC
WAVE1_CTRL	OUT_ERR_STROBE	Short (2 byte)	SR to PLC

For **wave-scan ROBOTIC** with index 2 the same OPC items with prefix WAVE2_CTRL have to be created.

3.1.4 Example List of OPC Signals

For the creation of this documentation following instruments - and corresponding OPC signals - have been created:

- BYK-mac i ROBOTIC [▸ 36] for robot #1 (USB)
- BYK-mac i ROBOTIC for robot #2 (USB)
- wave-scan ROBOTIC [▸ 55] for robot #1 (USB)
- wave-scan 3 ROBOTIC [▸ 63] for robot #2 (USB)
- wave-scan 3 ROBOTIC for robot #2 (LAN)

This results in the following list of OPC signals required. The different sections are described more detailed below the list in Description of Example List [▸ 16].

```
ALL_CTRL.IN_ERR_ACK // Section #1
ALL_CTRL.IN_HEARTBEAT
ALL_CTRL.IN_JOB_START
ALL_CTRL.IN_JOB_STOP
ALL_CTRL.IN_REQU_CAL
ALL_CTRL.IN_REQU_DAILY_CHECK
ALL_CTRL.IN_REQU_MAST
ALL_CTRL.OUT_ERR_NO
ALL_CTRL.OUT_ERR_STROBE
ALL_CTRL.OUT_HEARTBEAT
ALL_CTRL.OUT_JOB_RUN
ALL_CTRL.OUT_JOB_SUCCESS

ALL_JOB.DATA_COLOR // Section #2
ALL_JOB.DATA_COMMENT
ALL_JOB.DATA_MODEL
ALL_JOB.DATA_PAINTLINE
ALL_JOB.DATA_VID
MAC1_CTRL.IN_CURVATURE

MAC1_CTRL.IN_ENABLE // Section #3
MAC1_CTRL.IN_POINT_POS
MAC1_CTRL.IN_SYS_ERR_ACK
MAC1_CTRL.OUT_CAL_OK
MAC1_CTRL.OUT_CORR_K
MAC1_CTRL.OUT_CORR_Q
MAC1_CTRL.OUT_CORR_VAL
MAC1_CTRL.OUT_CORR_Z
MAC1_CTRL.OUT_ERR_NO
MAC1_CTRL.OUT_ERR_STROBE
MAC1_CTRL.OUT_POINT_READY
MAC1_CTRL.OUT_POINT_RESULT
```

```
MAC1_CTRL.OUT_SYS_ERR
MAC1_POINT.IN_CHECKZONE
MAC1_POINT.IN_POINTNR
MAC2_CTRL.IN_CURVATURE

MAC2_CTRL.IN_ENABLE // Section #4
MAC2_CTRL.IN_POINT_POS
MAC2_CTRL.IN_SYS_ERR_ACK
MAC2_CTRL.OUT_CAL_OK
MAC2_CTRL.OUT_CORR_K
MAC2_CTRL.OUT_CORR_Q
MAC2_CTRL.OUT_CORR_VAL
MAC2_CTRL.OUT_CORR_Z
MAC2_CTRL.OUT_ERR_NO
MAC2_CTRL.OUT_ERR_STROBE
MAC2_CTRL.OUT_POINT_READY
MAC2_CTRL.OUT_POINT_RESULT
MAC2_CTRL.OUT_SYS_ERR
MAC2_POINT.IN_CHECKZONE
MAC2_POINT.IN_POINTNR

WAVE1_CTRL.IN_ENABLE // Section #5
WAVE1_CTRL.IN_POINT_POS
WAVE1_CTRL.IN_SYS_ERR_ACK
WAVE1_CTRL.OUT_ERR_NO
WAVE1_CTRL.OUT_ERR_STROBE
WAVE1_CTRL.OUT_POINT_READY
WAVE1_CTRL.OUT_POINT_RESULT
WAVE1_CTRL.OUT_SYS_ERR
WAVE1_POINT.IN_CHECKZONE
WAVE1_POINT.IN_POINTNR

WAVE2_CTRL.IN_ENABLE // Section #6
WAVE2_CTRL.IN_POINT_POS
WAVE2_CTRL.IN_SYS_ERR_ACK
WAVE2_CTRL.OUT_ERR_NO
WAVE2_CTRL.OUT_ERR_STROBE
WAVE2_CTRL.OUT_POINT_READY
WAVE2_CTRL.OUT_POINT_RESULT
WAVE2_CTRL.OUT_SYS_ERR
WAVE2_POINT.IN_CHECKZONE
WAVE2_POINT.IN_POINTNR

WAVE3_CTRL.IN_ENABLE // Section #7
WAVE3_CTRL.IN_POINT_POS
WAVE3_CTRL.IN_SYS_ERR_ACK
WAVE3_CTRL.OUT_ERR_NO
WAVE3_CTRL.OUT_ERR_STROBE
WAVE3_CTRL.OUT_POINT_READY
WAVE3_CTRL.OUT_POINT_RESULT
WAVE3_CTRL.OUT_SYS_ERR
WAVE3_POINT.IN_CHECKZONE
WAVE3_POINT.IN_POINTNR

RESULT_CTRL.IN_ACK // Section #8
RESULT_CTRL.OUT_READY
RESULT_DATA.OUT_COLOR
RESULT_DATA.OUT_COMMENT
RESULT_DATA.OUT_DATETIME
RESULT_DATA.OUT_INSTRUMENT
RESULT_DATA.OUT_MODEL
RESULT_DATA.OUT_PAINTLINE
```

```
RESULT_DATA.OUT_STATUS
RESULT_DATA.OUT_VID
```

For the configuration of these signals in **smart-robotic** see OPC [▶ 28].

NOTICE

1 This example list is required to describe the **corresponding** items in the configuration of **smart-robotic**.

2 The signals listed above are **examples** only – you always HAVE to adapt the signals according to YOUR configuration(!).

3.1.5 Description of Example List

The example list of OPC signals shown above consists of the following sections.

No.	Prefix	Meaning	
1	ALL_CTRL	Common control items (**mandatory**); valid for all instruments, see Common Control Signals [▶ 31].	
2	ALL_JOB	Common job items (specific), valid for a specific car / body, see Common Job Signals [▶ 32].	
3	MAC1_xxx	Items for BYK-mac i ROBOTIC with index 1 (**mandatory**)	
		MAC1_CTRL	Items for instrument control
		MAC1_POINT	Items for measurement point / check zone
4	MAC2_xxx	Items for BYK-mac i ROBOTIC with index 2 (**mandatory in case of 2nd instrument**)	
		MAC2_CTRL	Items for instrument control
		MAC2_POINT	Items for measurement point / check zone
5	WAVE1_xxx	Items for wave-scan ROBOTIC with index 1 (**mandatory**)	
		WAVE1_CTRL	Items for instrument control, see OPC Control Signals [▶ 58].
		WAVE1_POINT	Items for measurement point / check zone, see OPC Point Signals [▶ 58].
6	WAVE2_xxx	Items for wave-scan ROBOTIC with index 2 (**mandatory in case of 2nd instrument**)	
		WAVE2_CTRL	Items for instrument control
		WAVE2_POINT	Items for measurement point / check zone
7	WAVE3_xxx	Items for wave-scan ROBOTIC with index 3 (**mandatory in case of 3rd instrument**)	
		WAVE3_CTRL	Items for instrument control
		WAVE3_POINT	Items for measurement point / check zone
8	RESULT	Measurement result items (specific), see Quality Alarm [▶ 99].	
		RESULT_CTRL	Items for result control
		RESULT_DATA	Items for result data

NOTICE

Do not forget to adapt the list of OPC signals according to your required configuration.

3.2 Software smart-chart

The software **smart-robotic** is installed along with **smart-chart**. It offers close interworking with **smart-chart**.

If **smart-chart** is used, measurement results can be transferred automatically to **smart-chart** - according to the organizers and standards in the DB.

The software package also includes the necessary drivers for the BYK-Gardner robotic instruments.

3.2.1 Download

The software package for **BYK-mac i ROBOTIC** and **wave-scan ROBOTIC** is the same. To download the package go to following web-site:

- www.byk-instruments.com/byk-maci or
- www.byk-instruments.com/wave-scan

Via these links you can easily open and view the software package with your preferred browser application.

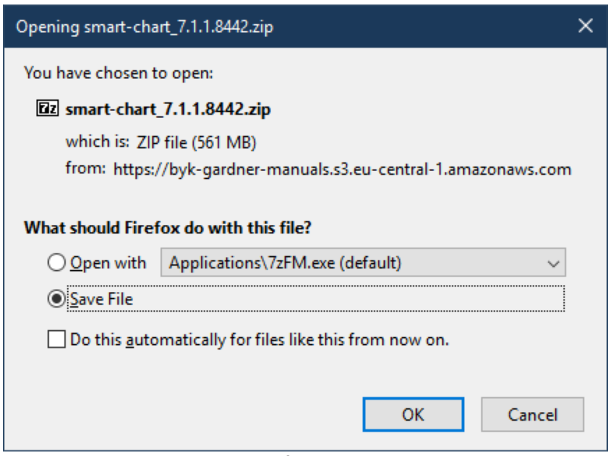


Illustration 5: Download-Software-Package

It is recommended to save the package on the hard drive of your PC before extraction or installation.

NOTICE

During beta phase an alternatively download link may be provided. In this case use the alternative link. It will take some time until the latest software package has been placed on our website.

3.2.2 Installation

NOTICE

You need administrator privilege on the PC in order to install the software package.

Perform following steps:

1. Save the ZIP file on your hard drive into a new folder.
2. Extract the complete ZIP archive.
3. In the extracted folder, right mouse click on the file “install.exe“.
4. In the context menu select **Run as administrator**.
5. Follow the setup instructions on the screen.

For **smart-chart** following information is relevant:

- Program files: “C:\Program Files (x86)\BykWare\smart-chart3”
- Configuration and DB: “C:\ProgramData\BYK\smart-chart 3.0”

To start the software open the file “App.SmartChart.exe”. After program start following sections are available:

- **General**
- **smart-process**
- **smart-lab**

For **smart-robotic** the section smart-process is relevant.

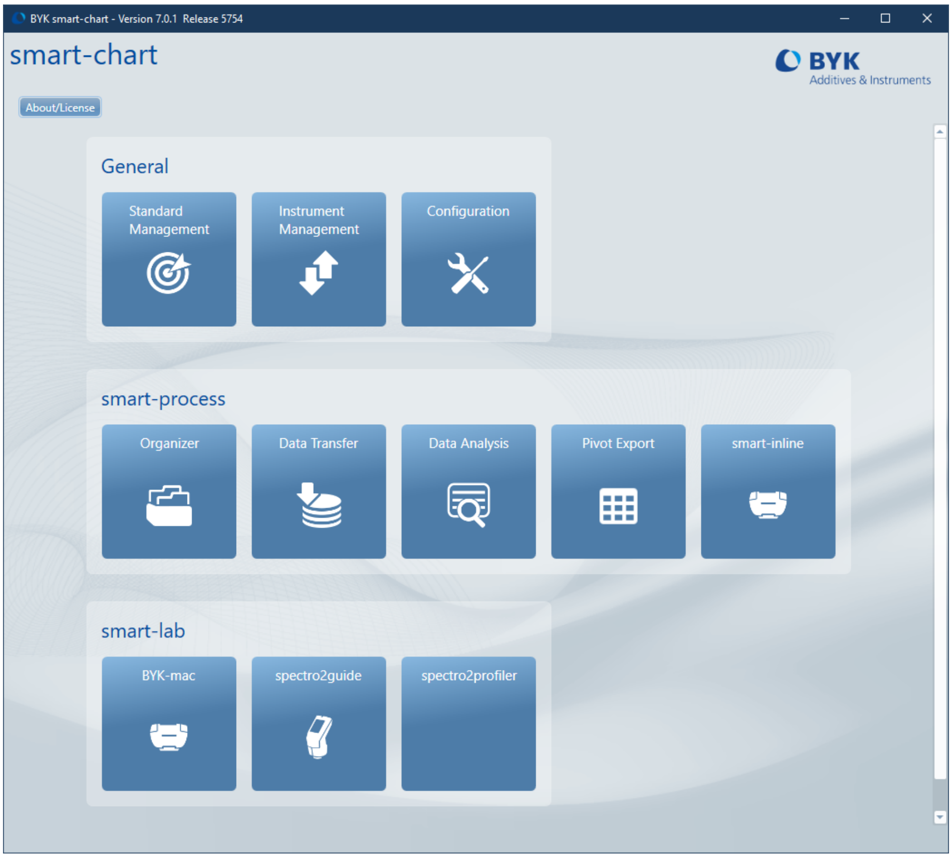


Illustration 6: Installed-Software-Package

After download and installation the software package can be used for **30 days** free trial. Thereafter, you need to register your software package. The standard delivery includes two PC licenses for the selected software package.

NOTICE

During registration you have to decide for **smart-process**. Afterwards the section **smart-lab** will not be available anymore.

In the section **General** of **smart-chart** the measurement database can be linked.

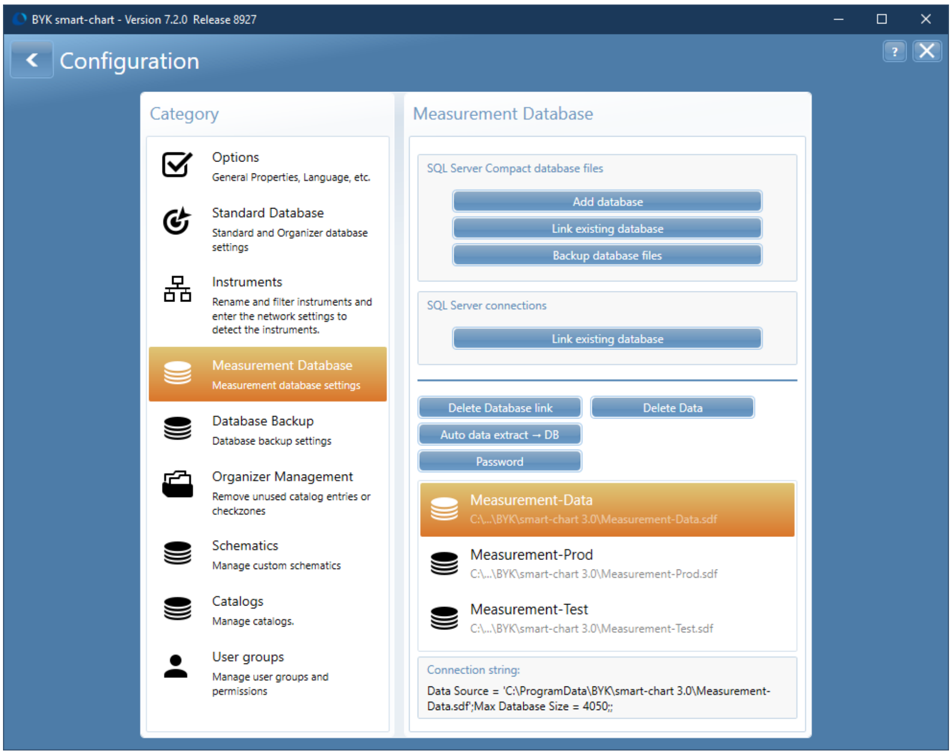


Illustration 7: Link to measurement database in smart-chart

The option shown above was chosen for the creation of this documentation.

NOTICE

For a productive **smart-robotic** system the option **SQL Server Connections > Link existing database** is recommended, see Integration [▶ 11].

3.2.3 Robotic

The software **smart-robotic** is installed along with smart-chart. For **smart-robotic** following information is relevant:

- Program files: "C:\Program Files (x86)\BykWare\smart-robotic"
- Configuration files: "C:\ProgramData\BYK\smart-robotic"

To start the software open the file "SmartRobotic.exe".

3.2.4 Runtime

Both **smart-chart** and **smart-robotic** are written in C# (C-Sharp). In order to run the program the runtime .NET core is required.

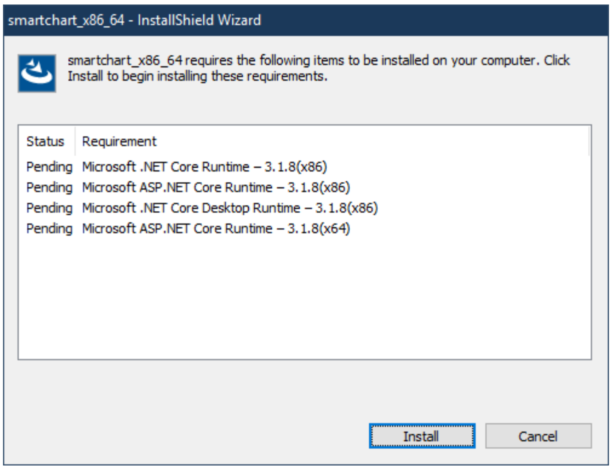


Illustration 8: Installation of smart-chart - Runtimes

If this runtime is not yet available in the system, it will be installed during the installation of **smart-chart**.

3.2.5 Upgrade

The installer for **smart-chart** will uninstall an existing installation prior to the installation of a newer software version.

In case of fallback to an older version (downgrade) deinstall the older version manually using the Windows functions.

In both scenarios the information stored in "C:\ProgramData\BYK\smart-chart" and "C:\ProgramData\BYK\smart-robotic" remains unchanged.

3.3 Robotic Instruments

The software package for **smart-chart** also includes the necessary drivers for the BYK-Gardner ROBOTIC instruments. Use these drivers to create following setups:

1. FTDI Driver [▶ 21]
2. USB Bulk Driver [▶ 22]

⚠ WARNING

To avoid instrument damage, only use the cables which are part of the delivery for connecting the instruments!

3.3.1 FTDI Driver

The instruments **BYK-mac i ROBOTIC** and **wave scan ROBOTIC** are using an RS422 interface for data communication. They are connected via a USB to serial interface adapter with a Future Technology Devices International (FTDI) driver. The driver is available in "..\smart-chart-7.2.0.8927\Tools\USBDriver".

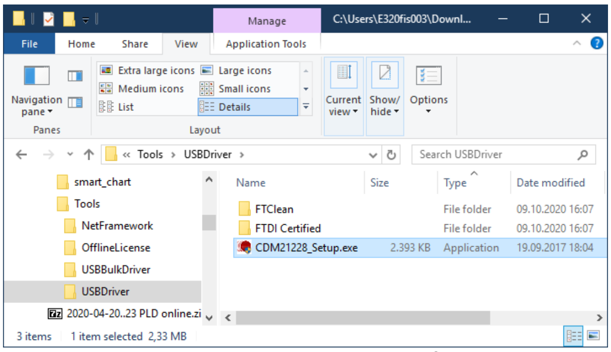


Illustration 9: FTDI driver in smart-chart software package

Perform following steps:

1. Extract the folder with the driver.
2. Run the file "CDM21228_Setup.exe".
3. Connect instrument via appropriate cable to your PC. Wiring details see instrument documentation.
4. The driver creates a new **USB Serial Port** (COMx).
5. Check the installation in the Windows device manager.

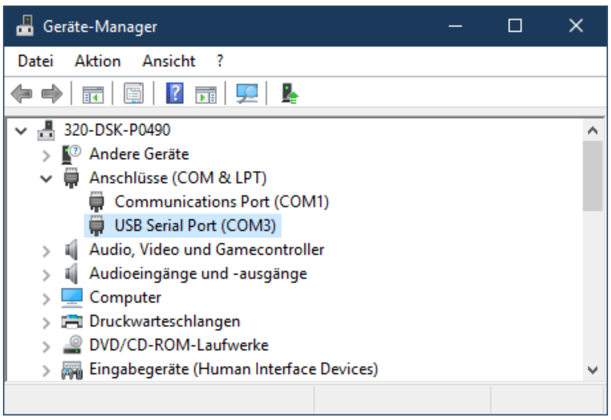


Illustration 10: COM port from FTDI driver in Windows device manager

This COM port will be used later on in **smart-robotic**.

Illustration 11: Sample test setup for wave-scan ROBOTIC

Power supply and data interface are provided to the instrument via the 9-pole RS422 plug. The data interface is provided via USB to serial adapter. This interface can also be provided through a PC interface card with physical serial ports.

3.3.2 USB Bulk Driver

The instrument **wave scan 3 ROBOTIC** is using an Ethernet interface for data communication. For system integration and test an additional USB3 port is provided. The driver is available in “..\smart-chart-7.2.0.8927\Tools\USBBulkDriver \DriverFilesWin10”.

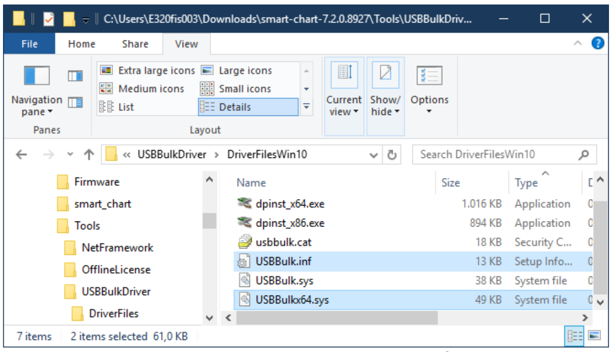


Illustration 12: USB driver in smart-chart software package

Perform following steps:

1. Extract the folder with the driver.
2. Install the device driver “USBBulkx64.inf” / “USBBulkx64.sys”.
3. Connect instrument via USB3 cable to your PC.
4. The driver will be installed in the Windows system.
5. Check the installation in the Windows device manager.

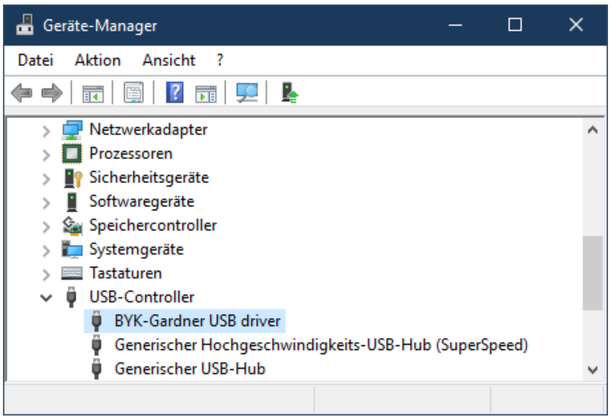


Illustration 13: USB device for wave-scan 3 ROBOTIC in Windows device manager

The new USB device will be detected later on in **smart-robotic**. A possible test setup may look like following example.

Illustration 14: Sample test setup for wave-scan 3 ROBOTIC

Power is provided to the instrument via the black 8-pole plug. The data interface for test is provided via USB. The green 4-pole plug is the Ethernet interface. It will be used in the production system. The cables are part of the instrument delivery.

4 System Basics

It is recommended to perform all steps in a test environment in a first phase and to bring the final configuration to the productive system in a second phase.

4.1 Startup

To startup the system perform following steps:

1. Start the OPC server.
2. Connect power supply to the instruments.
3. Connect the data cable to the instruments.
4. Start **smart-robotic**.

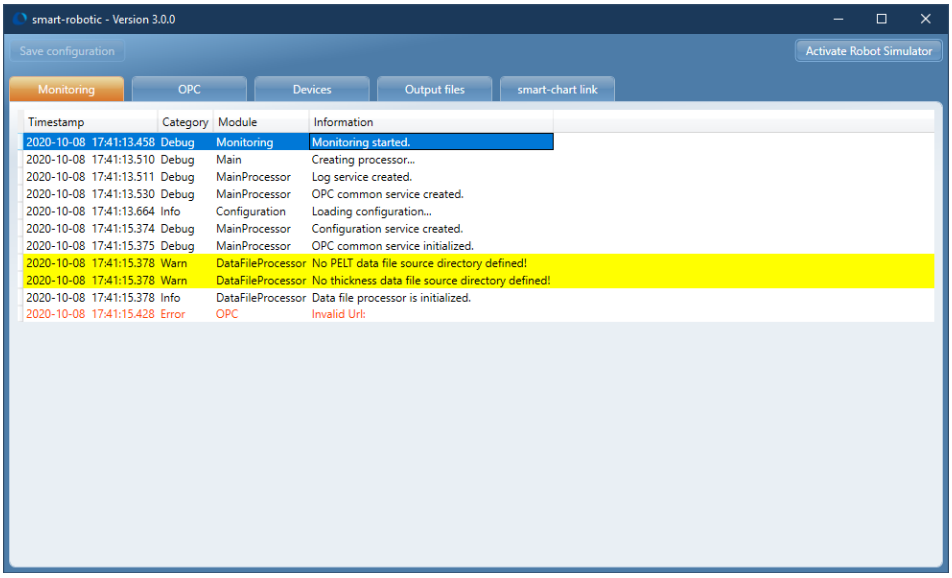


Illustration 15: Initial monitoring screen in smart-robotic

NOTICE

The complete configuration of the system - including connection testing and instrument testing - takes place in **smart-robotic**; no other software is needed.

4.2 Shutdown

The shutdown procedure is the startup procedure in reverse order. Perform following steps:

1. Close **smart-robotic** with **Alt** + **F4** or with the **X** symbol in the upper right corner.
2. Disconnect the data cables from the instruments, if required.
3. Disconnect the power supply from the instruments, if required.
4. Close the OPC server.

The configuration done in **smart-robotic** is stored in an XML file. The file is placed in the folder "C:\ProgramData\BYK\Robotic". The name of the file is "Configuration.xml_<Timestamp>.xml".

Every day a new file is created. It is read when **smart-robotic** is started and written when **smart-robotic** is closed. Backup these files in regular intervals.

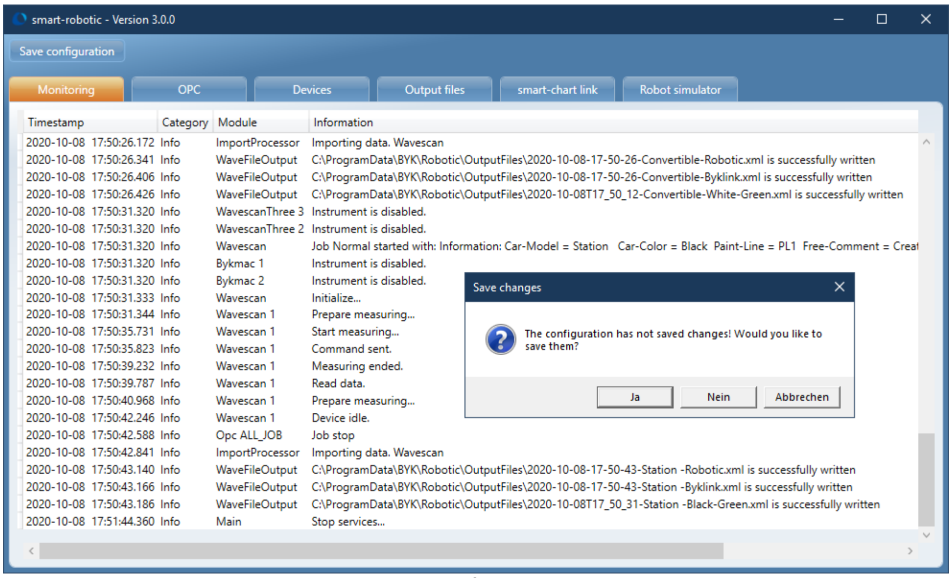


Illustration 16: Shutdown smart-robotic – confirmation message

In the upper left corner the button **Save Configuration** is available. It is recommended to click this button after important changes. This writes all configuration data immediately into the XML file – without the need of closing the application. The button is inactive if no changes took place after last save.

NOTICE

If you have unsaved changes in the configuration, a confirmation message is displayed. You can close and save, close without saving or abort the program shutdown.

4.3 Monitoring

On the **Monitoring** tab all important system messages are displayed. This tab is used to check the logging of events such as errors, warnings, debug events and info.

The log files are placed in the folder "C:\ProgramData\BYK\smart-robotic\Logs". Every day a separate file is written. Backup these files in regular intervals.

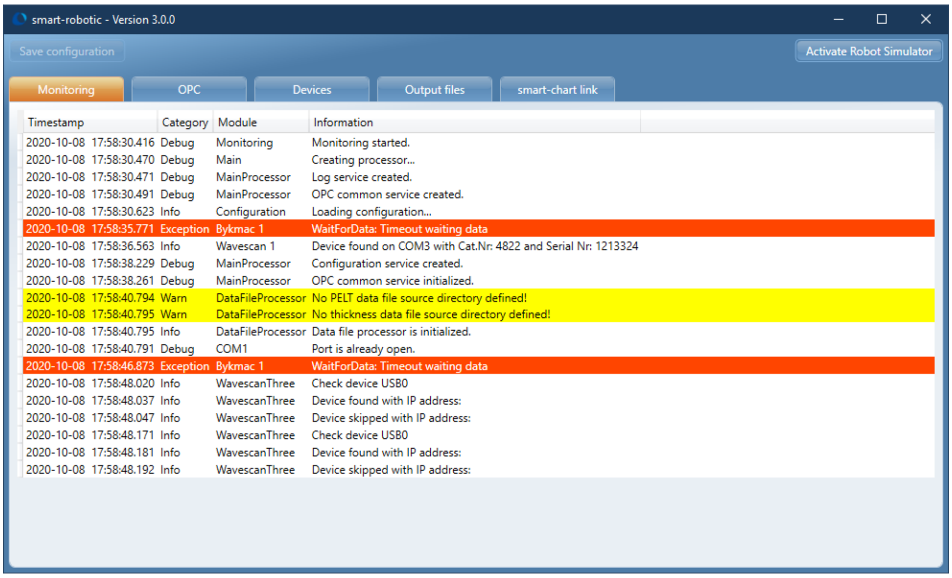


Illustration 17: Monitoring screen in smart-robotic

Following colors are used:

- White: Debug / Information
- Red: Error / Exception
- Yellow: Warning

The entries can be sorted by clicking into the corresponding tab. A 2nd click inverts the sorting.

NOTICE

For more details on the error messages see Error Handling [▶ 46].

4.4 Operation

When all configuration and testing has finished in the test system the final configuration can be delivered to the productive system. Perform following steps:

1. Setup the productive system.
2. Copy the XML configuration file for **smart-robotic**.
3. Place it in the program folder for the productive system.
4. Start **smart-robotic** it in the productive system.
5. Make all necessary adaptations and save.
6. Restart **smart-robotic**.

The application is now listening to OPC signals coming from the OPC server. When the signals arrive, the measurements are started according to the operation modes described in Run Procedure [▸ 146].

5 OPC

On the tab **OPC** the connection to the OPC server and the communication between OPC server and **smart-robotic** is configured.

This communication is based on "OPC signals". In general an OPC signal is defined by its type and by its content / data. Different types of signals are supported.

Following information is provided:

1. OPC Signal Basics [▶ 28]
2. OPC Server Settings [▶ 29]
3. Common Control Signals [▶ 31]
4. Common Job Signals [▶ 32]

5.1 OPC Signal Basics

The communication between **smart-robotic** and OPC server is based on OPC signals. The OPC signals carry data e.g. to initialize the measurement instruments and hand over information about the measurement object from the PLC to **smart-robotic**.

Signal Types

In **smart-robotic** different types of OPC signals are used for communication:

- Control Signals
- Job Data
- Point Data

Control Signals

Control data is needed for the operation of the measuring head. They represent a so called handshake to the PLC. Here information is handed over such as start measurement, measurement finished or errors. Control data is handed over for a complete measuring instrument group and separately for each **BYK-mac i ROBOTIC** or **wave-scan ROBOTIC**.

Example: `IN_JOB_START` = Start a new measurement series on a car body.

Job Data

General data for a job. A job is e.g. a vehicle or a component and can consist of many measuring points. These data are valid for all measuring instruments used in a group.

Example: `TYPE` = Denotes the model of the measured car body, e.g. "SUV".

Point Data

General data for a measuring point, for example measuring point coordinates or point numbers. These data are handed over separately for each measuring instrument.

Example: `PART` = Denotes the measured part on the car body, e.g. "Roof".

OPC Naming Conventions

All signals must have one of the following group names be placed in front - according to their function:

- ALL_CTRL: Contains general control data, job start, error handshake etc. for a group.
- ALL_JOB: Contains all job data for a group.
- MAC1_CTRL: Addresses a **BYK-mac i ROBOTIC** with index 1.
- MAC1_POINT: Contains check point data for a **BYK-mac i ROBOTIC** with index 1.
- WAVE1_CTRL: Addresses a **wave-scan ROBOTIC** with index 1.
- WAVE1_POINT: Contains check point data for a **wave-scan ROBOTIC** with index 1.

For all signals a prefix must be defined and preset in the OPC server configuration as well as in the OPC settings of **smart-robotic**, see also OPC Signals.

5.2 OPC Server Settings

Click on the tab **OPC Server Settings**.

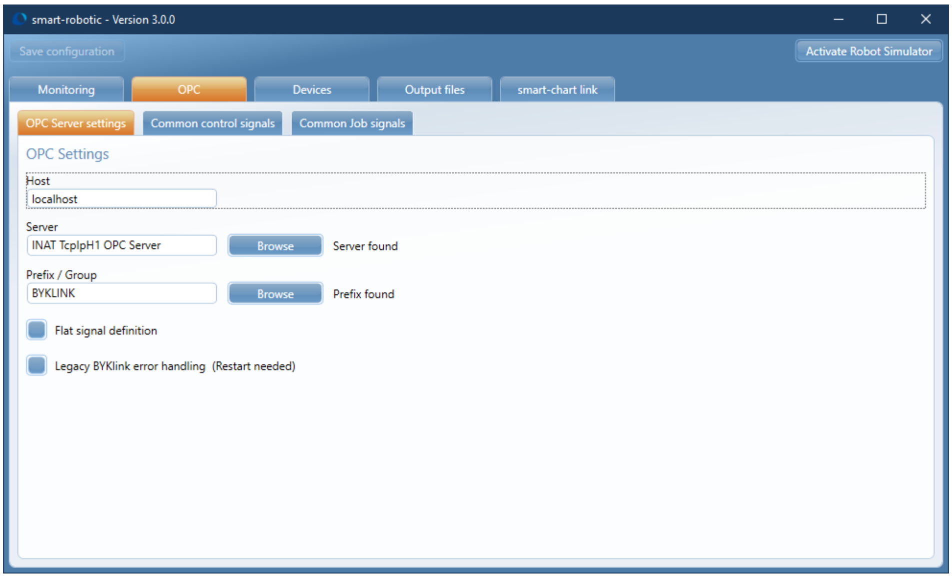


Illustration 18: OPC server settings

Perform following steps:

1. **Host**: Enter hostname or IP address of the machine where the OPC server is installed. In the example shown above the OPC server is installed on the same machine as **smart-robotic**.

2. **Server**: Enter the name / ID of the OPC server. This ID is manufacturer dependent and must be taken from the documentation of the OPC server. Alternatively click the **Browse** button to select the OPC server. All servers available on the target machine are displayed. In the sample shown below one server was found - supporting the protocols Data Access V1 and V2.

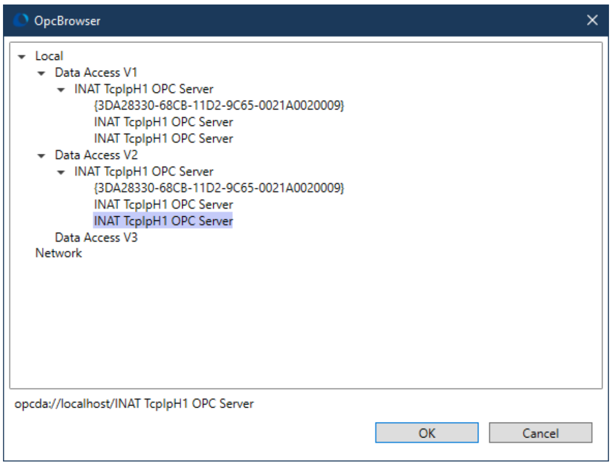


Illustration 19: OPC server list on target machine

3. **Prefix** / **Group**: Enter a unique name under which all **smart-robotic** signals are summarized in the OPC signal definition, see Example List of OPC Signals [▸ 14]. This comprises control signals, job signals and a group item for each individual instrument. This unique group item ensures that the correct instrument is addressed always (and this one only).

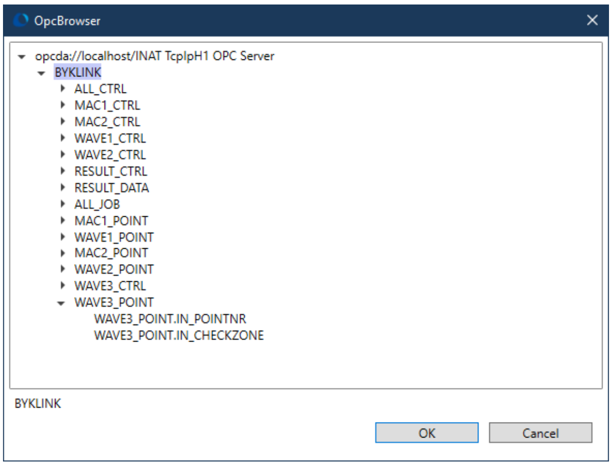


Illustration 20: OPC items with hierarchical structure / grouping

4. **Flat Signal Definition**: Activate this option if the **Prefix** / *Group* does not have a hierarchy (not recommended). In the OPC signal definition hierarchies / subgroups are formed by e.g. points as with `MAC1_CTRL.IN_ENABLE`. If the OPC server does not offer any hierarchies the checkbox must be activated, then `MAC1_CTRL_IN_ENABLE` is a single signal and not a signal of the group `MAC1_CTRL`.

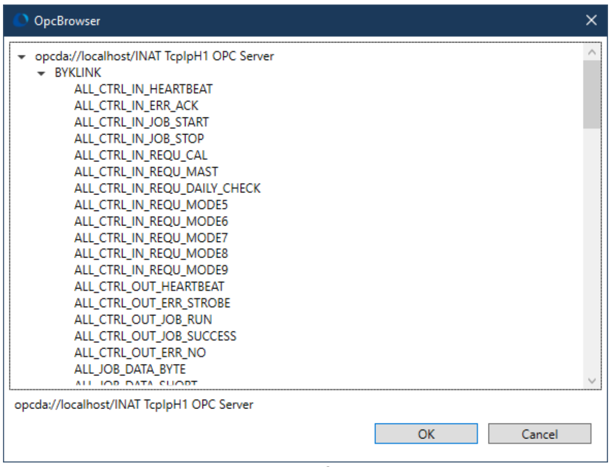


Illustration 21: OPC items with flat structure / no grouping

5. **Legacy BYKlink Error Handling**: Check this option to activate the global error handling. Uncheck this option to activate instrument-specific error handling. For more details see Error Handling [▶ 158] in the appendix.

NOTICE

1 In earlier versions of **smart-robotic** the "OPC signals" were referenced as "OPC items".

2 The list of signals must match on OPC server and in **smart-robotic**.

3 "BYKlink" was the predecessor of the software **smart-robotic**.

5.3 Common Control Signals

The **Common OPC Control Signals** (`ALL_CTRL`) define high level commands which can be executed by the PLC.

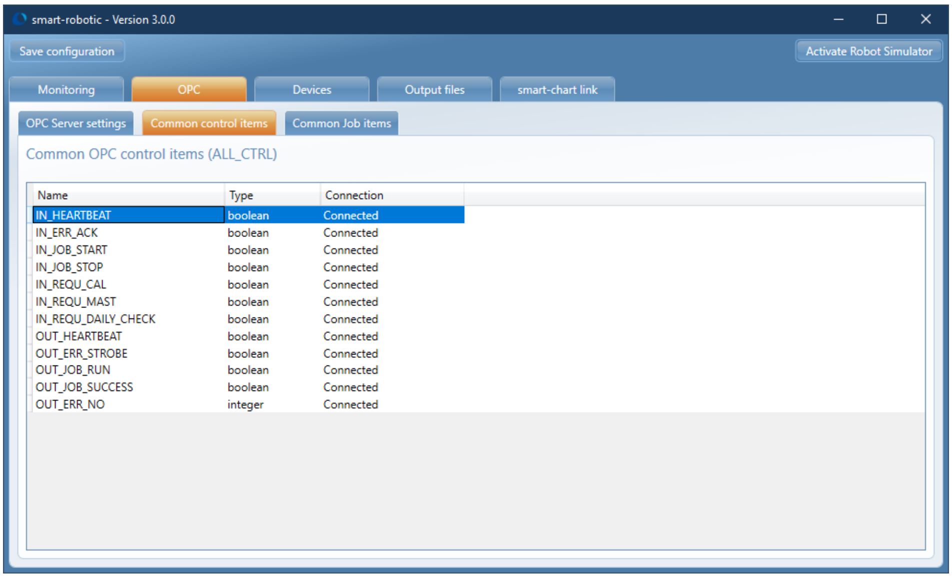


Illustration 22: Common OPC control signal in status Connected

Perform following steps:

1. Click the tab **Common OPC Control Signals**.
2. Check if the connection status is **Connected**.

3. If status is **Not found**, check / edit the signals in the OPC server and restart **smart-robotic**.

The common OPC control signals are well known in **smart-robotic**. Thus they have a fix implementation here – there is no need to manage these items (add / modify / delete).

5.4 Common Job Signals

By using these types of parameters the data can be accordingly filtered and analyzed. This is not mandatory and may be skipped (not recommended).

The **Common Job Signals** (`ALL_JOB`) define the necessary information to store the measurement results for the corresponding object in the **smart-chart** database:

- Model
- Color
- Paintline
- Comment
- Vehicle ID

Perform following steps:

1. Click the tab **Common Job Signals**.
2. Add a new entry by clicking on the button **Add**.
3. Modify an existing entry by clicking on the button **Edit**.
4. Delete an existing entry (without confirmation) by clicking on the button **Remove**.
5. Check if the connection status for all signals is **Connected**.
6. If status is **Not found**, check / edit the signals in the OPC server and restart **smart-robotic**.

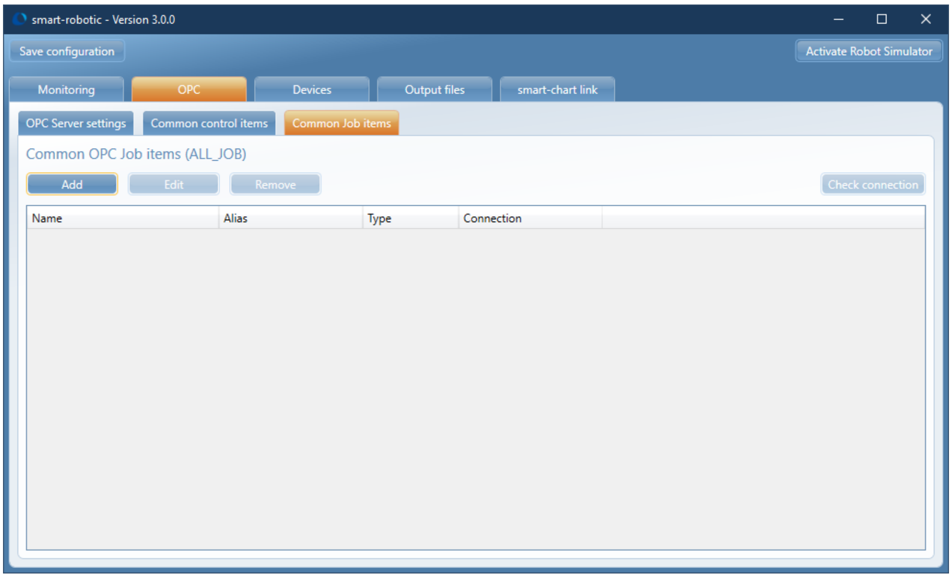


Illustration 23: Common job signals – initial state

When adding or editing a signal, a dialogue box opens.

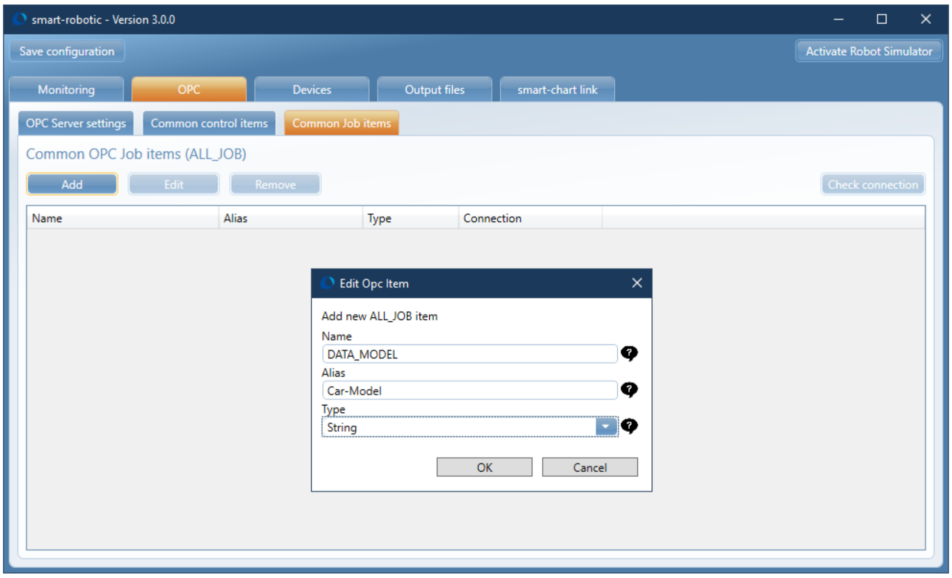


Illustration 24: Common job signals – adding a new entry

A job item has following parameters:

1. **Name**: Corresponds to the OPC item on that occasion, it must be defined precisely as in the OPC server configuration, e.g. `DATA_MODEL`.
2. **Alias**: A free value. Under this name the parameter can be used for outputting the measurement result files and for naming the files.
3. **Type**: Defines the parameter type used.
   - Boolean
   - Double
   - Float
   - Integer
   - String

NOTICE

For **Name** and **Alias** the value can be entered manually or via copy / paste function.

The results can look like the following.

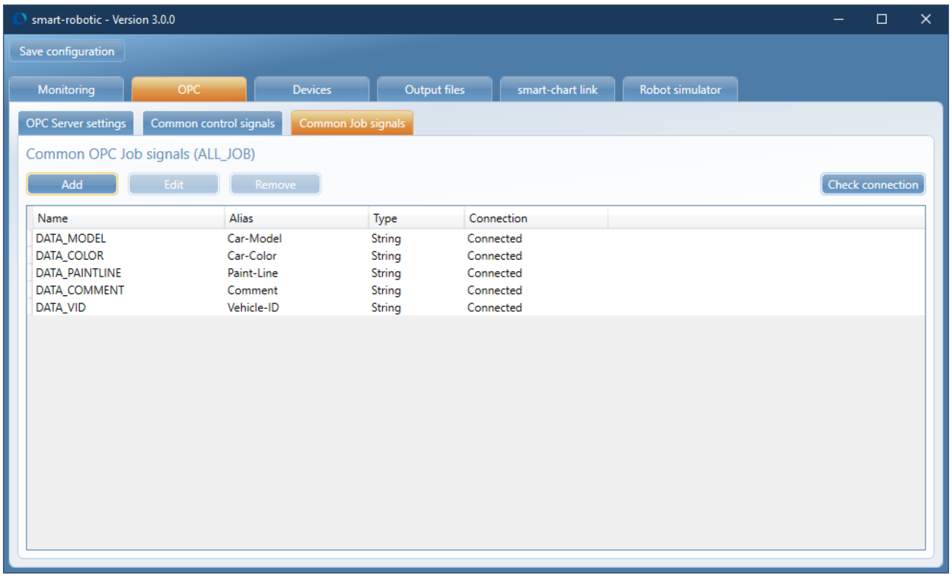


Illustration 25: Common job signals – all entries created and connected

With this step the OPC configuration in smart-robotic is finished.

6 Devices

On the tab **Devices** the measurement instruments can be configured and tested. There are two groups of instruments:

1. Color measurement: **BYK-mac** instruments
2. Appearance measurement: wave-scan instruments

Each group provides two buttons:

1. **Add**: Create an entry for each measurement instrument attached in the robotic system or test environment. When adding a wave-scan, select the type – wave-scan 2 or wave-scan 3.
2. **Remove**: Remove the selected entry from the instrument group.

Up to 9 **BYK-mac i ROBOTIC** and 9 **wave-scan ROBOTIC** can be operated within each device group (with index 1 … 9).

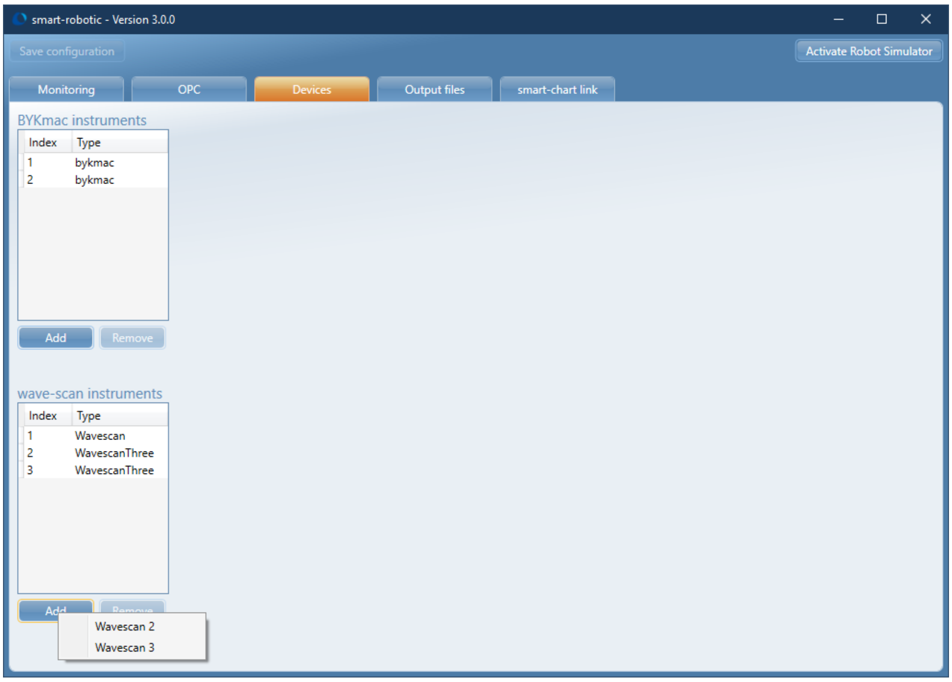


Illustration 26: Device-Management-Main

The number is the index for the measuring head. This index is used to identify the instrument in all signals and error messages – for example:

- `MAC1_CTRL` = OPC control items for the 1st **BYK-mac i ROBOTIC**
- `MAC2_CTRL` = OPC control items for the 2nd **BYK-mac i ROBOTIC**

Following BYK-Gardner robotic instrument types can be created:

- 7036 - BYK-mac i ROBOTIC [▶ 36]
- 4822 - wave-scan ROBOTIC [▶ 55]
- 7410 - wave-scan 3 ROBOTIC [▶ 63]

The sequence of configuration steps required is nearly the same, but the configuration details are different for each type.

