Schaeffler DuraSense

User manual

Foreword

Schaeffler DuraSense is a sensor-based system for analysing and monitoring the lubrication status of Schaeffler monorail guidance systems. It records the current running behaviour of the carriage, evaluates and visualises the data, and enables automated lubrication.

With two operating modes, Schaeffler DuraSense can be used to provide lubrication in accordance with requirements and to monitor an existing central lubrication system. The system enables lubricant savings and the avoidance of unplanned machine downtimes.

The increased productivity creates a decisive competitive advantage for the user of Schaeffler DuraSense. Schaeffler DuraSense represents a key step in manufacturing toward Industry 4.0.

Contents

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About the user manual This user manual describes the Schaeffler DuraSense system.

The current version of the associated setup software Service Setup Tool (SST) is: 03.11.01339.

Symbols The warning and hazard symbols are defined in accordance with ANSI Z535.6-2011.

NOTICE In case of non-compliance, damage or malfunctions in the product or the adjacent construction may occur. ◁

Note There follows additional or more detailed information that must be observed.

Legal guidelines The information in this manual reflects the status as of November 2021.

Unauthorised modifications to or improper use of the device are not permitted. Schaeffler accepts no liability in these cases.

General safety guidelines

Usage for the intended purpose Schaeffler DuraSense may only be used to analyse and monitor Schaeffler monorail guidance systems.

Schaeffler DuraSense may only be used in an industrial environment.

Usage not for the intended purpose Schaeffler DuraSense may not be used in environments with an explosion risk.

Usage not for the intended purpose can result in personal injury, damage to the monorail guidance system and damage to adjacent systems.

Selection and qualification of operating and commissioning personnel

Schaeffler DuraSense may only be fitted and commissioned by qualified personnel.

Qualified personnel:

- are authorised to fit Schaeffler DuraSense by the machine manufacturer or operator
- have all the necessary knowledge
- are familiar with the safety guidelines
- have read and understood this manual

Work on electrical devices

Work on electrical devices and components may only be carried out by a trained electrician.

On the basis of their technical training, knowledge and experience as well as their knowledge of the appropriate regulations, trained electricians are in a position to assess the work assigned to them and recognise possible hazards.

Electromagnetic compatibility

Schaeffler DuraSense is designed to comply with the provisions on electromagnetic compatibility in accordance with EU Directive 2014/30/EU.

In order not to jeopardise compliance with the provisions on electromagnetic compatibility (EMC), no unauthorised modifications may be made to the pre-processing unit (PPU), the cables (including shielding) and the sensors.

If you have any questions, please contact Schaeffler.

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Safety regulations

This section contains important safety regulations relating to working with Schaeffler DuraSense. Further guidelines can be found in the individual chapters of this user manual.

Read this document before commissioning the device. Make sure that the product is suitable without restrictions for the envisaged use.

The device may only be installed by a trained electrician.

The installation must be carried out in accordance with the national and international regulations covering the installation of electrical equipment.

Before fitting the device, check for any external damage.
If damage or some other defect is found, the device must not be commissioned.

Any interference in or modifications to the device, or the addition or removal of inappropriate components is impermissible,
can endanger occupational safety and may render any warranty claim null and void.

Any work on wiring, opening or closing of electrical connections may only be performed with the device in a voltage-free state.

The use of Schaeffler DuraSense is only admissible within the boundaries of the conditions stated and illustrated in the user manual.

Schaeffler DuraSense may only be operated within the limits described in the technical data. If Schaeffler DuraSense is operated outside these limits, the device may be destroyed.

Do not carry out repairs on a damaged Schaeffler DuraSense device.

Arrange to have any necessary repairs carried out by Schaeffler.

Only use Schaeffler DuraSense with the lubricants approved for this product, see page 29.

Only dismount Schaeffler DuraSense when it is in a voltage-free state.

Never bend the sensor cable and the connection cables of the PPU. The bending radius of the sensor cable must not fall below the specified minimum value, see page 36.

The sensor head must not be subjected to external forces.
Any contact with surrounding components is not permitted.
For fixing, use the threaded stud on the sensor only.