6.1 7036 - BYK-mac i ROBOTIC

The BYK-mac i ROBOTIC (catalog number 7036) is the BYK-Gardner colorimeter for effect colors.

Illustration 27: BYK-mac-i ROBOTIC

For product details see: https://www.byk-instruments.com/p/7036.

The product operation is described in:

- Operating Instructions: 300 000 877 - 1309

The configuration comprises following steps:

1. Connection Settings [▶ 37]
2. Device Configuration [▶ 38]
3. OPC Control Signals [▶ 39]
4. OPC Point Signals [▶ 40]
5. Device Calibration [▶ 42]
6. Error Handling [▶ 46]
7. Device Test [▶ 47]

These steps are described below.

NOTICE

If necessary, restart smart-robotic in order to take changes made to the configuration into effect.

6.1.1 Connection Settings

The BYK-mac i ROBOTIC communicates via RS422 with smart-robotic, see FTDI Driver [▶ 21]. It requires a COM port.

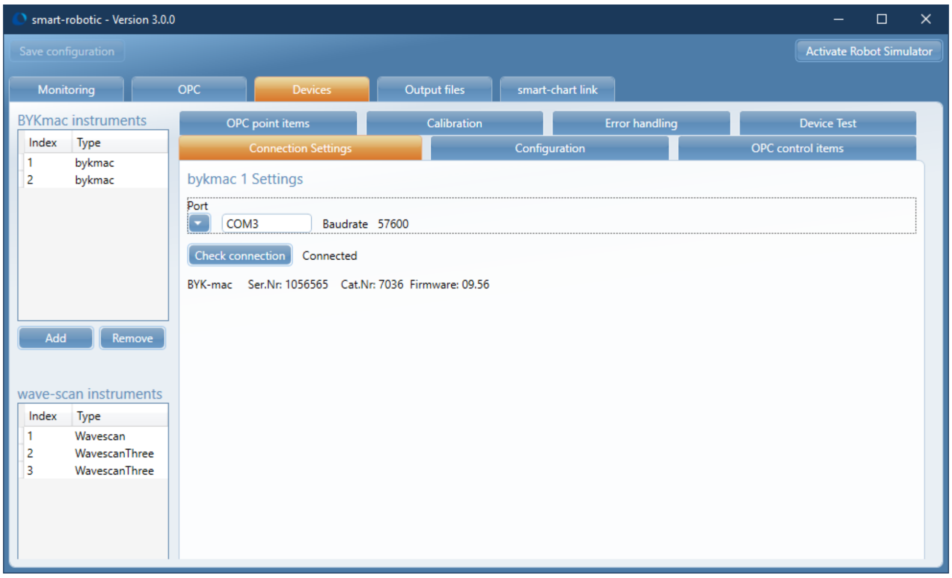


Illustration 28: BYK-mac i ROBOTIC – Connection details

Perform following steps:

1. Choose the correct COM port to establish a connection to the device.
2. Use the button Check connection to verify the connection.

You can select only free COM ports here. If you try a COM port which is already in use, you get a system message.

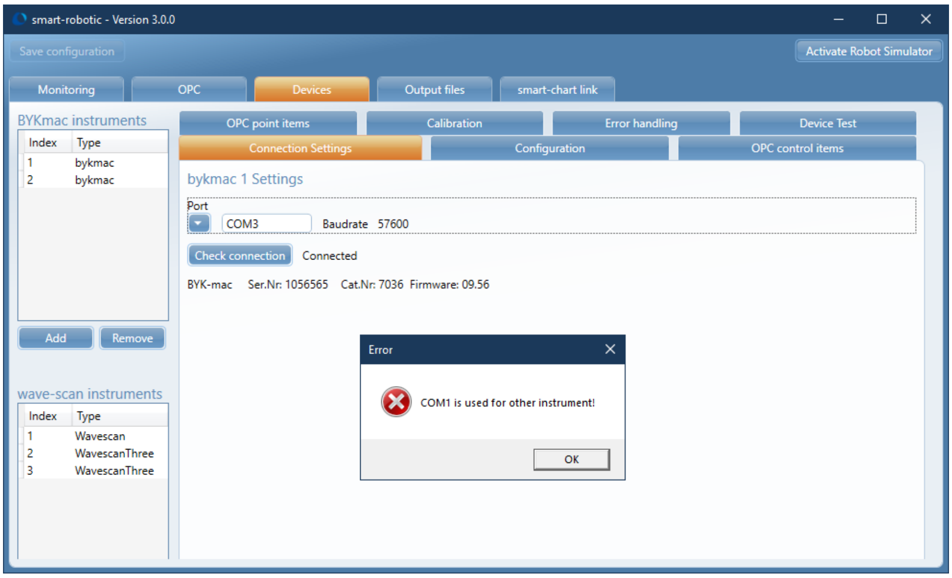


Illustration 29: BYK-mac i ROBOTIC – COM port selection

In this case you have following options:

- Choose another COM port.
- Unassign the COM port from the other device.

You can unassign a COM port by selecting a different COM port or by deleting the device.

6.1.2 Device Configuration

This Configuration tab manages the measurement data captured by the respective instrument.

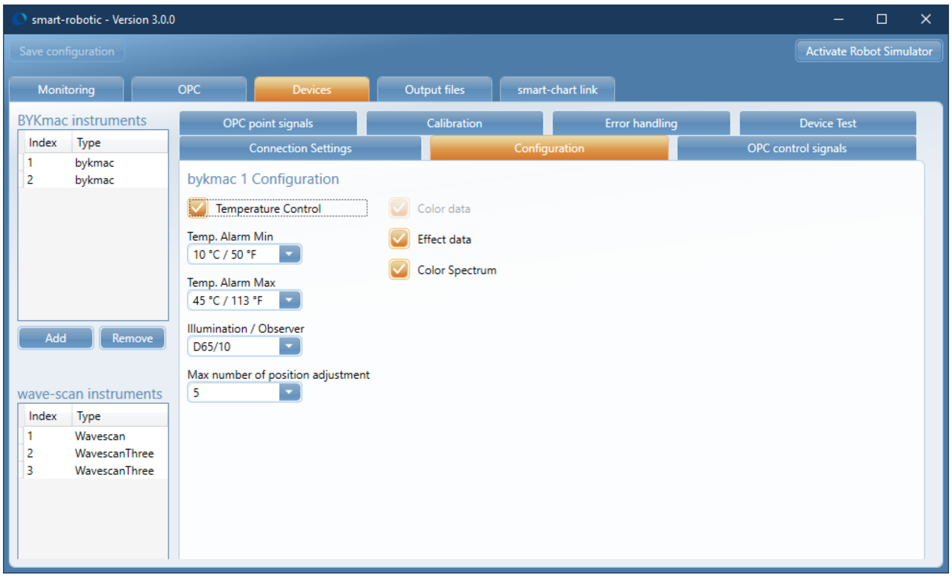


Illustration 30: BYK-mac i ROBOTIC – Configuration details

You have following options:

- Temperature control: Sends an alarm if the measurement surface temperature is out of the given limits.
  - Temperature Alarm Minimum: Send alarm, if temperature is below this value.
  - Temperature Alarm Maximum: Send alarm, if temperature is above this value.
- Illumination/Observer: Defines the measurement conditions. Default is D65 (Daylight) and 10° for the observer.
- Maximum number of position adjustments: Sets a limit to the number of position corrections the BYK-mac i ROBOTIC can reach before skipping a check zone. Range is 5..15. Recommended is a maximum of 10.
- Color Data / Effect Data / Color Spectrum: If activated, the BYK-mac i ROBOTIC performs all these measurements sequentially.

NOTICE

These configurations options are known from smart-chart. For the hand-held instruments, these configurations are covered by the smart-chart items Standard and Organizer Management.

6.1.3 OPC Control Signals

Control data are compellingly necessary for the operation of the measuring head, the symbolic names are fix defined in smart-robotic.

The control data are to be found in the OPC group of MACx_CTRL, the x stands for the index of the current BYK-mac i ROBOTIC.

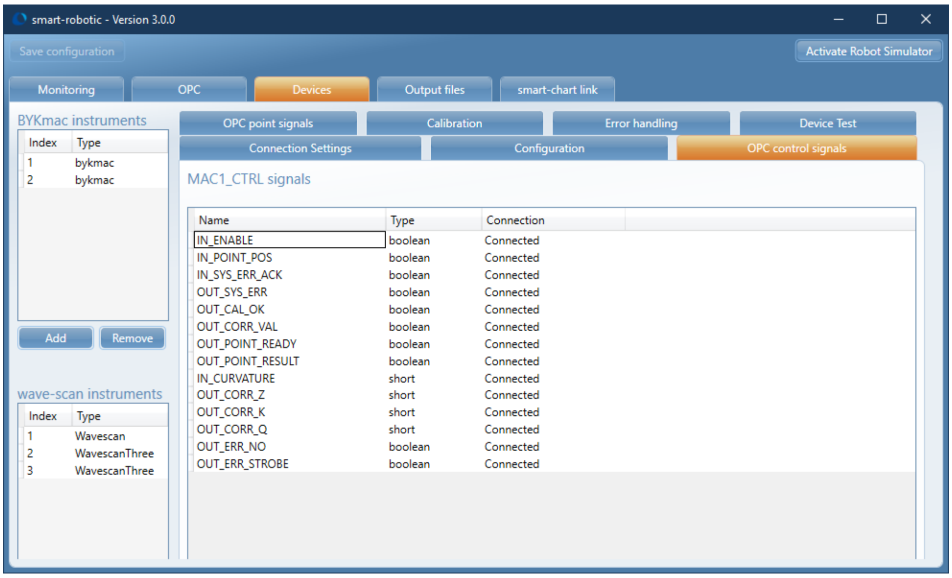


Illustration 31: BYK-mac i ROBOTIC – OPC control signals

Perform following steps:

1. Click the OPC control signals tab.
2. Check if the connection status is Connected, see also Control Signals for BYK-mac i ROBOTIC [▶ 13].
3. If status is Not found, check / edit the signals in the OPC server and restart smart-robotic.

The OPC control signals have following meaning.

Symbol / Signal	Description
IN_ENABLE	The BYK-mac i ROBOTIC is chosen.
IN_POINT_POS	The measuring point hit.
IN_CURVATURE	Surface curvature at the measuring point.
IN_SYS_ERR_ACK	System error acknowledged.
OUT_SYS_ERR	System error, measurement series aborted.
OUT_CAL_OK	At present not used, must be existing, however.
OUT_CORR_VAL	Correction values valid.
OUT_POINT_READY	Point finished, off to the next one.
OUT_POINT_RESULT	Measurement at the point was successful
OUT_CORR_Z	Correction value distance (1/1000mm).
OUT_CORR_K	Correction value tilt angle K (1/1000°).
OUT_CORR_Q	Correction value tilt angle Q (1/1000°).
OUT_ERROR_NO	The number / ID of a system error.
OUT_ERROR_STROBE	The details for the system error.

These OPC control signals are predefined by smart-robotic.

6.1.4 OPC Point Signals

Point data give information to a measuring point. If they are defined, this information is stored internally with the results of measurement of this point and are available by the symbolic names for outpassing with the measuring data. The list of symbols can be defined at will.

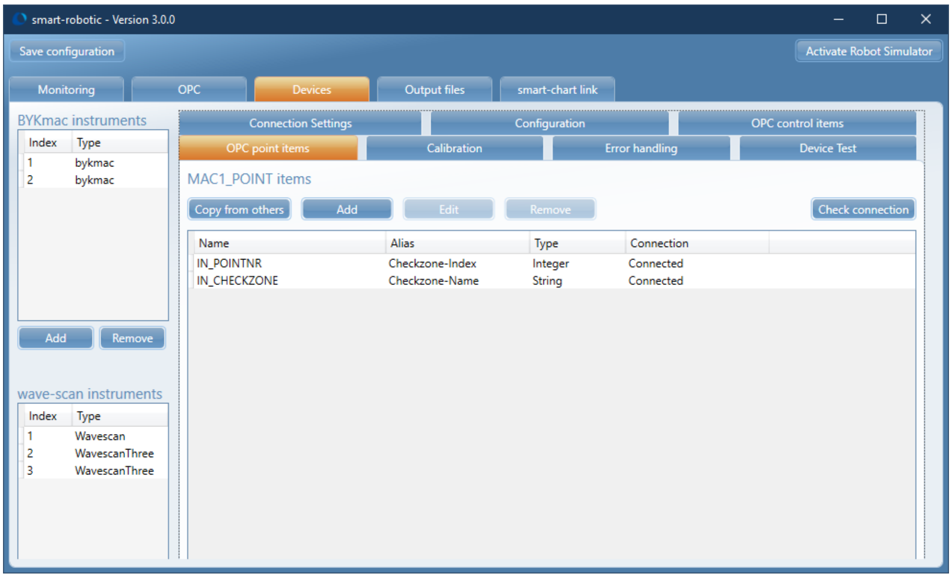


Illustration 32: BYK-mac i ROBOTIC – Add OPC point items

In the OPC server configuration these signals must be compellingly contained then. The point data are to be found in the OPC group of MACx_POINT. The x stands for the current number of the BYK-mac i ROBOTIC in the plant.

Perform following steps:

1. Click the OPC control items tab.
2. Check if the connection status is Connected, see also Example List of OPC Signals [▶ 14].
3. If status is Not found, check / edit the items in the OPC server and restart smart-robotic.

In the example shown above following OPC signals have been created:

- MAC1_POINT.IN_POINTNR: The PLC / robot programmer can send (increasing) **number** > smart-robotic can map it to the correct check zone in smart-chart.
- MAC1_POINT.IN_CHECKZONE: The PLC / robot programmer can also send the correct check zone **name** > in this case no additional mapping is necessary.

An example list of defined signals may look like the following.

OPC item	Alias	Type	Description
PART	Part	String	Part number
POINT	Point	String	Measuring point number
ROBOTX	robot_x	Integer	X-coordinate of measuring point
ROBOTY	robot_y	Integer	Y-coordinate of measuring point

It is also possible to copy existing OPC point items from another device (if already created in that device). Click the Copy from others button.

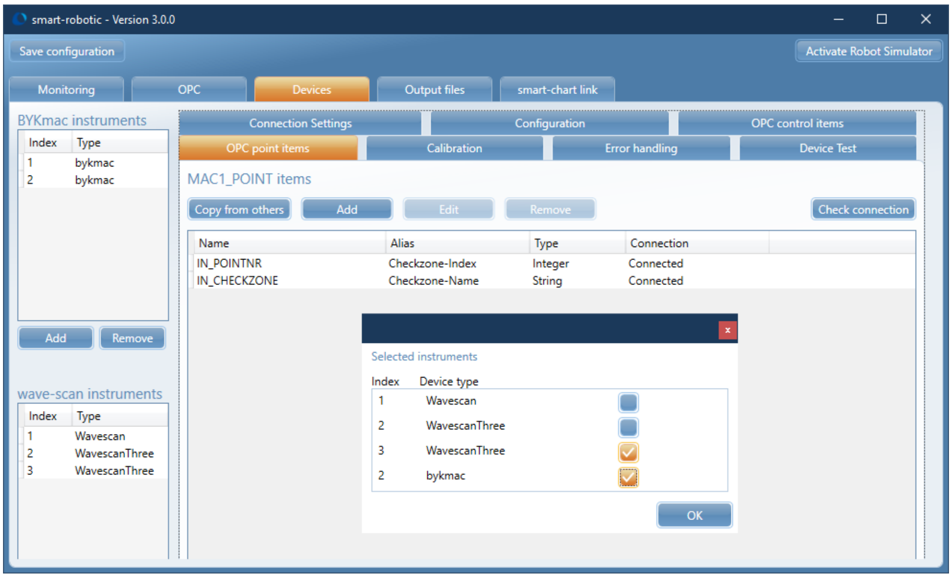


Illustration 33: BYK-mac i ROBOTIC – Copy OPC point signals

The dialog box Selected instruments opens. It lists all devices created in the system. The copy from function works as a pure adding – if the selected instrument has no items created, no item will be added (and no item will be deleted).

6.1.5 Device Calibration

On this screen the calibration and check details can be configured.

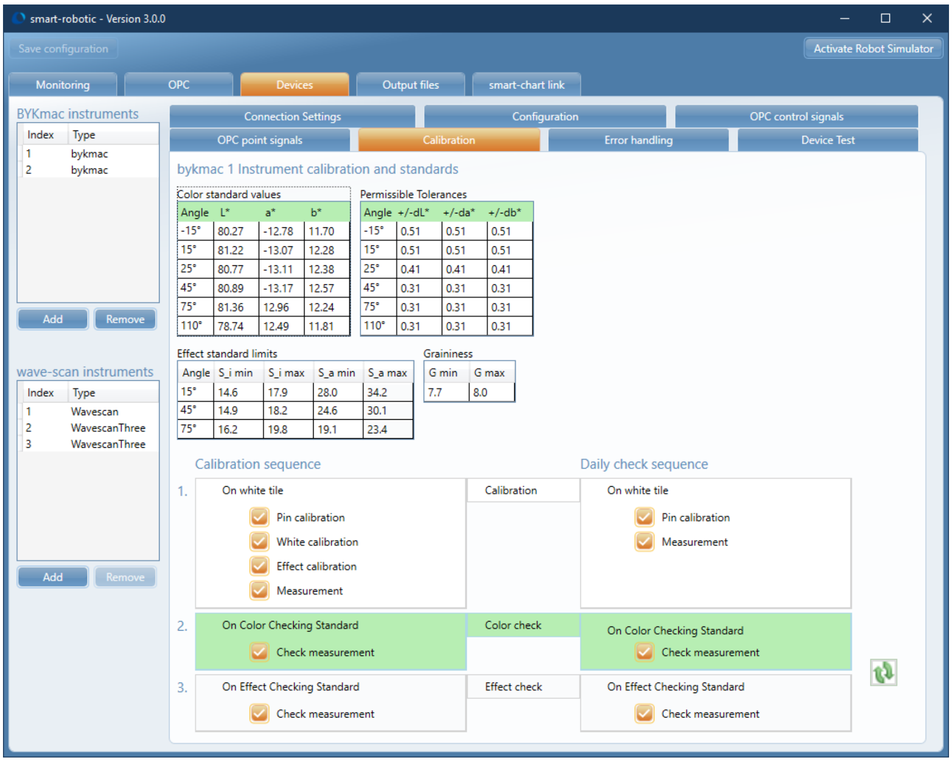


Illustration 34: BYK-mac i ROBOTIC – Calibration

The check and calibration details comprises following items:

1. Data in Certificate [▶ 42]
2. Calibration Sequence [▶ 44]
3. Daily Check Sequence [▶ 45]

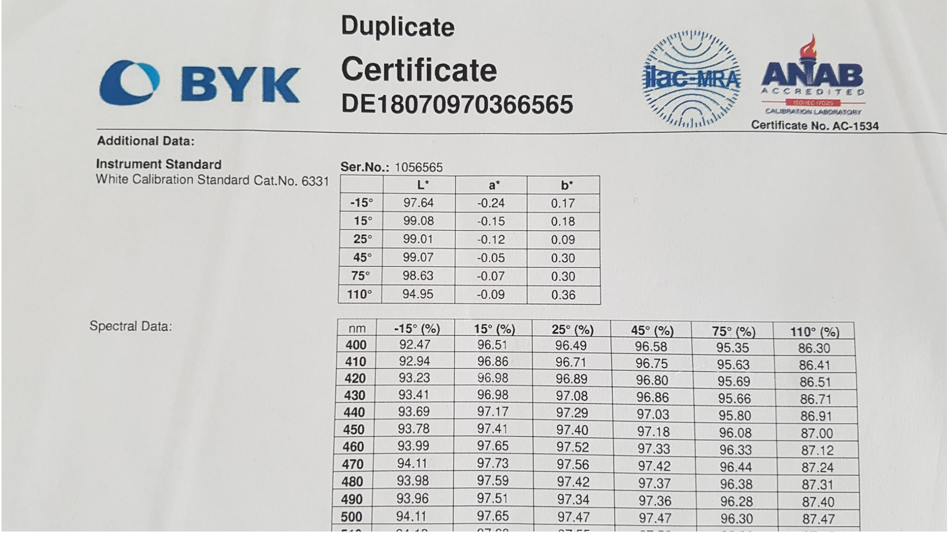
Make sure that the configured sequence is also programmed in the robot sequence.

6.1.5.1 Data in Certificate

The BYK-mac i ROBOTIC comes with three different standard tiles:

1. White: Calibration tile
2. Green: Color check tile
3. Silver: Effect check tile

These tiles and their measurement values are instrument specific and can vary from instrument to instrument. Therefore, the values and tolerances of color check tile and effect tile must be filled in. The color and effect standard values and tolerances are documented in the certification letter which is delivered with the instrument. The serial number of the device is important here.



Duplicate
Certificate
DE18070970366565

Certificate No. AC-1534

Additional Data:

Instrument Standard
White Calibration Standard Cat.No. 6331

Ser.No.: 1056565

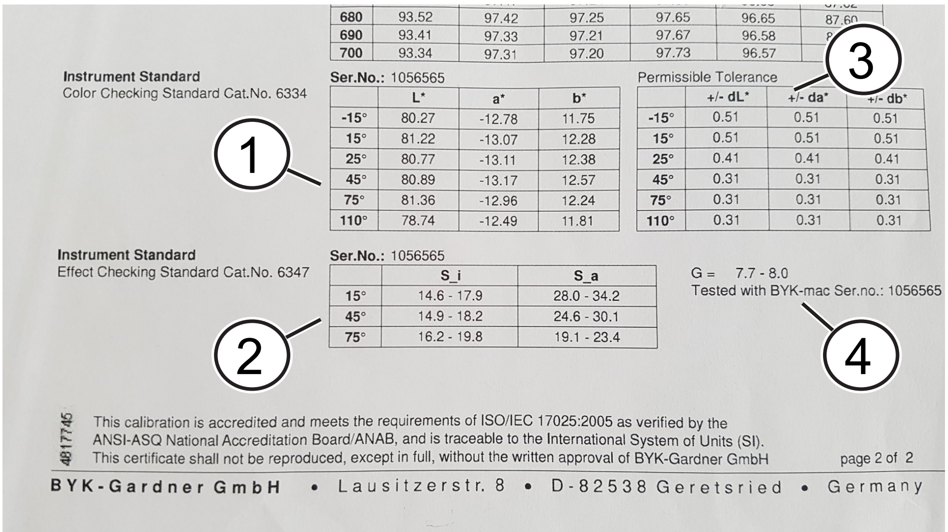
	L*	a*	b*
-15°	97.64	-0.24	0.17
15°	99.08	-0.15	0.18
25°	99.01	-0.12	0.09
45°	99.07	-0.05	0.30
75°	98.63	-0.07	0.30
110°	94.95	-0.09	0.36

Spectral Data:

nm	-15° (%)	15° (%)	25° (%)	45° (%)	75° (%)	110° (%)
400	92.47	96.51	96.49	96.58	95.35	86.30
410	92.94	96.86	96.71	96.75	95.63	86.41
420	93.23	96.98	96.89	96.80	95.69	86.51
430	93.41	96.98	97.08	96.86	95.66	86.71
440	93.69	97.17	97.29	97.03	95.80	86.91
450	93.78	97.41	97.40	97.18	96.08	87.00
460	93.99	97.65	97.52	97.33	96.33	87.12
470	94.11	97.73	97.56	97.42	96.44	87.24
480	93.98	97.59	97.42	97.37	96.38	87.31
490	93.96	97.51	97.34	97.36	96.28	87.40
500	94.11	97.65	97.47	97.47	96.30	87.47

Illustration 35: BYK-mac i ROBOTIC – Certificate / header

The standard values to be entered in smart-robotic can be found in the lower part of the certificate.



nm	-15° (%)	15° (%)	25° (%)	45° (%)	75° (%)	110° (%)
680	93.52	97.42	97.25	97.65	96.65	87.60
690	93.41	97.33	97.21	97.67	96.58	[illegible]
700	93.34	97.31	97.20	97.73	96.57	[illegible]

Instrument Standard
Color Checking Standard Cat.No. 6334

Ser.No.: 1056565

	L*	a*	b*
-15°	80.27	-12.78	11.75
15°	81.22	-13.07	12.28
25°	80.77	-13.11	12.38
45°	80.89	-13.17	12.57
75°	81.36	-12.96	12.24
110°	78.74	-12.49	11.81

Permissible Tolerance

	+/- dL*	+/- da*	+/- db*
-15°	0.51	0.51	0.51
15°	0.51	0.51	0.51
25°	0.41	0.41	0.41
45°	0.31	0.31	0.31
75°	0.31	0.31	0.31
110°	0.31	0.31	0.31

Instrument Standard
Effect Checking Standard Cat.No. 6347

Ser.No.: 1056565

	S_i	S_a
15°	14.6 - 17.9	28.0 - 34.2
45°	14.9 - 18.2	24.6 - 30.1
75°	16.2 - 19.8	19.1 - 23.4

G = 7.7 - 8.0
Tested with BYK-mac Ser.no.: 1056565

This calibration is accredited and meets the requirements of ISO/IEC 17025:2005 as verified by the ANSI-ASQ National Accreditation Board/ANAB, and is traceable to the International System of Units (SI).
This certificate shall not be reproduced, except in full, without the written approval of BYK-Gardner GmbH page 2 of 2

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Illustration 36: BYK-mac i ROBOTIC – Certificate / standards

1	Color standard values	3	Permissible tolerances
2	Effect standard limits	4	Graininess

Click the button Save configuration to write the new configuration data immediately into the XML file.

NOTICE

1 Checks are recommended daily.

2 Calibration is recommended monthly.

3 New certificate is recommended yearly.

6.1.5.2 Calibration Sequence

The calibration performs following steps – details see Device Test [▸ 47]:

1. On white calibration tile:
   - Pin calibration
   - White calibration
   - Effect calibration
   - Measurement
2. On green color check tile:
   - Color check
3. On silver effect check tile:
   - Effect check

The sequence of the process for calibration can be set:

1. Calibration always takes place first and can not be swapped.
2. The test of color and effect can be swapped. Click on the green double arrow to the right of the tests.

The standards are mounted to the wall in the robot cell. For calibration and test, the robot first runs over the white standard, then over the green and finally over the silver standard.

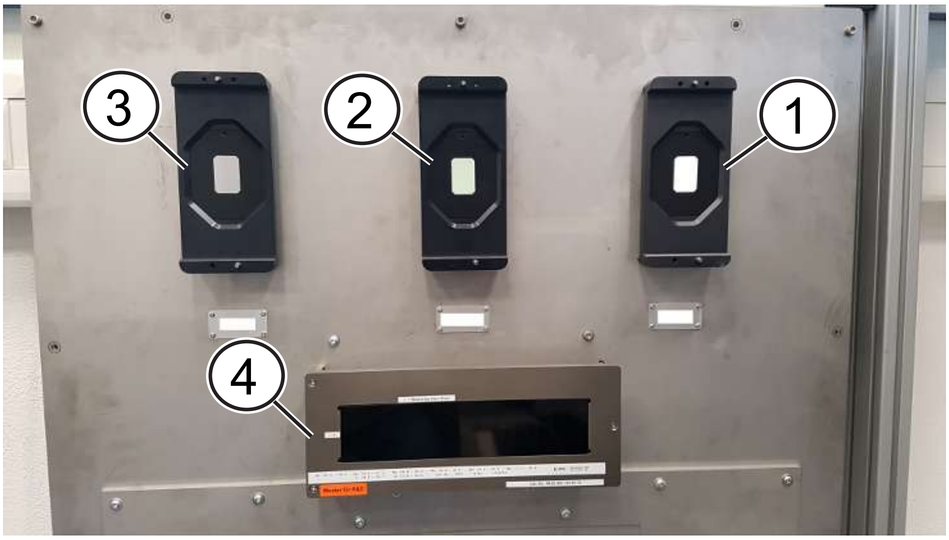

Illustration 37: BYK-mac i ROBOTIC – Calibration sequence

1	White: BYK-mac i ROBOTIC - calibration tile
2	Green: BYK-mac i ROBOTIC - color check tile
3	Silver: BYK-mac i ROBOTIC - effect check tile
4	Black: wave-scan ROBOTIC – check tile (see Daily Check [▸ 61])

All standards provide an orientation:

1. One pin is located in the middle.
2. One pin is located outside the middle.

These pins can be used to fit the instrument precisely to the standard. Make sure to mount the standards with correct orientation to the wall.

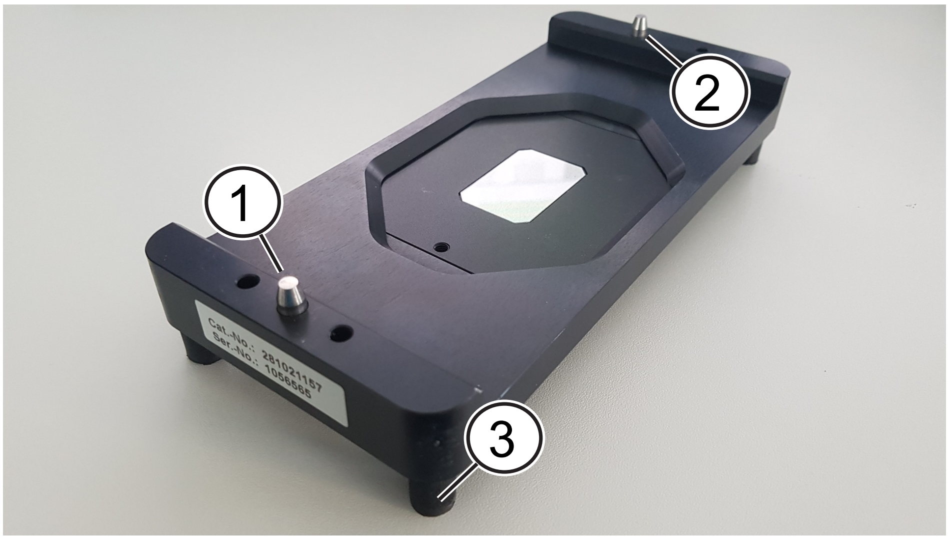

Illustration 38: BYK-mac i ROBOTIC – Effect check standard

1	Pin is located in the middle.
2	Pin is located outside the middle.
3	Rubber buffers are damping movements.

During calibration, the measured values are compared with the standards belonging to that specific instrument.

NOTICE

1 It is recommended to mount the tiles vertically. This avoids collection of dust on the tiles, which could falsify the calibration and test process.

2 Make sure the four rubber buffers on the feet of each standard are in place and in good condition. Order spare parts if necessary.

6.1.5.3 Daily Check Sequence

This sequence is linked to the calibration sequence. The daily check performs following steps:

1. On white calibration tile:
   - Pin calibration
   - Measurement
2. On green color check tile:
   - Color check
3. On silver effect check tile:
   - Effect check

The color and effect check only checks the values of the measurment. There is no change in the device. It is up to the PCL programmer how often the “daily check” should take place.

NOTICE

For more details on calibration and check see Device Test [▶ 47].

6.1.6 Error Handling

On the Error Handling tab possible error messages for the BYK-mac i ROBOTIC are listed.

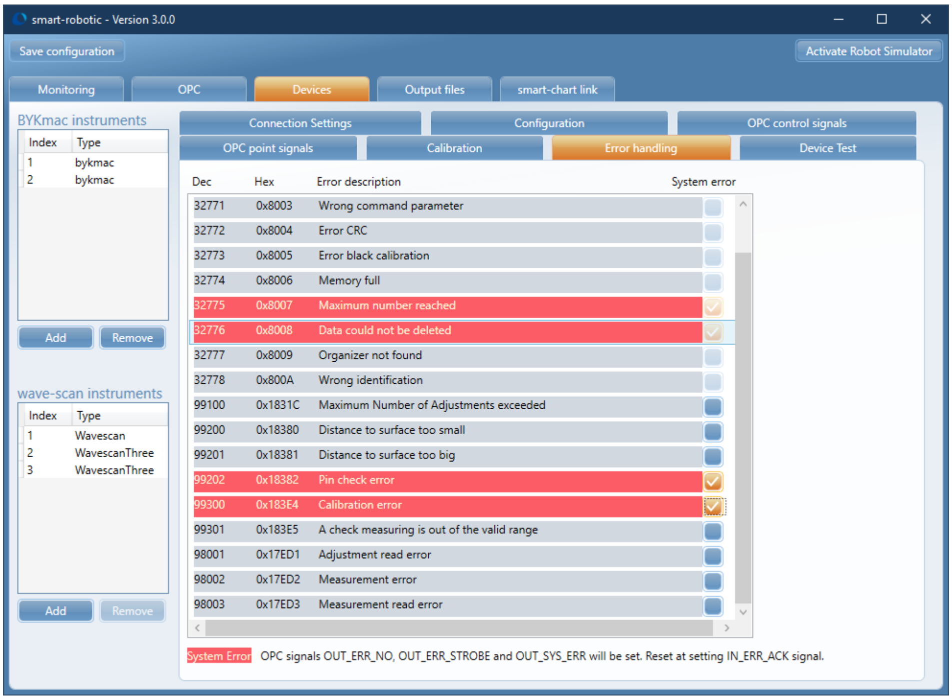

Illustration 39: BYK-mac i ROBOTIC – Error handling

Two types of error are possible:

- Red: System error
- Grey: No system error

In case of a system error the measurement will be aborted. Click the option System Error to the right of an entry to mark this entry accordingly. For more details see Error Handling [▸ 158] in the appendix.

NOTICE

1 Some entries are always system errors and can not be deactivated.

2 Some entries are never system errors and can not be activated.

6.1.7 Device Test

The Device Test offers functions for measurement, check and calibration of the instrument. Additionally, the position adjustment using the instrument pins can be checked.

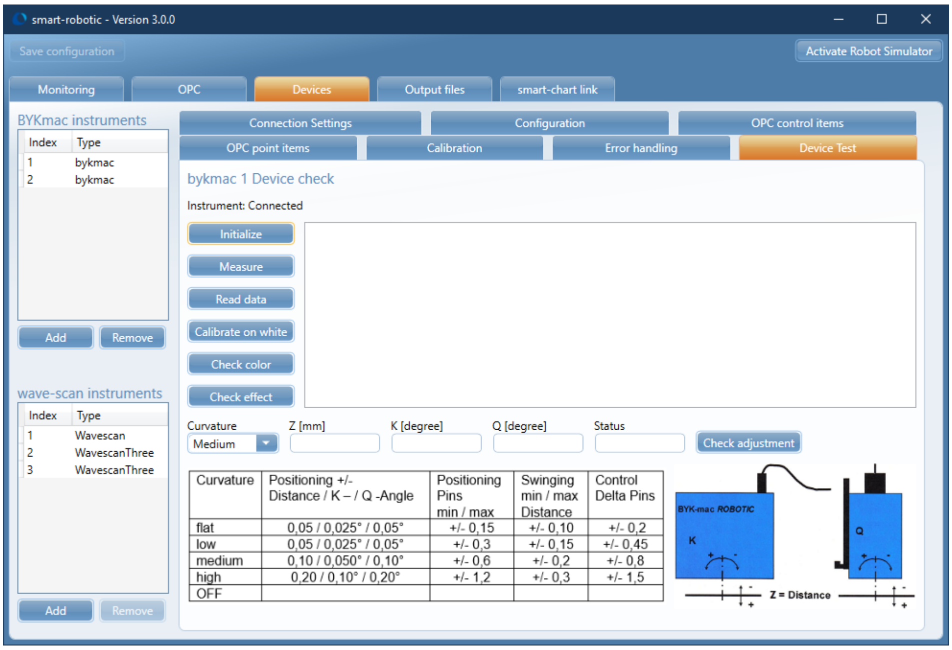

Illustration 40: BYK-mac i ROBOTIC - Device-test initial state

To test the device perform following steps:

1. Initialize
2. Measure
3. Read data
4. Calibrate on white
5. Check color
6. Check effect

These steps are described below.

NOTICE

Make sure the standard values given in the certificate for your instrument have been stored in smart-robotic, see Data in Certificate [▶ 42]. Otherwise the device test will not finish successfully.

6.1.7.1 Initialize

To initialize the device test perform following steps:

1. Make sure the instrument is connected – see Connection Settings [▶ 37].
2. Remove the dust protection from one of the standards.
3. Remove protective cap from the instrument.
4. Place the instrument on the standard.
5. Click the button Initialize.

This function prepares the instrument for measuring and calibration / testing.

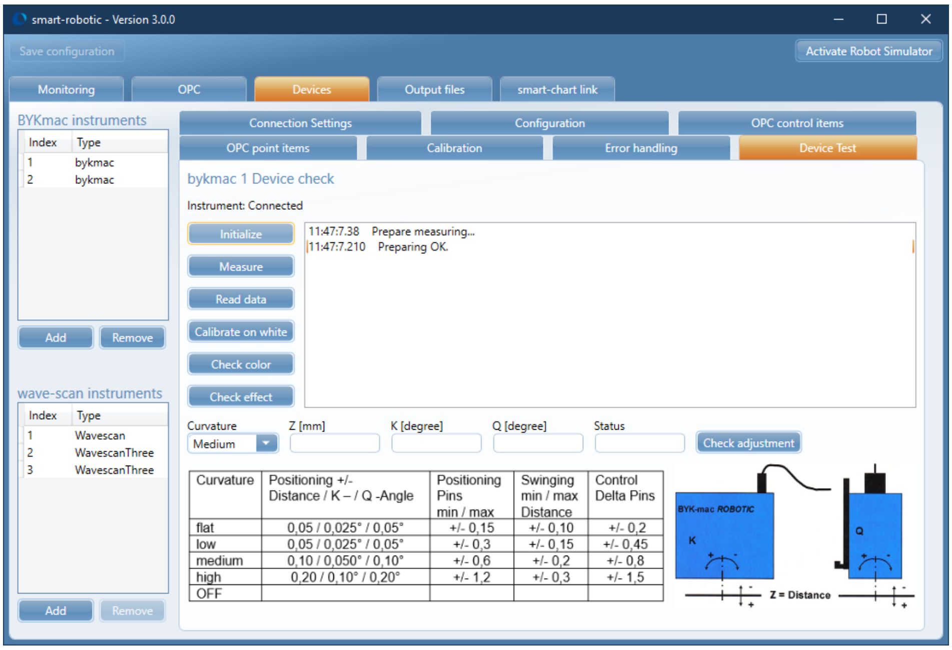

Illustration 41: BYK-mac-Device-Test-Initialize

The systems responses with Preparing OK.

6.1.7.2 Measure

Click the button Measure to take a measurement.

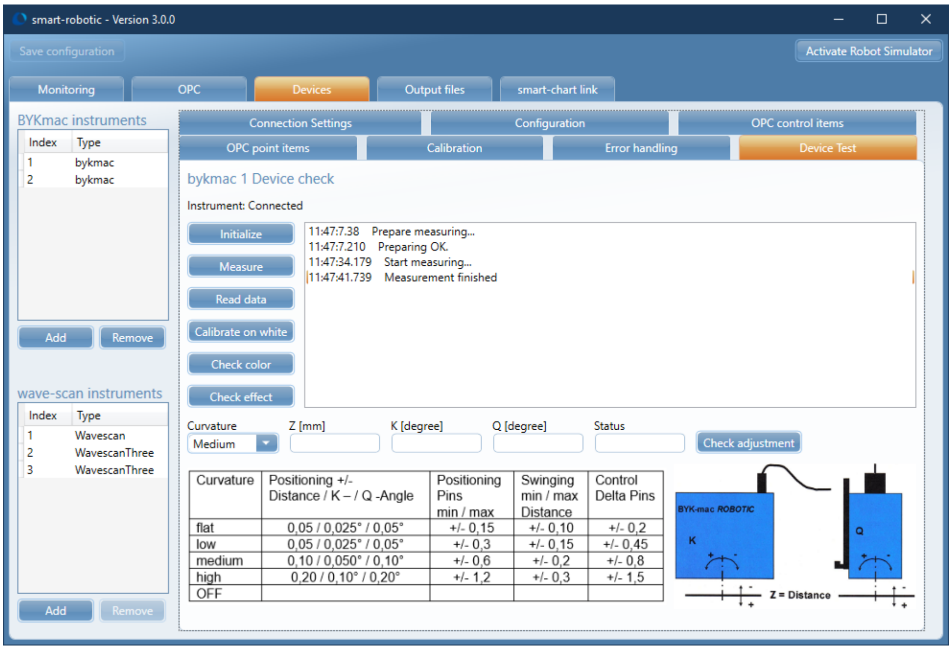

Illustration 42: BYK-mac-Device-Test-Measure

The measured data is stored in the instrument memory.

6.1.7.3 Read Data

Click the button Read data. This reads the measured data in the instrument memory and displays it.

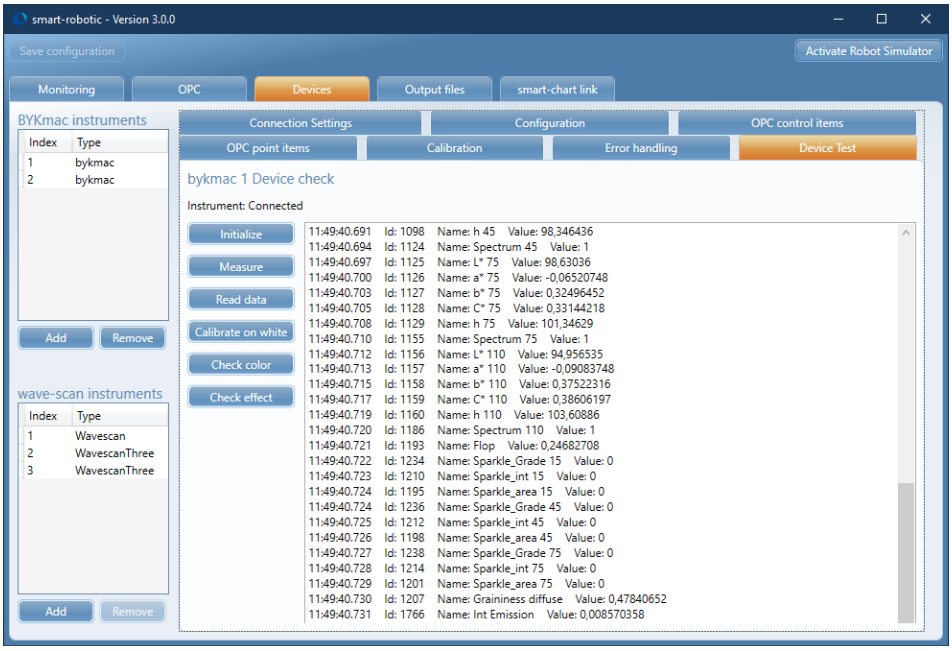

Illustration 43: BYK-mac-Device-Test-Reading

Scroll up and down to see all data.

6.1.7.4 Calibrate on White

To calibrate in a test environment without robot, place the white calibration standard on a table.

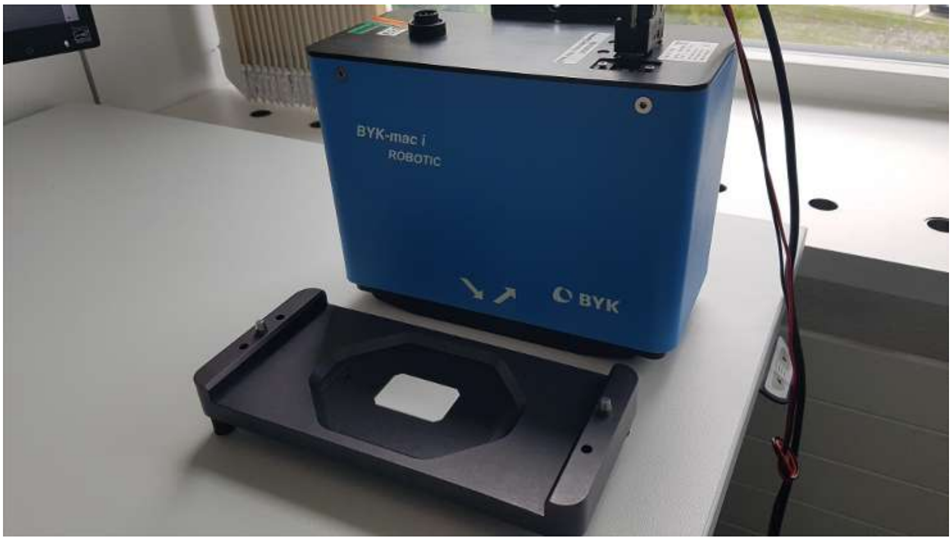

Illustration 44: BYK-mac - Device and calibration tile

The instrument has four positioning pins on the bottom. It measures only, if all for pins are pressed. This way the correct position of the instrument can be detected.

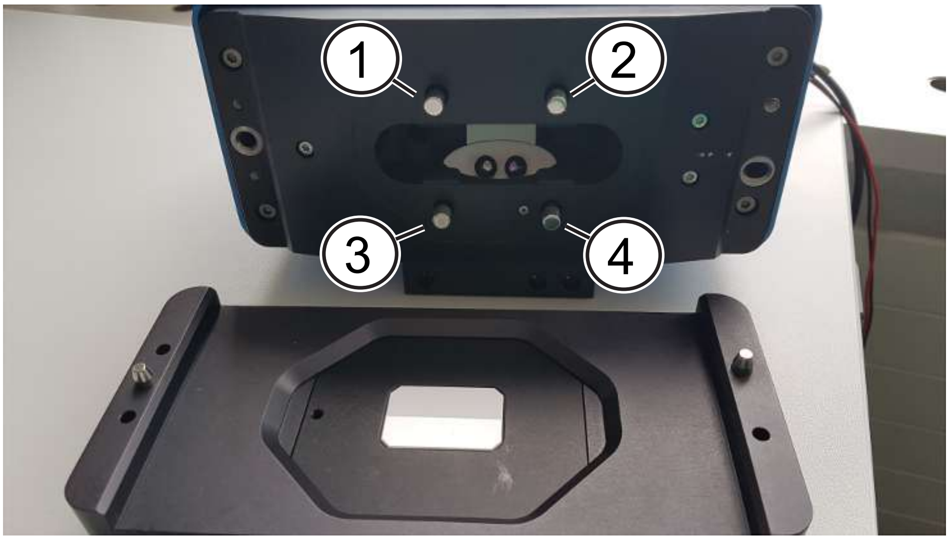

Illustration 45: BYK-mac-Calibration-Pins

Place the instrument on the white calibration standard.

Illustration 46: BYK-mac-Device on calibration tile

To calibrate the instrument perform following steps:

1. Press the instrument with both hands down – ca. 4 mm – until you hear the 1st "Click" from the four positioning pins.
2. Press the instrument with both hands further down until you hear the 2nd "Click" from the four positioning pins.
3. Hold the instrument in this position and click the button calibrate on white.
4. A message is displayed stating this procedure.
5. Click on OK to start the process.
6. Wait ca. 25 seconds for the end.

The procedure needs some exercise. Help from a 2nd person is recommended in order to click the button in the correct state.

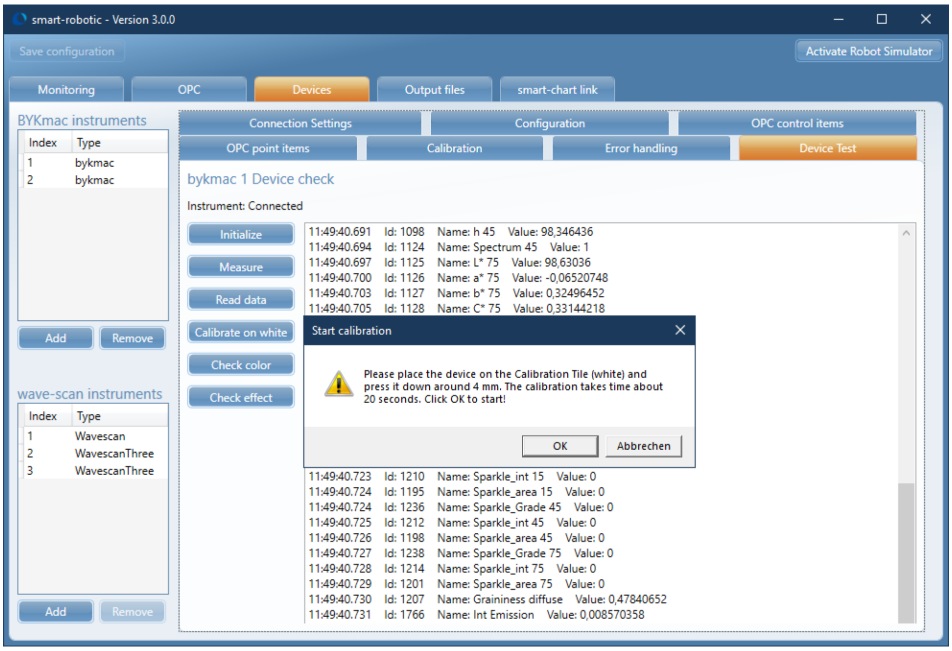

Illustration 47: BYK-mac-Device-Test-Calibrate-Message

If the positioning was not performed correctly, the message "Robotic calibration switch not pressed" will be displayed. Repeat the procedure.

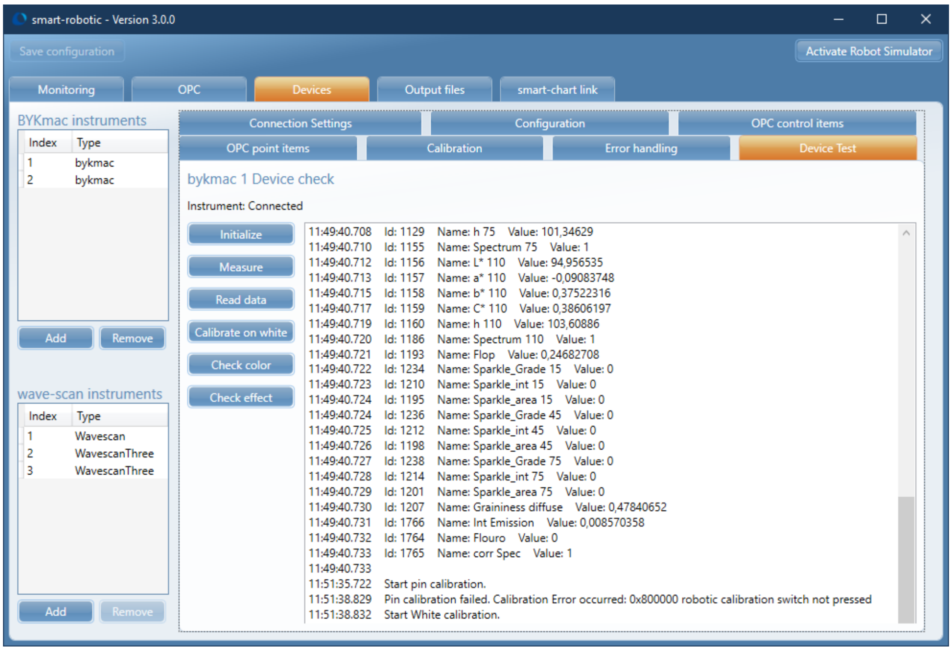

Illustration 48: BYK-mac-Device-Test-Calibrate-Failed

If the positioning was performed correctly the instrument performs following steps – see Data in Certificate [▶ 42]:

1. Pin calibration
2. White calibration
3. Camera / effect calibration
4. Measurement

The progress is displayed in the screen.

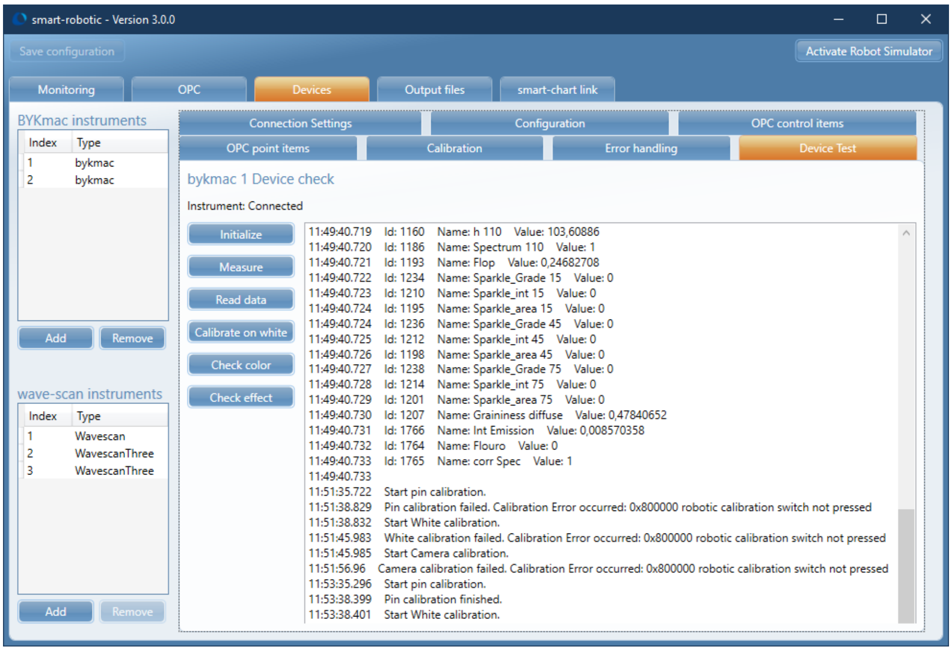

Illustration 49: BYK-mac-Device-Test-Calibrate-OK

For the calibration process following rules apply:

- Calibration is required, if the measurement results are not in the range of the standards.
- If calibration fails, try cleaning the standards, details see instrument documentation.
- If cleaning does not help, send instrument to BYK-Gardener service team.
- The service team will re-calibrate the instrument and provide new certificate.

NOTICE

The re-calibration and the issue of a new certificate is recommended once a year.

6.1.7.5 Color check

This function checks if the instruments color readings are within the specified tolerances. The target values and tolerances can be set in the Device Calibration [▶ 42] tab.

Perform following steps:

1. Please place the instrument on the green color check tile.
2. Click the button Color check to perform the color check.

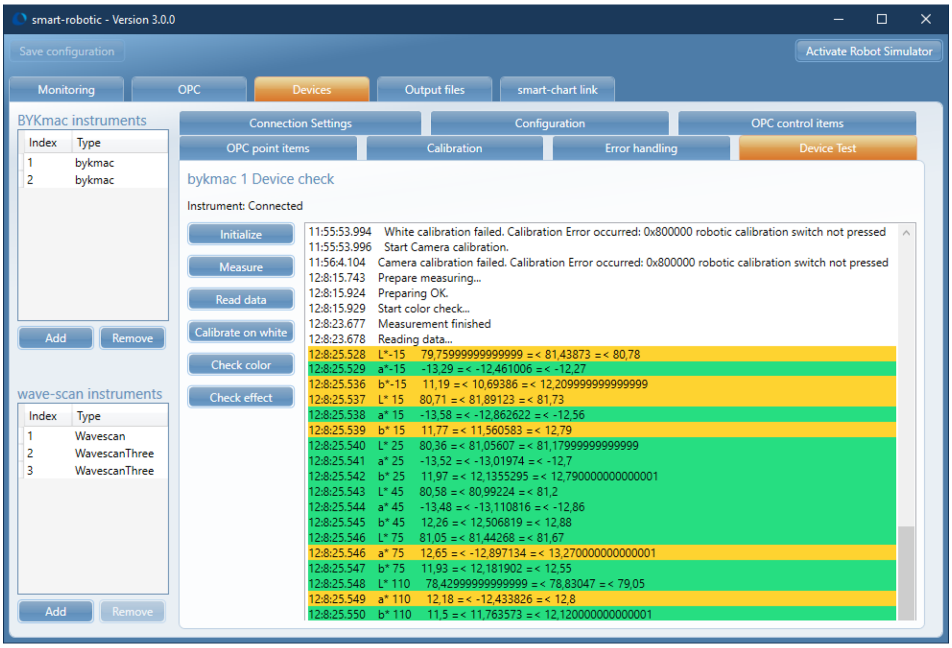

Illustration 50: BYK-mac-Device-Test-Color

The results of the color check - in the L*a*b* color system - are shown on the screen.

6.1.7.6 Effect check

This function checks if the instruments effect readings are within the specified tolerances. The target values and tolerances can be set in the Device Calibration [▶ 42] tab.

Perform following steps:

1. Please place the instrument on the silver effect check tile.
2. Click the button Effect check to perform the effect check.

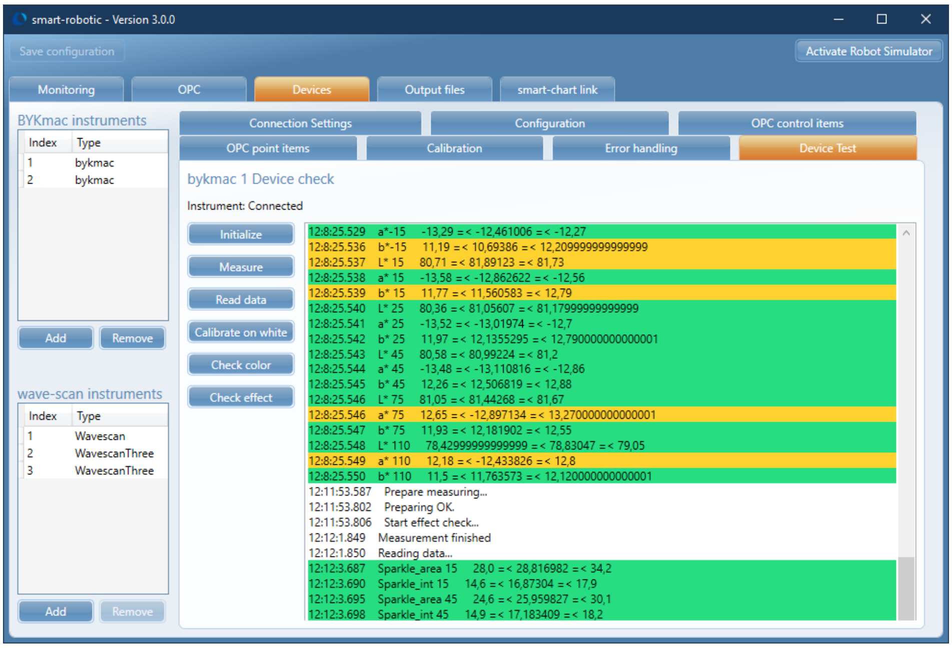

Illustration 51: BYK-mac-Device-Test-Effect

The results of the effect check - amount of sparkle under different angles - are shown on the screen.

NOTICE

Information, warnings and errors will be logged in the log file and displayed in the Monitoring [▶ 26] screen.

6.2 4822 - wave-scan ROBOTIC

The wave-scan ROBOTIC (catalog number 4822) is the BYK-Gardner instrument for appearance measurement.

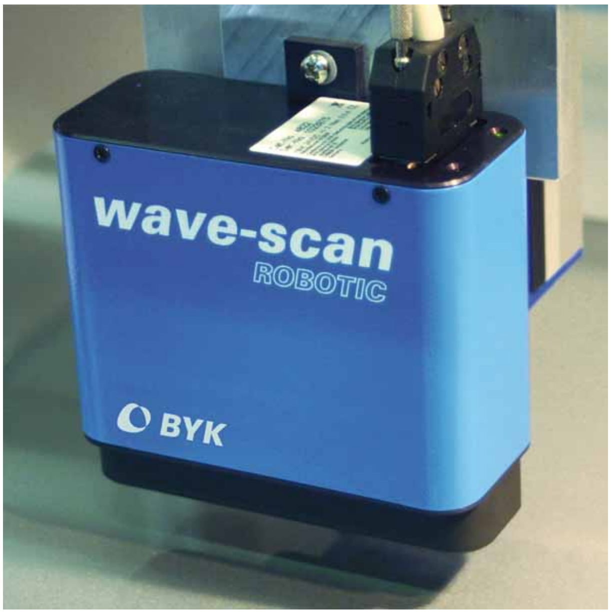

Illustration 52: BYK-Gardner wave-scan ROBOTIC

For product details see: https://www.byk-instruments.com/p/4822.

The product operation is described in:

- Operating Instructions: 266 018 740 - 0606

The configuration comprises following steps:

1. Connection Settings [▶ 56]
2. Device Configuration [▶ 56]
3. OPC Control Signals [▶ 58]
4. OPC Point Signals [▶ 58]
5. Device Test [▶ 59]
6. Daily Check [▶ 61]
7. Error Handling [▶ 62]

These steps are described below.

6.2.1 Connection Settings

The wave-scan ROBOTIC communicates via RS422 with smart-robotic, see FTDI Driver [▶ 21]. It requires a COM port.

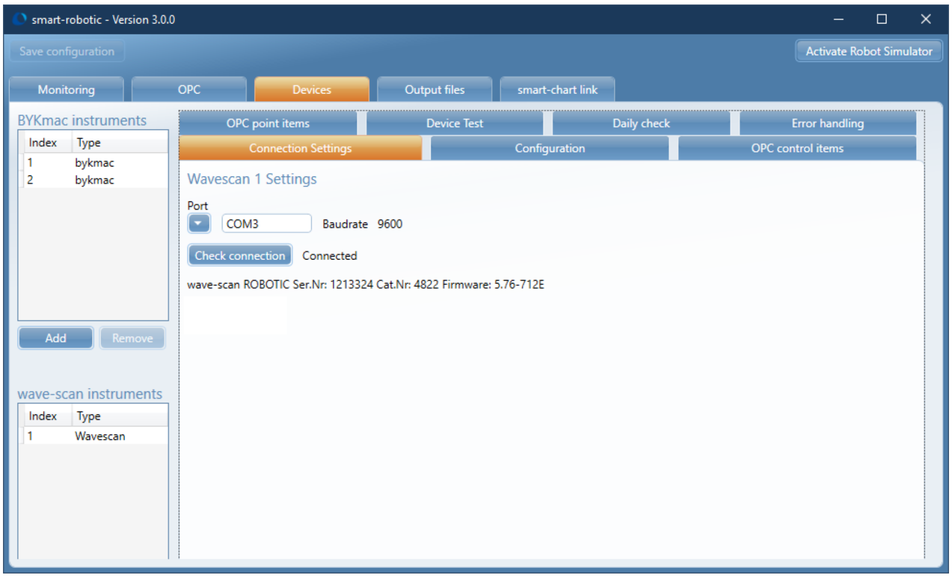

Illustration 53: BYK-Gardner wave-scan ROBOTIC – Connection details

Perform following steps:

1. Choose the correct COM port to establish a connection to the device.
2. Use the button Check connection to verify the connection.

For details concerning COM port selection see 7036 - BYK-mac i ROBOTIC [▶ 36].

6.2.2 Device Configuration

The Configuration tab manages the measurement properties of the instrument.

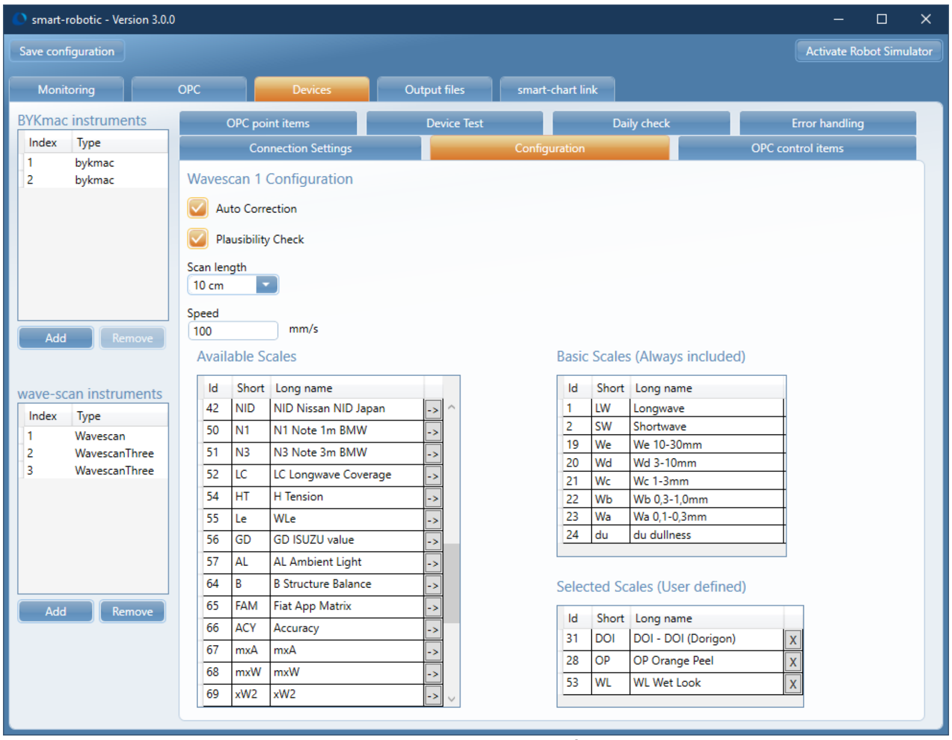

Illustration 54: BYK-Gardner wave-scan ROBOTIC - Configuration

You have following options:

- Auto Correction: Defects on the sample surface, such as scratches or craters, can cause major errors in measurement values. When Auto correction is activated, the affected scan areas are cut out and the measurement values are calculated from the corrected data.
- Plausibility Check: An option for comparing the corrected and uncorrected measurement value. The greater the difference between the corrected and uncorrected data, the more critical is the surface defect. If the difference is greater than 20 %, the measurement will be evaluated as a faulty measurement.
- Scan Length / Speed: Defines the length of the scan trajectory and the required speed of the instrument. The robot must be programmed to move according the definitions.

NOTICE

It is recommended to program the robot with an offset scan length for the acceleration ramp.

- Available Scales: The measurement results can be calculated according the various scales available. All these scales are customer-specific.
- Basic Scales (Always included): The calculation according to these scales takes place always.
- Selected Scales (User defined): Select required scales by clicking the arrow button in the Available Scales list. They appear under Selected Scales and can be removed from here using the X button.

NOTICE

With the hand-held instruments, these configurations are covered by the smart-chart Standard and Organizer Management or via the measurement parameters in the device configuration.

6.2.3 OPC Control Signals

Control data are compellingly necessary for the operation of the measuring head, the symbolic names are fix defined in smart-robotic.

The control data are to be found in the OPC group of WAVEx_CTRL, The x stands for the index of the current wave-scan ROBOTIC.

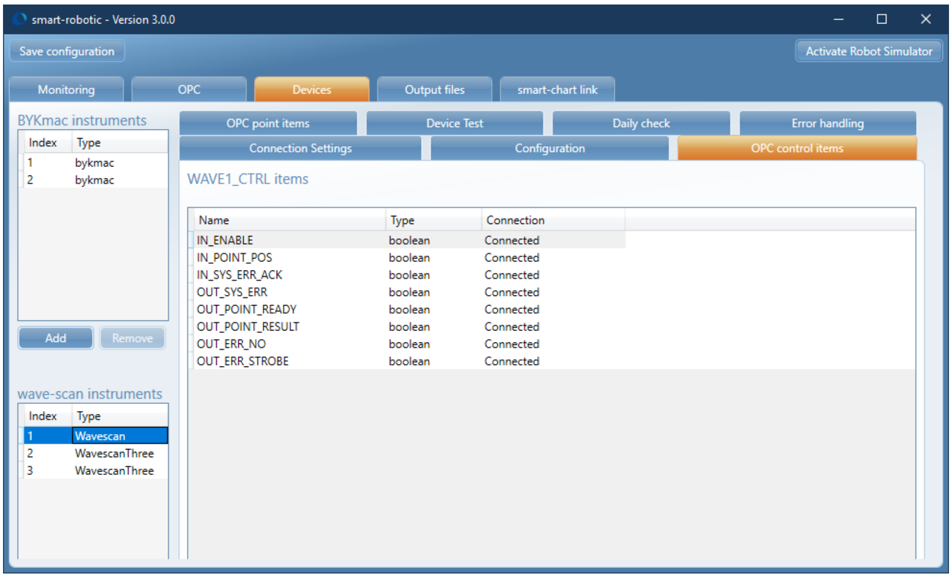

Illustration 55: BYK-Gardner wave-scan ROBOTIC – Control signals

Perform following steps:

1. Click the OPC control signals tab.
2. Check if the connection status is Connected, see also Control Signals for wave-scan ROBOTIC [▸ 13].
3. If status is Not found, check / edit the signals in the OPC server and restart smart-robotic.

These OPC control signals are predefined by smart-robotic. For a description see OPC Control Signals [▸ 39] for the BYK-mac i ROBOTIC.

6.2.4 OPC Point Signals

Details see OPC Point Signals [▸ 40] for the BYK-mac i ROBOTIC.

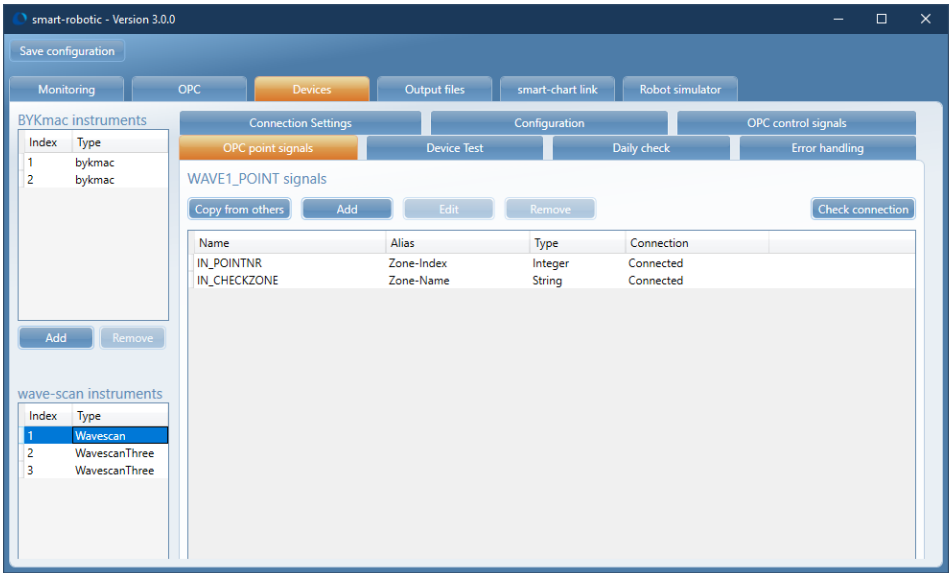

Illustration 56: BYK-Gardner wave-scan ROBOTIC – OPC Point Signals

6.2.5 Device Test

The tab Device Test offers functions for checking the instrument and performing test measurements.

In difference to the BYK-mac i ROBOTIC the wave-scan ROBOTIC performs a non-contact measurement.

A possible test setup is shown below.

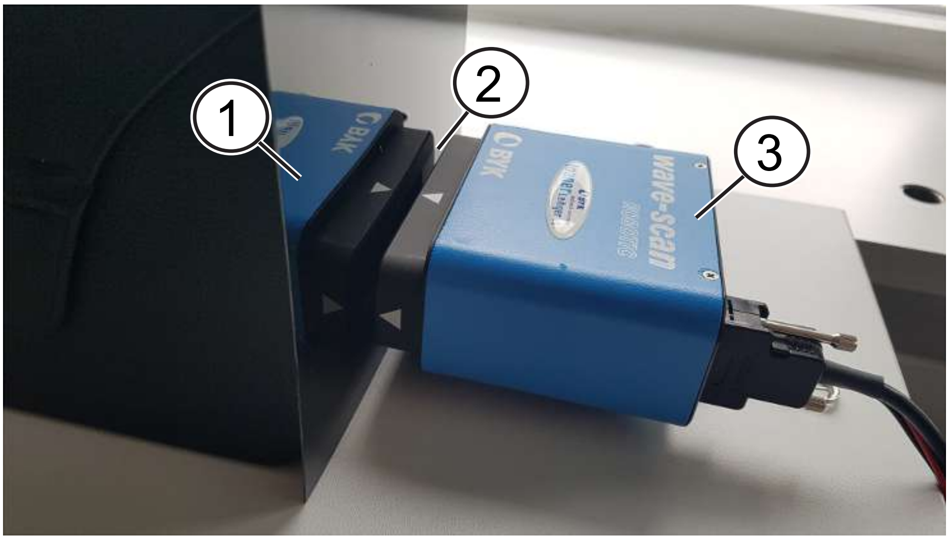

Illustration 57: BYK-Gardner wave-scan ROBOTIC – Test setup (example)

1	Sample to be used for device test
2	Measurement distance of ~ 15 mm
3	Instrument wave-scan ROBOTIC

Perform following steps:

1. Initialize
2. Measure
3. Get status
4. Read data
5. Delete data to perform new test

These results are shown in the following example.

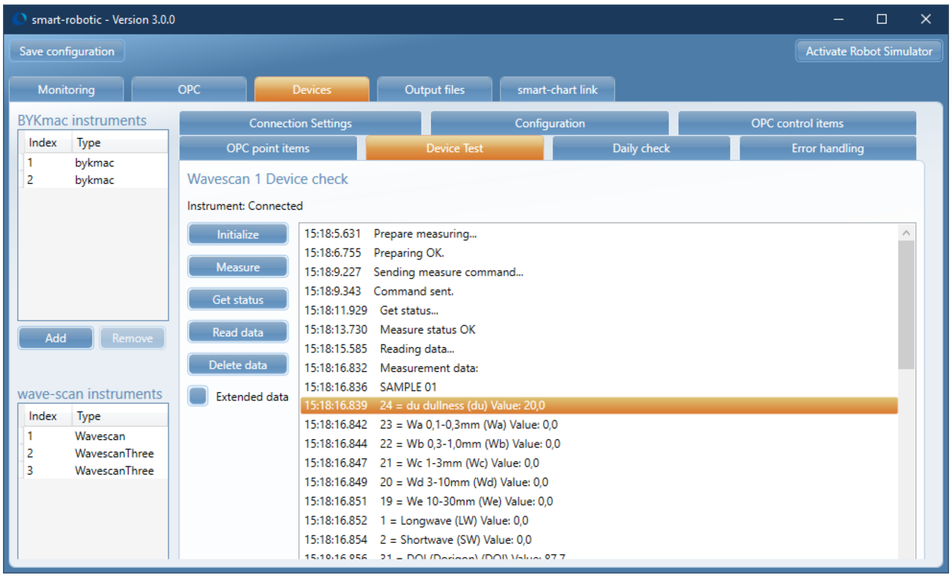

Illustration 58: BYK-Gardner wave-scan ROBOTIC – Device test (static)

In the test setup shown above the probe is **fix** installed. Thus only the dullness can be measured – all other values are zero. In order to get all data included wave-length details you have two options:

- Slowly move the sample or
- slowly move the instrument.

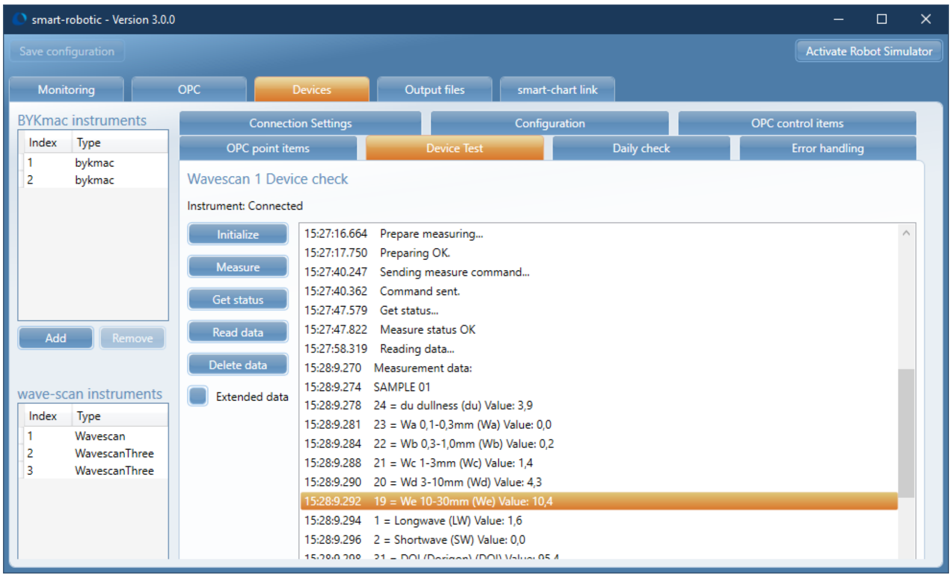

Illustration 59: BYK-Gardner wave-scan ROBOTIC – Device test (moved)

Now all other values can also be measured.

6.2.6 Daily Check

The instrument comes with a certificate and a checking / test tile. Enter the values given there here in the Daily Check tab. These values will be compared during the check with the measurement results.

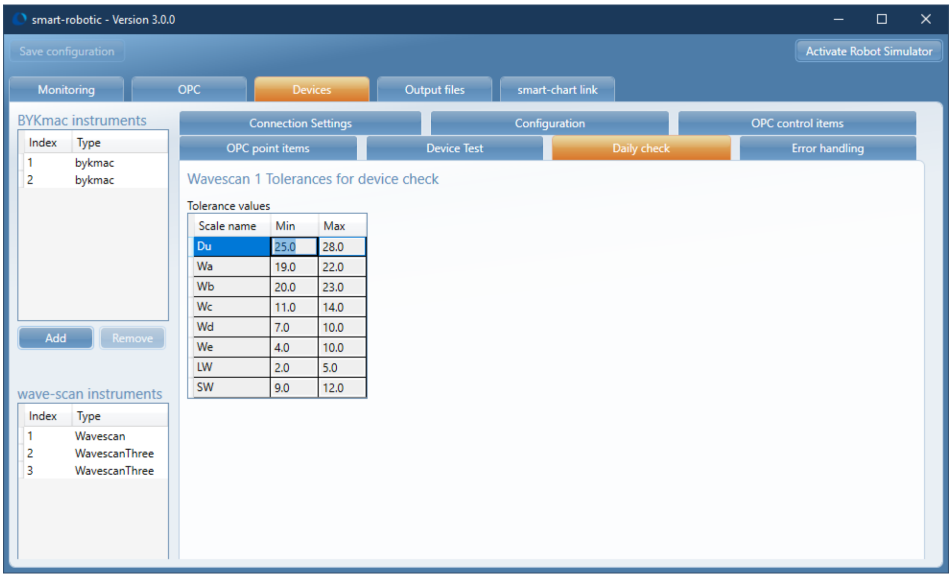

Illustration 60: BYK-Gardner wave-scan ROBOTIC – Device check

Mount the test tile in the robot cell to the position intended for the device check.

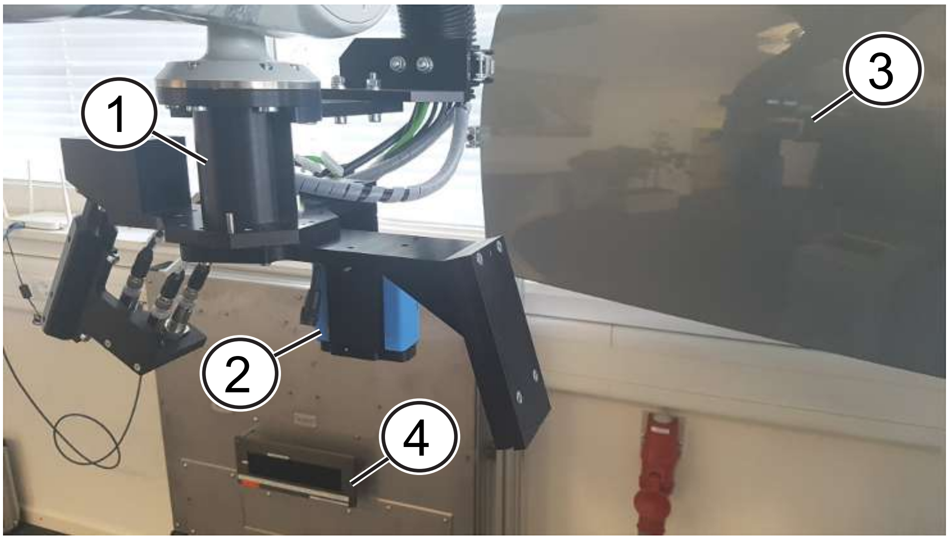

Illustration 61: BYK-Gardner wave-scan ROBOTIC –Check tile mounting

1	Robot arm with rotable adapter
2	Instrument on rotable adapter
3	Car body / part in robot cell
4	Checking tile mounted to wall

The daily check is successful, if the measured data is within the given tolerances. More details about daily check see user manual for the robotic instrument.

6.2.7 Error Handling

The error handling for the wave-scan ROBOTIC is similar to the BYK-mac i RO-BOTIC.

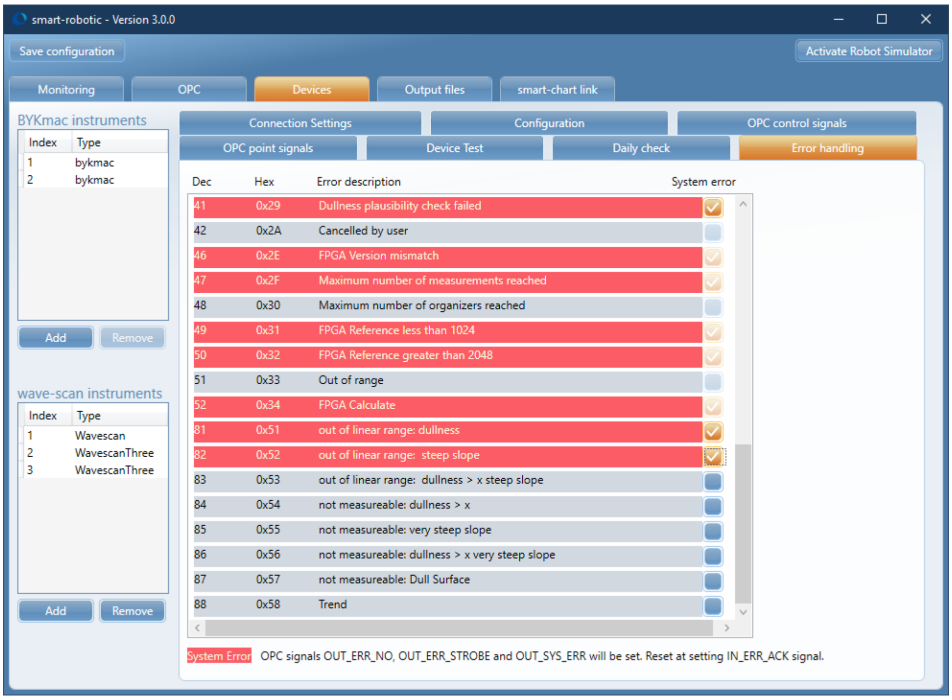

Illustration 62: BYK-Gardner wave-scan ROBOTIC – Error handling

For more details see Error Handling [▶ 46] for the BYK-mac i ROBOTIC.

6.3 7410 - wave-scan 3 ROBOTIC

The wave-scan 3 ROBOTIC (catalog number 7410) is the successor of the 4822 - wave-scan ROBOTIC [▸ 55].

Illustration 63: BYK-Gardner wave-scan 3 ROBOTIC

For product details see: https://www.byk-instruments.com/p/7410.

The product operation is described in:

- Operating Instructions: 301 200 141 - 2009

The configuration comprises following steps:

1. Connection Settings - USB [▸ 64]
2. Connection Settings - LAN [▸ 65]
3. Device Configuration
4. OPC Control Items
5. OPC Point Items
6. Device Test [▸ 66]
7. Daily Check
8. Error Handling

Steps 1, 2 and 6 are described below. All other steps are similar to 4822 - wave-scan ROBOTIC [▸ 55].

6.3.1 Connection Settings - USB

The wave-scan 3 ROBOTIC communicates via USB with smart-robotic during setup, see USB Bulk Driver [▶ 22]. It requires a free USB port.

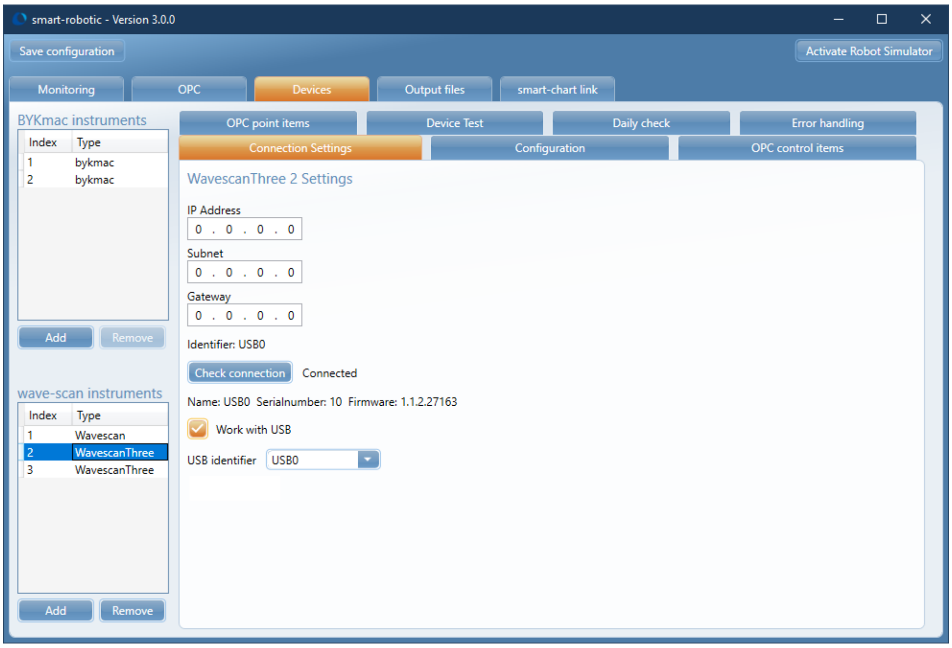

Illustration 64: BYK-Gardner wave-scan 3 ROBOTIC – Connection details USB

Perform following steps:

1. Click the option Work with USB.
2. Choose the correct USB identifier to establish a connection to the device.
3. Use the button Check connection to verify the connection.

Proceed if status is Connected.

6.3.2 Connection Settings - LAN

The wave-scan 3 ROBOTIC communicates via Ethernet / LAN with smart-robotic during operation. In this connection mode it requires an IP address.

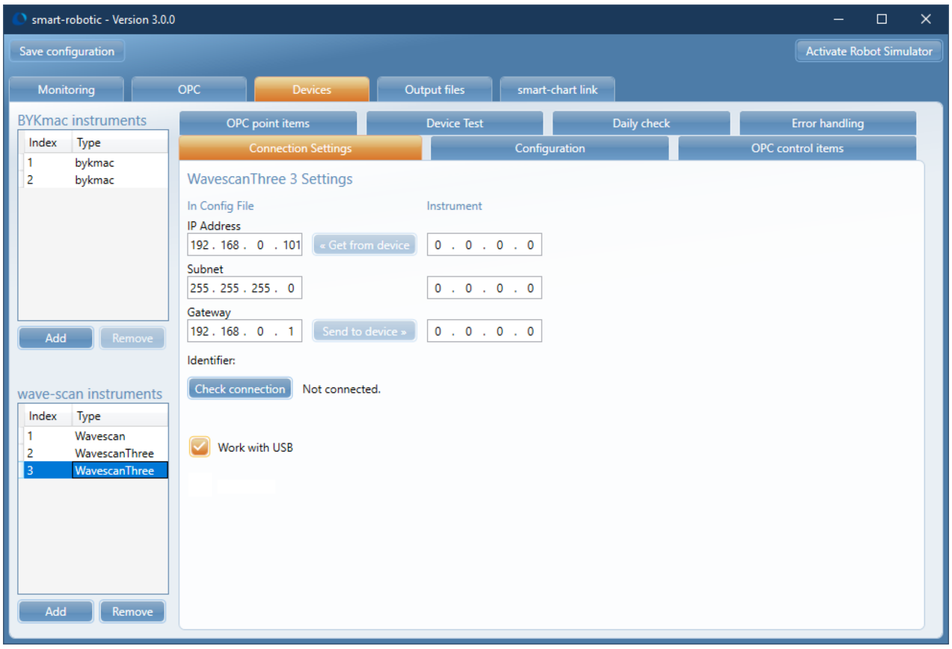

Illustration 65: BYK-Gardner wave-scan 3 ROBOTIC – Connection details LAN

Perform following steps:

1. Enter the IP address foreseen for the connection to the device.
2. Connect the instrument via USB cable to your PC.
3. Activate the option Work with USB.

Now you have following options for the IP Address:

- Get from device: Click this button to receive IP data from device.
- Send to device: Click this button, if the device has no IP data yet.

Perform following steps:

1. Deactivate the option Work with USB.
2. Disconnect the USB cable from instrument and / or PC.
3. Use the button Check connection to verify the IP connection.

Proceed if status is Connected.

6.3.3 Device Test

The functions available in the tab Device Test are different, see Device Test [▶ 59] for the wave-scan ROBOTIC.

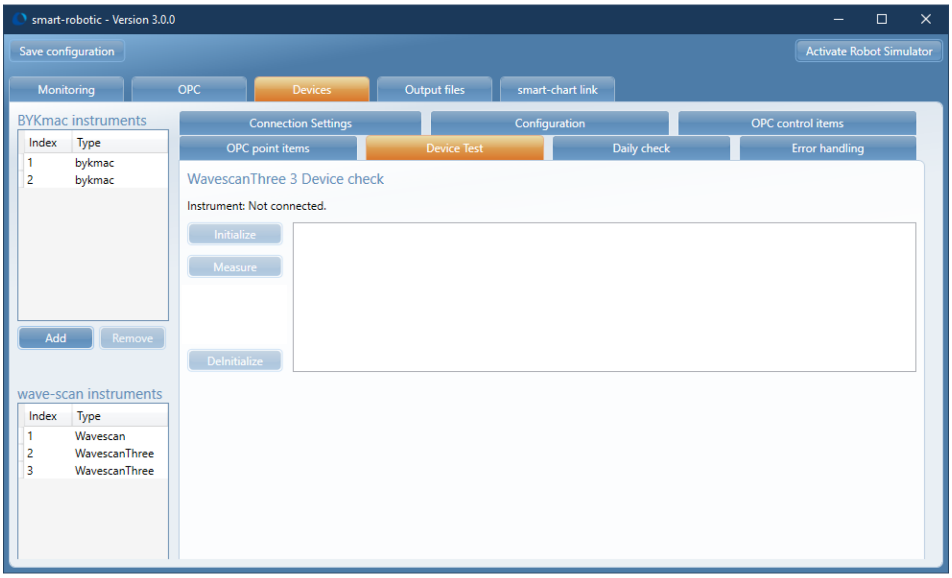

Illustration 66: BYK-Gardner wave-scan ROBOTIC 3- Device test

Perform following steps:

1. Initialize: Load device driver.
2. Measure: Get measurement data.
3. De-Initialize: Unload device driver.

NOTICE

The wave-scan 3 ROBOTIC is much more powerful than its predecessor wave-scan ROBOTIC. The new device has a modern processor and sufficient memory to calculate ALL scales immediately. Thus the configuration of the scales can be omitted here – all this data will be available always.

7 Output Files

In the Output files tab, additional user-defined output files can be defined for following instruments:

- BYK-Gardner BYK-mac i ROBOTIC
- BYK-Gardner wave-scan ROBOTIC
- Compatible thickness measurement instruments

This is optional and does not influence the measurement data stored in the smart-chart database.

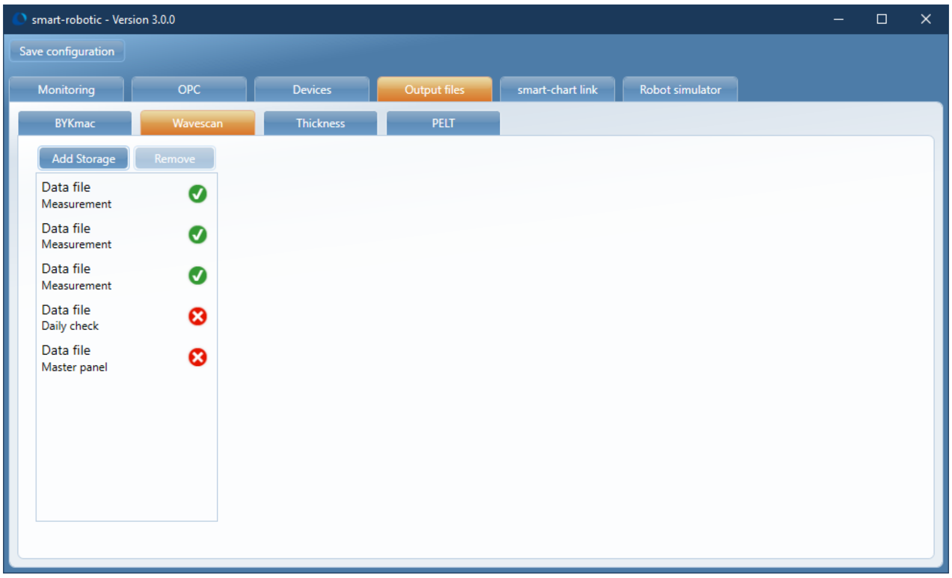

Illustration 67: Output-Files-Main-Window

In order to create such an additional output file, select an instrument and click the button Add Storage to add a new output file for configuration.

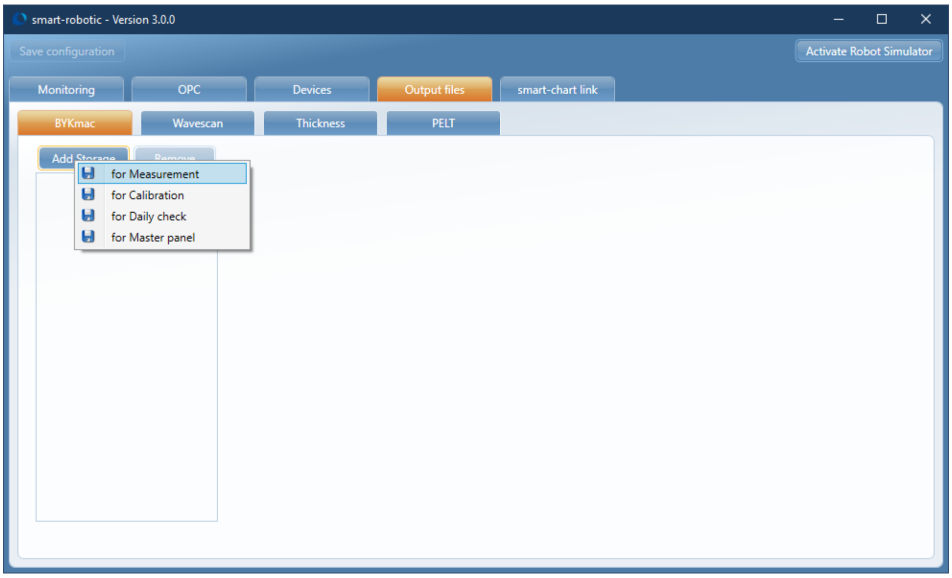

Illustration 68: Output-Files-Add-Menu

Depending on the instrument, different options appear in the context menu to generate different output files:

- Normal measurement
- Calibration
- Daily check

- Measure on master panel

After selection the output file can be defined on the right side.

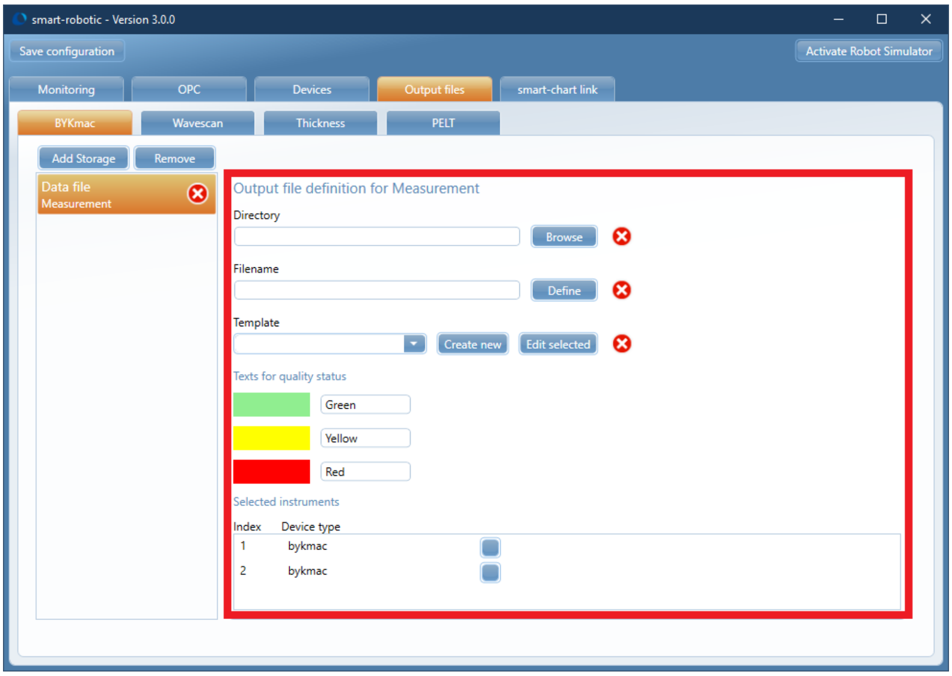

Illustration 69: Output-Files-Add-Details

Complete configurations get a green icon; incomplete a red icon. To complete enter following details:

1. Output Directory [▶ 69]
2. Output Filename [▶ 70]
3. Template File [▶ 71]
4. Quality Status [▶ 74]
5. Active Devices [▶ 76]

These tasks are described below.

NOTICE

1 If multiple output files have been defined, multiple output files will be generated.

2 In the example shown above three configurations exist for “Measurement”.

3 So for each measurement job these three files will be generated.

7.1 Output Directory

In the Directory tab the path can be defined, under which the output files are stored. Use the Browse button to navigate to the desired directory.

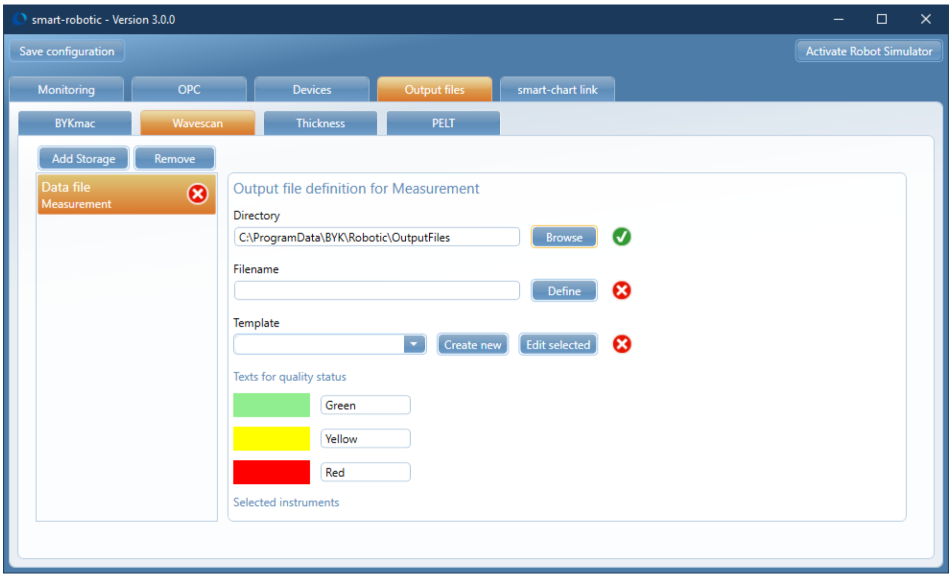

Illustration 70: Output-Files-Directory-Set

In the example shown above following directories will be used:

- C:\ProgramData\BYK\Robotic\TemplateFiles

Following sub-directories will also be created in the given location:

- ..\TemplateFiles\BykMacJob
- ..\TemplateFiles\WavescanJob

NOTICE

The application allows copy and paste for most input options. This way you can exchange existing information between different configurations or external editors.