Safe handling of information interfaces

This product has the following information interfaces:
- Fieldbus (Profinet IRT)
- Ethernet

The product can be connected with other devices, components or internal or external networks (e.g. internet) via each of these interfaces. Devices (like data carriers) connected via information interfaces may contain malware or execute malicious functions undetected. This product, or your company infrastructure (e.g. IT infrastructure) can be damaged due to the use of these kinds of information interfaces. In addition, your company's data security may be compromised.

Before using our product and its information interfaces, please familiarise yourself with the following:
- the security features offered by the product and its information interfaces
- the security provisions of your company (e.g. on IT security)

Before commissioning, clarify with your responsible contact person whether and which safety precautions must be taken when using the product and its information interfaces.

Maintenance and repair work

Maintenance and repair work may only be carried out by qualified professionals and in compliance with accident prevention regulations. Suitable personal protective equipment must be worn for all work.

Schaeffler DuraSense must be placed in a voltage-free state before starting maintenance and repair work.

If any safety devices must be removed during maintenance or repair, these must be refitted once the work is complete and their function must be checked.

When carrying out maintenance and repair work, only suitable tools may be used.

Troubleshooting and rectification

Troubleshooting and rectification may only be carried out by qualified professionals and in compliance with accident prevention regulations. Suitable personal protective equipment must be worn for all work.

Disposal

Schaeffler DuraSense and the corresponding components must not be disposed of with household waste, as they contain electronic components that must be disposed of correctly.

Electronic devices must be disposed of in accordance with the relevant regulations.

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Constructional modifications (conversion)	For safety reasons, autonomous modifications (conversion) of Schaeffler DuraSense are not permitted.

Any modifications that will impair electromagnetic compatibility (EMC) are also not permitted, see page 5.

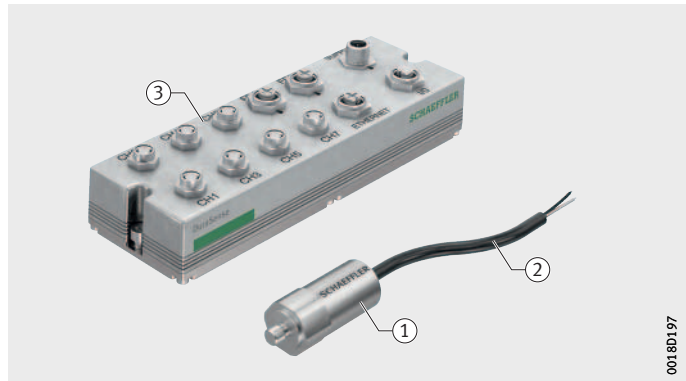If you have any questions, please contact Schaeffler.

Scope of delivery

The scope of delivery of Schaeffler DuraSense includes:
- pre-processing unit (PPU)
- sensors (including sensor cable), number according to order:
  - up to 7 sensors can be used per PPU

① Sensor
② Sensor cable
③ Pre-processing unit (PPU)

Figure 1
Scope of delivery

Not included in the scope of delivery:
- user manual BA 60, Schaeffler DuraSense
  Download at: https://www.schaeffler.de/std/1F35
- ethernet cable for connection between PPU and Windows PC (required during setup)
- power cable with plug
- plug and cable for connection between PPU and programmable logic controller (PLC)
- plug for connection between sensor cable and PPU

Observe the guidelines regarding the required plugs and cables, see page 34.

Description

Function

Schaeffler DuraSense is a sensor-based system for analysing and monitoring the lubrication status of Schaeffler monorail guidance systems.

The system consists of a sensor for measuring vibrations, a pre-processing unit (PPU), a carriage prepared for fitting the sensor and a guideway.

The PPU fulfils the following functions:

- conversion of analogue to digital sensor signals
- calculation of a lubrication parameter from the measured sensor signals
- comparison of the lubrication parameters obtained from the measurements with the threshold value defined on the basis of the reference run
- output of the quality of the lubrication status (digital output signal for threshold values which have been exceeded or not exceeded; analogue output signal for continuous monitoring)

Schaeffler DuraSense enables two different operating modes for monitoring the lubrication status:

- lubrication appropriate to requirements, see page 10
- monitoring of the lubrication status and lubrication circuit, see page 11

All of the interfaces required to operate Schaeffler DuraSense are integrated in the PPU. All inputs and outputs are located on the top of the housing.