7.2 Output Filename

The Filename defines a template to dynamically create the name of the file for each measurement.

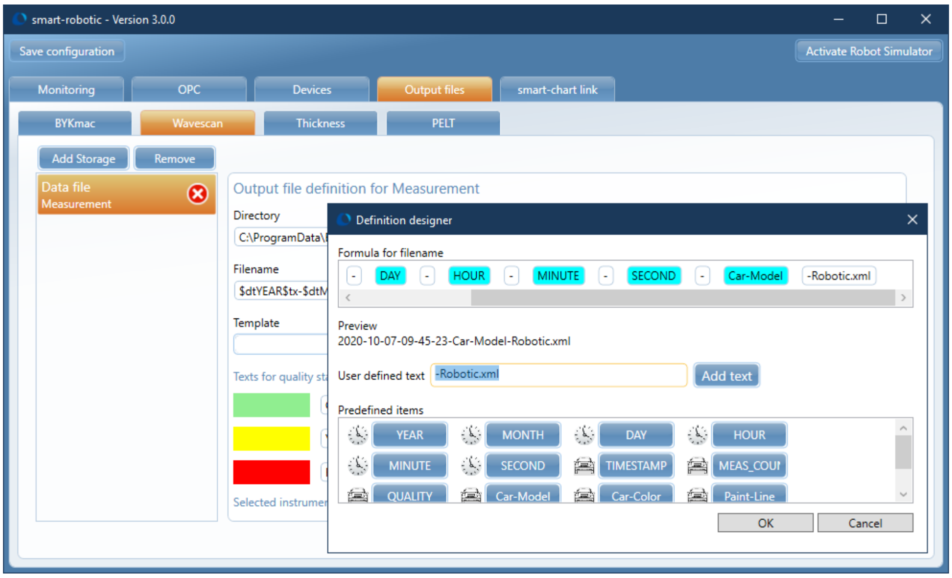

Illustration 71: Output-Files-Filename-Set

The button Define opens an editor to configure the file name using predefined items of measurement metadata - e.g. timestamp, color or vehicle ID – and free text – e.g. separators and file extension.

NOTICE

1 After adding all required fields use Drag & Drop to bring a field into correct position.

2 Do not forget to append the file name with an appropriate file type like ".csv" or ".xml".

3 The extension is to be entered in the Definition designer – not in the Output file definition(!).

7.3 Template File

The Template defines the actual content of the output file:

- If no template is existent, a new template must be created.
- The button Create new opens the Template editor for a new template.
- The button Edit selected opens the template editor for a blank template.

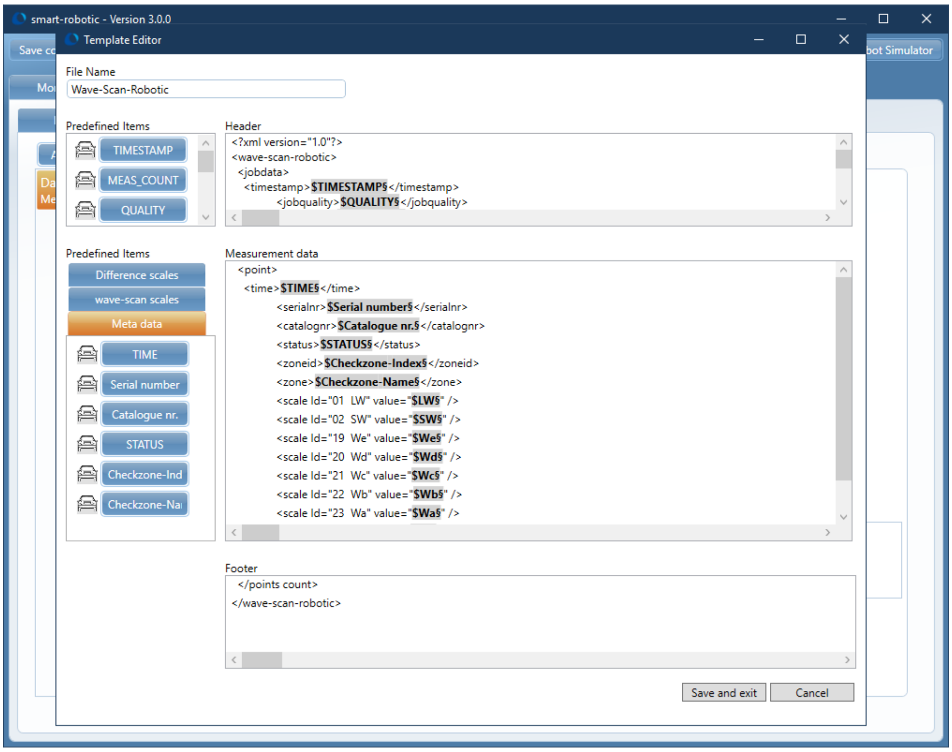

Illustration 72: Output-Files-Template-Editor

Perform following steps:

1. Choose a File Name for the template.
2. Add the Predefined Items in the Header box.
3. Add the Predefined Items in the Measurement Data box.
4. Add appropriate text in the Footer box.

Following rules apply:

- The section Header will appear once at the top.
- The section Measurement data will appear for every check zone.
- The section Footer will appear once at the end of the file.

Write free text to structure the data with XML tags or CSV column names.

NOTICE

Follow conventions such as ";" separator for CSV files for structuring text and predefined items.

In the example shown above following **template** file is created.

Header

```
<?xml version="1.0"?>
<wave-scan-robotic>
<jobdata>
<timestamp>$TIMESTAMP§</timestamp>
    <jobquality>$QUALITY§</jobquality>
    <carmodel>$Car-Model§</carmodel>
    <carcolor>$Car-Color§</carcolor>
    <paintline>$Paint-Line§</paintline>
    <comment>$Free-Comment§</comment>
    <vehicleid>$Vehicle-ID§</vehicleid>
</jobdata>
<points count="$MEAS_COUNT§">
```

Measurement data

```
<point>
<time>$TIME§</time>
    <serialnr>$Serial number§</serialnr>
    <catalognr>$Catalogue nr.§</catalognr>
    <status>$STATUS§</status>
    <zoneid>$Checkzone-Index§</zoneid>
    <zone>$Checkzone-Name§</zone>
    <scale Id="01 LW" value="$LW§" />
    <scale Id="02 SW" value="$SW§" />
    <scale Id="19 We" value="$We§" />
    <scale Id="20 Wd" value="$Wd§" />
    <scale Id="21 Wc" value="$Wc§" />
    <scale Id="22 Wb" value="$Wb§" />
    <scale Id="23 Wa" value="$Wa§" />
    <scale Id="24 Du" value="$du§" />
</point>
```

Footer

```
</points count>
</wave-scan-robotic>
```

With the example template shown above the following **output** XML file will be created after a measurement.

```
<?xml version="1.0"?>
<wave-scan-robotic>
<jobdata>
<timestamp>2020-10-06T17:38:33</timestamp>
    <jobquality>Green</jobquality>
    <carmodel>Combi</carmodel>
    <carcolor>Pearl</carcolor>
    <paintline>PL1</paintline>
    <comment>Created with simulator.</comment>
    <vehicleid>123456</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-10-06T17:38:38</time>
    <serialnr>1213324</serialnr>
    <catalognr>4822</catalognr>
    <status>None</status>
    <zoneid>4</zoneid>
    <zone>rear bumper</zone>
    <scale Id="01 LW" value="0" />
    <scale Id="02 SW" value="0" />
    <scale Id="19 We" value="0" />
    <scale Id="20 Wd" value="0" />
    <scale Id="21 Wc" value="0" />
    <scale Id="22 Wb" value="0" />
    <scale Id="23 Wa" value="0" />
    <scale Id="24 Du" value="12,1" />
</point>
</points count>
</wave-scan-robotic>
```

NOTICE

The template files will be stored with extension ".btmp" in the sub-folders for the BYK-mac and the wave-scan.

7.4 Quality Status

The software can handle the quality status. This status denotes if measured values are within tolerances. For this the function smart-chart link [▶ 77] is required – the tolerances are part of the standards stored in smart-chart. The quality status can have following values:

- Green: Measured values within tolerances.
- Yellow: Measured values in warning area.
- Red: Measured values out of tolerances.

The **Texts for Quality Status** can be modified in the text fields right to the green / yellow / red rectangle.

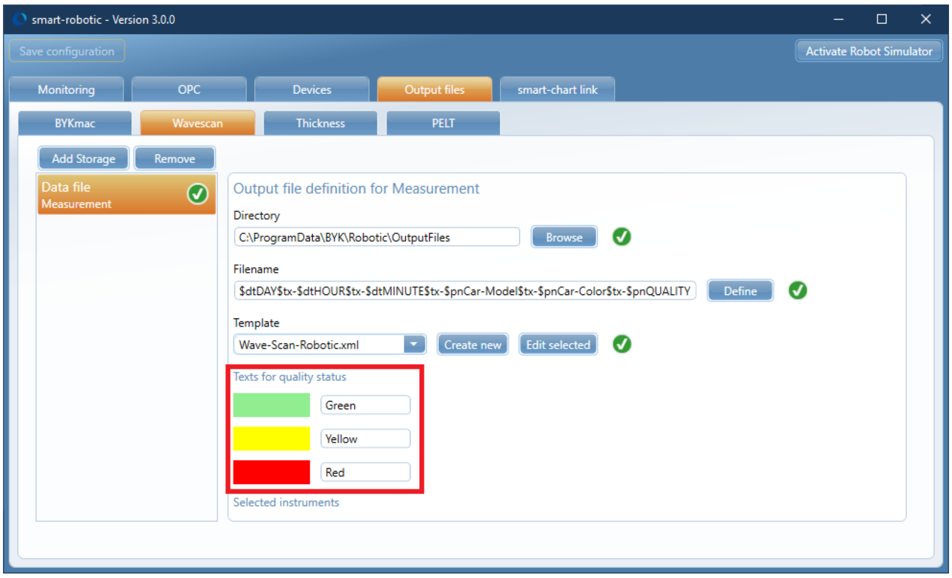

Illustration 73: Output-Files-Quality-Status

If you want to use traffic light status for pass / fail indication you can enter for example:

- Within tolerances: Green
- In warning area: Yellow
- Out of tolerances: Red

If you want to use just OK / NOK for pass / fail indication only can enter for example:

- Within tolerances: OK
- In warning area: OK or NOK (depending on your requirements)
- Out of tolerances: NOK

The defined text will appear in the Filename if the QUALITY item is inserted.

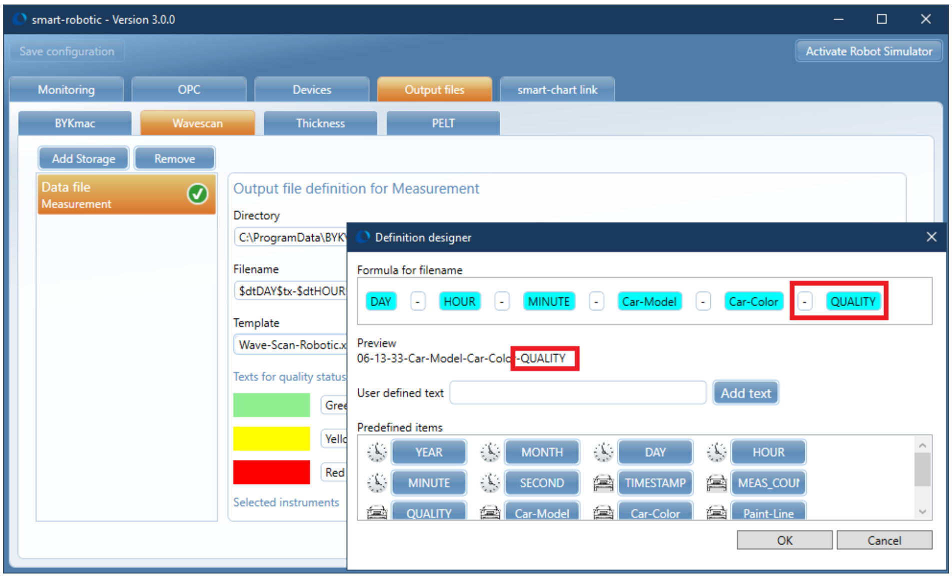

Illustration 74: Output-Files-Quality-Field

With the example configuration shown above the following file will be created.

```
2020-10-06T17_38_33-Combi-Pearl-Green.xml
```

Th status will also appear in the content of the output file if it is part of the template, see example template file above.

```
<jobquality>$QUALITY§</jobquality>
...
<status>$STATUS§</status>
```

These entries have the following meaning:

- $QUALITY§: The quality status for the complete job / car body.
- $STATUS§: The quality status for one single measurement point / check zone.

In the example output file shown above following entries have been created by smart-robotic.

```
<jobquality>Green</jobquality>
...
<status>None</status>
```

These entries have the following meaning:

- Job Quality: The overall quality status for the complete job is “Green”.
  - It will be “Red” if at least one check point is red.
  - It will be “Yellow” if at least one check points is yellow.
  - It will be “Green” if all check points are green.
- Status: The quality status for this measurement point / check zone will be "None" if no standard can be associated (for example if smart-chart link has not been configured yet).

For more details see Testing the Configuration [▸ 100].

NOTICE

In an output file with multiple measurement points (check zones) the status will be inserted separately within each single point.

7.5 Active Devices

On the bottom of the window the devices can be selected for which the output files have to be generated. The device list is depending on the device type.

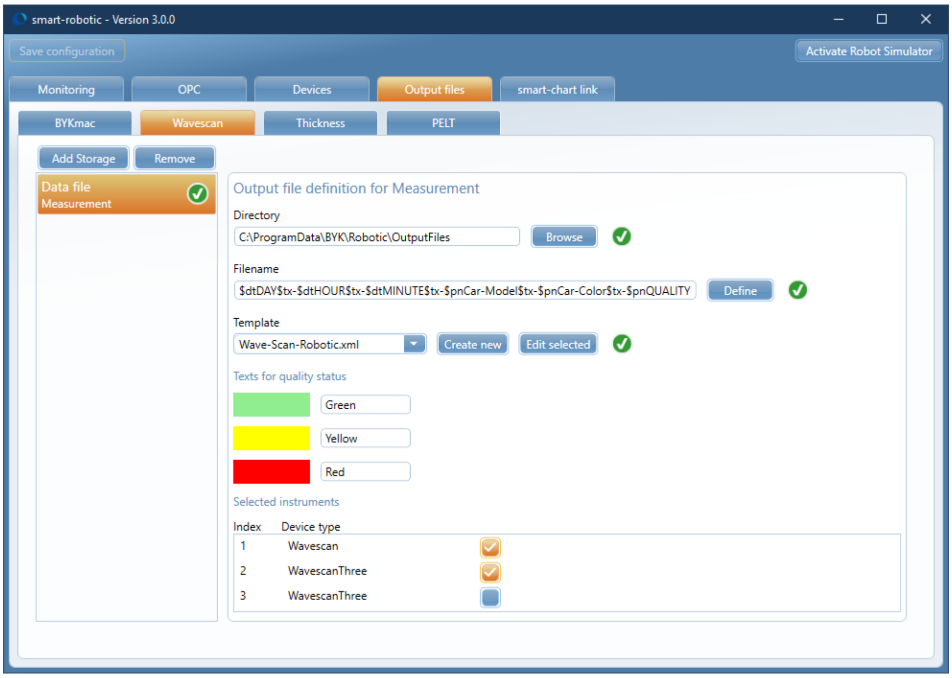

Illustration 75: Output-Files-Device-Select

The output file configuration for the other instrument types is analogue.

NOTICE

The output files will be generated when performing measurements with the robotic instruments. The configuration can be tested with the Robot Simulator [▶ 140].

8 smart-chart link

When using the software **smart-chart** for data analysis and tolerance settings, the tab **smart-chart link** manages the connection between measurement devices, OPC server and **smart-chart**. With the configuration of **smart-chart link** following operations are supported:

- The information in the standard and organizer database is retrieved for pass / fail check.
- The measurement results are stored in the measurement database according to existing standards and organizers.

NOTICE

The generation of Output Files [▸ 67] can be used in addition to the storage in the **smart-chart** database.

8.1 Configuration in smart-chart

In the application **smart-chart** the color standards and the organizers are defined. The configuration required for the interaction with **smart-chart** comprises following steps:

- Databases [▸ 77]
- Catalog [▸ 79]
- Standards [▸ 79]
- Organizers [▸ 82]
- Data Analysis [▸ 89]

⚠ CAUTION

Do not use the module **Instrument Management**. It is not required for the interaction with **smart-robotic** and it is not possible to access the instrument from **smart-chart** and **smart-robotic** at the same time. If you have used the module, restart **smart-chart** without using it again.

See also

Installation [▸ 18]

8.1.1 Database

In **smart-chart** following databases are used:

- Standard Database [▸ 77]
- Measurement Database [▸ 78]

8.1.1.1 Standard Database

This database stores the definitions for color standards and organizers.

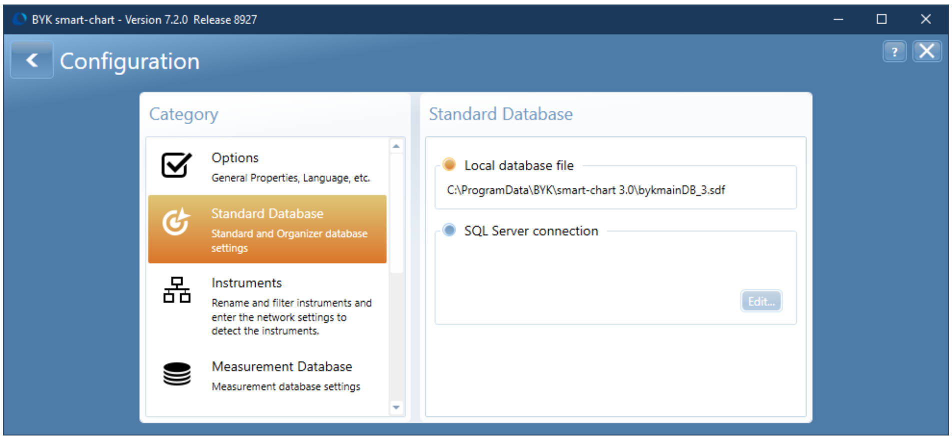

Illustration 76: Standard database in smart-chart

Name and location of this database are fix assigned in **smart-chart**: "C:\Program-Data\BYK\smart-chart 3.0\bykmainDB_3.sdf".

NOTICE

For the creation of this documentation a **compact database file** was used. Alternatively an **SQL server connection** can be used. This is the preferred option in a production environment, see also Installation [▶ 18] of **smart-chart**.

8.1.1.2 Measurement Database

This database stores the measurement data. Name and location of the database can be defined here.

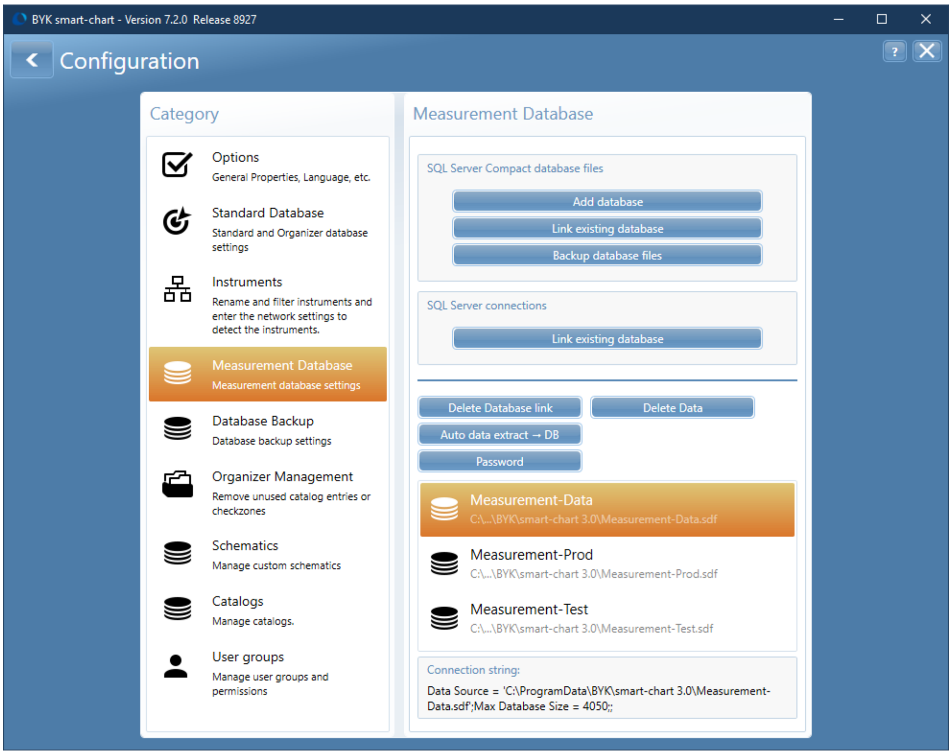

Illustration 77: Measurement database in smart-chart

In the example shown above the database "Measurement-Data.sdf" was selected. If more than one database is existing, the measurement data will be stored in all of them.

8.1.2 Catalog

In the **Catalog** configuration the various parameters for identification of the measured objects are selected.

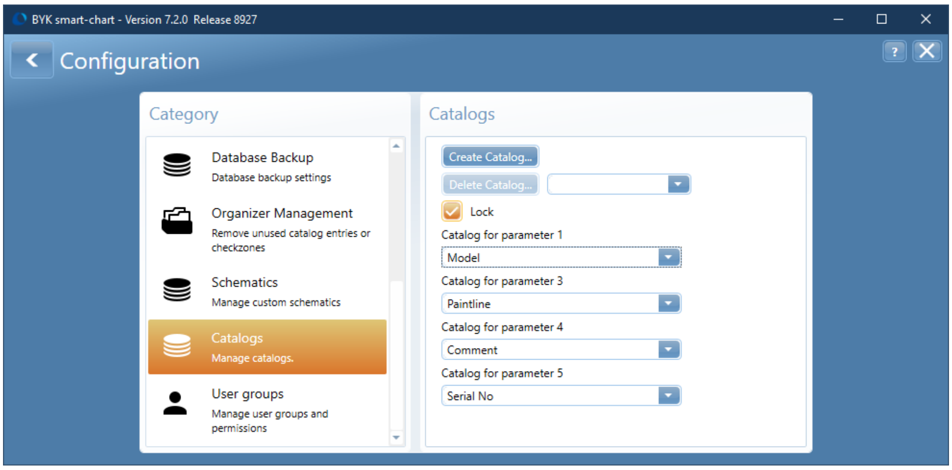

Illustration 78: Catalog configuration in smart-chart

For the creation of this documentation following catalogs were selected:

- **Catalog for parameter 1**: “Model”
- [Catalog for parameter 2: “Color”]
- **Catalog for parameter 3**: “Paintline”
- **Catalog for parameter 4**: “Comment”
- **Catalog for parameter 5**: “Serial No.”

NOTICE

The **Catalog for parameter 2** can not be configured here. It is always mapped to the catalog “Color”.

8.1.3 Standards

The module **Standard Management** is used to configure the settings for the various color standards. These standards can then be added the check zone organizers later on. The configuration of color standards comprises following steps:

- Standard Family [▶ 79]
- Standard [▶ 81]

8.1.3.1 Standard Family

Via the button **Add Family** a new standard family - or group of standards - can be created.

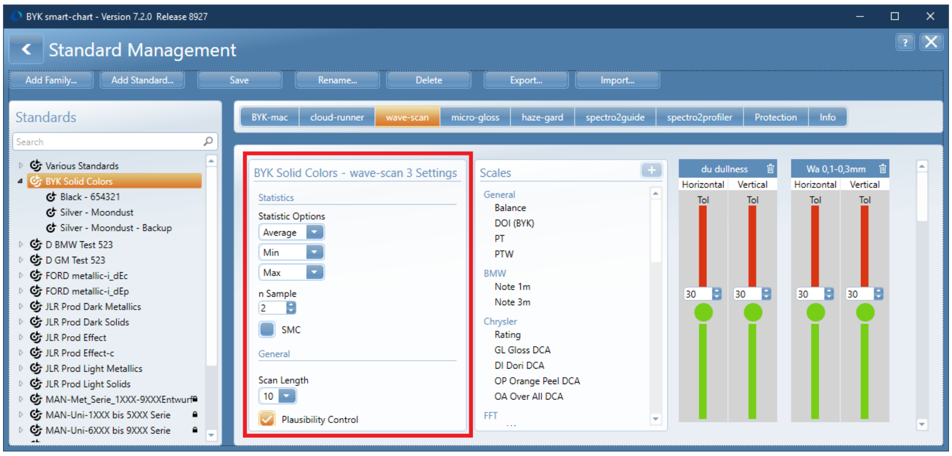

Illustration 79: Standard management in smart-chart

In each standard family the scales and tolerances for the pass / fail measurements can be configured. In the example shown above the standard family "BYK Solid Colors" and the instrument "wave-scan" is shown. Following rules apply:

- **<Group name> - wave-scan 3 Settings**: These parameters (red frame) are **only** relevant for the wave-scan 3 handheld device.
- **Scales**: Select the customer relevant scales with defined tolerances / limits. In addition, the structure spectrum data (du, W_a .. W_e, LW, SW, B) will be automatically saved.

Scales can be added to the selection using the **+** symbol. Scales can be removed from selection using the **Trash can** symbol.

NOTICE

These functions only work on **Family** level – here: "BYK Solid Colors".

8.1.3.2 Standard

For the creation of this documentation the standard “Silver – Moondust” was created.

Example

Below following pass / fail tolerances were configured in this standard for the scale “Dullness (du)”:

- Below 10 = **Red**: Measured value = Not in tolerance.
- 10 … 20 = **Yellow**: Measured value = In warning area.
- 20 … 30 = **Green**: Measured value = In tolerance.
- 30 … 40 = **Yellow**: Measured value = In warning area.
- Above 40 = **Red**: Measured value = Not in tolerance.

These values have been entered for **Horizontal** check points / zones only. The entries **Horizontal** and **Vertical** are relevant later on for the check zones, see below.

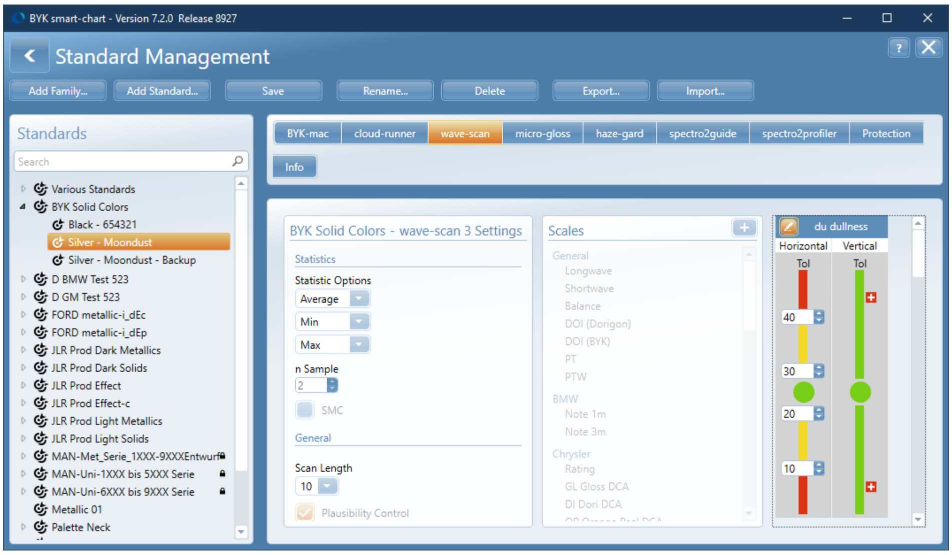

Illustration 80: Color standard and tolerances in smart-chart

Tolerance values can be entered via the plus (**+**) symbol and removed via the minus (**–**) symbol. To do so the **Edit** icon (pencil) has to be activated. This only works on **Standard** level – here: “Silver – Moondust”.

NOTICE

All changes are stored via the **Save** button in the top level button row.

8.1.4 Organizers

The module **Organizer** is used to configure the check points / zones to be measured. The organizer management comprises following steps:

- Model [▶ 83]
- Standards [▶ 84]
- Paint line [▶ 85]
- Instruments [▶ 86]
- Check zones [▶ 87]

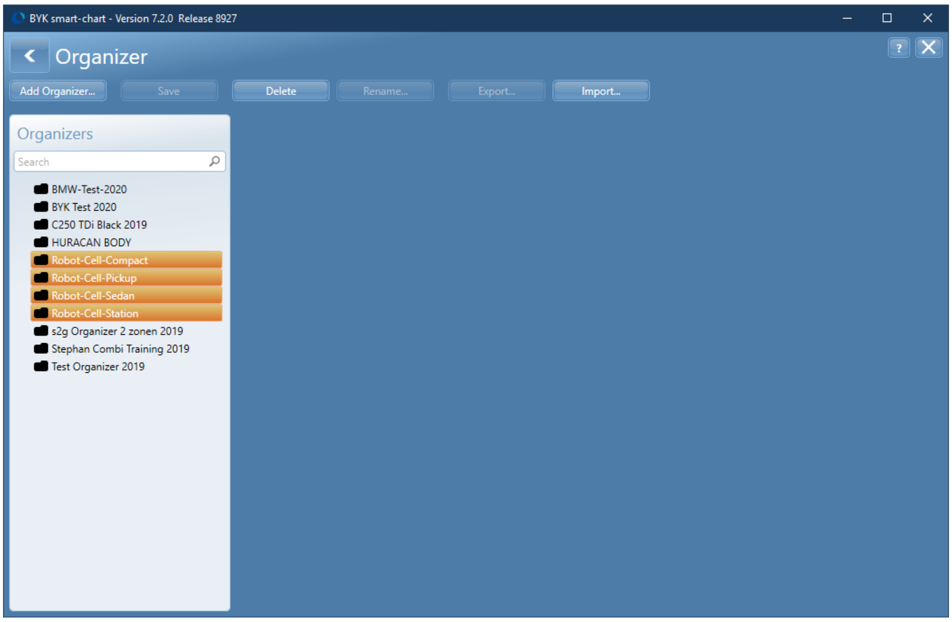

Illustration 81: List of organizers in smart-chart

For this example the following organizers were created:

- "Robot-Cell-Compact"
- "Robot-Cell-Pickup"
- "Robot-Cell-Sedan"
- "Robot-Cell-Station"

These organizers will be used by **smart-robotic** to identify the parameters 1..5 listed above. In the color standards the corresponding tolerance values will be identified.

8.1.4.1 Model Selection

On the tab **Parameter 1** the "car models" can be selected. You have following options:

- Use the buttons **Create Model** and **Delete Model** to manage the models in the catalog.
- Use the **Add / Remove (All)** buttons to manage the models in the organizer.

You can create for example an organizer for "Compact" cars and add all models habe the same measurement procedure.

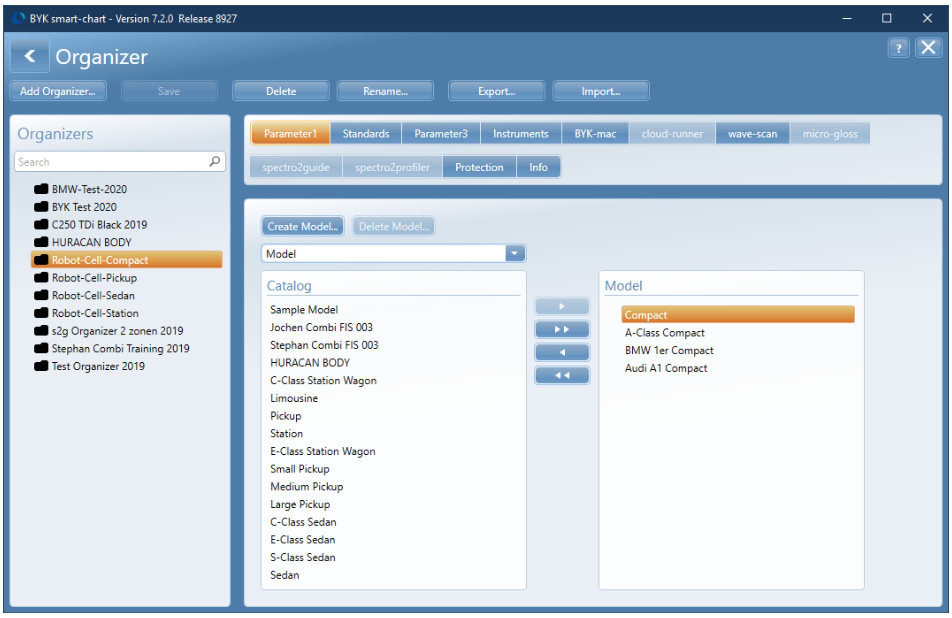

Illustration 82: Organizer and model selection in smart-chart

For the example tests later on in **smart-robotic** the model entry "Compact" is important.

NOTICE

The combo box with selected entry "Model" appears only, if this entry has been created in the Catalog [▶ 79] before.

8.1.4.2 Standard Selection

On the tab **Standards** the color standards can be added to this organizer. You have following options:

- Standards are managed in the module Standards [▶ 79].
- Use the **Add / Remove (all)** buttons to manage the models in the organizer.

You can add here all color standards you want to measure with **smart-robotic**.

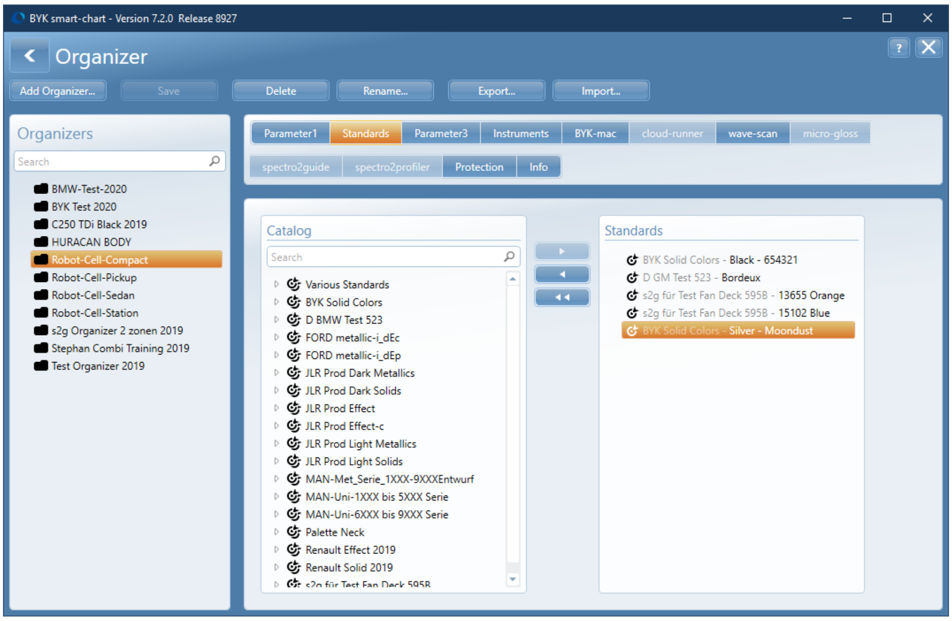

Illustration 83: Organizer and standards in smart-chart

For the example tests later on in **smart-robotic** the entry “Silver - Moondust” is important.

8.1.4.3 Paint Lines

On the tab **Parameter 3** the “Paint Lines” can be selected. You have following options:

- Use the buttons **Create Paintline** and **Delete Paintline** to manage the paint lines in the catalog.
- Use the **Add / Remove (all)** buttons to manage the paint lines in the organizer.

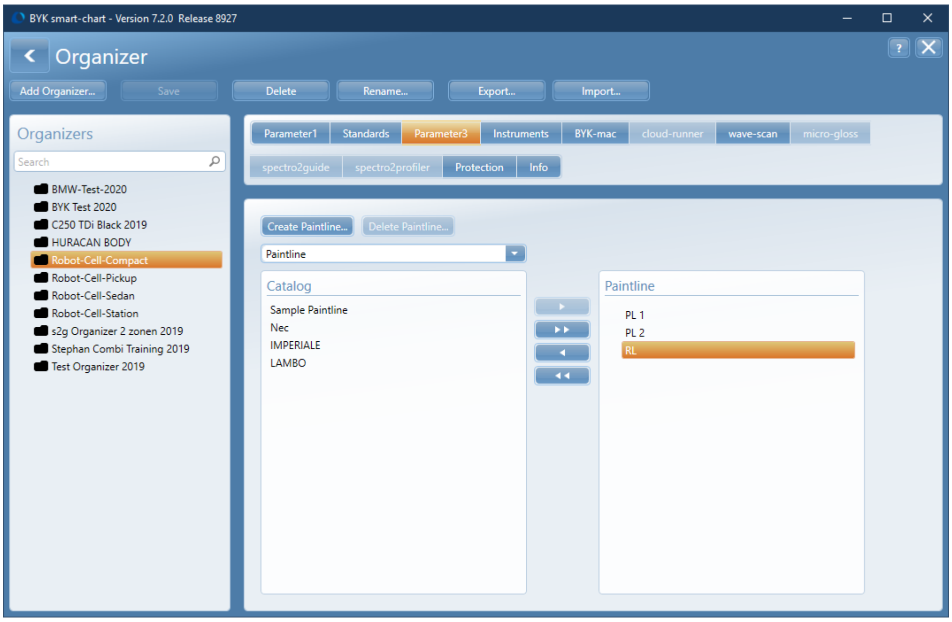

Illustration 84: Organizer and paint lines in smart-chart

For the example tests later on in **smart-robotic** the entries “PL 1”, “PL 2” and “RL” are important.

8.1.4.4 Active Instruments

On the tab **Instruments** the measurement devices to be used can be activated.

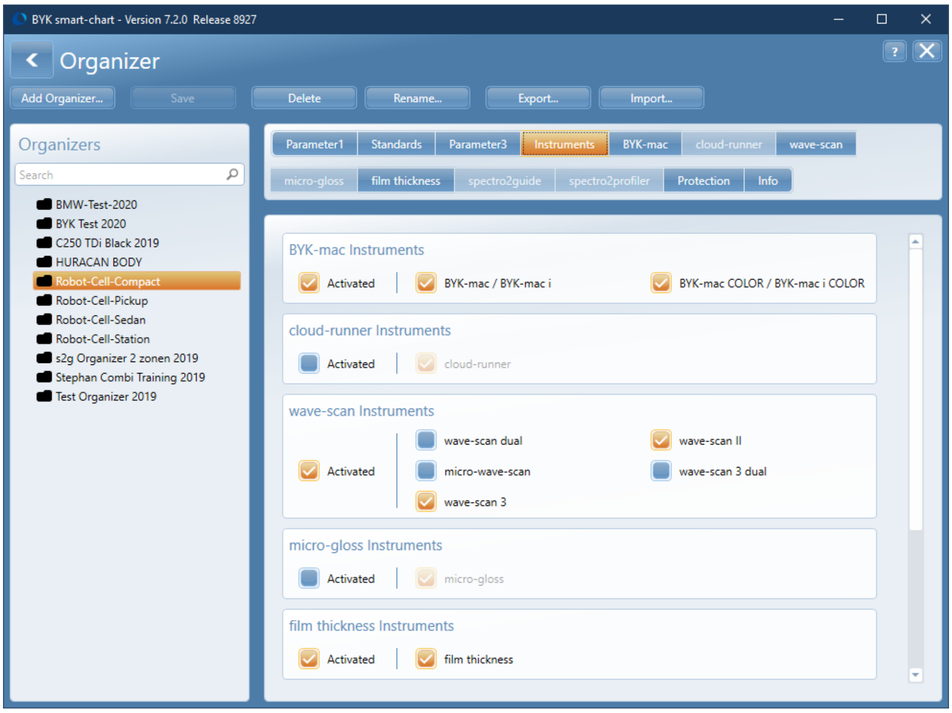

Illustration 85: Organizer and active instruments in smart-chart

For **smart-robotic** the instruments **BYK-mac**, **wave-scan** and **Film Thickness** are important.

8.1.4.5 Check Zones

On the tab **wave-scan** the check zones valid for this device type can be configured. You have following options:

- Settings [▶ 87]
- Test Procedure [▶ 88]

8.1.4.5.1 Settings

On the tab **Settings** the parameters are available for selection which can be configured in the handheld device. These parameters are not relevant for **smart-robotic**.

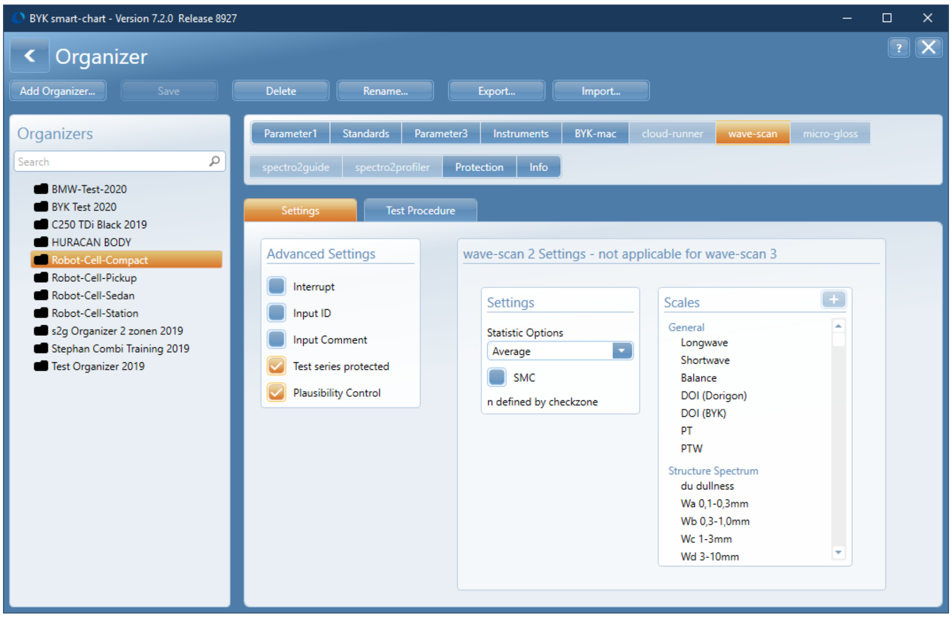

Illustration 86: Organizer settings in smart-chart

The tab provides following options:

- **Advanced Settings**: These settings apply to wave-scan 2 **and** wave-scan 3.
- **Wave-scan 2 Settings**: These settings apply only to the wave-scan 2; they are not required for the wave-scan 3 anymore.

8.1.4.5.2 Test Procedure

On the tab **Test Procedure** the check zones for this type of car can be defined. The appropriate car schematic can be selected and the check zones can be added via Drag & Drop from the catalog.

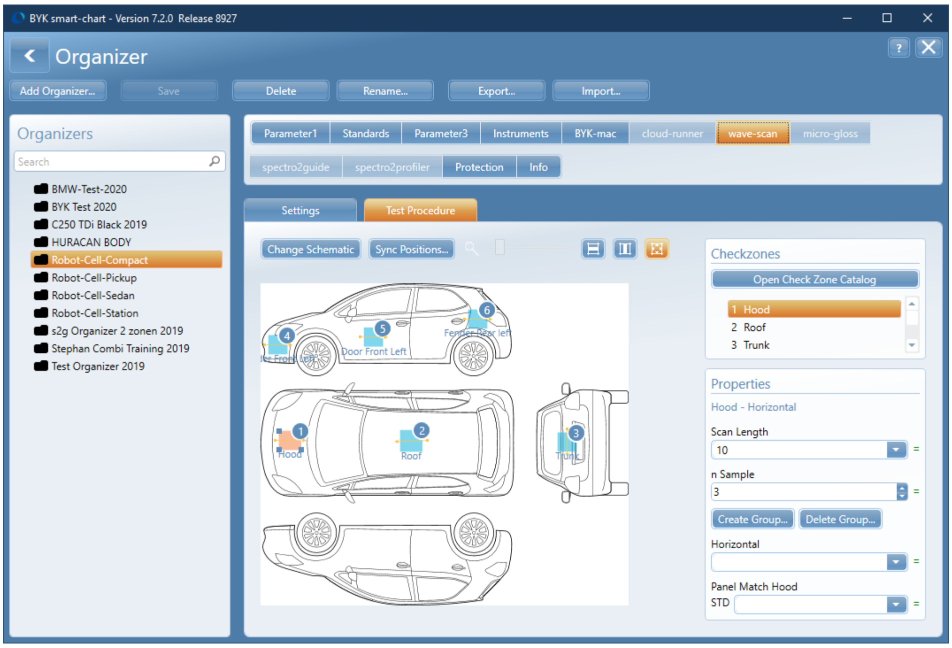

Illustration 87: Organizer check-zones in smart-chart

For this example the following check zones were created:

- "Hood"
- "Roof"
- "Trunk"

All these check zones have the orientation **Horizontal**. These check zones will be used in **smart-robotic** to receive the valid tolerance values for the pass / fail indication.

8.1.5 Data Analysis

The module **Data Analysis** is used to view and evaluate the measurement data. After starting the module the required measurement database is to be selected.

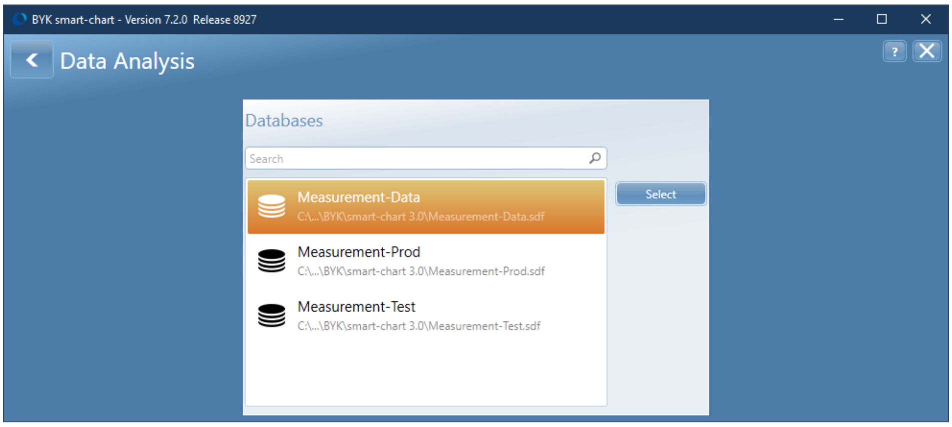

Illustration 88: Data analysis – database selection in smart-chart

After selecting the database the measurement data in this database are displayed.

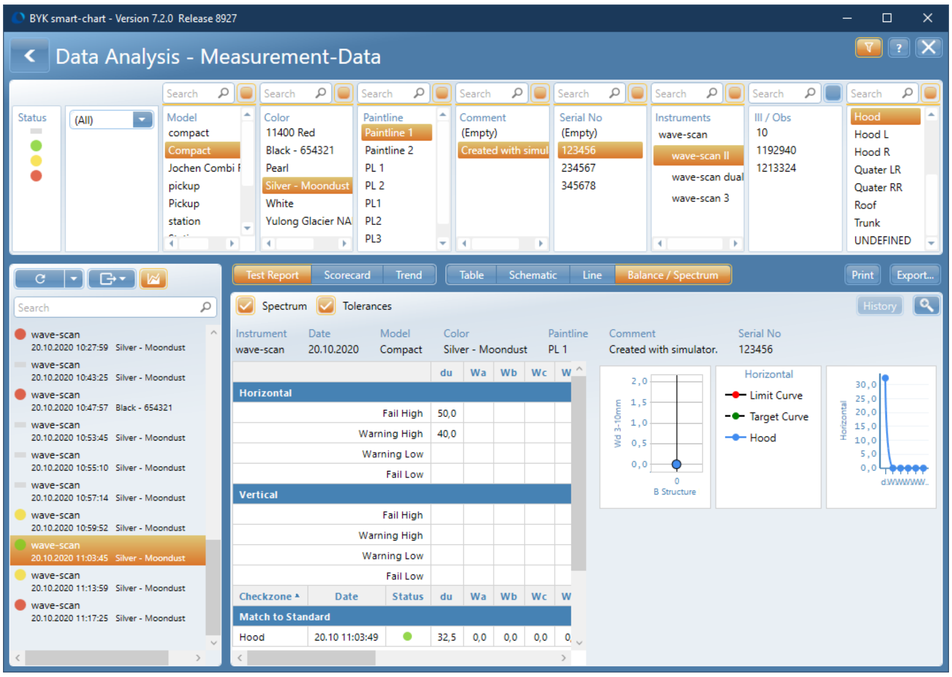

Illustration 89: Data analysis – measurement details in smart-chart

The data display consists of following sections:

- Top: Filter list
- Left: Results list
- Right: Details for selected result

In the example shown above the filter criteria have been selected which will be used in the next step – the measurements with **smart-robotic**.

8.2 Configuration in smart-robotic

The configuration in **smart-robotic** comprises following steps:

- Database [▶ 90]
- wave-scan Settings [▶ 91]
- Color Standards [▶ 98]
- Paint Lines [▶ 98]
- Quality Alarm [▶ 99]

For the creation of this documentation the **wave-scan ROBOTIC** has been used. The configuration of smart-chart link for the **BYK-mac i ROBOTIC** is analogue.

NOTICE

The configuration in **smart-chart** is read by **smart-robotic** during program start. After each change in standards and organizers the program **smart-robotic** has to be restarted.

8.2.1 Standard Database

On the tab **Database** the standards and organizer database “bykmainDB_3.sdf” from **smart-chart** is to be linked.

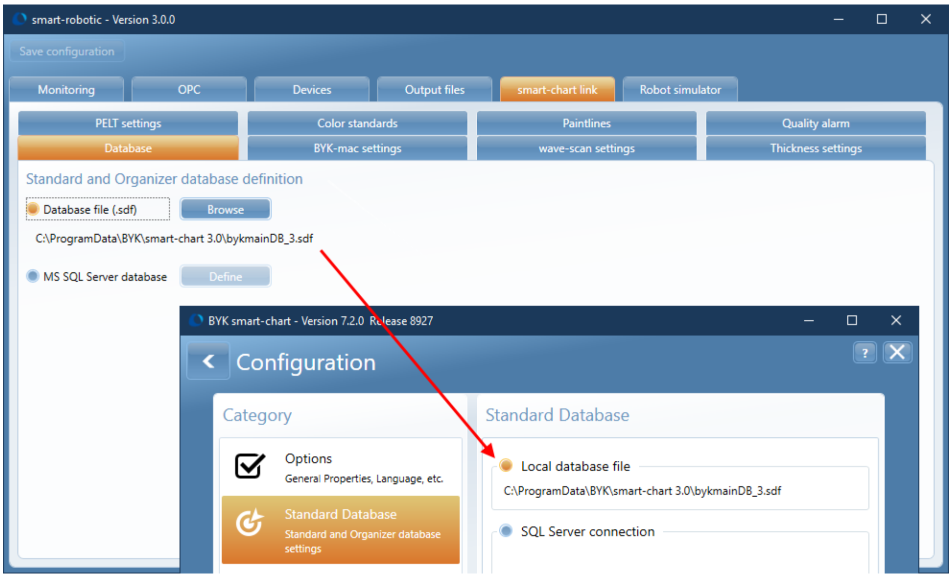

Illustration 90: Link to standard database in smart-robotic

For using a local database, its path is: “C:\ProgramData\BYK\smart-chart 3.0”, see Standard Database [▶ 77].

8.2.2 wave-scan Settings

The **wave-scan settings** comprise following steps:

- Signal Mapping [▸ 91]
- Check Zones [▸ 96]
- Output Database [▸ 97]

8.2.2.1 Signal Mapping

The **smart-chart** data import settings define, how the unprocessed measurement data is linked to **smart-chart** organizers and standards, e.g. target values, tolerances and check zones. A car model can have a different name in the robotic system than defined in the organizer, e.g. the PLC is limited in characters. Therefore, a mapping is required. Following XML file gives an example of a **wave-scan ROBOTIC** device output for unprocessed measurement data.


```
<?xml version="1.0"?>
<wave-scan-robotic>
  <jobdata>
    <timestamp>2020-10-22T14:11:37</timestamp>
    <jobquality>Green</jobquality>
    <carmodel>Compact</carmodel>  ← Model
    <carcolor>Silver</carcolor>  ← Color
    <paintline>Paintline 1</paintline>  ← Paint Line
    <comment>Created with simulator.</comment>
    <vehicleid>123456</vehicleid>  ← Vehicle ID
  </jobdata>
  <points count="1">
  <point>
    <time>2020-10-22T14:11:41</time>
    <serialnr>1213324</serialnr>
    <catalognr>4822</catalognr>
    <status>Green</status>
    <zoneid>1</zoneid>  ← Check Zone Number
    <zone>Front</zone>  ← Check Zone Name
    <scale Id="01  LW" value="0" />
    <scale Id="02  SW" value="0" />
    <scale Id="19  We" value="0" />
    <scale Id="20  Wd" value="0" />
    <scale Id="21  Wc" value="0" />
    <scale Id="22  Wb" value="0" />
    <scale Id="23  Wa" value="0" />
    <scale Id="24  Du" value="38,8" />
  </point>
  </points count>
</wave-scan-robotic>
```


Illustration 91: Example XML output file and mapping

The example file shown above contains meta data including time stamp, car model, color and check points / zones as well as measurement data of the **wave-scan ROBOTIC**. In order to process this data with the corresponding organizer and standard in **smart-chart**, the data must be mapped.

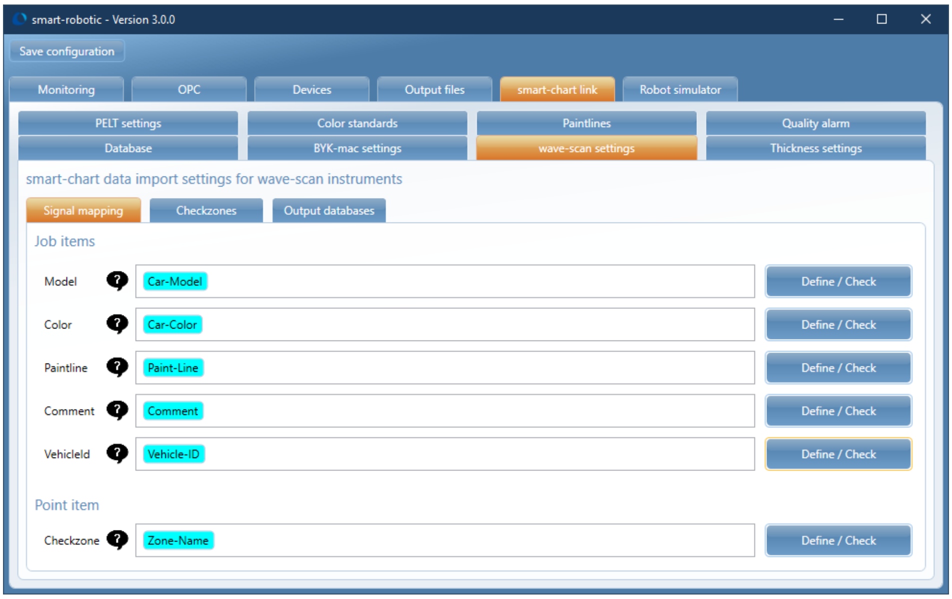

Illustration 92: Signal mapping for wave-scan in smart-robotic

The mapping is to be done for the two types of OPC signals:

- Job Items [▶ 93]
- Point Item [▶ 94]

NOTICE

Below the example device **wave-scan ROBOTIC** is shown. The configuration for the **BYK-mac i ROBOTIC** is analogue.

8.2.2.1.1 Job Items

Click the **Define / Check** button to open the **Definition Designer**.

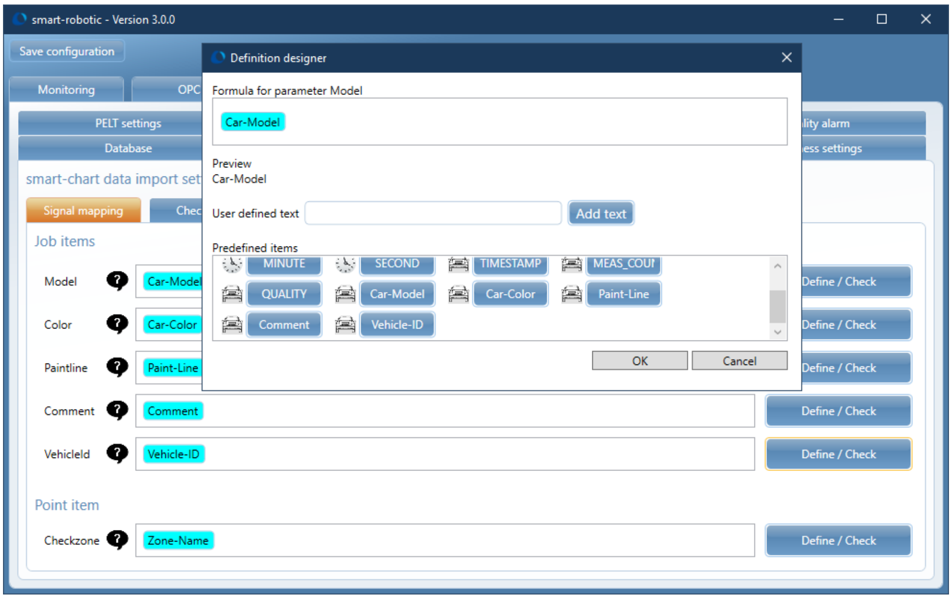

Illustration 93: Job signal mapping for wave-scan in smart-robotic

Use the **Predefined Items** to create the **Formula for Parameter Model**. You can also add **User-defined Text** here – similar to the options described in the Output Files [▸ 67] under Output Filename [▸ 70].

NOTICE

The **Predefined Items** are coming from the OPC [▸ 28] settings > section Common Job Signals [▸ 32]. These signals are common to all devices - they have to be created once in the system.

8.2.2.1.2 Point Item

Click the **Define / Check** button to open the **Definition Designer**.

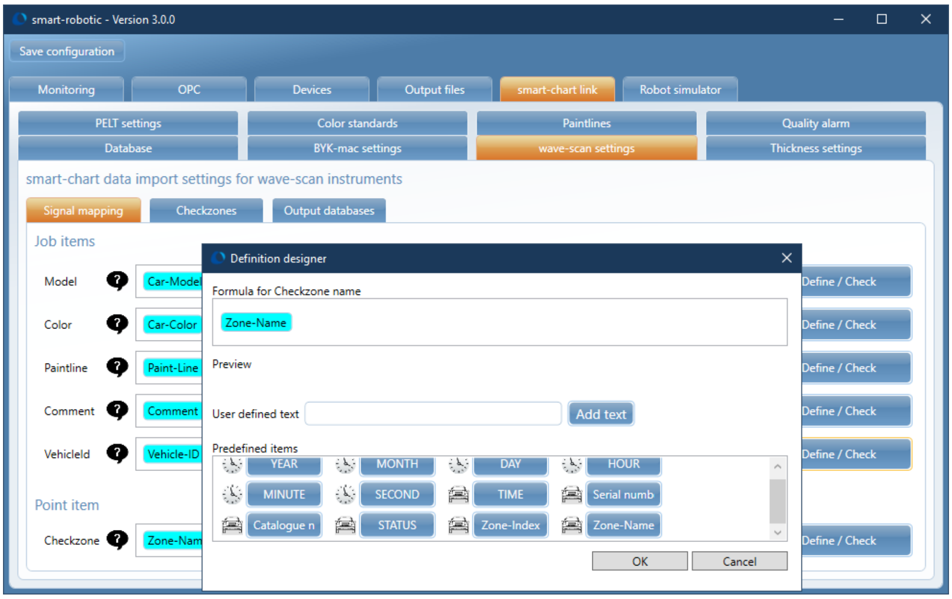

Illustration 94: Point signal mapping for wave-scan in smart-robotic

Use the **Predefined Items** to create the **Formula for Parameter Model**. You can also add **User-defined Text** here – similar to the options described in the Output Files [▶ 67] under Output Filename [▶ 70].

NOTICE

The **Predefined Items** for the wave-scan are coming from the device 4822 - wave-scan ROBOTIC [▶ 55] > section OPC Point Signals [▶ 58] - and from all other devices(!). These signals have to be created separately for each device in the system.

The signal mapping connects the OPC signals containing standard and organizer information with the objects in the **smart-chart** database.

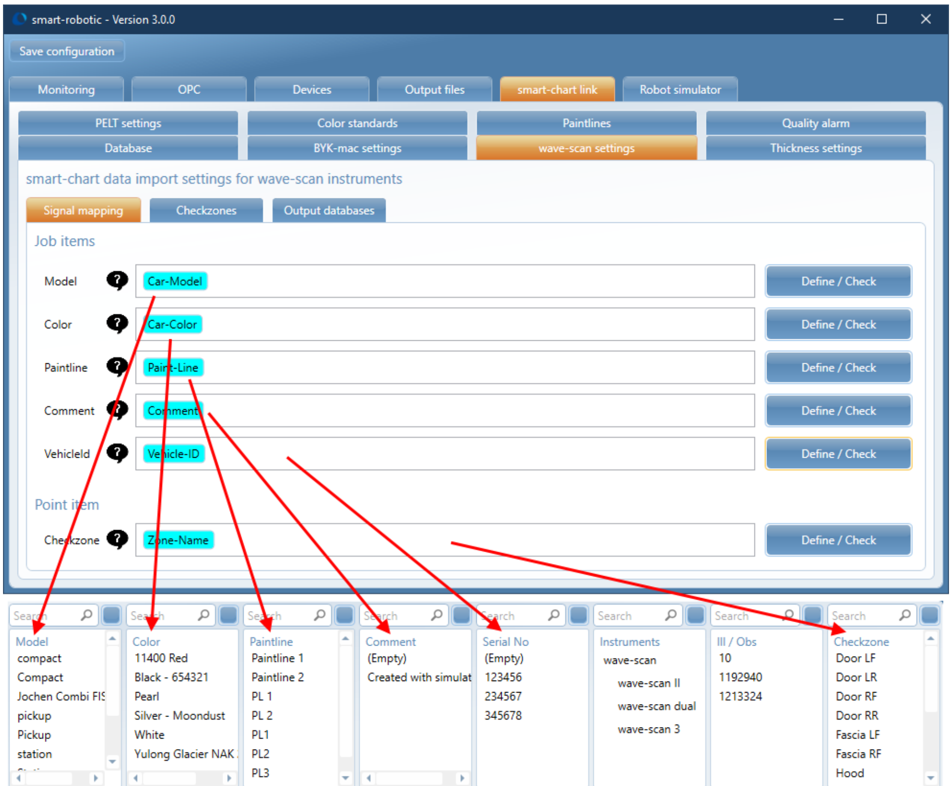

Illustration 95: Signal mapping for wave-scan between smart-robotic and smart-chart

In the **smart-chart** database these data are visible in the module Data Analysis [▸ 89].

8.2.2.2 Check Zones

The organizers created in **smart-chart** are characterized by check zones defined by the user, see Organizers [▶ 82].

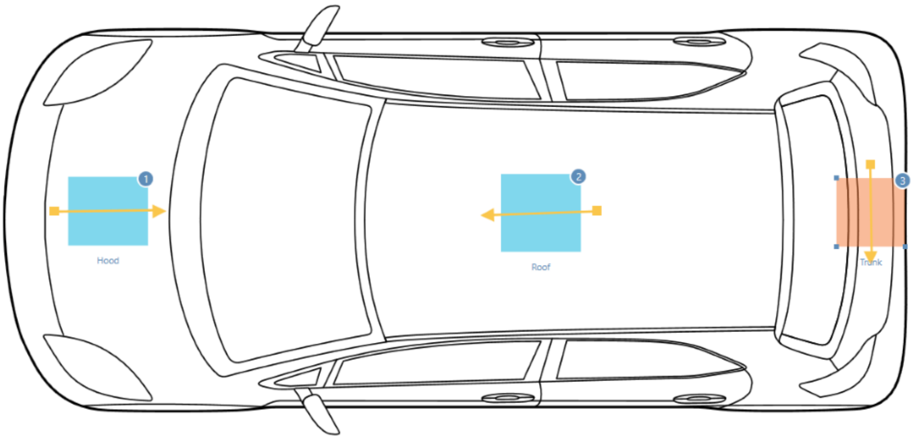

Illustration 96: Definition of organizer check zones in smart-chart

In the PLC environment, check zones are often given technical names different than the naming in **smart-chart** domain. Therefore, also the check zones must be linked.

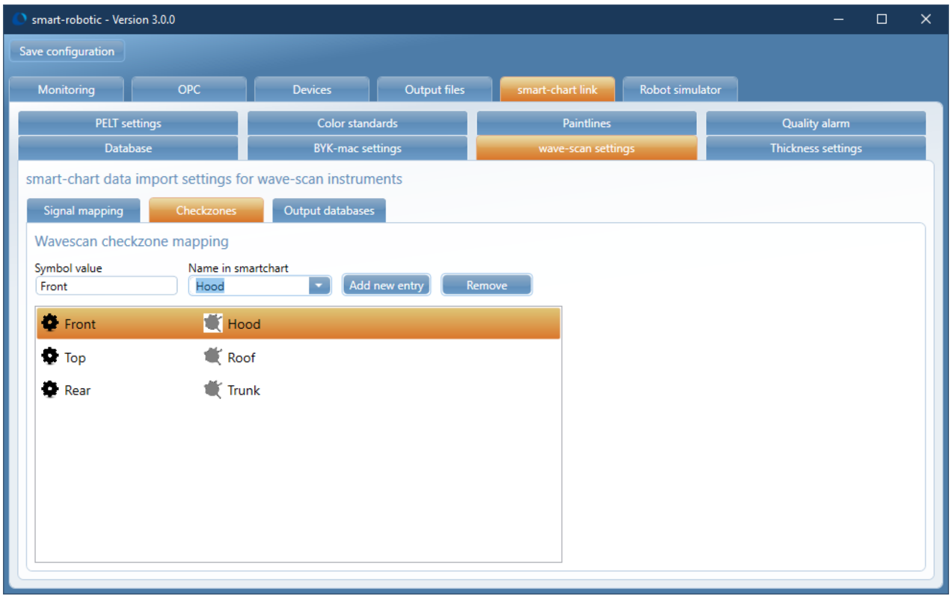

Illustration 97: Check zone mapping for wave-scan in smart-robotic

Perform following steps:

1. **Symbol Value**: Enter the name of the check zone in the PLC domain.
2. **Name in smart-chart**: Open the drop down menu to select the corresponding check zone in smart-chart.
3. **Add new entry**: Click the button to be linked both values.

NOTICE

The names of the check zones in the PLC domain are case-sensitive.

8.2.2.3 Output Database

The section **Output Databases** specifies the measurement database, in which the measurement data is stored, see Measurement Database [▶ 78].

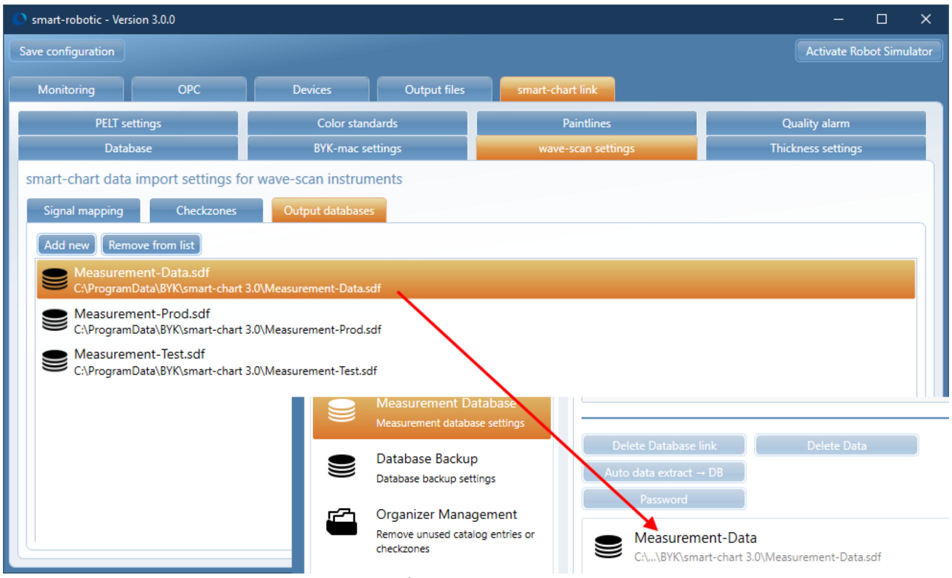

Illustration 98: Measurement database for wave-scan in smart-robotic

New entries can be created using the **Add new** button and selecting the desired option (compact or server) from the context menu.

8.2.3 Color Standards

On the tab **Color Standards** the mapping to the objects in the smart-chart database is to be done, see Standards [▶ 79].

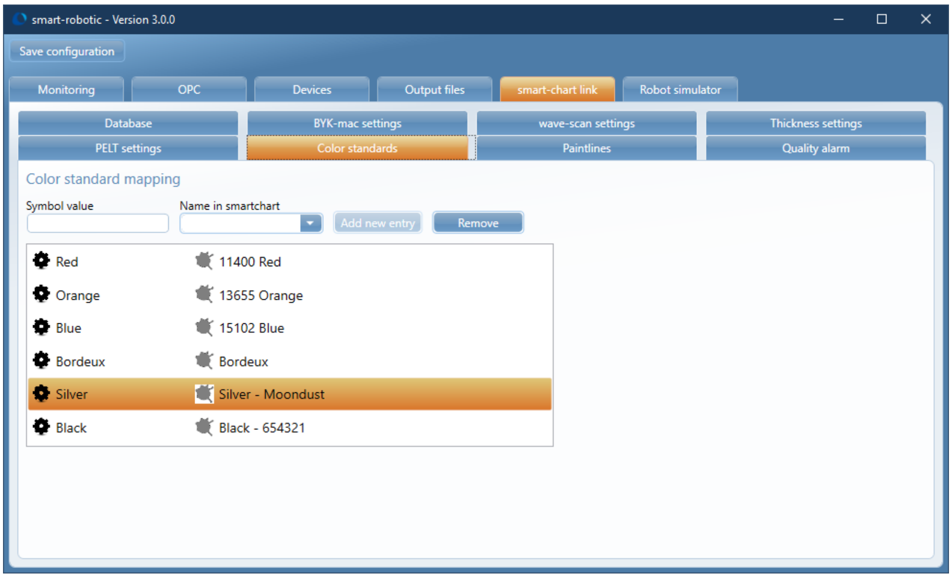

Illustration 99: Smart-Robotic-Color-Standards

The mapping is analogue to the mapping of the Check Zones [▶ 96]. In the example shown above the value “Silver” in smart-robotic is linked to the value “Silver - Moondust” in smart-chart.

8.2.4 Paint Lines

In smart-chart the paint lines are configured in the Organizers [▶ 82], see Paint Lines [▶ 85].

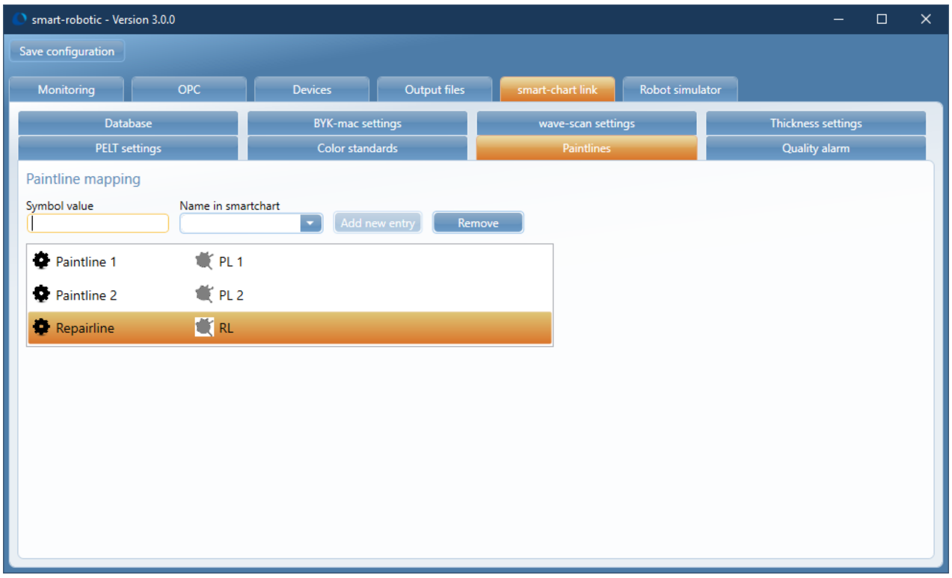

Illustration 100: Paint line mapping in smart-robotic

The mapping is analogue to the mapping of the Check Zones [▶ 96] and the Standards [▶ 79]. In the example shown above the value “Repairline” in smart-robotic is linked to the value “RL” in smart-chart.

8.2.5 Quality Alarm

To give feedback to the PLC about the measurement status of the car body or measured object, the tab **Quality Alarm** can be used.

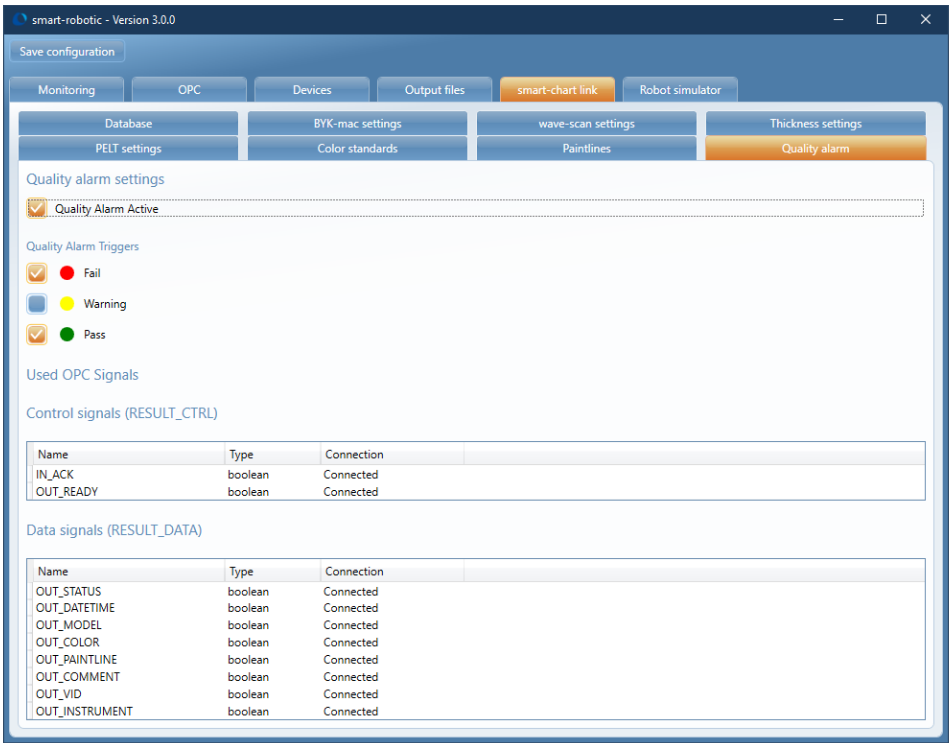

Illustration 101: Quality alarm settings in smart-robotic

Perform following steps:

1. Activate the flag **Quality Alarm Active**.
2. Select the **Quality Alarm Triggers** to be used, see Quality Status [▸ 74].
3. Check the OPC **Control signals**, and the OPC **Data Signals**, see Example List of OPC Signals [▸ 14] and Description of Example List [▸ 16] > Section #8.

An example for each alarm trigger is shown in Testing the Configuration [▸ 100].

NOTICE

It is up to the PLC domain to evaluate these triggers and to communicate the alarm situation.

8.3 Testing the Configuration

To test the configuration perform measurements with **smart-robotic** and check the results in the **smart-chart** database. Perform following steps:

- Prepare Measurements [▶ 100]
- Perform Measurements [▶ 102]
- Check Results [▶ 107]

The test measurements shown below have been made with the **Robot Simulator**.

8.3.1 Prepare Measurements

On the device tab for your current measurement instrument create a check zone which can be mapped to the corresponding check zone in an existing organizer – for example "Front". Enable the device.

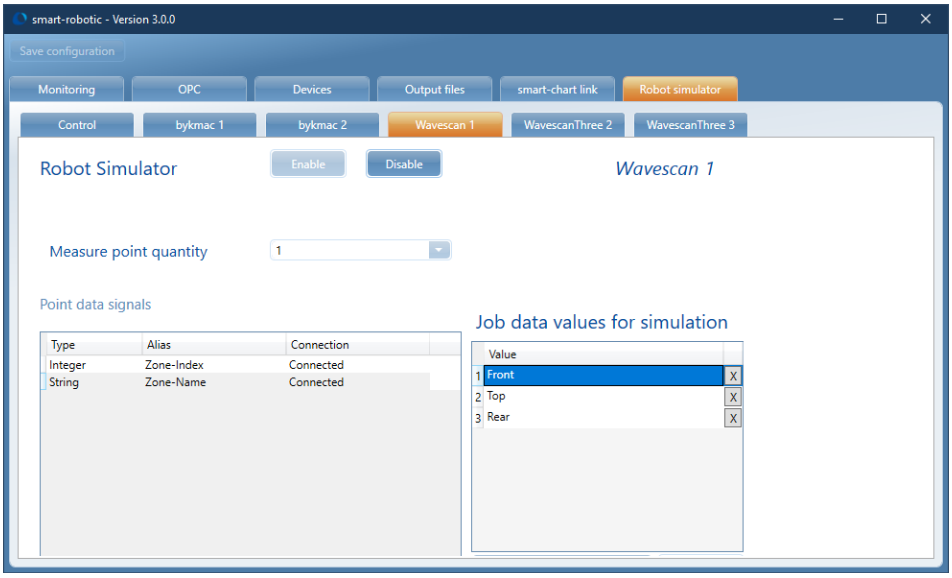

Illustration 102: Test measurement – check zone definition in simulator

On the **Control** tab first create a car model which can be mapped to an existing organizer, for example "Compact".

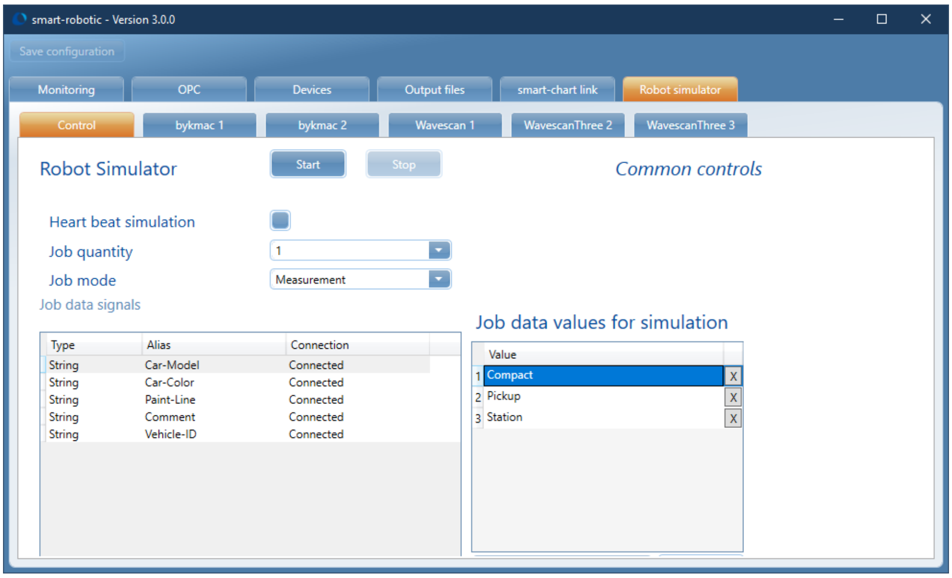

Illustration 103: Test measurement – car model definition in simulator

Second create a car color which can be mapped to a color standard in that organizer, for example “Silver”.

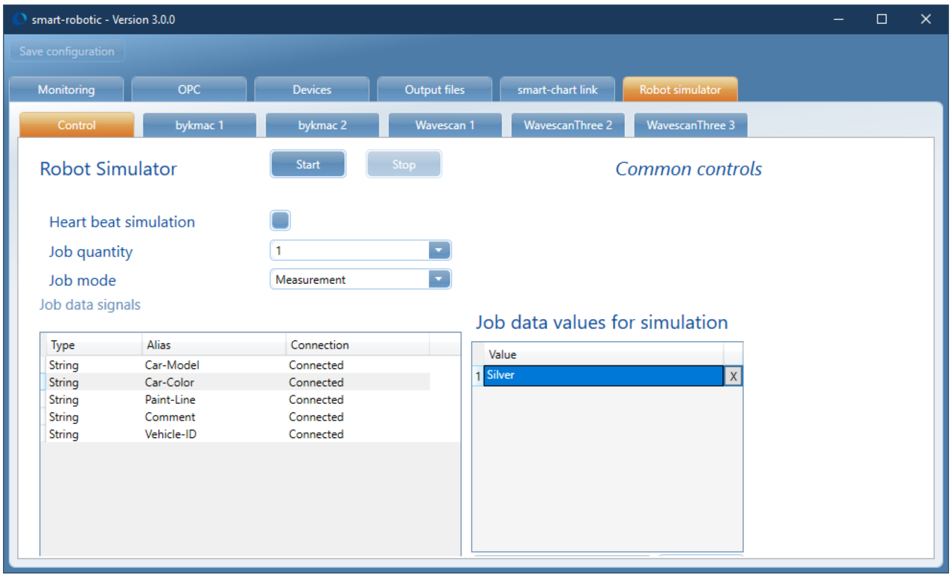

Illustration 104: Test measurement – color standard definition in simulator

Start the simulator and wait for the data output.

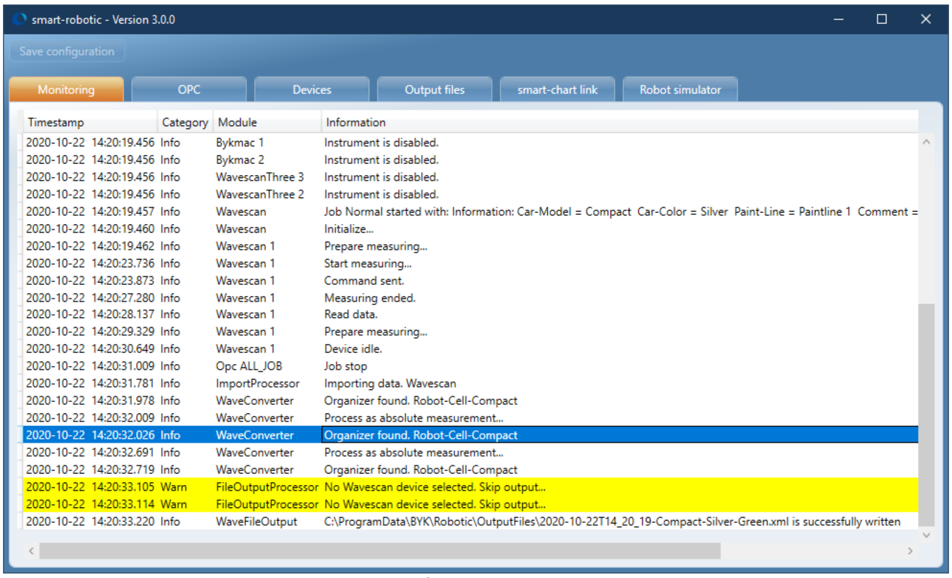

Illustration 105: Test measurement – log for data output in simulator

With the given information the organizer and standard can be found in smart-chart. In the organizer the check zone can be found. In the standard the tolerance values can be found.

NOTICE

1 Make sure the color standard has been added to the organizer, see Standard Selection [▶ 84].

2 Create an additional output file with the quality status as part of the Output Filename [▶ 70].

8.3.2 Perform Measurements

Below an example is shown for each quality status scenario:

- Quality Status "None" [▸ 102]: Standard / organizer not found
- Quality Status "Red" [▸ 104]: Measurement values not in tolerances
- Quality Status "Yellow" [▸ 105]: Measurement values in warning area
- Quality Status "Green" [▸ 106]: Measurement values in tolerances

For the meaning of each status and the impact of each check zone status on the overall job status see Quality Status [▸ 74].

NOTICE

In the following examples the tolerance settings in **smart-chart** will be changed. Remember to restart **smart-robotic** after each change in **smart-chart** in order to read the changed values in the database.

8.3.2.1 Quality Status "None"

The quality status for a check zone will be “None”, if organizer or standard can not be found in the smart-chart database. In this case the simulator will generate the following data output:

- Job Quality = **Green**
- Zone Status = **None**

```
<?xml version="1.0"?>
<wave-scan-robotic>
<jobdata>
<timestamp>2020-10-22T14:20:19</timestamp>
    <jobquality>Green</jobquality>
    <carmodel>Compact</carmodel>
    <carcolor>Silver</carcolor>
    <paintline>Paintline 1</paintline>
    <comment>Created with simulator.</comment>
    <vehicleid>123456</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-10-22T14:20:23</time>
    <serialnr>1213324</serialnr>
    <catalognr>4822</catalognr>
    <status>None</status>
    <zoneid>1</zoneid>
    <zone>Front</zone>
    <scale Id="01 LW" value="0" />
    <scale Id="02 SW" value="0" />
    <scale Id="19 We" value="0" />
    …
    <scale Id="23 Wa" value="0" />
    <scale Id="24 Du" value="38,8" />
</point>
</points count>
</wave-scan-robotic>
```

Check the measurement value for the scale “Dullness (du)”, here: “38,8”. In the following examples this value will be used as base for the modification of the tolerance settings.

8.3.2.2 Quality Status "Red"

Enter a tolerance value, which can not be achieved during measurement.

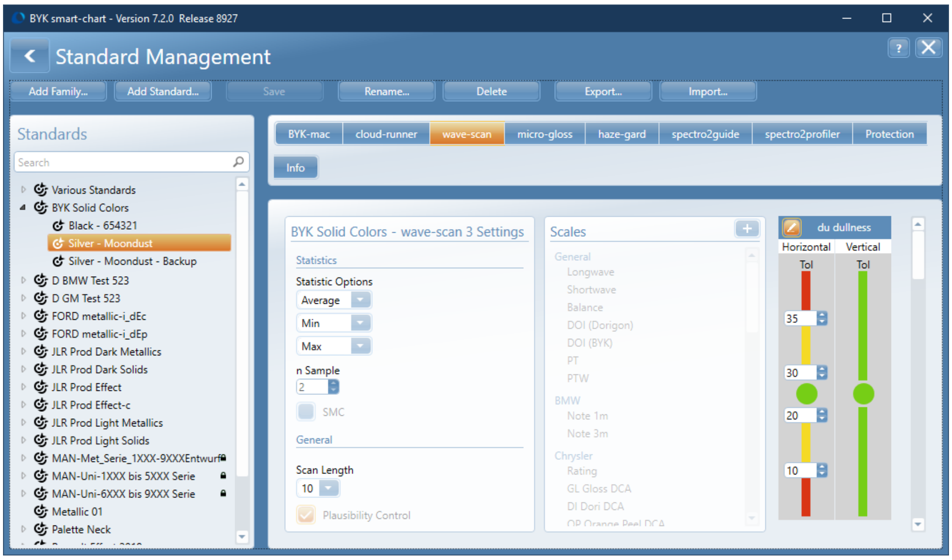

Illustration 106: Test measurement – tolerance for quality status “Red” in smart-chart

In our example the dullness measured is “38,8”. Setting a limit of “35” will give the condition “Red = Out of tolerance”. The simulator will generate the following data output:

- Job Quality = **Red**
- Zone Status = **Red**


```
<?xml version="1.0"?>
<wave-scan-robotic>
<jobdata>
<timestamp>2020-10-22T14:07:09</timestamp>
    <jobquality>Red</jobquality>
    <carmodel>Compact</carmodel>
    <carcolor>Silver</carcolor>
    <paintline>Paintline 1</paintline>
    <comment>Created with simulator.</comment>
    <vehicleid>123456</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-10-22T14:07:13</time>
    <serialnr>1213324</serialnr>
    <catalognr>4822</catalognr>
    <status>Red</status>
    <zoneid>1</zoneid>
    <zone>Front</zone>
    <scale Id="01 LW" value="0" />
    <scale Id="02 SW" value="0" />
    <scale Id="19 We" value="0" />
    …
    <scale Id="23 Wa" value="0" />
    <scale Id="24 Du" value="38,8" />
</point>
</points count>
</wave-scan-robotic>
```

8.3.2.3 Quality Status "Yellow"

Now enter a tolerance value, which will lead the quality status to the condition "Yellow".

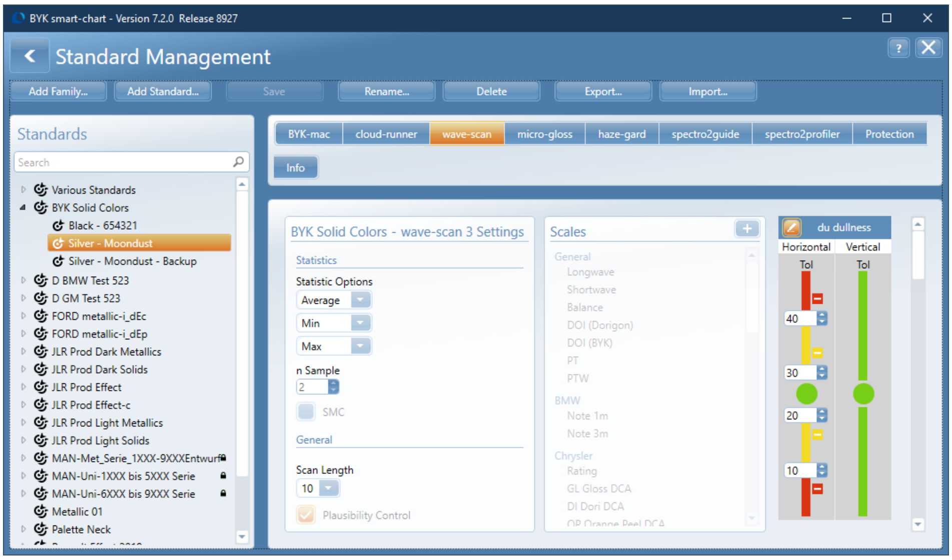

Illustration 107: Test measurement – tolerance for quality status "Yellow" in smart-chart

In the example shown above all values between "10..20" and "30..40" will set the condition "Yellow = In warning area". The simulator will generate the following data output:

- Job Quality = **Yellow**
- Zone Status = **Yellow**


```
<?xml version="1.0"?>
<wave-scan-robotic>
<jobdata>
<timestamp>2020-10-22T14:04:25</timestamp>
    <jobquality>Yellow</jobquality>
    <carmodel>Compact</carmodel>
    <carcolor>Silver</carcolor>
    <paintline>Paintline 1</paintline>
    <comment>Created with simulator.</comment>
    <vehicleid>123456</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-10-22T14:04:29</time>
    <serialnr>1213324</serialnr>
    <catalognr>4822</catalognr>
    <status>Yellow</status>
    <zoneid>1</zoneid>
    <zone>Front</zone>
    <scale Id="01 LW" value="0" />
    <scale Id="02 SW" value="0" />
    <scale Id="19 We" value="0" />
    …
    <scale Id="23 Wa" value="0" />
    <scale Id="24 Du" value="38,8" />
</point>
</points count>
</wave-scan-robotic>
```

8.3.2.4 Quality Status "Green"

Now enter a tolerance value, which will lead the quality status to the condition "Green".

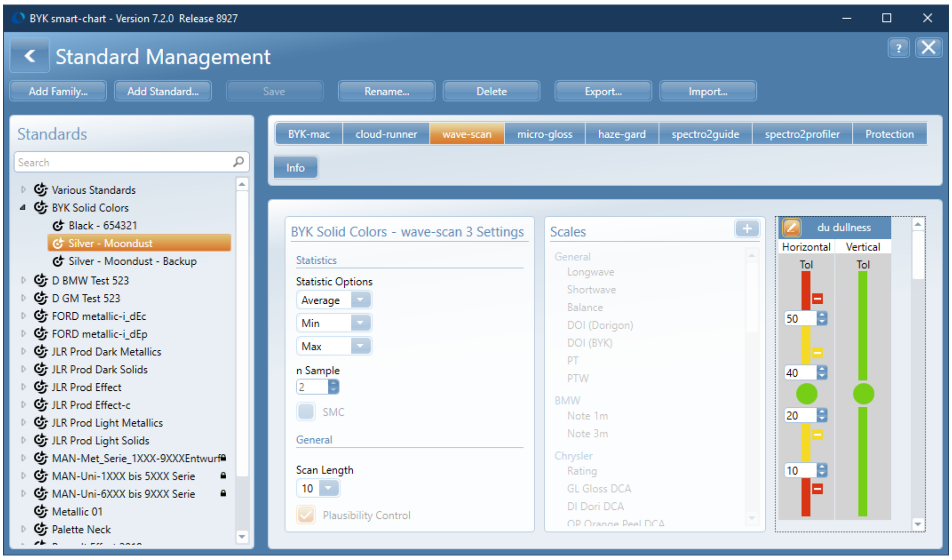

Illustration 108: Test measurement – tolerance for quality status "Green" in smart-chart

In the example shown above all values between "20..40" will set the condition "Green = Within tolerances". The simulator will generate the following data output:

- Job Quality = **Green**
- Zone Status = **Green**


```
<?xml version="1.0"?>
<wave-scan-robotic>
<jobdata>
<timestamp>2020-10-22T14:11:37</timestamp>
    <jobquality>Green</jobquality>
    <carmodel>Compact</carmodel>
    <carcolor>Silver</carcolor>
    <paintline>Paintline 1</paintline>
    <comment>Created with simulator.</comment>
    <vehicleid>123456</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-10-22T14:11:41</time>
    <serialnr>1213324</serialnr>
    <catalognr>4822</catalognr>
    <status>Green</status>
    <zoneid>1</zoneid>
    <zone>Front</zone>
    <scale Id="01 LW" value="0" />
    <scale Id="02 SW" value="0" />
    <scale Id="19 We" value="0" />
    …
    <scale Id="23 Wa" value="0" />
    <scale Id="24 Du" value="38,8" />
</point>
</points count>
</wave-scan-robotic>
```

8.3.3 Check Results

Final step is the check of the measurement results in the **smart-chart** database using the module Data Analysis [▶ 89].

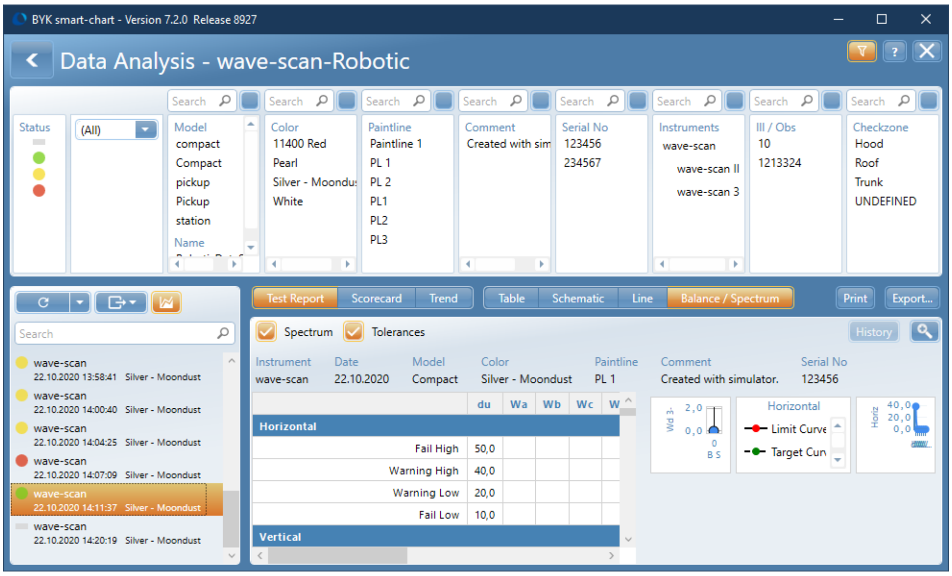

Illustration 109: Test measurements – data analysis in smart-chart

With this check the configuration of **smart-chart link** for the **wave-scan ROBOTIC** is complete. You can now configure the **BYK-mac i ROBOTIC** analogue.

8.4 Thickness Measurement

The software **smart-robotic** can process measurement data from **Fisher** thickness measurement instruments:

- https://www.helmut-fischer.com

In difference to the BYK-Gardner instruments **BYK-mac i ROBOTIC** and **wave-scan ROBOTIC** the thickness measurement instruments are not controlled by **smart-robotic**.

These instruments create XML files which can be processed by **smart-robotic**.

NOTICE

The XML files are required in a specific structure to be processed by **smart-robotic**. Details see below.

8.4.1 Prerequisites

Understanding of following topics is required:

- Configuration of Output Files [▶ 67]
- Configuration in smart-chart [▶ 77]
- Configuration in smart-robotic [▶ 90]

These topics are about the BYK-Gardner ROBOTIC instruments. In the following the differences are described.

8.4.2 Input XML File

The XML data file to be processed by **smart-robotic** needs to include following information:

```
<scale Id ="102" value ="<mic-value>"></scale>
```

or

```
<scale Id ="103" value ="<mil-value>"></scale>
```

Each entry for a scale has the following syntax:

1. The “Scale ID” is the name of the thickness scale used.
2. The “Value” is the measurement for the thickness in **µm** or **mil**.

A complete XML data file may look like the following example.


```
<?xml version="1.0"?>
<byklink_service_thickness>
<jobdata>
<timestamp>2020-10-30T11:16:00</timestamp>
<Comment>This is a comment.</Comment>
<Paintline>X</Paintline>
<Model>Compact</Model>
<VID>Vehicle 12458</VID>
<Color>White</Color>
<Body_type>4DR</Body_type>
</jobdata>
<points count="2">
<point>
<deviceid>1210833</deviceid>
<timestamp>2020-10-30T11:16:00</timestamp>
<Checkzone>Front</Checkzone>
<PartNo>01</PartNo >
<PointNo>08</PointNo >
<Name>SAMPLE 01</Name>
<scale Id ="112 (mic/µm)" value ="302"></scale>
</point>
<point>
<deviceid>1210833</deviceid>
<timestamp>2020-10-30T11:16:00</timestamp>
<Checkzone>Top</Checkzone>
<PartNo>02</PartNo >
<PointNo>09</PointNo >
<Name>SAMPLE 02</Name>
<scale Id ="112 (mic/µm)" value ="259"></scale>
</point>
</points>
</byklink_service_thickness>
```


With this information **smart-robotic** can search for the corresponding standard in the **smart-chart** standard database and save the measured values in the results database – including pass / fail indication.

8.4.3 Configuration in smart-chart

The configuration in **smart-chart** comprises following steps:

1. License File [▸ 109]
2. Color Standard [▸ 110]
3. Organizer Instruments [▸ 112]
4. Organizer Settings [▸ 112]
5. Organizer Procedure [▸ 113]

These steps are described below.

8.4.3.1 License File

For the thickness measurement instruments a separate license is required.

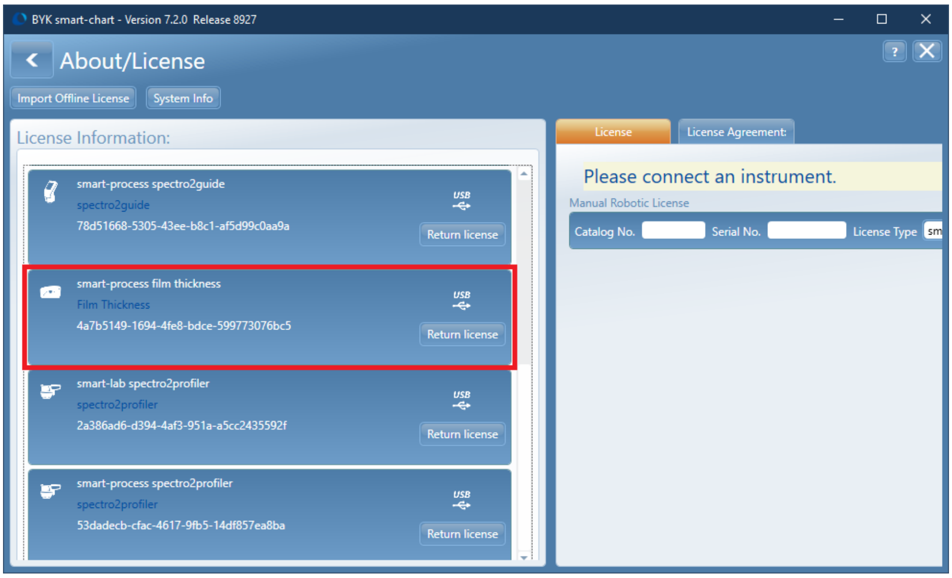

Illustration 110: License information in smart-chart

With this license the thickness measurement instruments can be activated in the organizers, see Organizer Instruments [▸ 112].

8.4.3.2 Color Standard

In each used color standard the scale for the thickness measurement is to be added. For the **Fisher** instruments the scale **Thickness** in **µm** or **mil** is relevant.

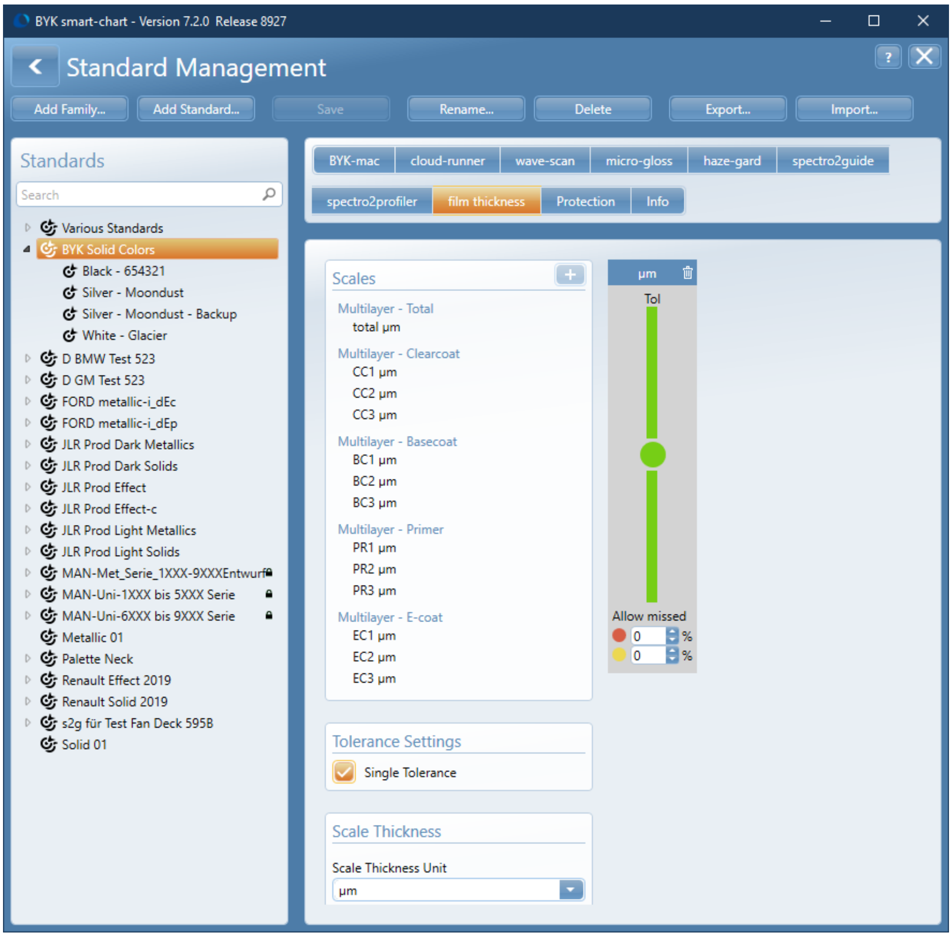

Illustration 111: Color standard family in smart-chart

In the scale **µm** the tolerance value(s) for the pass / fail indication have to be entered. This can be once done for all colors in the family or separately for each color.

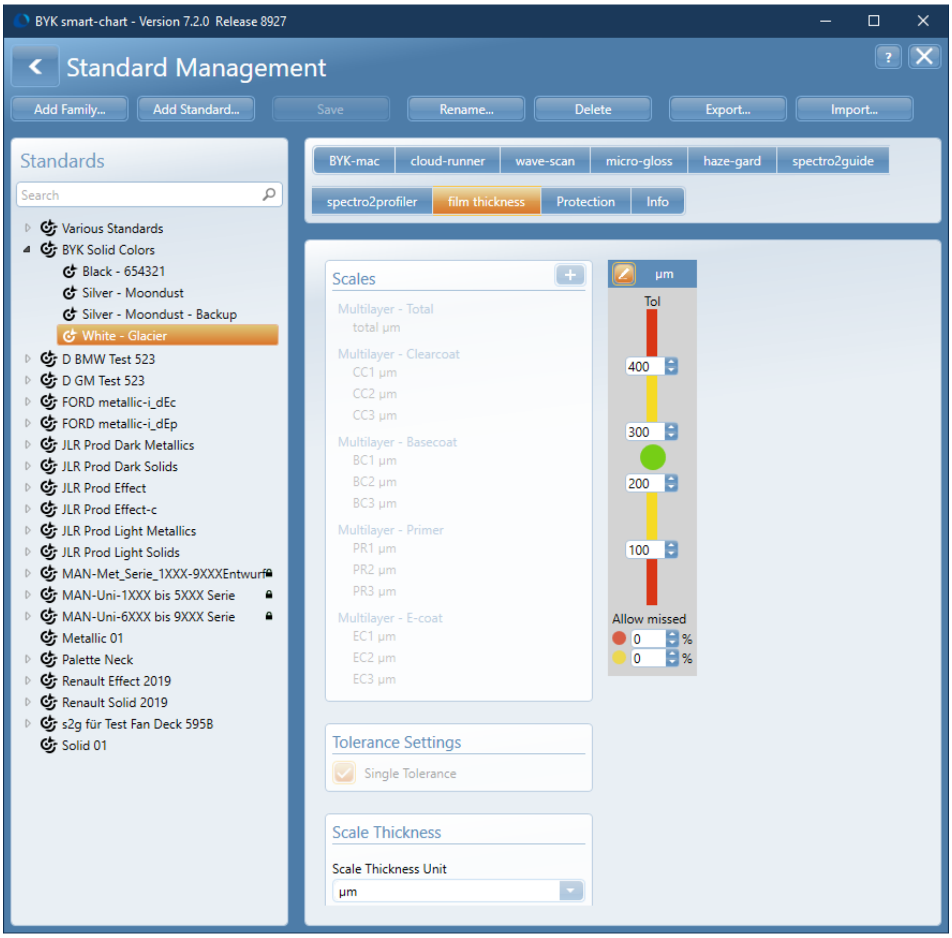

Illustration 112: Color standard details in smart-chart

In the example shown above for the color standard “White - Glacier” following tolerances have been set:

- < 100 = Red
- 100..200 = Yellow
- 200..300 = Green
- 300..400 Yellow
- > 400 = Red

These tolerances will be used in the description below.

NOTICE

Refer also to Allow Missed [▶ 138] for more information on color standards.

8.4.3.3 Organizer Instruments

In the **Organizer** on the tab **Instruments** the option **film thickness** is to be activated.

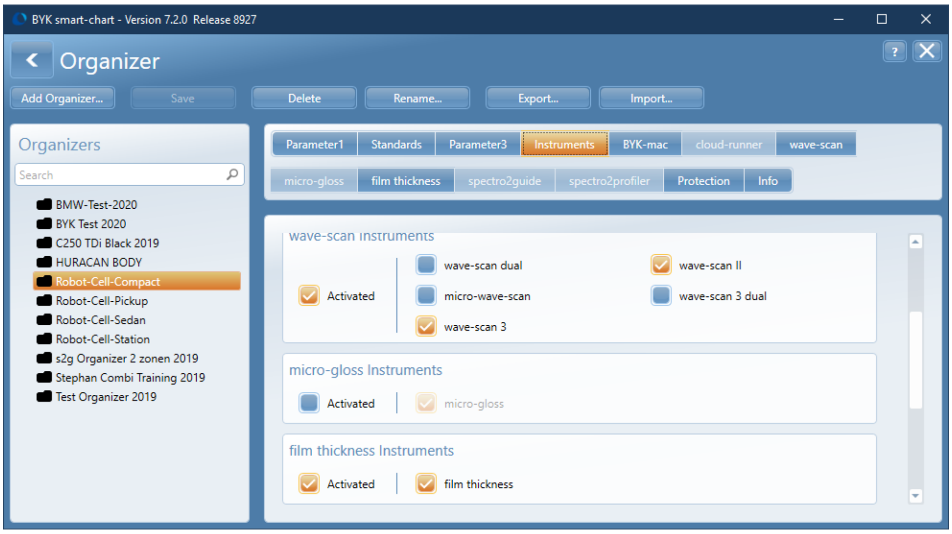

Illustration 113: Organizer instruments in smart-chart

With activated option this organizer becomes relevant for the thickness measurements.

8.4.3.4 Organizer Settings

In the module **Organizer** on the tab **Settings** the correct **Scale Thickness Unit** is to be selected.

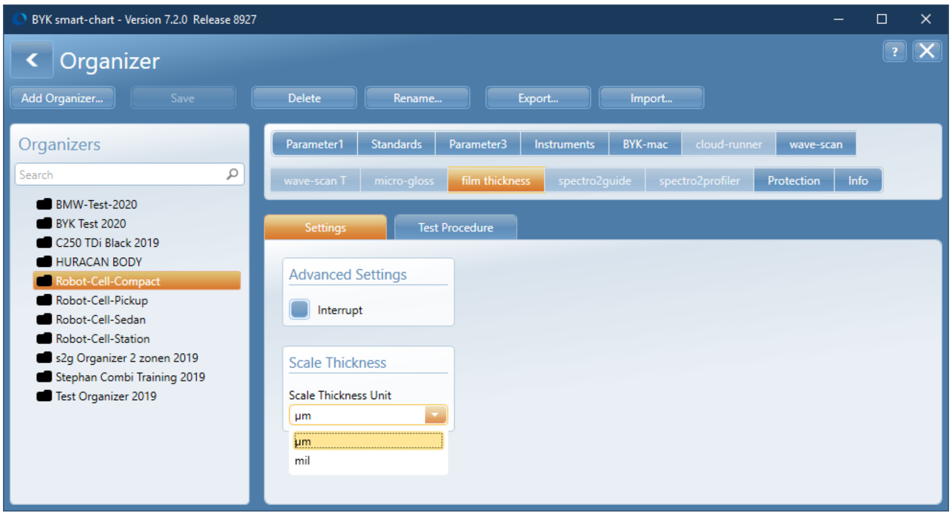

Illustration 114: Organizer settings in smart-chart

Following options are supported:

- Micrometer: **µm**
- Mil: **mil**

Following table shows the conversion.

mil	inch	µm	mm
1	0.001	2.54	0.0254

The option **Interrupt** allows a test series to be aborted before all check zones in the organizer have been measured.

8.4.3.5 Organizer Procedure

In the **Organizer** on the tab **Test Procedure** the check zones are defined.

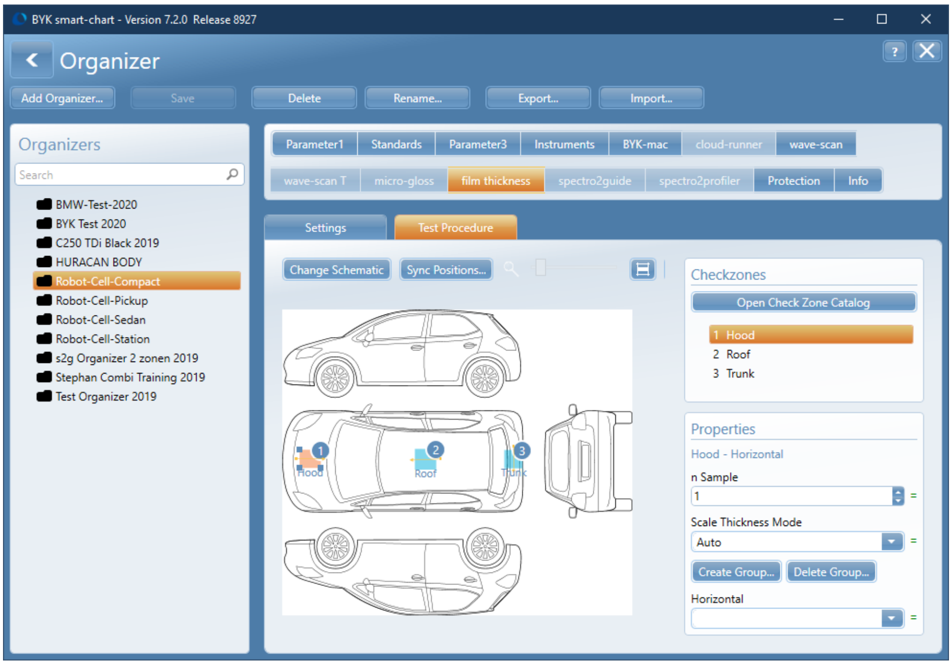

Illustration 115: Organizer procedure in smart-chart

In the box **Properties** the **Scale Thickness Mode** is to be selected. Following options are supported:

- Ferrous metal: **FE**
- Non-ferrous metals: **NFE**
- Detection of metal: **Auto**

With this step the configuration in **smart-chart** is complete.

8.4.4 Configuration in smart-robotic

The configuration in **smart-robotic** comprises following steps:

1. Source Folders [▸ 113]
2. Symbol Mapping [▸ 114]
3. Check Zones [▸ 116]
4. Output Databases [▸ 116]
5. Color Standards [▸ 117]
6. Paint Lines [▸ 117]
7. Output Files [▸ 118]

These steps are described below.

8.4.4.1 Source Folders

In **smart-chart link** on the tab **Thickness Settings** selected directories can be set to monitoring. If an XML file is placed in a monitored directory it is processed automatically by **smart-robotic**.

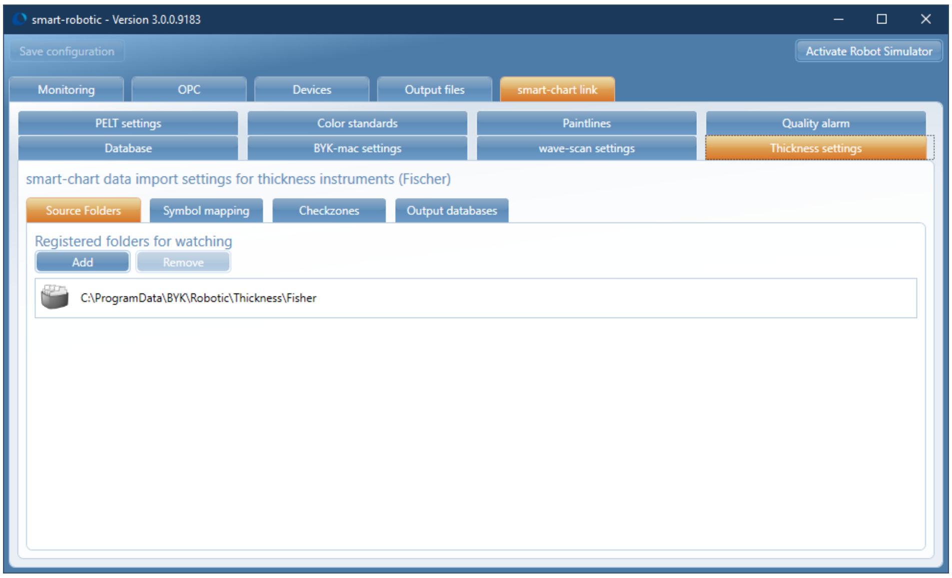

Illustration 116: Monitored thickness-folders in smart-robotic

You have following options:

- **Add**: Click this button to select a directory for monitoring.
- **Remove**: The selected directory will not be monitored anymore.

An existing folder can be added or a new folder can be created in the browse dialog.

8.4.4.2 Symbol Mapping

The measurement data of the thickness measurement system can use own parameter names. Thus the parameter names of the thickness measurement system must be mapped to the corresponding parameter names in **smart-chart**.

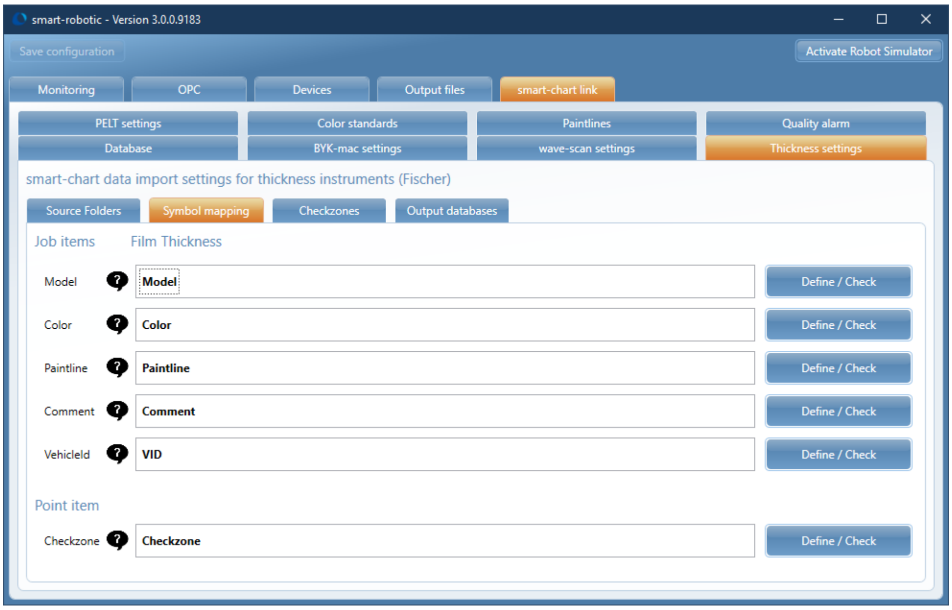

Illustration 117: Thickness parameter mapping in smart-robotic

Perform following steps:

1. Click the button **Define / Check** beside a parameter.
2. Load an XML data file from the **Fisher** system.
3. Select the corresponding parameter in the file.
4. Click the button **Add XML Node**.

5. Save with the button **OK**.

When you open the dialog the 1st time, it is empty.

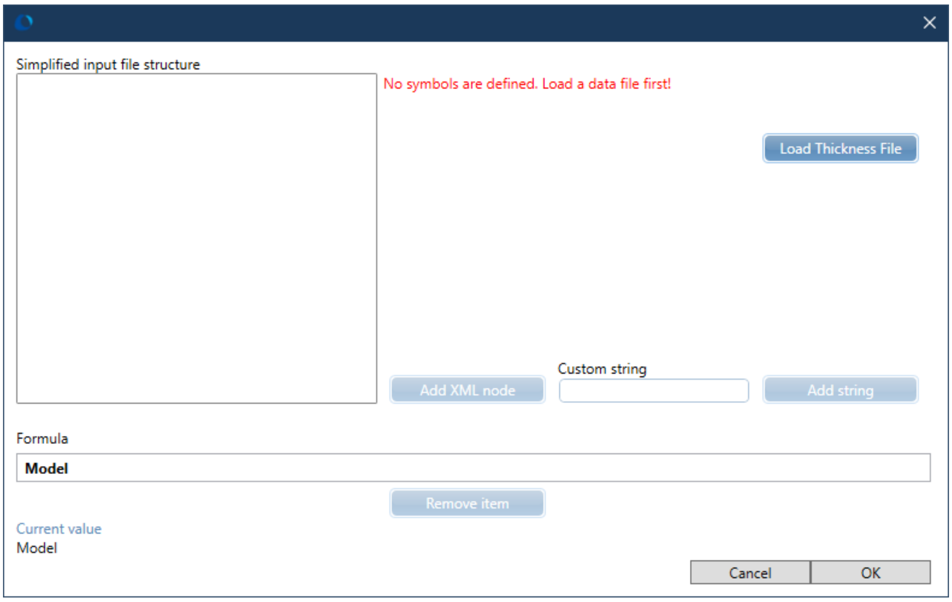

Illustration 118: Thickness parameter mapping – initial state

Click the button **Load Thickness File** to open an existing XML file.

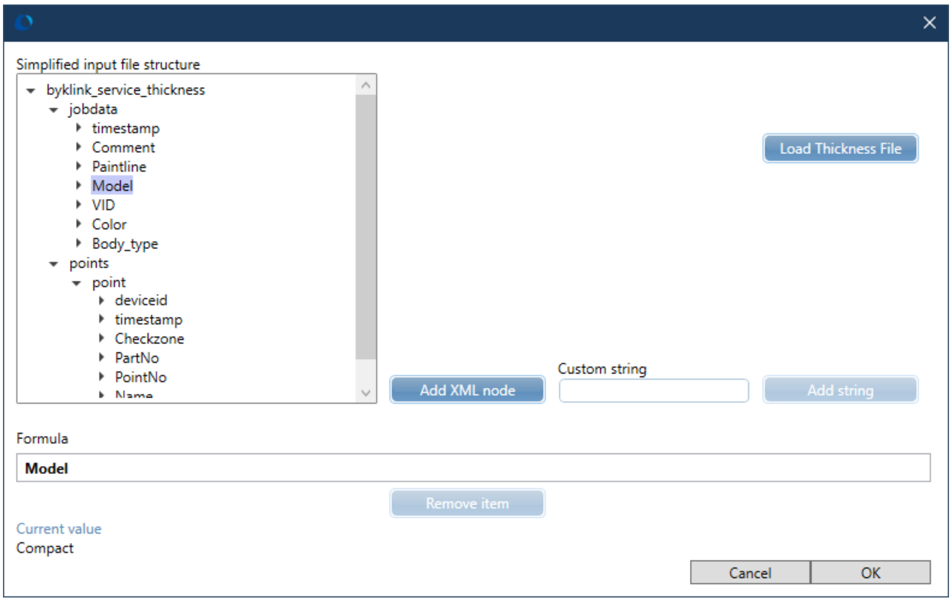

Illustration 119: Thickness parameter mapping – final state

Following rules apply:

- When you open the dialog a 2nd time during the same session, the previous XML file is still loaded.
- The option **Custom String** can be used to combine parameters and or fix text, for example "Model - Color".
- The output field **Formula** shows the current selection.
- The output field **Current Value** shows the content of the fields in the current selection.

Repeat this procedure for all **Job Items** and for the **Point Item**.

8.4.4.3 Check Zones

The measurement data of the thickness measurement system can use own check zone names. Thus the check zone names of the thickness measurement system must be mapped to the corresponding check zone names in **smart-chart**.

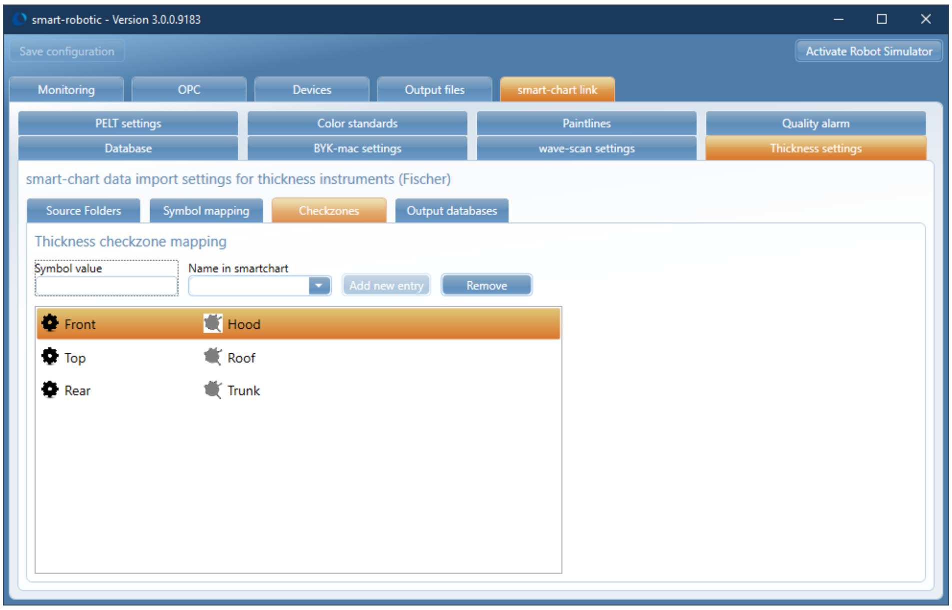

Illustration 120: Check zones for thickness measuring in smart-robotic

Perform following steps:

1. Enter the **Symbol Value** present in the input XML file.
2. Select the corresponding **Name in smart-chart** from the combo box.

Repeat this procedure for all other check zones present in the input XML file.

8.4.4.4 Output Databases

Final step on the **Thickness Settings** tab is the selection of the measurement database in **smart-chart**.

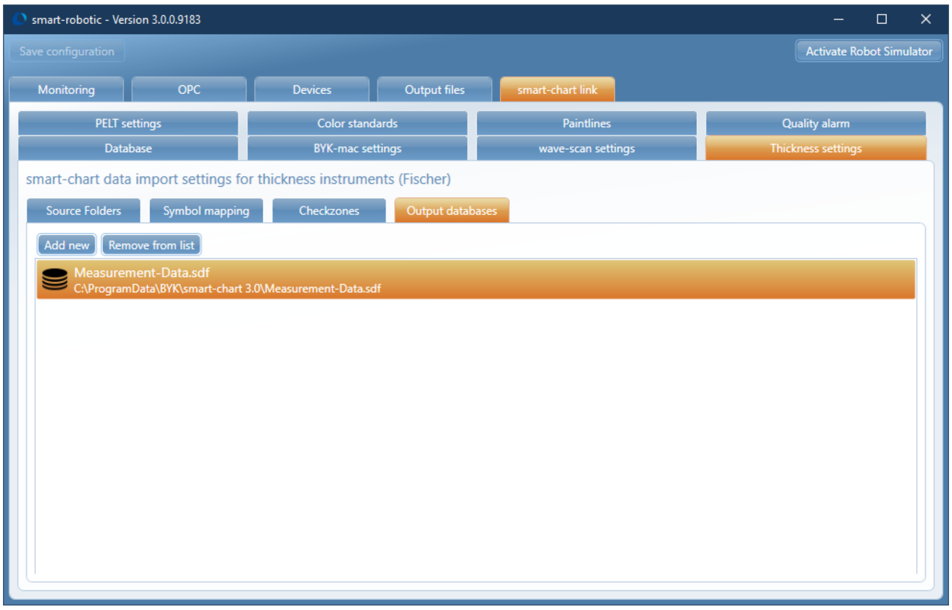

Illustration 121: Output database for thickness measuring in smart-robotic

In this database the results from the thickness input XML files will be stored.

8.4.4.5 Color Standards

If the thickness input XML files use additional values for the color, these values are also to be mapped on the **Color Standards** tab.

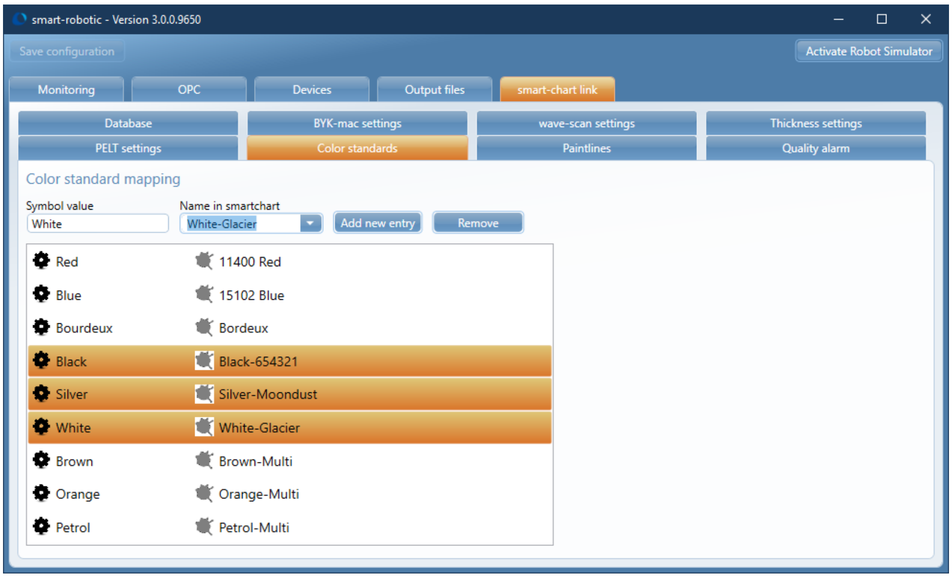

Illustration 122: Color mapping for thickness measuring in smart-robotic

In the example shown above the highlighted colors are mapped to the corresponding entries in the color family “BYK Solid Colors”, see Color Standard [▶ 110].

8.4.4.6 Paint Lines

If the thickness input XML files use different values for the identification of the paint line, these values are also to be mapped on the **Paint Lines** tab.

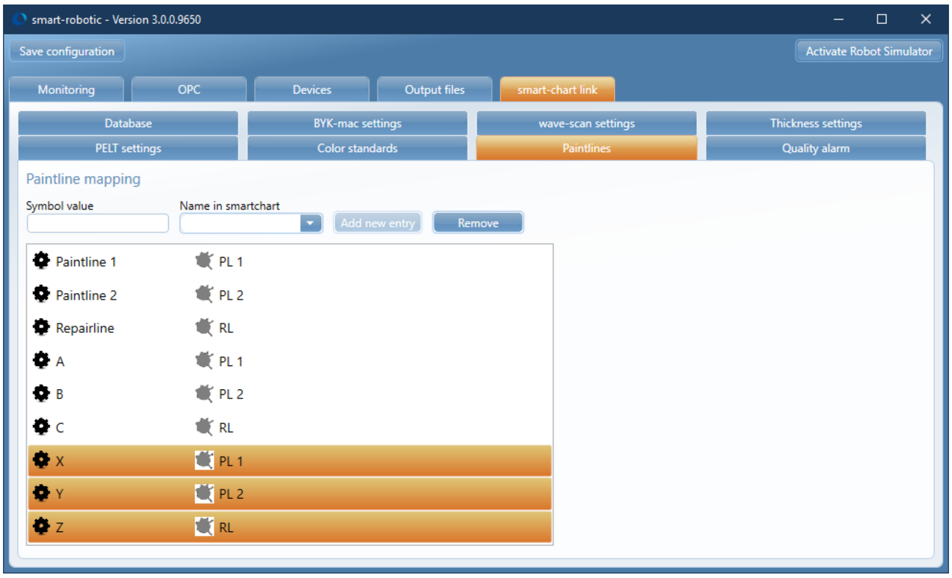

Illustration 123: Paint line mapping for thickness measuring in smart-robotic

In the example shown above the input values X / Y / Z are mapped to PL 1 / PL 2 / RL.

8.4.4.7 Output Files

This step is optional. Output Files [▸ 67] can be configured, if the Quality Status [▸ 74] is required for further processing.

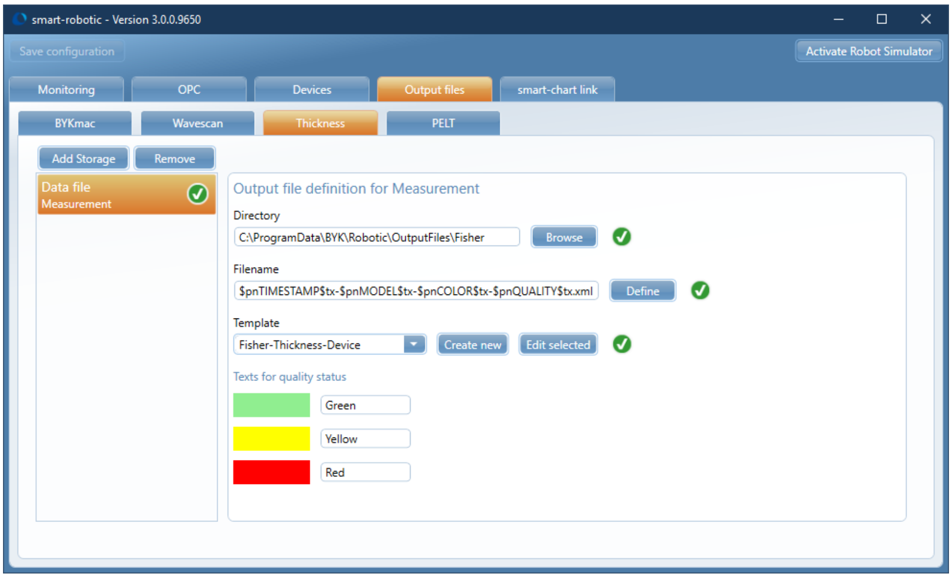

Illustration 124: Output file configuration for thickness measuring in smart-robotic

The configuration of the **Filename** is similar to that for the BYK-Gardner devices, see Output Filename [▸ 70].

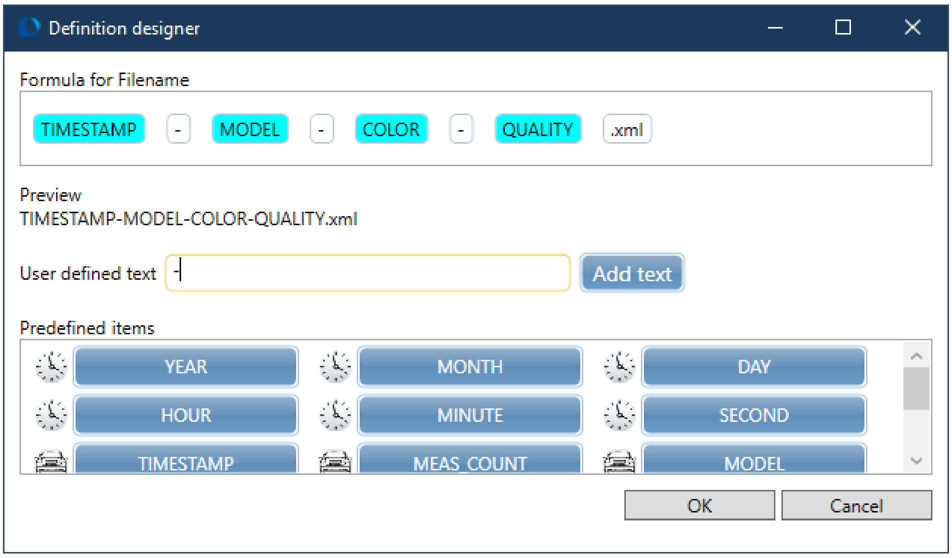

Illustration 125: Output file name configuration for thickness measuring in smart-robotic

The configuration of the **Template** file is similar to that for the BYK-Gardner devices, see Template File [▸ 71]. The differences are:

- There is a new option **Thickness Scales** under **Predefined Items**.
- OPC signals are NOT relevant here, instead the values from **smart-chart link** > **Thickness** are used.

This is shown in the following example.

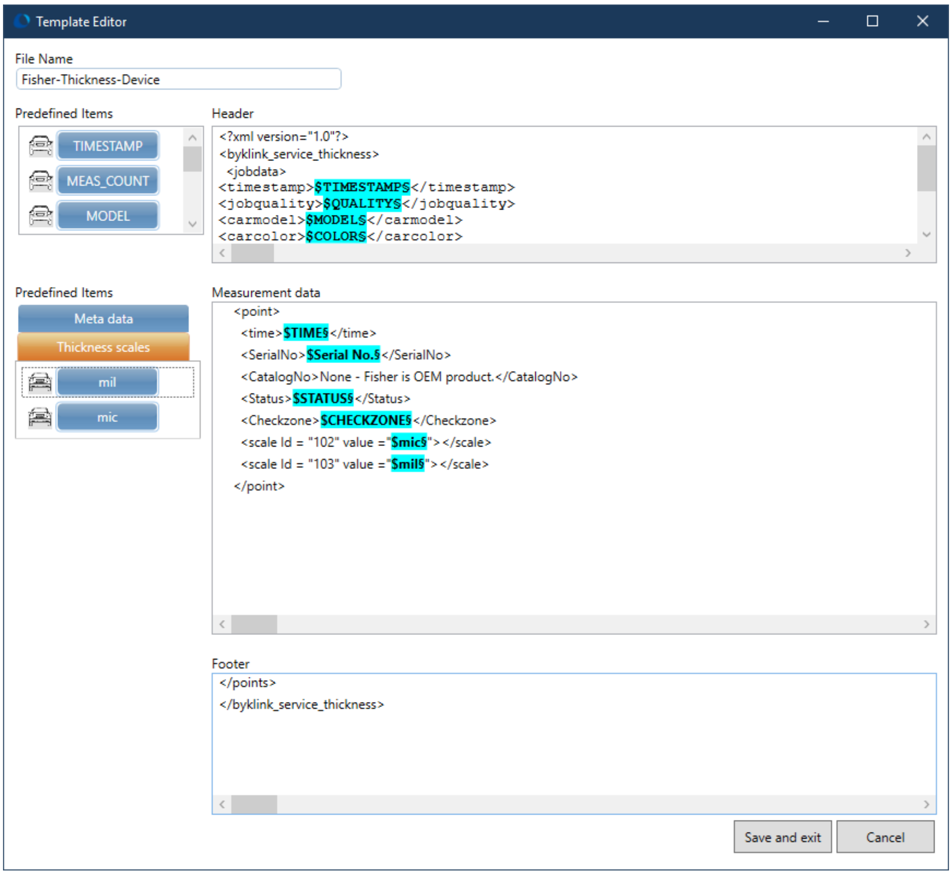

Illustration 126: Output file template configuration for thickness measuring in smart-robotic

NOTICE

Remember that valid parameters are highlighted in cyan color. Check this for all parameters to be replaced with current values. The syntax check is performed when opening the template for editing.

Following example shows a possible template file.

Header

```
<?xml version="1.0"?>
<byklink_service_thickness>
<jobdata>
<timestamp>$TIMESTAMP$</timestamp>
<jobquality>$QUALITY$</jobquality>
<carmodel>$MODEL$</carmodel>
<carcolor>$COLOR$</carcolor>
<paintline>$PAINTLINE$</paintline>
<comment>$COMMENT$</comment>
<vehicleid>$VEHICLE_ID$</vehicleid>
</jobdata>
<points count="$MEAS_COUNT$">
```

Measurement data

```
<point>
<time>$TIME$</time>
<SerialNo>$Serial No.$</SerialNo>
<CatalogNo>None - Fisher is OEM product.</CatalogNo>
<Status>$STATUS$</Status>
<Checkzone>$CHECKZONE$</Checkzone>
<scale Id = "102" value ="$mic$"></scale>
<scale Id = "103" value ="$mil$"></scale>
</point>
```

Footer

```
</points>
</byklink_service_thickness>
```

With this step the configuration in **smart-robotic** is complete for **Fisher** thickness measurement.

NOTICE

Thickness measurement instruments of type **Fisher** can have a "Serial Number" - but they don't have a "Catalog Number", which is specific to BYK-Gardner products.

8.4.5 Testing the Configuration

Perform following steps:

1. Create an XML data file.
2. Place it in the monitored folder.
3. Check folder content and **Monitoring** tab.

The file is automatically processed by **smart-robotic**.

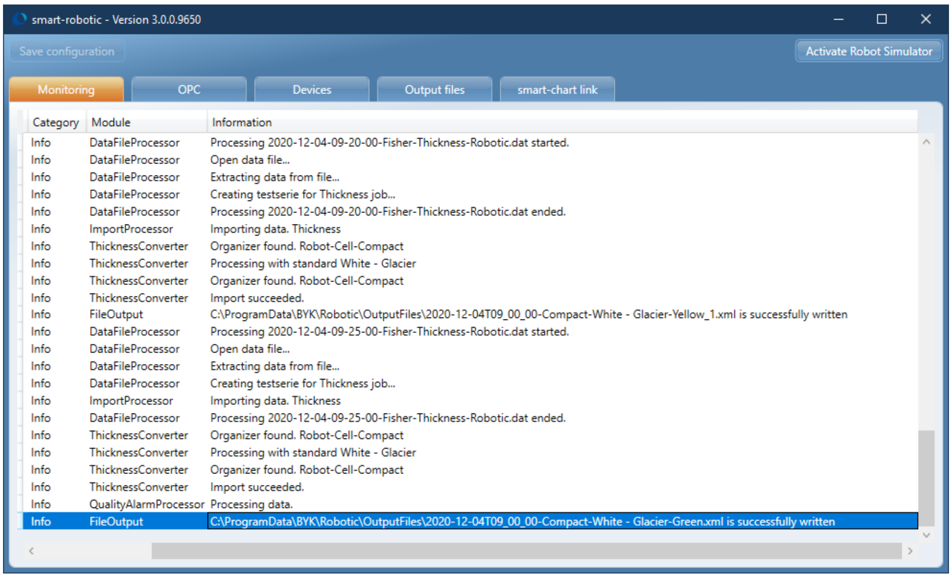

Illustration 127: Process monitoring for thickness measuring XML files in smart-robotic

After data extraction the file will be moved to the sub-folder “ProcessedDir”.

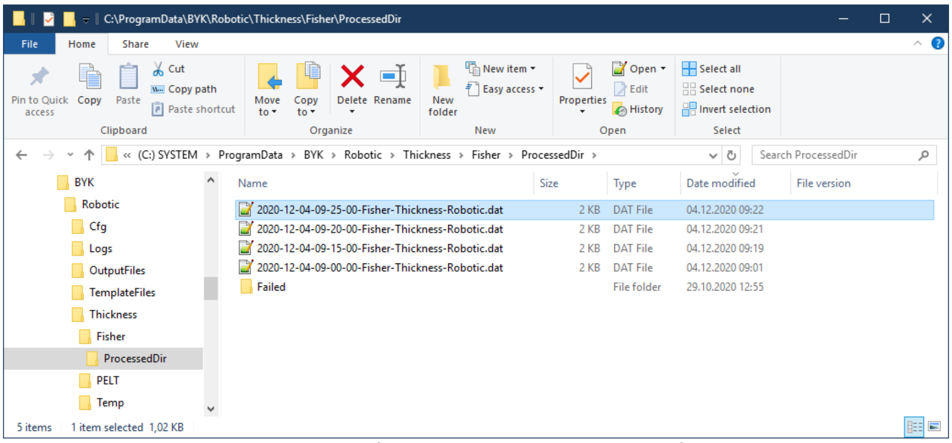

Illustration 128: Processed directory for thickness measuring XML files

The measurement data will be stored in the **smart-chart** database.

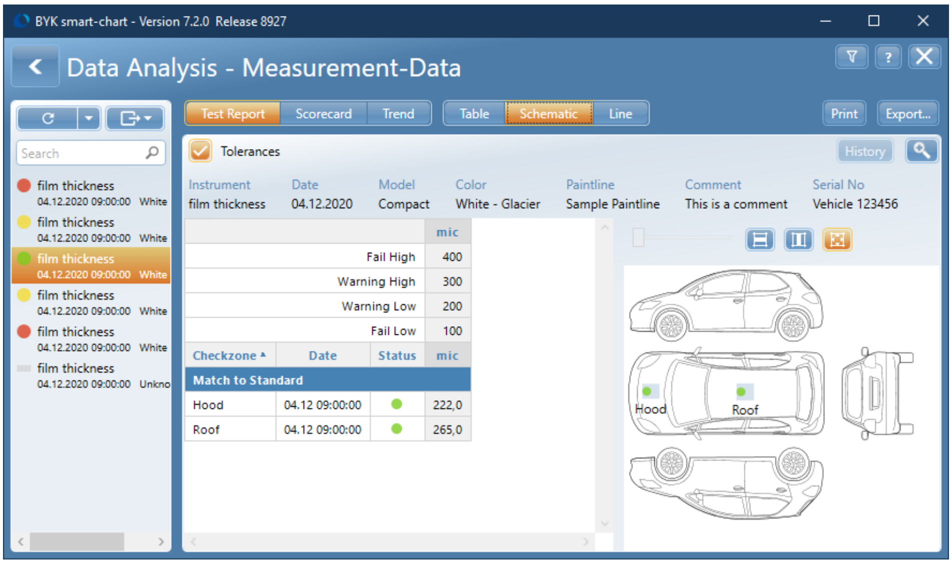

Illustration 129: Data analysis in smart-chart

An additional output file will be generated – including the pass / fail indication. With the template defined in Output Files [▸ 118] the following result file was generated.


```
<?xml version="1.0"?>
<byklink_service_thickness>
<jobdata>
<timestamp>2020-12-04T09:00:00</timestamp>
<jobquality>Green</jobquality>
<carmodel>Compact</carmodel>
<carcolor>White - Glacier</carcolor>
<paintline>PL 1</paintline>
<comment>This is a comment.</comment>
<vehicleid>Vehicle 123456</vehicleid>
</jobdata>
<points count="2">
<point>
<time>2020-12-04T09:00:00</time>
<SerialNo>1210833</SerialNo>
<CatalogNo>None - Fisher is OEM product.</CatalogNo>
<Status>Green</Status>
<Checkzone>Hood</Checkzone>
<scale Id = "102" value ="222"></scale>
```

```
<scale Id = "103" value ="UNDEFINED"></scale>
</point>
<point>
<time>2020-12-04T09:00:00</time>
<SerialNo>1210833</SerialNo>
<CatalogNo>None - Fisher is OEM product.</CatalogNo>
<Status>Green</Status>
<Checkzone>Roof</Checkzone>
<scale Id = "102" value ="265"></scale>
<scale Id = "103" value ="UNDEFINED"></scale>
</point>
</points>
</byklink_service_thickness>
```


NOTICE

Do not forget to clean-up the file system in regular intervals. This applies to both input and output files.

8.5 PELT Measurement

The software **smart-robotic** can process measurement data from **PELT** (Pulse/Echo Layer Thickness) thickness measurement instruments:

- http://www.jsrultrasonics.com/robotic-pelt

In difference to the BYK-Gardner instruments **BYK-mac i ROBOTIC** and **wave-scan ROBOTIC** the PELT measurement instruments are not controlled by **smart-robotic**.

These instruments create XML files which can be processed by **smart-robotic**.

NOTICE

The XML files are required in a specific structure to be processed by **smart-robotic**. Details see below.

8.5.1 Prerequisites

Understanding of following topics is required:

- Configuration of Output Files [▶ 67]
- Configuration in smart-chart [▶ 77]
- Configuration in smart-robotic [▶ 90]
- Thickness Measurement [▶ 107] (Fisher)

In the following the differences to these topics are described.

8.5.2 Input XML File

The PELT thickness measurement system is a special thickness measurement since it measures multiple layers of the coating:

- EC: Electro Coating

- PR: Prime Coating
- BC: Base Coating
- CC: Clear Coating

Each layer can have a different tolerance, thus multiple tolerances are usually defined in **smart-chart**, see Color Standard [▶ 124].

The XML data file to be processed by **smart-robotic** consists typically of following sections:

1. <JobInformation>
2. <MultipleMeasurements>
3. <Layers>

For the complete **job** the following data is relevant.

```
...
<Id>00000098020041</Id>
<StyleNumber>Compact</StyleNumber>
<Booth>B</Booth>
<BaseColor>Petrol</BaseColor>
<ClearColor>HE05</ClearColor>
<MeasurementUnits>Microns</MeasurementUnits>
...
```

For each **measurement** the following data is relevant.

```
...
<Location>1</Location>
<LayerCount>4</LayerCount>
...
```

For each **layer** following information is required.

```
...
<LayerNumber>1</LayerNumber>
<Thickness> 34.46</Thickness>
<LayerName>Clear_T</LayerName>
<LayerCode>CC</LayerCode>
...
```

These data are to be mapped in **smart-robotic**. In **smart-robotic** the total of all measured layers is calculated and stored in the **smart-chart** database.

With this information **smart-robotic** can search for the corresponding standard in the **smart-chart** standard database and save the measured values in the results database – including pass / fail indication.

NOTICE

The PELT input XML files used to create this documentation are large – they include multiple measurements. An example file has been added to the appendix – see XML Input File PELT [▶ 161].

8.5.3 Configuration in smart-chart

The configuration in **smart-chart** comprises following steps:

1. License File [▶ 124]
2. Color Standard [▶ 124]
3. Organizer Instruments [▶ 125]
4. Organizer Settings [▶ 125]
5. Organizer Procedure [▶ 125]

These steps are described below.

8.5.3.1 License File

For the PELT measurement instruments a separate license is required. This is the same as for the thickness measurement instruments, see License File [▶ 109].

With this license the PELT measurement instruments can be activated in the organizers, see Organizer Instruments [▶ 125].

8.5.3.2 Color Standard

In the color standards the scales for the multilayer thickness measurements are to be added on the tab **Film Thickness**.

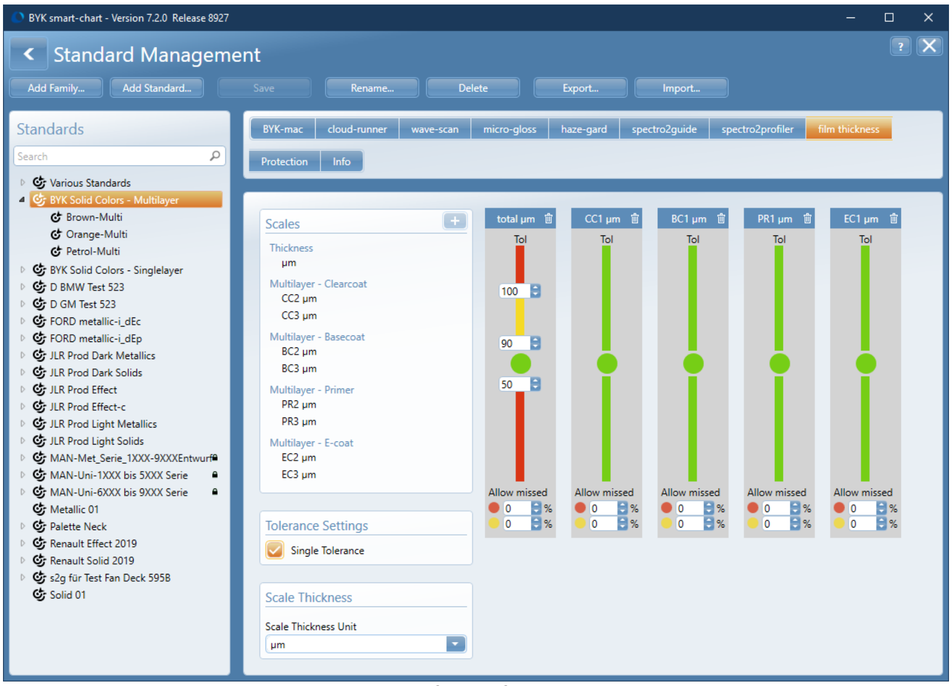

Illustration 130: Multilayer color standard family for PELT in smart-chart

For the **PELT** measurements instruments these are following scales:

- **Multilayer – Total**
- **Multilayer – E-coat**
- **Multilayer - Primer**
- **Multilayer - Basecoat**
- **Multilayer - Clearcoat**

For each layer the subscales 1..3 can be added. To keep it simple only subscale 1 has been added for each layer the example shown above.

In the scale **µm** for each layer the tolerance value(s) for the pass / fail indication have to be entered. This can be once done for all colors in the family or separately for each color, see Color Standard [▶ 110].

In the example shown above for the complete standard family "BYK Solid Colors - Multilayer" following tolerances have been set:

- < 50 = Red
- 50..90 = Yellow
- 90..100 = Green
- > 100 = Red

These tolerances will be used in the description below.

NOTICE

It is recommend to create separate color standard families for **Fisher** (single-layer) and for **PELT** (multi-layer) thickness measurements and to add required scales only.

8.5.3.3 Organizer Instruments

In the **Organizer** on the tab **Instruments** the option **Film Thickness** is to be activated, see Organizer Instruments [▶ 112].

With activated option this organizer becomes relevant for the thickness measurements for **Fisher** and for **PELT**.

8.5.3.4 Organizer Settings

In the module **Organizer** on the tab **Settings** the correct **Scale Thickness Unit** is to be selected, see Organizer Settings [▶ 112].

8.5.3.5 Organizer Procedure

In the **Organizer** on the tab **Test Procedure** the check zones are defined, see Organizer Procedure [▶ 113].

With this step the configuration in **smart-chart** is complete.

8.5.4 Configuration in smart-robotic

The configuration in **smart-robotic** comprises following steps:

1. Source Folders [▶ 126]
2. Symbol Mapping [▶ 126]
3. Check Zones [▶ 128]
4. Multi-Layer Scales [▶ 129]
5. Output Databases [▶ 130]
6. Color Standards [▶ 131]
7. Paint Lines [▶ 131]

8. Output Files [▶ 132]

These steps are described below.

8.5.4.1 Source Folders

In **smart-chart link** on the tab **PELT Settings** selected directories can be set to monitoring. If an XML file is placed in a monitored directory it is processed automatically by **smart-robotic**.

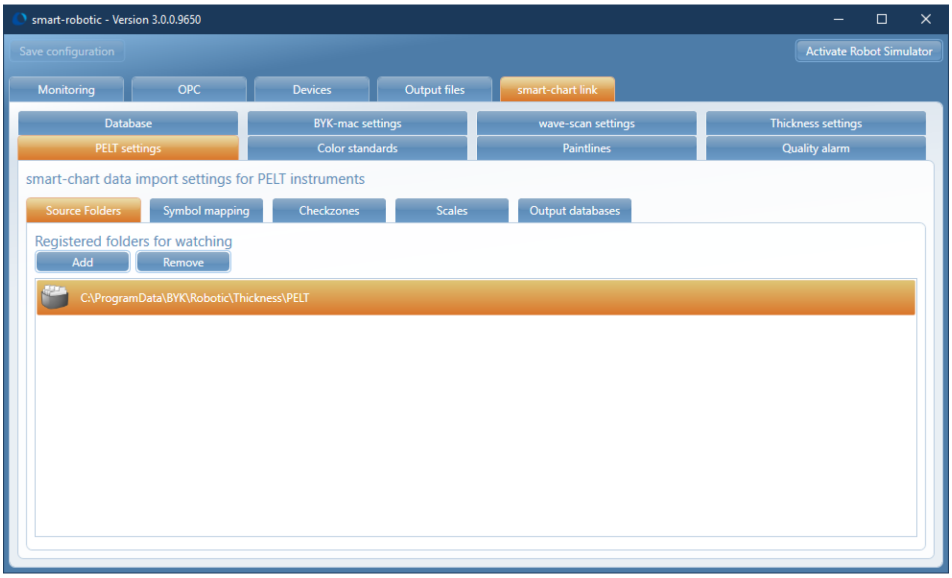

Illustration 131: Monitored PELT folders in smart-robotic

You have following options:

- **Add**: Click this button to select a directory for monitoring.
- **Remove**: The selected directory will not be monitored anymore.

An existing folder can be added or a new folder can be created in the browse dialog.

8.5.4.2 Symbol Mapping

The measurement data of the PELT measurement system can use own parameter names.

```
<JobInformation>
<Id>00000098020041</Id>
<StyleNumber>Compact</StyleNumber>
<Booth>B</Booth>
<BaseColor>Petrol</BaseColor>
<ClearColor>HE05</ClearColor>
<MeasurementUnits>Microns</MeasurementUnits>
</JobInformation>
```

Illustration 132: Car model in PELT thickness input XML file

Thus the parameter names of the PELT measurement system must be mapped to the corresponding parameter names in **smart-chart**.

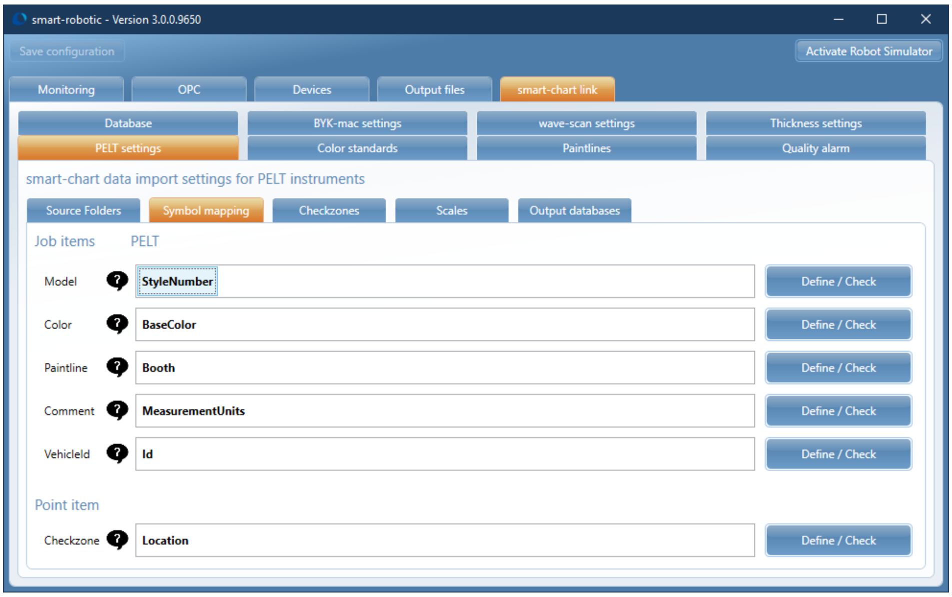

Illustration 133: PELT parameter mapping in smart-robotic

Perform following steps:

1. Click the button **Define / Check** beside a parameter.
2. Load an XML data file from the **PELT** system.
3. Select the corresponding parameter in the file.
4. Click the button **Add XML Node**.
5. Save with the button **OK**.

When you open the dialog the 1st time, it is empty.

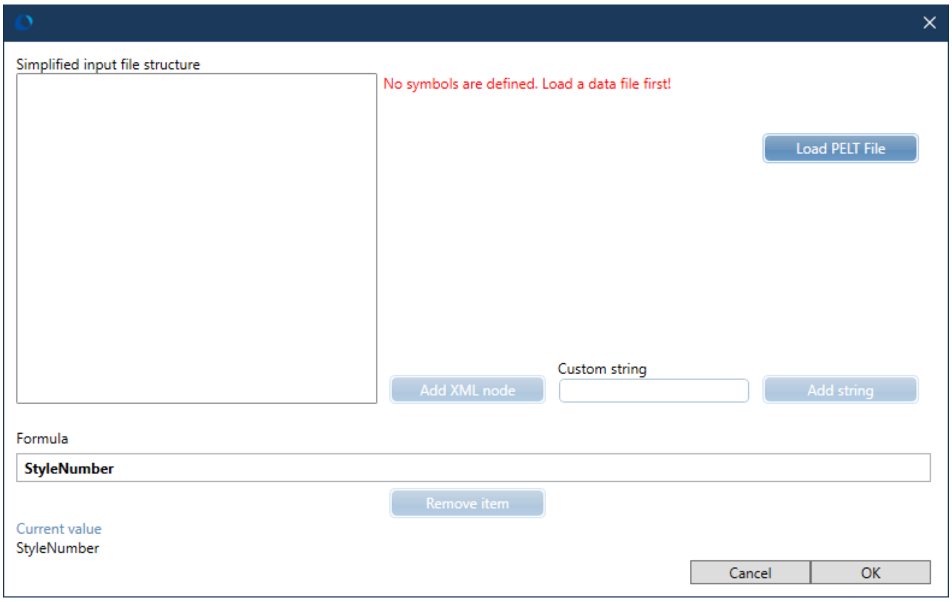

Illustration 134: PELT parameter mapping – initial state

Click the button **Load PELT File** to open an existing XML file.

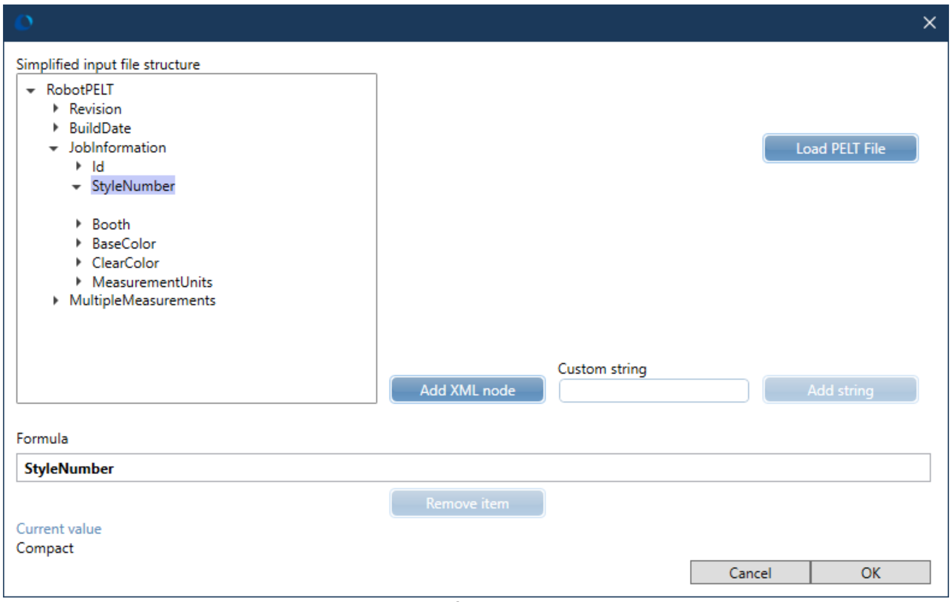

Illustration 135: PELT parameter mapping – final state

Following rules apply:

- When you open the dialog a 2nd time during the same session, the previous XML file is still loaded.
- The option **Custom String** can be used to combine parameters and or fix text, for example “StyleNumber - BaseColor”.
- The output field **Formula** shows the current selection.
- The output field **Current Value** shows the content of the fields in the current selection.

Repeat this procedure for all **Job Items** and for the **Point Item**.

8.5.4.3 Check Zones

The measurement data of the PELT measurement system can use own check zone names.

```
<Measurement>
<PanelName>R01 X01 0:1</PanelName>
<PanelNumber>0</PanelNumber>
<PanelLocation>1</PanelLocation>
<Location>1</Location>
<Robot>1</Robot>
<Sensor>1</Sensor>
<Placement>1</Placement>
<GroupCode>T</GroupCode>
```

Illustration 136: Check zone in PELT thickness input XML file

Thus the check zone names of the PELT measurement system must be mapped to the corresponding check zone names in **smart-chart**.

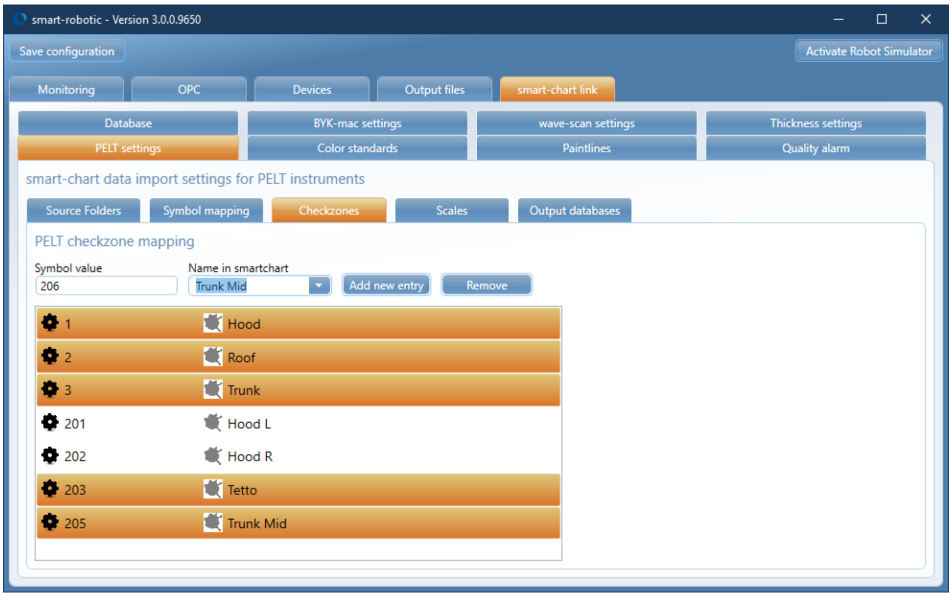

Illustration 137: Check zones for PELT measuring in smart-robotic

Perform following steps:

1. Enter the **Symbol Value** present in the input XML file.
2. Select the corresponding **Name in smart-chart** from the combo box.

Repeat this procedure for all other check zones present in the input XML file.

8.5.4.4 Multi-Layer Scales

The measurement data of the PELT measurement system can use own layer names.

```
<Layer>
<LayerNumber>1</LayerNumber>
<Thickness>  34.46</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 59.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>33.50</TOF>
<LayerName>Clear_T</LayerName>
<LayerCode>CC</LayerCode>
<LayerVendor>VW</LayerVendor>
</Layer>
<Layer>
```

Illustration 138: Layer name in PELT thickness input XML file

Thus the layer names of the PELT measurement system must be mapped to the corresponding layer names in **smart-chart**.

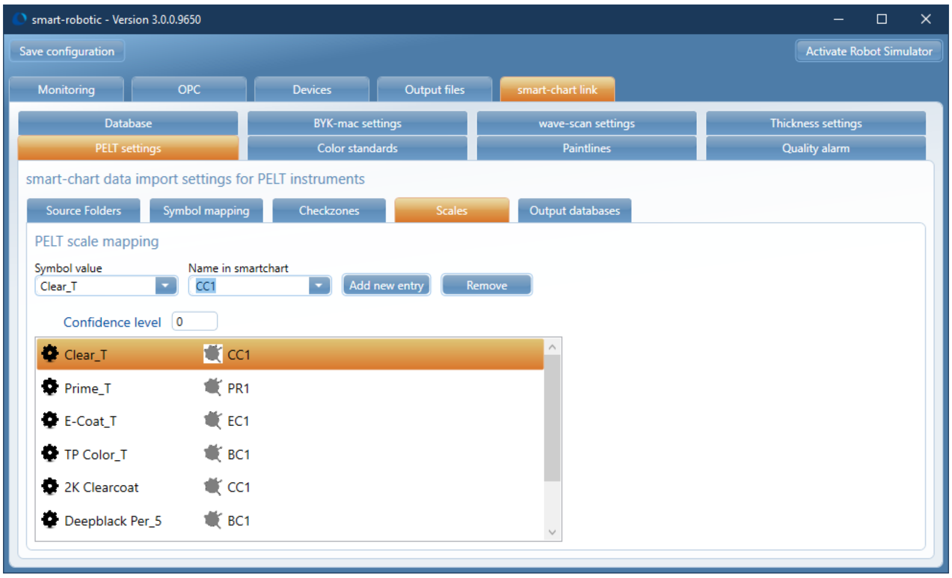

Illustration 139: Multi-layer names for PELT measuring in smart-robotic

Perform following steps:

1. Enter the **Symbol Value** present in the input XML file.
2. Select the corresponding **Name in smart-chart** from the combo box.

Repeat this procedure for all other layer names present in the input XML file.

8.5.4.5 Output Databases

Final step on the **PELT Settings** tab is the selection of the measurement database in **smart-chart**.

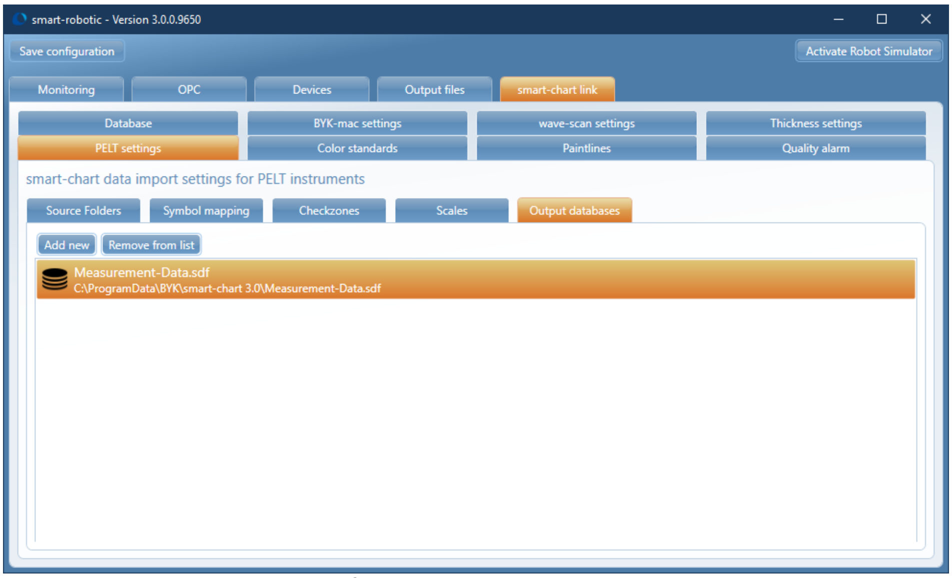

Illustration 140: Output database for PELT measuring in smart-robotic

In this database the results from the PELT input XML files will be stored.

8.5.4.6 Color Standards

If the PELT input XML files use additional values for the color, these values are also to be mapped on the **Color Standards** tab.

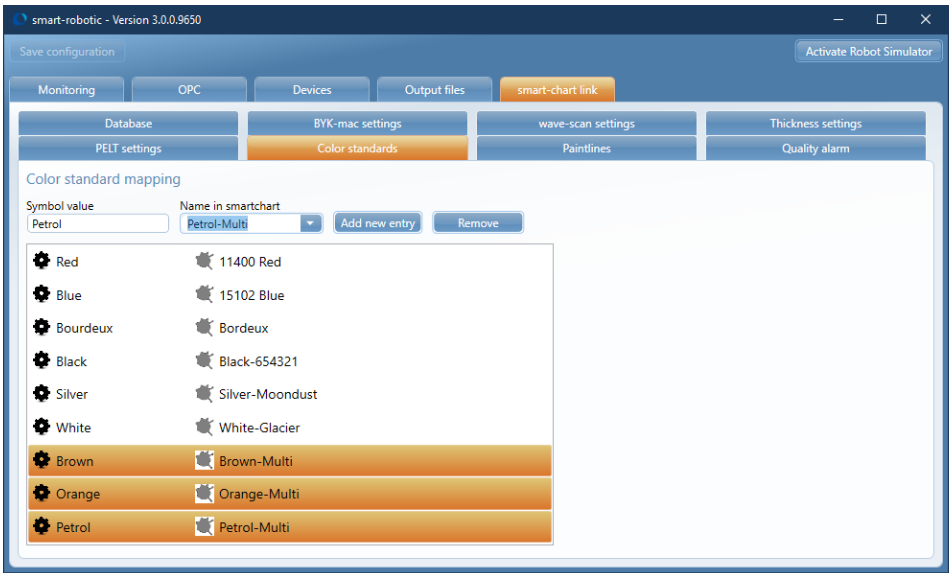

Illustration 141: Color mapping for PELT measuring in smart-robotic

In the example shown above the highlighted colors are mapped to the corresponding entries in the color family "Multi-Layer", see Color Standard [▶ 124].

8.5.4.7 Paint Lines

If the PELT input XML files use different values for the identification of the paint line, these values are also to be mapped on the **Paint Lines** tab.

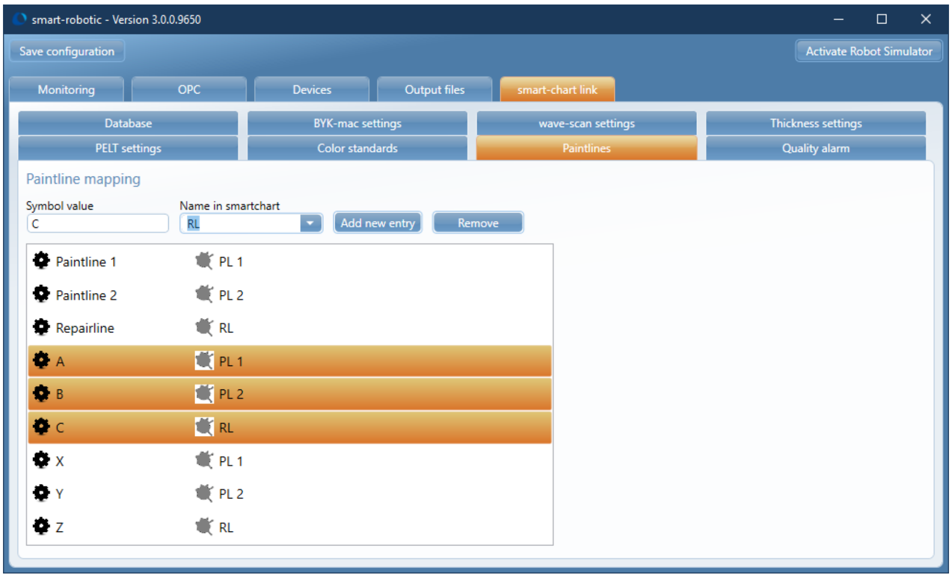

Illustration 142: Paint line mapping for PELT measuring in smart-robotic

In the example shown above the input values A / B / C are mapped to PL 1 / PL 2 / RL.

8.5.4.8 Output Files

This step is optional. Output Files [▸ 67] can be configured, if the Quality Status [▸ 74] is required for further processing.

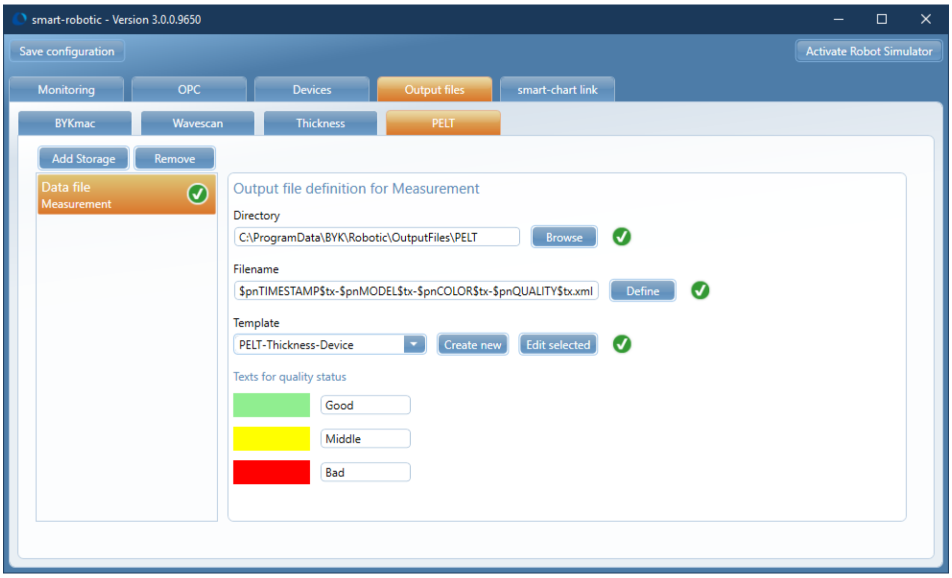

Illustration 143: Output file configuration for PELT measuring in smart-robotic

The configuration of the **Filename** is similar to that for the BYK-Gardner devices, see Output Filename [▸ 70].

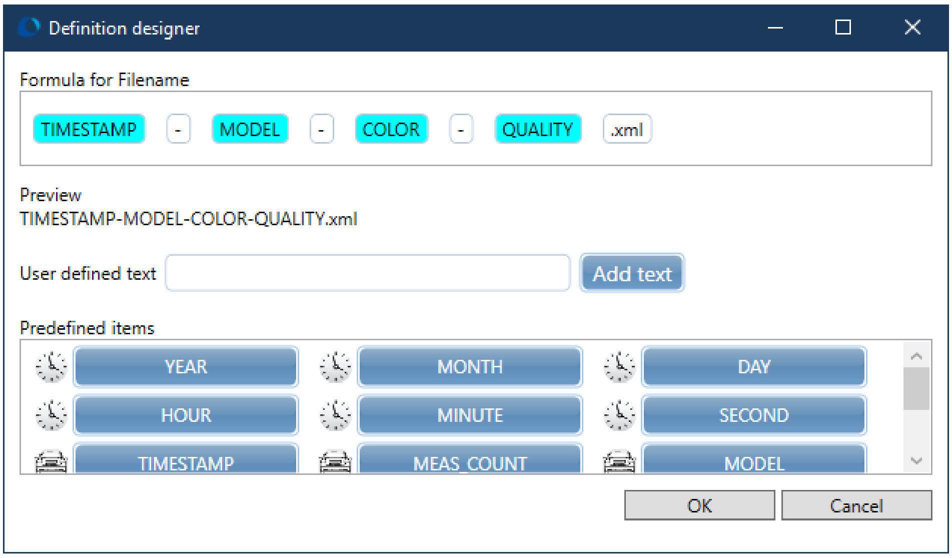

Illustration 144: Output file name configuration for PELT measuring in smart-robotic

The configuration of the **Template** file is similar to that for the BYK-Gardner devices, see Template File [▸ 71]. The differences are:

- There is a new option **Thickness Scales** under **Predefined Items**.
- OPC signals are NOT relevant here, instead the values from **smart-chart link** > **Thickness** are used.

This is shown in the following example.

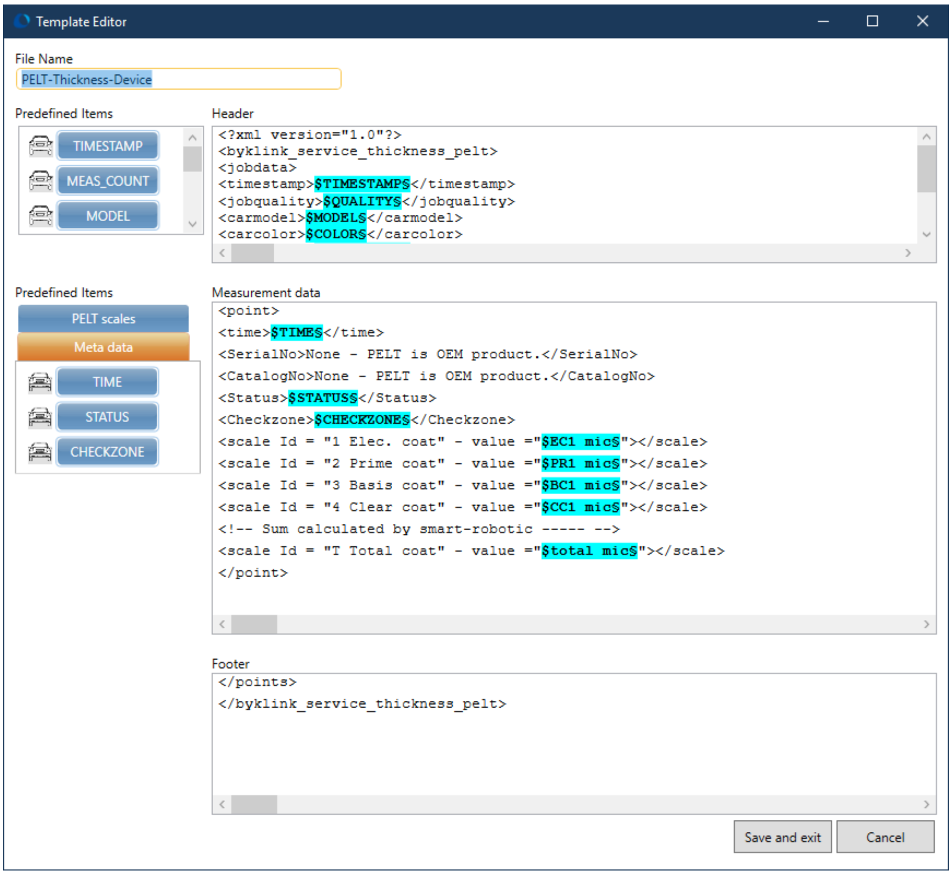

Illustration 145: Output file template configuration for PELT measuring in smart-robotic

NOTICE

Remember that valid parameters are highlighted in cyan color. Check this for all parameters to be replaced with current values. The syntax check is performed when opening the template for editing.

Following example shows a possible template file.

Header

```
<?xml version="1.0"?>
<byklink_service_thickness_pelt>
<jobdata>
<timestamp>$TIMESTAMP$</timestamp>
<jobquality>$QUALITY$</jobquality>
<carmodel>$MODEL$</carmodel>
<carcolor>$COLOR$</carcolor>
<paintline>$PAINTLINE$</paintline>
<comment>Units: $COMMENT$ (Mics)</comment>
<vehicleid>$VEHICLE_ID$</vehicleid>
</jobdata>
<points count="$MEAS_COUNT$">
```

Measurement data

```
<point>
<time>$TIME§</time>
<SerialNo>None - PELT is OEM product.</SerialNo>
<CatalogNo>None - PELT is OEM product.</CatalogNo>
<Status>$STATUS§</Status>
<Checkzone>$CHECKZONE§</Checkzone>
<scale Id = "1 Elec. coat" - value ="$EC1 mic§"></scale>
<scale Id = "2 Prime coat" - value ="$PR1 mic§"></scale>
<scale Id = "3 Basis coat" - value ="$BC1 mic§"></scale>
<scale Id = "4 Clear coat" - value ="$CC1 mic§"></scale>
<!-- Sum calculated by smart-robotic ----- -->
<scale Id = "T Total coat" - value ="$total mic§"></scale>
</point>
```

Footer

```
</points>
</byklink_service_pelt>
```

With this step the configuration in **smart-robotic** is complete for **PELT** thickness measurement.

NOTICE

Thickness measurement instruments of type **PELT** don't have a “Serial Number” or a “Catalog Number” – these parameters can be skipped in the output files.

8.5.5 Testing the Configuration

Perform following steps:

1. Create an XML data file.
2. Place it in the monitored folder.
3. Check folder content and **Monitoring** tab.

The file is automatically processed by **smart-robotic**.

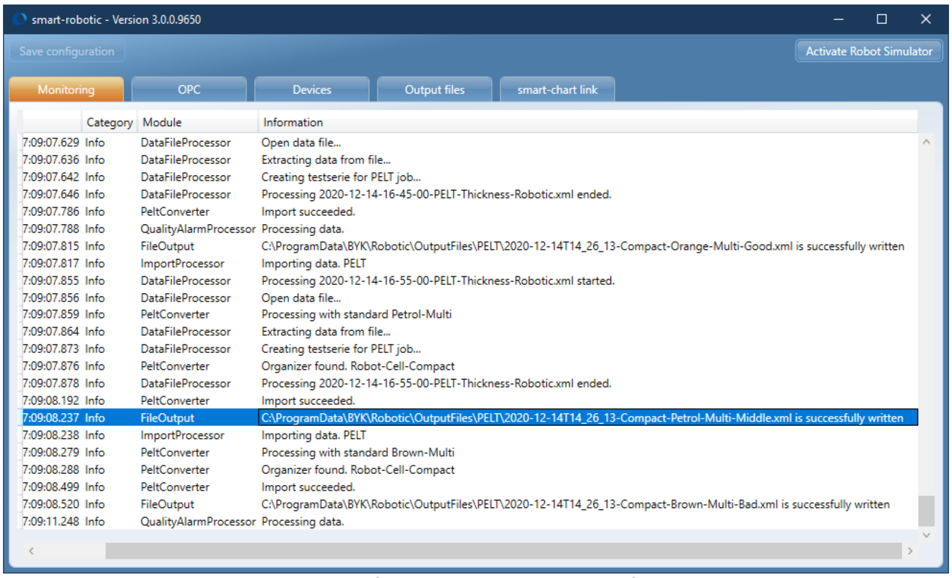

Illustration 146: Process monitoring for PELT measuring XML files in smart-robotic

After data extraction the file will be moved to the sub-folder “ProcessedDir”.

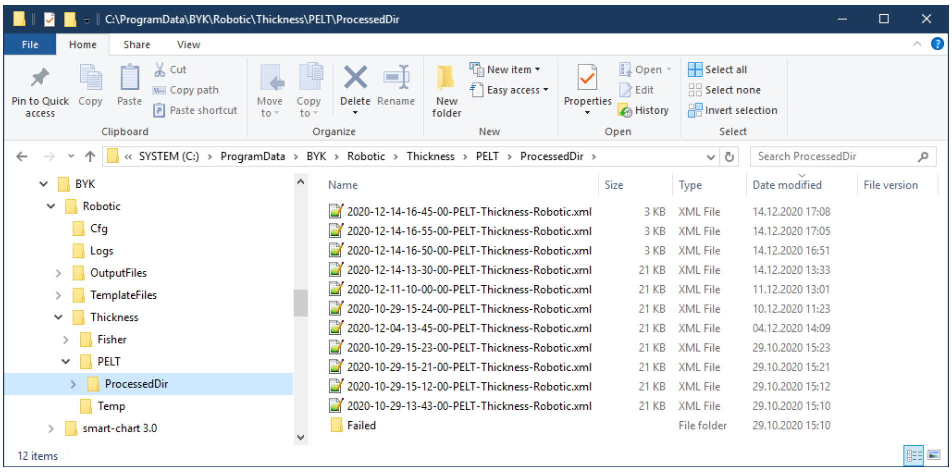

Illustration 147: Processed directory for PELT measuring XML files

The measurement data will be stored in the **smart-chart** database.

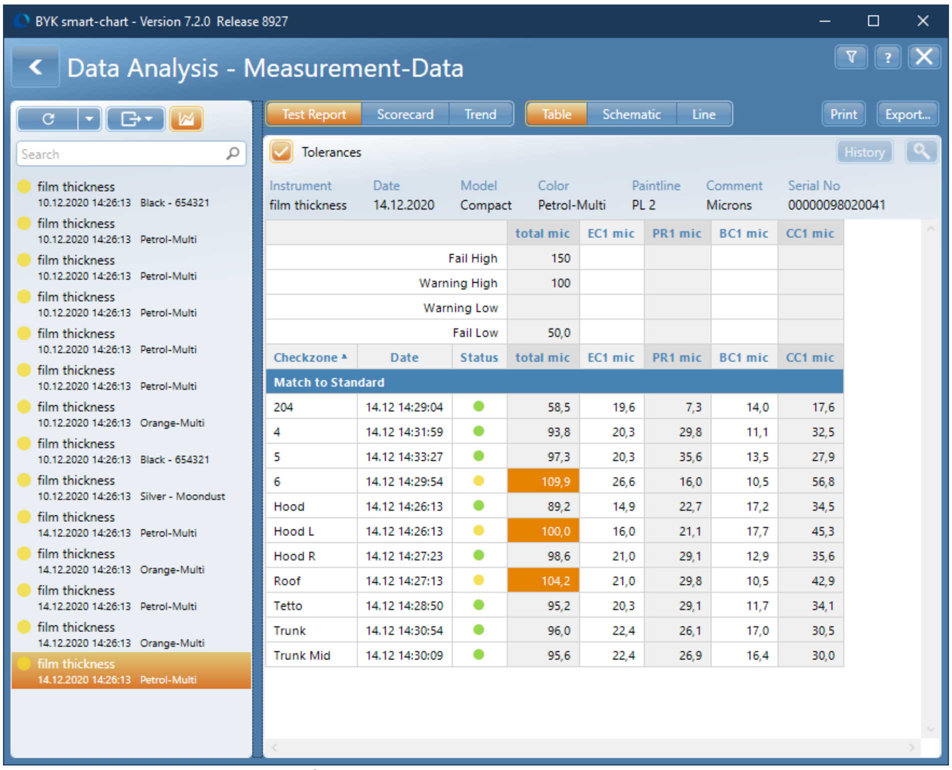

Illustration 148: Data analysis for PELT thickness in smart-chart

An additional output file will be generated – including the pass / fail indication. With the template defined in Output Files [▸ 132] the following result file was generated.


```
<?xml version="1.0"?>
<byklink_service_thickness_pelt>
<jobdata>
<timestamp>2020-12-14T14:26:13</timestamp>
<jobquality>Middle</jobquality>
<carmodel>Compact</carmodel>
<carcolor>Petrol-Multi</carcolor>
<paintline>PL 2</paintline>
<comment>Units: Microns (Mics)</comment>
<vehicleid>00000098020041</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-12-14T14:26:13</time>
<SerialNo>None - PELT is OEM product.</SerialNo>
<CatalogNo>None - PELT is OEM product.</CatalogNo>
<Status>Middle</Status>
<Checkzone>Hood</Checkzone>
<scale Id = "1 Elec. coat" - value ="24,94"></scale>
<scale Id = "2 Prime coat" - value ="22,66"></scale>
<scale Id = "3 Basis coat" - value ="27,18"></scale>
<scale Id = "4 Clear coat" - value ="24,46"></scale>
<!-- Sum calculated by smart-robotic ----- -->
<scale Id = "T Total coat" - value ="99,24"></scale>
</point>
</points>
</byklink_service_thickness_pelt>
```

NOTICE

Do not forget to clean-up the file system in regular intervals. This applies to both input and output files.

8.5.6 Confidence Level

Both **PELT** measurement system and **smart-robotic** support the feature **Confidence Level**:

- A measurement is valid, if the confidence level is above a configurable threshold.
- Measurements with a lower value will not be saved in the **smart-chart** database.

The confidence level is written by the **PELT** system for each layer.

```
<LayerNumber>4</LayerNumber>
<Thickness> 24.94</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 44.0</Confidence>
<Indirect>0</Indirect>
```

The threshold for the **Confidence Level** can be entered on the tab **Scales**, see also Multi-Layer Scales [▶ 129].

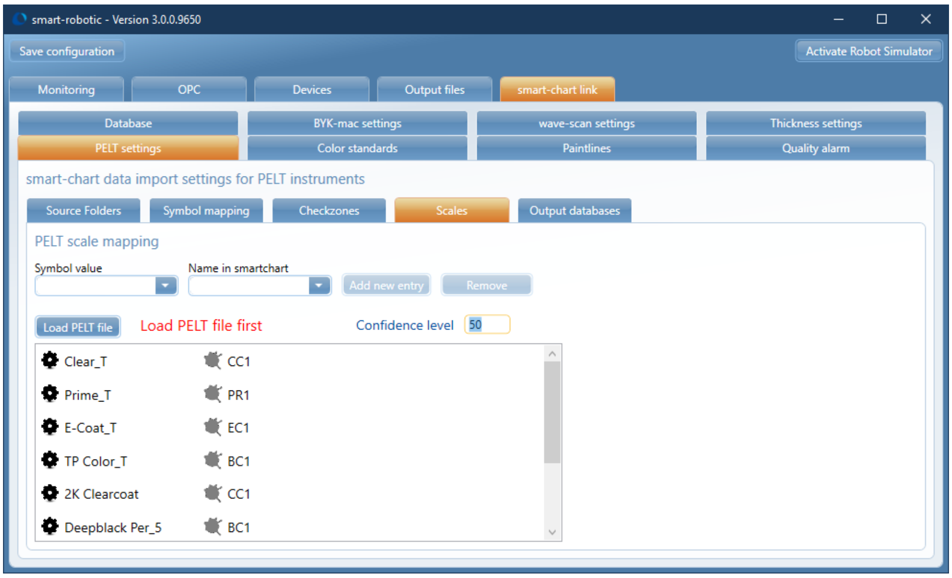

Illustration 149: Confidence level threshold for PELT measurement system

The resulting output file may look like the following example.

```
<?xml version="1.0"?>
<byklink_service_thickness_pelt>
<jobdata>
<timestamp>2020-12-15T14:26:13</timestamp>
<jobquality>Good</jobquality>
<carmodel>Compact</carmodel>
<carcolor>Petrol-Multi</carcolor>
<paintline>PL 2</paintline>
<comment>Units: Microns (Mics)</comment>
<vehicleid>00000098020041</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-12-15T14:26:13</time>
<SerialNo>None - PELT is OEM product.</SerialNo>
<CatalogNo>None - PELT is OEM product.</CatalogNo>
<Status>None</Status>
<Checkzone>Hood</Checkzone>
<scale Id = "1 Elec. coat" - value ="UNDEFINED"></scale>
<scale Id = "2 Prime coat" - value ="22,66"></scale>
<scale Id = "3 Basis coat" - value ="UNDEFINED"></scale>
<scale Id = "4 Clear coat" - value ="24,46"></scale>
<!-- Sum calculated by smart-robotic ----- -->
<scale Id = "T Total coat" - value ="UNDEFINED"></scale>
</point>
</points>
</byklink_service_thickness_pelt>
```

If at least one measurement is “Undefined”, the total thickness cannot be calculated. The quality status for this measurement is “None”.

8.5.7 Allow Missed

The overall quality status for a complete job will always have the lowest status of all measurements in the job, see Quality Status [▶ 74]. To avoid that single failed measurements lead to a failed / red overall quality status a threshold (in percent) can be set for red and yellow measurements.

Illustration 150: PELT-Allow-Missed

The two fields **Allow Missed** indicate how many tests for this scale may be out of tolerance over the whole job before the status of the test series changes.

In the example shown above the threshold is 50 percent. This will result in the following output file.


```
<?xml version="1.0"?>
<byklink_service_thickness_pelt>
<jobdata>
<timestamp>2020-12-15T14:26:13</timestamp>
<jobquality>Good</jobquality>
<carmodel>Compact</carmodel>
<carcolor>Petrol-Multi</carcolor>
<paintline>PL 2</paintline>
<comment>Units: Microns (Mics)</comment>
<vehicleid>00000098020041</vehicleid>
</jobdata>
<points count="2">
<point>
<time>2020-12-15T14:26:13</time>
<SerialNo>None - PELT is OEM product.</SerialNo>
<CatalogNo>None - PELT is OEM product.</CatalogNo>
<Status>Middle</Status>
<Checkzone>Hood</Checkzone>
<scale Id = "1 Elec. coat" - value ="24,94"></scale>
<scale Id = "2 Prime coat" - value ="22,66"></scale>
<scale Id = "3 Basis coat" - value ="27,18"></scale>
<scale Id = "4 Clear coat" - value ="24,46"></scale>
<!-- Sum calculated by smart-robotic ----- -->
<scale Id = "T Total coat" - value ="99,24"></scale>
</point>
<point>
<time>2020-12-15T14:27:13</time>
<SerialNo>None - PELT is OEM product.</SerialNo>
<CatalogNo>None - PELT is OEM product.</CatalogNo>
<Status>Good</Status>
<Checkzone>Roof</Checkzone>
<scale Id = "1 Elec. coat" - value ="21,01"></scale>
<scale Id = "2 Prime coat" - value ="29,79"></scale>
<scale Id = "3 Basis coat" - value ="10,53"></scale>
<scale Id = "4 Clear coat" - value ="22,86"></scale>
<!-- Sum calculated by smart-robotic ----- -->
<scale Id = "T Total coat" - value ="84,19"></scale>
</point>
</points>
</byklink_service_thickness_pelt>
```


The overall status is “Good”, although one of the two measurements was only “Middle”.

9 Robot Simulator

The simulation allows testing of software configuration and physical instruments without the need of a robot.

Instead of sending the OPC signals to the PLC the signals are sent to the simulation. The simulation fills in all data.

The results of each operation can be checked directly in the **smart-robotic** application.

Perform following steps:

1. Prepare Simulation [▸ 140]
2. Activate Simulation [▸ 141]
3. Configure Instrument [▸ 142]
4. Control Simulation [▸ 143]
5. Monitor Simulation [▸ 144]
6. Check Results [▸ 145]

These steps are described below. For the examples given below the device **wave-scan ROBOTIC** is used. The usage of the simulation with the **BYK-mac i ROBOTIC** or **wave-scan 3 ROBOTIC** is analogue.

9.1 Prepare Simulation

Setup instrument and sample(s) as described in Device Test [▸ 59] for the **wave-scan ROBOTIC**.

Illustration 151: BYK-Gardner wave-scan ROBOTIC - Simulator setup

Connect the instrument to power supply and the data interface.

9.2 Activate Simulation

Click the button **Activate Robot Simulator** in the upper right corner. A warning message is displayed.

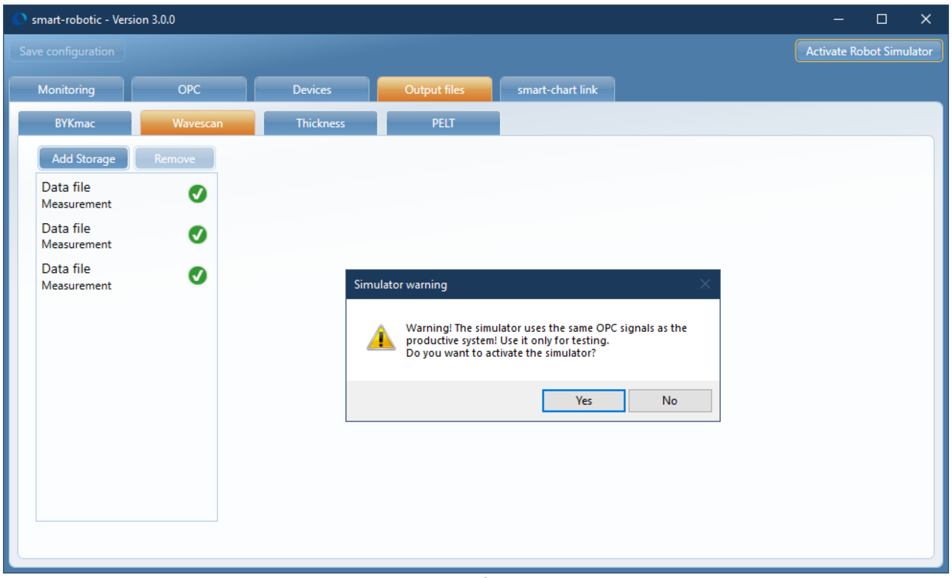

Illustration 152: Activate robot simulator – confirmation message

Make sure that no communication to the PLC in the productive environment is active and confirm the message. The button disappears. Instead a new tab is inserted.

NOTICE

The button will be displayed again after restarting **smart-robotic**.

9.3 Configure Instrument

Click the new tab **Robot** simulator and configure your (physical) measurement instrument. For each device created a separate tab is displayed. In the example shown below the tab for the device “Wavescan1” is selected.

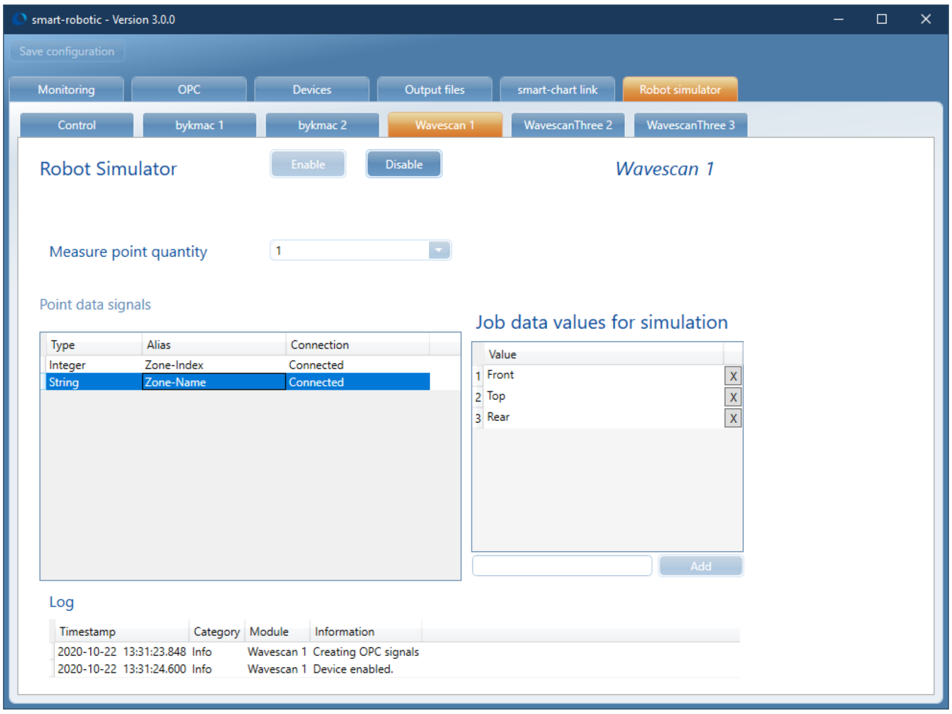

Illustration 153: Robot simulator – device configuration

The device configuration consists of following elements:

1. **Enable / Disable**: In mode “Disabled” you can change the configuration. In mode “Enabled” you can start the simulation.
2. **Measure Point Quantity**: Select the number of measurement points / check zones from the list. The range is 1..9. The according entries will be taken from the values on the right side.
3. **Point Data Signals**: For the example instrument **wave-scan ROBOTIC** these are the point items as defined in OPC Point Signals [▶ 58].
4. **Job Data Values**: In the productive system these data are transferred from the PLC. Here in the simulation all entries have to be created using the Add button. Remove an entry using the X symbol to the right of the entry.
   – Checkzone-Index: Create for example “1”, “2”, “3” and “4”.
   – Checkzone-Name: Create for example “Front”, “Hood”, “Rear” and “Roof”.
5. **Log**: Here all events for the current measurement instrument are displayed.

When configuration is finished click the button **Enable** to proceed.

NOTICE

To change an existing configuration which is already in status **Enabled** first click the button **Disable**.

9.4 Control Simulation

When the device has been set to status “Enabled” click the tab **Control**.

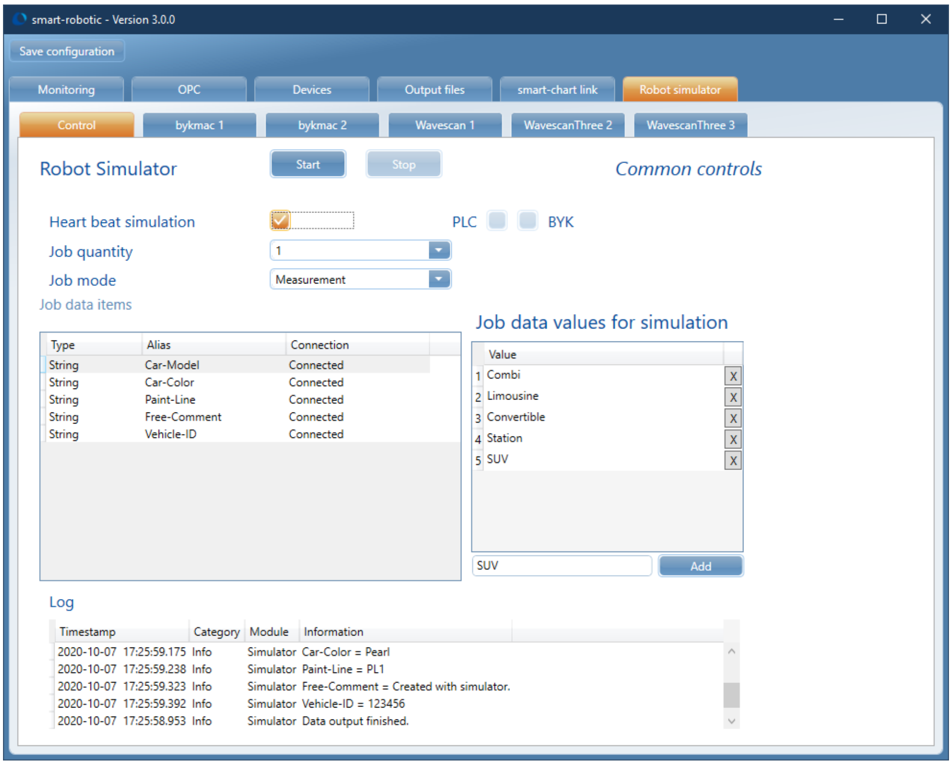

Illustration 154: Robot simulator – Control of the simulation

The control tab consists of following elements:

1. **Start / Stop**: With these buttons you can start and stop the simulation. Stop is only required in case of long running jobs. The simulation stops automatically when all jobs are done. If both buttons are inactive enable a device first.
2. **Heart Beat**: The availability of the communication partners can be simulated. The OPC signals “ALL_CTRL.IN_HEARTBEAT” and “ALL_CTRL.OUT_HEART-BEAT” are used.
   - PLC sets IN to 1.
   - SR sets OUT to the inverse value = 0.
   - PLC checks that OUT is 0 and sets IN to 0.
   - SR checks that OUT is 0 and sets IN to the inverse value = 1.
   - This happens as long as the communication is active (good).
3. **Job Quantity**: Select the number of jobs (cars) from the list. The range is 1..9 or Endless processing. The according values will be taken from the values on the right side.
4. **Job Mode**: Select the mode from the list. The range is **Measurement**, **Calibration** (BYK-mac only), **Master Panel** and **Daily Check**.
5. **Job Data Items**: For the given example instrument **wave-scan ROBOTIC** the job items in OPC Control Signals [▸ 58] are used.

6. **Job Data Values**: In the productive system these data are transferred from the PLC. Here in the simulation all entries have to be created using the **Add** button. Remove an entry using the **X** symbol to the right of the entry.
   - **Car-Model**: Create for example “Limousine”, “Convertible”, “Station Wagon” and “SUV”.
   - **Car-Color**: Create for example “Black”, “Pearl”, “Red” and “White”.
   - **Paint-Line**: Create for example “PL1”, “PL2”, and “PL3”.
   - **Free-Comment**: Create for example “Created with Simulator”.
   - **Vehicle-ID**: Create for example “123456” and “654321”.
7. **Log**: Here all events for the simulation are displayed.

When configuration is finished click the button **Start** to proceed.

NOTICE

1 To calculate the number of measurements: If the quantity for the **Device** is for example “4” and for the **Control** it is for example “5” the robot simulation will make “20” measurements.

2 If **Job Quantity** is “1” it will use the 1^{st} data value for the 1^{st} run, the 2^{nd} data value for the 2^{nd} run (etc.) If the quantity is higher it will use one data value after the other within one run.

9.5 Monitor Simulation

When the simulation has been started click the tab **Monitoring** in the main program.

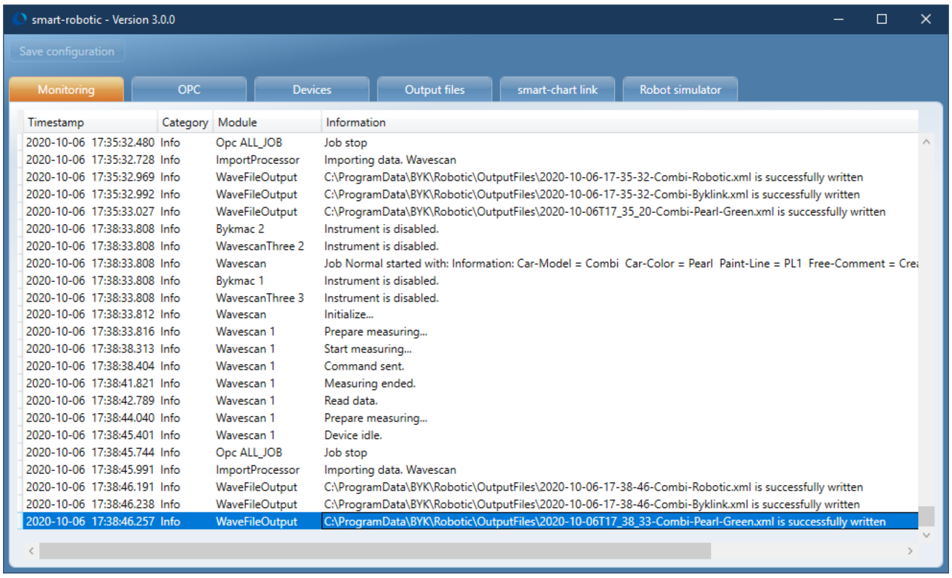

Illustration 155: Robot Simulator – Monitoring the simulation

Here the messages from the simulation are displayed. This information is stored in the file “C:\ProgramData\BYK\Robotic\Logs\RobotSimulator.log”.

9.6 Check Results

When the simulation has finished check the output result file(s). With the template defined in Output Files [▶ 67] the following result file was generated.


```
<?xml version="1.0"?>
<wave-scan-robotic>
<jobdata>
<timestamp>2020-10-06T17:38:33</timestamp>
    <jobquality>Green</jobquality>
    <carmodel>Combi</carmodel>
    <carcolor>Pearl</carcolor>
    <paintline>PL1</paintline>
    <comment>Created with simulator.</comment>
    <vehicleid>123456</vehicleid>
</jobdata>
<points count="1">
<point>
<time>2020-10-06T17:38:38</time>
    <serialnr>1213324</serialnr>
    <catalognr>4822</catalognr>
    <status>None</status>
    <zoneid>4</zoneid>
    <zone>rear bumper</zone>
    <scale Id="01 LW" value="0" />
    <scale Id="02 SW" value="0" />
    <scale Id="19 We" value="0" />
    <scale Id="20 Wd" value="0" />
    <scale Id="21 Wc" value="0" />
    <scale Id="22 Wb" value="0" />
    <scale Id="23 Wa" value="0" />
    <scale Id="24 Du" value="12,1" />
</point>
</points count>
</wave-scan-robotic>
```


Now you can modify the various settings in the tabs for the **Devices** and in the **Control** tab and restart the simulation as often as you need to check the results.

10 Run Procedure

With BYK-mac i ROBOTIC the measurements can be accomplished in three different operation modes. In addition the appropriate bit for the operation mode must be set by the PLC. The wave-scan ROBOTIC has only one measurement mode. Following operation modes are to be programed on the PLC side:

1. Measurement Mode - BYK-mac [▶ 146]
2. Calibration Mode - BYK-mac [▶ 152]
3. Masterpanel Mode - BYK-mac [▶ 152]
4. Measurement Mode - wave scan [▶ 154]

10.1 Measurement Mode - BYK-mac

10.1.1 General

The operation mode “Normal Measurement” is reached by not setting one of the signals IN_REQU_MAST, IN_REQU_CAL, IN_REQU_MODE4-9.

A new measuring group is started by the handshake IN_JOB_START. A normal measurement can be divided into four partial sequences:

1. Start job
2. Fine position correction
3. Points end
4. Terminate job

Since a job can contain more than one point, the procedure jumps from partial sequence 3 to 2 at the next measuring point. Only with receipt of the signal IN_JOB_STOP smart-robotic is instructed to regard the job as terminated and passes all data out.

NOTICE

The signal IN_JOB_STOP always causes a complete end of measurement. Up to then measured data are passed out as result data. In the operating mode “Normal Measurement” this signal can be used as reset.

If the fine positioning (point 3) was not successful it is repeated several times. If it should not be successful nevertheless, the point is not measured. For the robot, handshake ends however normal (point 4) with the signal OUT_POINT_READY.

The signal OUT_POINT_RESULT indicates the result of the measurement at the time OUT_POINT_READY:

- 0 = NOK
- 1 = OK

After a point is reached (IN_POINT_POS), BYK-mac i ROBOTIC evaluates the 4 positioning pins. If the equipment is too near at the surface or too far, errors x99200 or x99201 are announced in connection with OUT_POINT_READY/ and OUT_POINT_RESULT=0.

If a calculation of the correction values is possible, the necessary correction values are handed over via OUT_CORR-Z/K/Q to the PLC and are indicated with OUT_CORR_VAL.

The robot must thereupon correct the position and indicate it in IN_POINT_POS again.

If the position according to the handed over curvature is in the permitted tolerances, a measurement is deployed, subsequently OUT_POINT_READY and OUT_POINT_RESULT is set.

10.1.2 Sequence

No.	Description	PLC	smart-robotic
10	If defined, job data must be available.	Job data..↑..	
11	New job is started.	IN_JOB_START..↑..	Internal start of a new job, takeover of the job data on the agenda.
12		..↑..OUT_JOB_RUN	Feedback to PLC that job runs.
		..↑..OUT_JOB_SUCCESS	Retraction of the job success signal.
13	Retraction of the job start signal.	IN_JOB_START..↓..	
14	Job data do not need to be valid any longer.	Job data..↓..	
20	Robot hit point. If defined, point data must be on the agenda. A curvature must be reported.	Point data..↑.. IN_CURVATURE..↑..	New point hit or correction executed.
21	Robot reports that a matching position is hit.	IN_POINT_POS..↑..	
	BYK-mac calculates correction values		
	BYK-mac reports back a correction value (continue at 22).		
	BYK-mac reports that measurement was successful (continue at 32).	OUT_POINT_RESULT=1	
	BYK-mac reports error, abort (continue at 32).	OUT_POINT_RESULT=0	
22	Return of values for Z, K, Q to SR: Z=1/1000mm, K=1/1000°; Q=1/1000°	..←..OUT_CORR_Z ..←..OUT_CORR_K ..←..OUT_CORR_Q	
23	Setting the correction values valid.	..↑..OUT_CORR_VAL	
24	Point data become invalid.	Point data..↓..	
24	Robot takes back positioning message and starts next correction.	IN_POINT_POS..↓..	
25	Cancelling of the correction value. Setting the distance value invalid.	..↓..OUT_CORR_AKQ ..↓..OUT_CORR_VAL	
	Continue at 20.		
32	Report at PLC that point is finished.	..↑..OUT_POINT_READY	Point is finished.

No.	Description	PLC	smart-robotic
33	Point data become invalid.	Point data..↓.. IN_CURVATURE..↓..	
33	Robot takes positioning message back and starts next correction.	IN_POINT_POS..↓..	
34	Retraction of the finished report.	..↓..OUT_POINT_READY	
	Continue at 20 (new point) or 40 (job end).		
40	Robot reports that the job is finished.	IN_JOB_STOP..↑..	Job is finished.
41	SR finishes the job and generates measuring file.	..↓..OUT_JOB_RUN	
	If measuring data are written successfully to disk, job success is reported to PLC.	..↑..OUT_JOB_ SUCCESS	
42	Retraction of the handshake.	IN_JOB_STOP..↓..	If measurements are available, an output file is generated.

10.1.3 Diagram

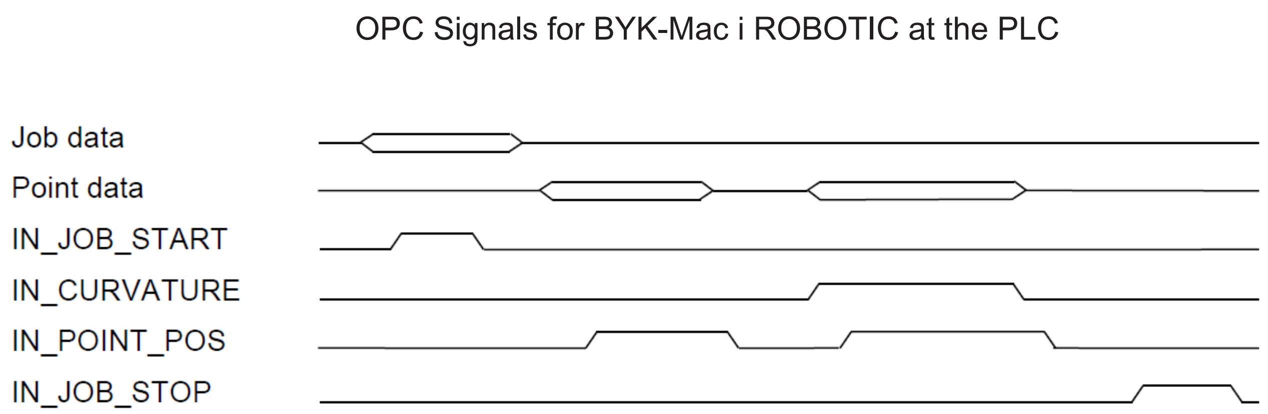

Illustration 156: BYK-mac-Time-Diagram-PLC

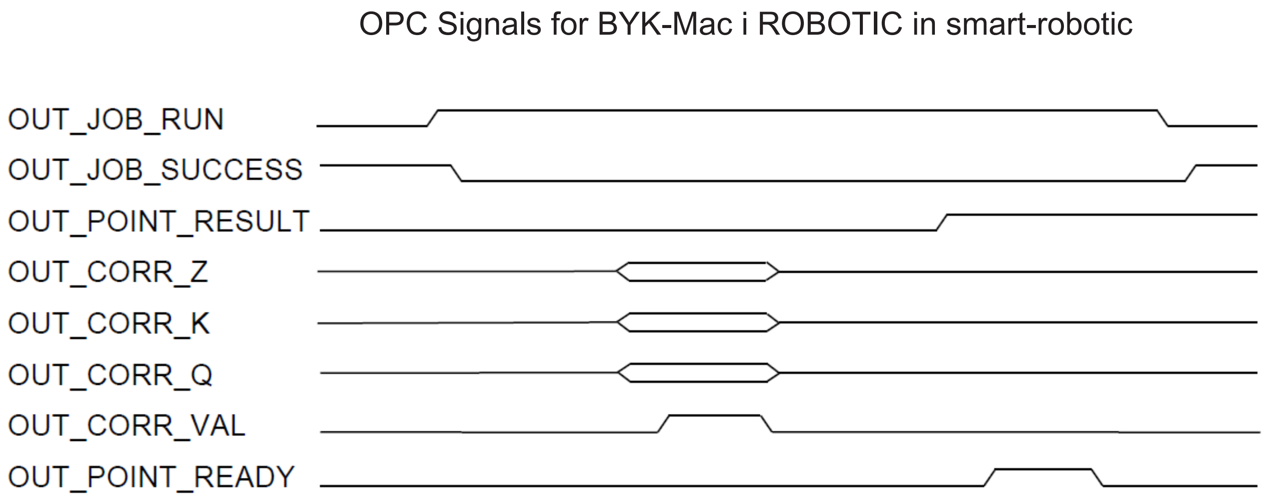

Illustration 157: BYK-mac-Time-Diagram-SR

10.1.4 Workflow

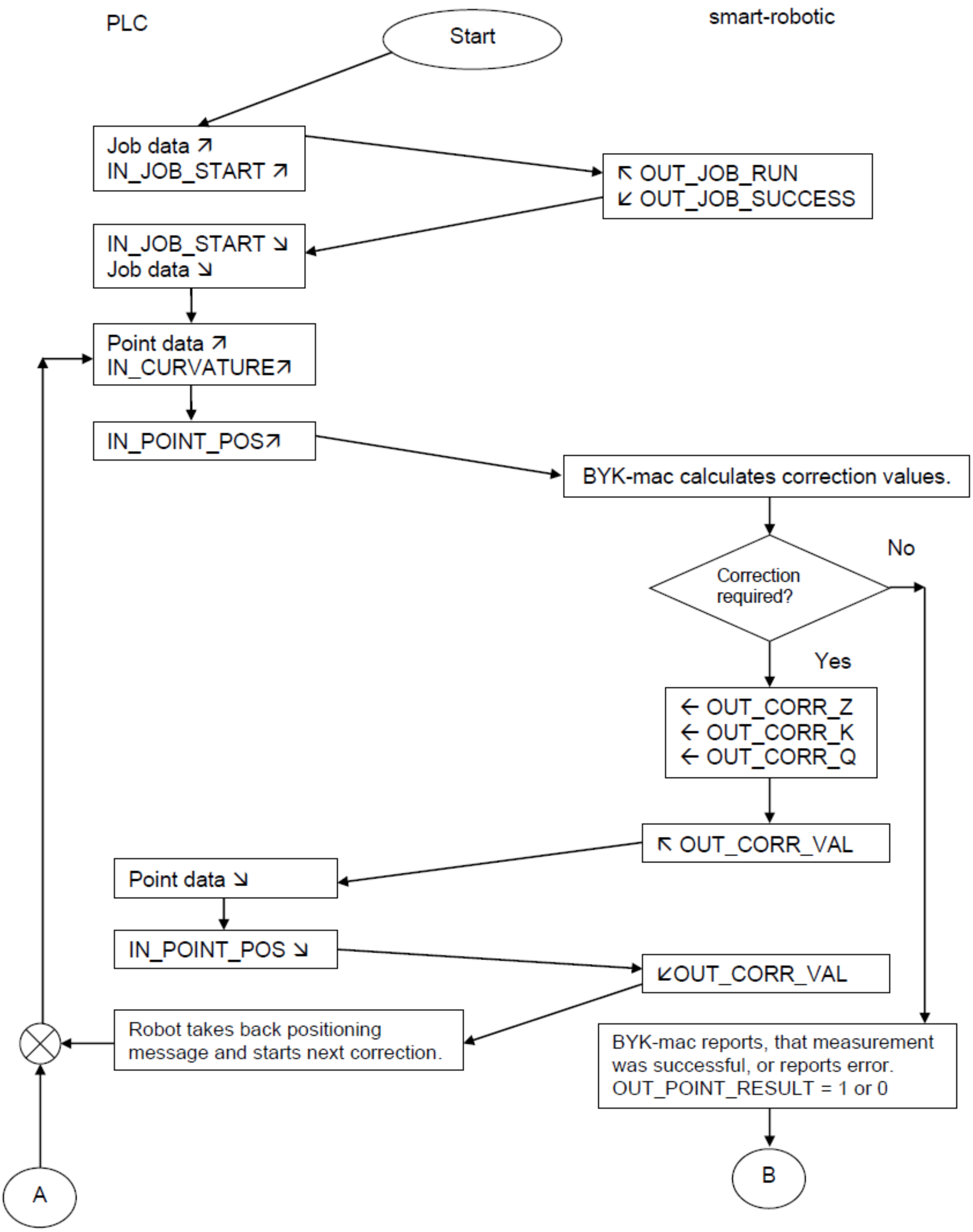

Illustration 158: BYK-mac-Flow-Diagram-Part1

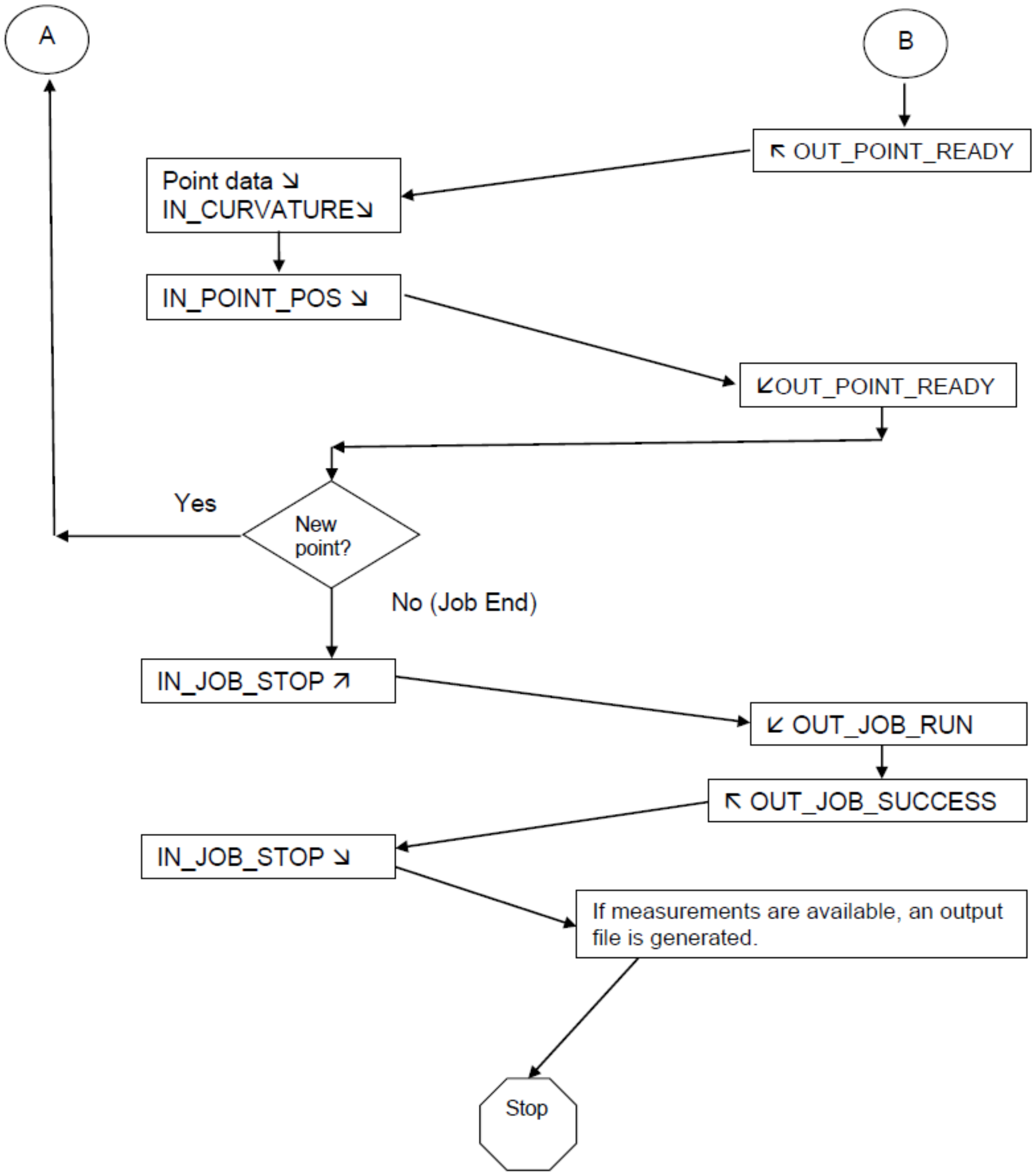

Illustration 159: BYK-mac-Flow-Diagram-Part2

10.2 Calibration Mode - BYK-mac

The operation mode "Calibration" is reached, as the signal IN_REQU_CAL is set.

During the calibration the head is driven by robots into the calibration station. Here it is docked over so-called tile holders. The holders are suspended elastic, thus it is guaranteed that the measuring head is positioned accurately parallel and in firm distance to the tile. An active fine positioning by the robot / BYK-mac does not take place here.

For the sequence of the calibration tiles and their meaning see Device Calibration [▸ 42].

No.	Description	PLC	smart-robotic
	Start Job:		
1	Operation mode bit "Calibration".	IN_REQ_CAL..↑..	
2	New Job is startet	IN_JOB_START..↑..	
3		..↑..OUT_JOB_RUN	
		..↑..OUT_JOB_SUCCESS	
4	Retraction of the job start signal.	IN_JOB_START..↓..	
	Start tile:		
10	Robot is at the first calibration tile	IN_POINT_POS..↑..	
	Start measurement		
	Tile O.K.:		
11	Report at robot that point is finished.	..↑..OUT_POINT_READY	
12	Robot reports that point is left.	..↓..IN_POINT_POS	
13	Retraction of the handshake.	..↓..OUT_POINT_READY	
	If further tile is measured, continue at 10.		
	End Job:		
40	Robot reports that the job is finished.	IN_JOB_STOP..↑..	
41	FL finishes the job and generates measuring file.	..↓..OUT_JOB_RUN	
42	Retraction of the handshake.	..↓..IN_JOB_STOP	
			If control measurements are available, output file is generated.

10.3 Masterpanel Mode - BYK-mac

In order to be able to make statements about the color deviation, it is necessary to measure a so-called 'original' or 'masterpanel' of a color. The result of the measurement is needed later on customer side in the quality database, in order to compute the deviation between item under test and the original.

The operation mode "Masterpanel" does not differ in the sequence from a normal measurement, since a fine positioning is accomplished here. Only for the output format of the results of the measurement, another format can be selected.

The output format which can be used must be freely adjustable. Job and point data can be made available by the PLC. Thus e.g. the color number of the new original can be stored.

The sequence given below is nearly the same as in shown in Measurement Mode - BYK-mac [▸ 146]. Except the positions 1 and 14 differ from the normal measurement mode.

No.	Description	PLC	smart-robotic
1	Request to the reading of the original is on the agenda.	IN_REQU_MAST..↑..	
10	If defined, job data must be available.	Job data..↑..	
11	New job is started.	IN_JOB_START..↑..	Internal start of a new job, takeover of the job data on the agenda.
12		..↑..OUT_JOB_RUN	Feedback to PLC that job runs.
		..↑..OUT_JOB_SUCCESS	Retraction of the job success signal.
13	Retraction of the job start signal.	IN_JOB_START..↓..	
14	Retraction of the original request.	IN_REQU_MAST..↓..	
15	Job data do not need to be valid any longer.	Job data..↓..	
20	Robot hit point. If defined, point data must be on the agenda. A curvature must be reported.	Point data..↑.. IN_CURVATURE..↑..	New point hit or correction executed.
21	Robot reports that a matching position is hit.	IN_POINT_POS..↑..	
	BYK-mac calculates correction values		
	BYK-mac reports back a correction value (continue at 22).		
	BYK-mac reports that measurement was successful (continue at 32).	OUT_POINT_RESULT=1	
	BYK-mac reports error, abort (continue at 32).	OUT_POINT_RESULT=0	
22	Return of values for Z, K, Q to SR: Z=1/1000mm, K=1/1000°; Q=1/1000°	..←..OUT_CORR_Z ..←..OUT_CORR_K ..←..OUT_CORR_Q	
23	Setting the correction values valid.	..↑..OUT_CORR_VAL	
24	Point data become invalid.	Point data..↓..	
24	Robot takes back positioning message and starts next correction.	IN_POINT_POS..↓..	
25	Cancelling of the correction value. Setting the distance value invalid.	..↓..OUT_CORR_AKQ ..↓..OUT_CORR_VAL	
	Continue at 20.		
32	Report at PLC that point is finished.	..↑..OUT_POINT_READY	Point is finished.
33	Point data become invalid.	Point data..↓.. IN_CURVATURE..↓..	

No.	Description	PLC	smart-robotic
33	Robot takes positioning message back and starts next correction.	IN_POINT_POS..↓..	
34	Retraction of the finished report.	..↓..OUT_POINT_READY	
	Continue at 20 (new point) or 40 (job end).		
40	Robot reports that the job is finished.	IN_JOB_STOP..↑..	Job is finished.
41	SR finishes the job and generates measuring file.	..↓..OUT_JOB_RUN	
	If measuring data are written successfully to disk, job success is reported to PLC.	..↑..OUT_JOB_ SUCCESS	
42	Retraction of the handshake.	IN_JOB_STOP..↓..	If measurements are available, an output file is generated.

10.4 Measurement Mode - wave scan

The wave-scan only has the operation mode “Normal Measurement“.

10.4.1 Sequence

No.	Description	PLC	smart-robotic
10	If defined, job data must be available.	Job data..↑..	
11	New job is started.	IN_JOB_START..↑..	Internal start of a new job, takeover of the job data on the agenda.
12		..↑..OUT_JOB_RUN	Feedback to PLC that job runs.
		..↑..OUT_JOB_SUCCESS	Retraction of the job success signal.
13	Retraction of the job start signal.	IN_JOB_START..↓..	
14	Job data do not need to be valid any longer.	Job data..↓..	
20	Robot hit point. If defined, point data must be on the agenda.	Point data..↑..	New point hit or correction executed.
21	Robot reports that a matching position is hit.	IN_POINT_POS..↑..	
	The wave-scan reports that measurement was successful (continue at 32).	OUT_POINT_RESULT=1	
	The wave-scan reports error, abort (continue at 32).	OUT_POINT_RESULT=0	
24	Point data become invalid.	Point data..↓..	
	Robot takes back positioning message and starts next correction.	IN_POINT_POS..↓..	
	Continue at 20.		
32	Report at PLC that point is finished.	..↑..OUT_POINT_READY	Point is finished.

No.	Description	PLC	smart-robotic
33	Point data become invalid.	Point data..↓.. IN_CURVATURE..↓..	
33	Robot takes positioning message back and starts next correction.	IN_POINT_POS..↓..	
34	Retraction of the finished report.	..↓..OUT_POINT_READY	
	Continue at 20 (new point) or 40 (job end).		
40	Robot reports that the job is finished.	IN_JOB_STOP..↑..	Job is finished.
41	SR finishes the job and generates measuring file.	..↓..OUT_JOB_RUN	
	If measuring data are written successfully to disk, job success is reported to PLC.	..↑..OUT_JOB_ SUCCESS	
42	Retraction of the handshake.	IN_JOB_STOP..↓..	If measurements are available, an output file is generated.

10.4.2 Diagram

OPC Signals for wave-scan ROBOTIC at the PLC

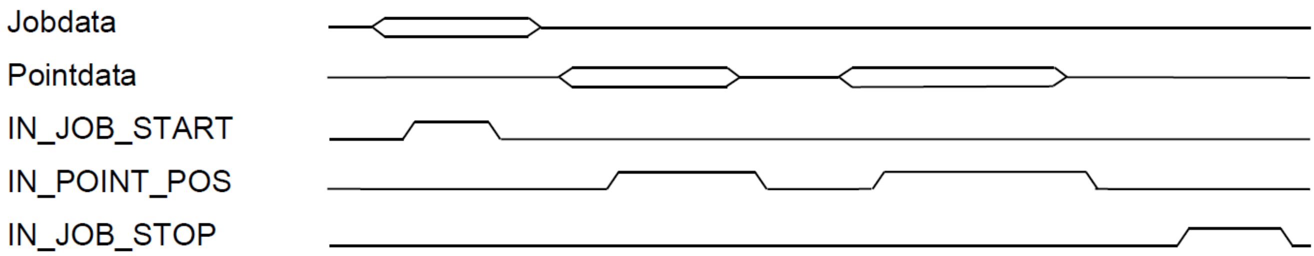

Illustration 160: Wave-Scan-Time-Diagram-PLC

OPC Signals for wave-scan ROBOTIC in smart-robotic

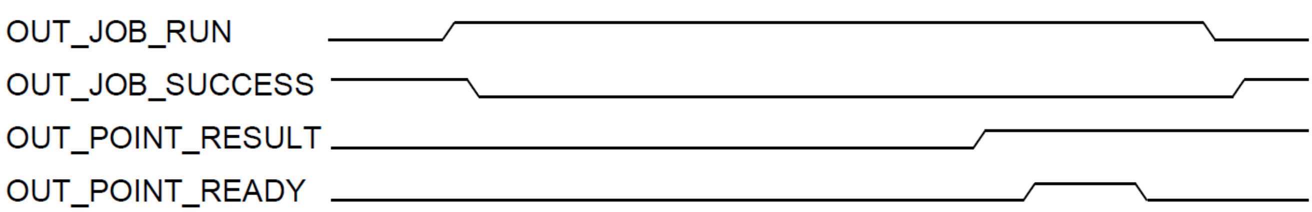

Illustration 161: Wave-Scan-Time-Diagram-SR

10.4.3 Workflow

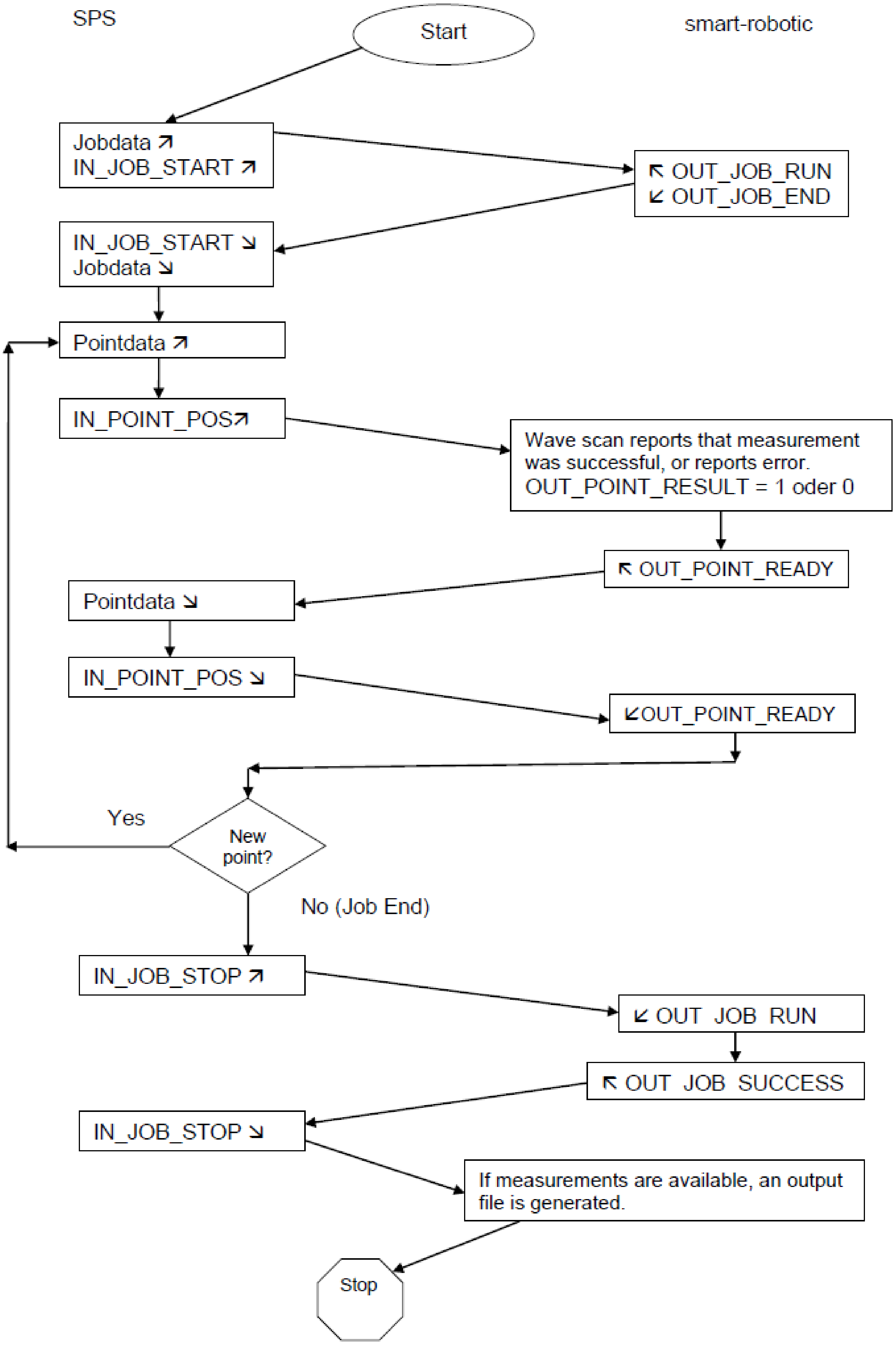

Illustration 162: Wave-Scan-Flow-Diagram

11 Appendix

11.1 Abbreviations

The following abbreviations are used in this documentation.

BMi	BYK-Gardner BYK-mac i (handheld instrument)
BMi-R	BYK-Gardner BYK-mac i ROBOTIC
CSV	Comma Separated Values
DB	Database
FTDI	Future Technology Devices International
IP	Internet Protocol
LAN	Local Area Network
PLC	Programmable Logic Controller
OEM	Original Equipment Manufacturer
OPC	Open Platform Communications
SC	BYK-Gardner smart-chart
SR	BYK-Gardner smart-robotic
USB	Universal Serial Bus
WS	BYK-Gardner wave-scan (handheld instrument)
WS-R	BYK-Gardner wave-scan ROBOTIC
WS3	BYK-Gardner wave-scan 3 (handheld instrument)
WS3-R	BYK-Gardner wave-scan 3 ROBOTIC
XML	Extensible Markup Language

11.2 Error Handling

Error conditions of a measuring instrument are transferred as an error code via OPC signal. It must be decided at the PLC side about the use of this information. An exception forms for example following signal, that is directly available as bit-information:

- BYK-mac i ROBOTIC: `MACx_CTRL.OUT_SYS_ERR`
- wave-scan ROBOTIC: `WAVEx_CTRL.OUT_SYS_ERR`

All error codes set this bit additionally as a signal of a critical disturbance, at which the measurement must be aborted. Since it however makes sense not to stop the measurement at some errors, but to simply go to the next measuring point, certain error codes can be configured in the device Error Handling [▶ 46] list that no "OUT_SYS_ERR" is set.

11.2.1 Error Code Transmission

The transmission of the error codes to the PLC is done sequentially by a variable. The transfer is controlled via handshake. Following variables are used:

- `xxx.OUT_ERR_NO`
- `xxx.OUT_ERR_STROBE`

- `xxx.IN_ERR_ACK`

The following procedure applies:

1. As soon as a new error is on the agenda, “OUT_ERR_NO” is updated with the error code. If the OPC server surely has updated the error code, “OUT_ERR_STROBE” is set to high.
2. This is the signal for the PLC that a new valid error code is to be done and can be read.
3. As soon as the PLC reads the code, the signal “IN_ERR_ACK” is set to high by the PLC.
4. Then smart-robotic sets back the signal “OUT_ERR_STROBE” to low again, and in the sequence PLC sets “IN_ERR_ACK” to low.
5. If further errors should occur, the handshake is repeated.

11.2.2 Usage of OPC Signals

The scenario to be used for error code transmission is selected in the OPC Server Settings [▶ 29]:

- System-wide Error Messages [▶ 159]
- Instrument-specific Error Messages [▶ 159]

For possible OPC signals see Example List of OPC Signals [▶ 14].

11.2.2.1 System-wide Error Messages

In this scenario the OPC signals in the common group ALL_CTRL are used:

- `ALL_CTRL.OUT_ERR_NO`
- `ALL_CTRL.OUT_ERR_STROBE`
- `ALL_CTRL.IN_ERR_ACK`

This scenario is not recommended anymore as it does not give details about the device raising the error.

11.2.2.2 Instrument-specific Error Messages

In this scenario the OPC signals in the device-specific groups MACx_CTRL and WAVEx_CTRL are used:

- BYK-mac i ROBOTIC with index “1”:
  - `MAC1_CTRL.OUT_ERR_NO`
  - `MAC1_CTRL.OUT_ERR_STROBE`
  - `MAC1_CTRL.IN_SYS_ERR_ACK`
- wave-scan ROBOTIC with index “1”:
  - `WAVE1_CTRL.OUT_ERR_NO`
  - `WAVE1_CTRL.OUT_ERR_STROBE`
  - `WAVE1_CTRL.IN_SYS_ERR_ACK`

This is the recommended scenario as the device raising the error can be easily identified.

11.3 Troubleshooting

Module	Problem	Solution
Main program	Configuration is yet not possible or can not be reached.	Restart smart-robotic.
Main program	There is a problem with smart-robotic.	Check log file in "C:\ProgramData\BYK\smart-robotic\Logs\ SmartRobotic.log".
Main program	Adding data is not possible on a configuration.	Add the data input value first. Click the Add button second.
Main program	There are too many XML files in the program data directory.	Backup all files, for example in a ZIP archive.
Main program	There are too many log files in the log directory.	Backup all files, for example in a ZIP archive.
OPC config	OPC control signal in status "Not connected".	Check / correct configuration on OPC server. Restart OPC server.
OPC config	OPC point signal in status "Not connected".	1 Check / correct configuration on OPC server. Restart OPC server. 2 Check / correct configuration in smart-robotic. Restart smart-robotic.
Device connect	COM port can not be assigned, it is occupied by other device.	1 Assign a free COM port. 2 If not possible, delete the other device.
Device test	Device initialization failed with "Error at Initialize".	1 Click the button **De-Initialize** first. 2 Reconnect USB cable and repeat with new connection. 3 Reconnect power cable and repeat after new instrument start.
Output files	Output files have no or unknown file extension.	Append the correct extension in the file name definition designer.
Output files	Output file is not written after measurement.	Activate the device used during measurement for this type of storage.
smart-chart link	Simulation hangs during a measurement.	1 Close smart-robotic. 2 Restart OPC server. 3 Restart smart-robotic. 4 Reactivate device and simulator. 5 Restart measurement.
smart-chart link	Expected quality status is not achieved during measurement.	A Save last modification in smart-chart and restart smart-robotic. B Check if matching car model AND color standard is used in smart-robotic.
Robot simulator	Robot simulator can not be started.	Enable a measurement device first.
Robot simulator	There is a problem with the robot simulator.	Check log file in "C:\ProgramData\BYK\ smart-robotic\Logs\ RobotSimulator.log".
Robot simulator	There are too many log files in the log directory.	Backup all files, for example in a ZIP archive.

11.4 XML Input File PELT

Following XML input files have been used to create this documentation. Details see PELT Measurement [▶ 122].

11.4.1 Job Information

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE RobotPELT SYSTEM "RobotPELT.dtd" >
<RobotPELT>
<Revision>420003.2.1.5</Revision>
<BuildDate>2020-12-14T11:15:50</BuildDate>
<JobInformation>
<Id>00000098020041</Id>
<StyleNumber>Compact</StyleNumber>
<Booth>B</Booth>
<BaseColor>Petrol</BaseColor>
<ClearColor>HE05</ClearColor>
<MeasurementUnits>Microns</MeasurementUnits>
</JobInformation>
```

11.4.2 Multiple Measurements

```
<MultipleMeasurements>
<Measurement>
…
<Layers>
…
</Layers>
</Measurement>
</MultipleMeasurements>
</RobotPELT>
```

11.4.2.1 Measurement 1

```
<Measurement>
<PanelName>R01 X01 0:1</PanelName>
<PanelNumber>0</PanelNumber>
<PanelLocation>1</PanelLocation>
<Location>1</Location>
<Robot>1</Robot>
<Sensor>1</Sensor>
<Placement>1</Placement>
<GroupCode>T</GroupCode>
<KD_KOORD_X>0</KD_KOORD_X>
<KD_KOORD_Y>0</KD_KOORD_Y>
<KD_KOORD_Z>0</KD_KOORD_Z>
<LayerCount>4</LayerCount>
<Temperature> 18.0</Temperature>
<Timestamp>2020-12-14T14:26:13</Timestamp>
```

```
<Layers>
```

11.4.2.1.1 Layer 1

```
<Layer>
<LayerNumber>1</LayerNumber>
<Thickness> 34.46</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 59.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>33.50</TOF>
<LayerName>Clear_T</LayerName>
<LayerCode>CC</LayerCode>
<LayerVendor>VW</LayerVendor>
</Layer>
```

11.4.2.1.2 Layer 2

```
<Layer>
<LayerNumber>2</LayerNumber>
<Thickness> 17.18</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 59.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>16.50</TOF>
<LayerName>TP Color_T</LayerName>
<LayerCode>BC</LayerCode>
<LayerVendor>VW</LayerVendor>
</Layer>
```

11.4.2.1.3 Layer 3

```
<Layer>
<LayerNumber>3</LayerNumber>
<Thickness> 22.66</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 83.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>21.50</TOF>
<LayerName>Prime_T</LayerName>
<LayerCode>PR</LayerCode>
<LayerVendor>VW</LayerVendor>
</Layer>
```

11.4.2.1.4 Layer 4

```
<Layer>
<LayerNumber>4</LayerNumber>
```

```
<Thickness> 14.94</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 84.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>14.00</TOF>
<LayerName>E-Coat_T</LayerName>
<LayerCode>EC</LayerCode>
<LayerVendor>VW</LayerVendor>
</Layer>
```

11.4.2.2 Measurement 2

```
<Measurement>
<PanelName>R01 X01 1:21</PanelName>
<PanelNumber>1</PanelNumber>
<PanelLocation>21</PanelLocation>
<Location>2</Location>
<Robot>1</Robot>
<Sensor>1</Sensor>
<Placement>2</Placement>
<GroupCode>S</GroupCode>
<KD_KOORD_X>0</KD_KOORD_X>
<KD_KOORD_Y>0</KD_KOORD_Y>
<KD_KOORD_Z>0</KD_KOORD_Z>
<LayerCount>4</LayerCount>
<Temperature> 19.0</Temperature>
<Timestamp>2020-12-14T14:27:13</Timestamp>
<Layers>
```

11.4.2.2.1 Layer 1

```
<Layer>
<LayerNumber>1</LayerNumber>
<Thickness> 42.86</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 48.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>41.50</TOF>
<LayerName>2K Clearcoat</LayerName>
<LayerCode>ALD 096050/ALZ</LayerCode>
<LayerVendor>Axalta</LayerVendor>
</Layer>
```

11.4.2.2.2 Layer 2

```
<Layer>
<LayerNumber>2</LayerNumber>
<Thickness> 10.53</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 48.0</Confidence>
<Indirect>0</Indirect>
```

```
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF> 9.00</TOF>
<LayerName>Deepblack Per_5</LayerName>
<LayerCode>2T2T</LayerCode>
<LayerVendor>Axalta</LayerVendor>
</Layer>
```

11.4.2.2.3 Layer 3

```
<Layer>
<LayerNumber>3</LayerNumber>
<Thickness> 29.79</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 95.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>20.50</TOF>
<LayerName>Anthrazit Prime</LayerName>
<LayerCode>ALG 670008</LayerCode>
<LayerVendor>Hemmelra</LayerVendor>
</Layer>
```

11.4.2.2.4 Layer 4

```
<Layer>
<LayerNumber>4</LayerNumber>
<Thickness> 21.01</Thickness>
<LayerTooThin>0</LayerTooThin>
<Confidence> 95.0</Confidence>
<Indirect>0</Indirect>
<TemperatureScaleValue>1.0000</TemperatureScaleValue>
<TOF>15.00</TOF>
<LayerName>CathoGuard 800</LayerName>
<LayerCode>ALE 074507</LayerCode>
<LayerVendor>BASF</LayerVendor>
</Layer>
```

NOTICE

The value for the “Multi-Layer Total Thickness” is not present in the file. It is calculated by **smart-robotic** from the values of the different layers belonging to the same check zone.

Notes

Download your software from:
https://www.byk-instruments.com/wave-scan

Download your manual from:
https://www.byk-instruments.com/p/7410

Find more information on our products and services:
https://www.byk-instruments.com

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