The lubrication status of up to 7 carriages (CH1 to CH7) can be monitored with a PPU.

Inputs and outputs for:
① Sensors
② Fieldbuses (Profinet IRT)
③ Voltage supply
④ Ethernet
⑤ PLC (and other systems with digital or analogue interfaces)

Figure 2
PPU inputs and outputs
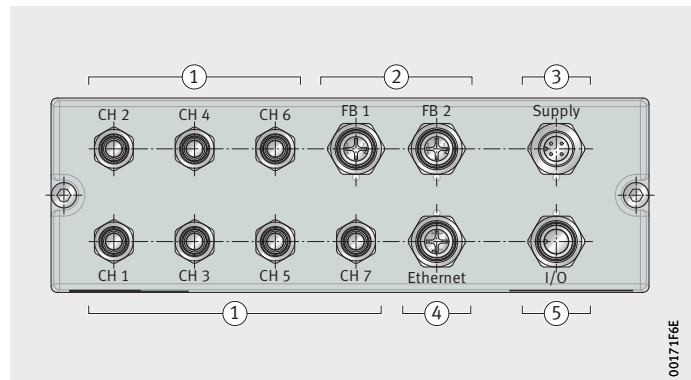
The PPU is available in two versions:

- PPU.DSE07-C-A-AA (fieldbus interfaces are active)
- PPU.DSE07-A-A-AA (fieldbus interfaces have no function)

Externally, there is no discernible difference between the two versions. Differentiation is provided in the form of a label attached to each PPU, which bears the designation of the respective version.

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Operating modes

Lubrication appropriate to requirements

The lubrication intervals are controlled by the signals from Schaeffler DuraSense. When the set threshold value is reached, the PPU sends a signal to the machine controller that can be used to initiate a relubrication impulse.

SKW = lubrication parameter
s = distance travelled

Figure 3
Example
of a lubrication parameter profile
(lubrication appropriate to
requirements)
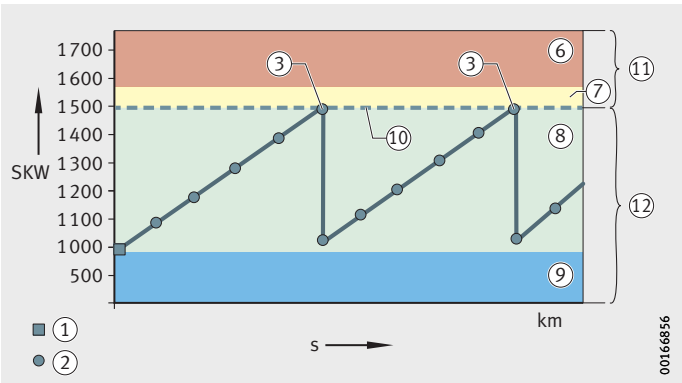
Legend
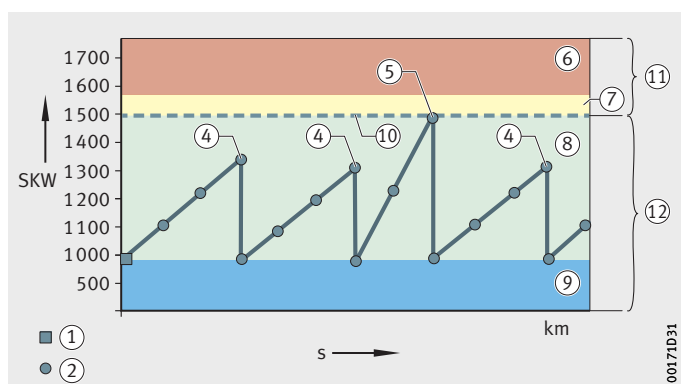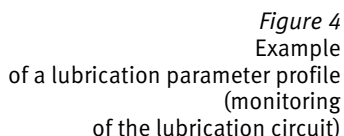① Reference run
② Measurement run
③ Relubrication recommended
⑥ Inadequate lubrication
⑦ Adequate lubrication
⑧ Optimum lubrication
⑨ Overlubrication
⑩ Threshold value, defined on the basis of the reference run
(in the example: threshold value = 1 500)
⑪ Output signal according to setting:
24 V, 0 V, 8 mA to 20 mA
⑫ Output signal according to setting:
0 V, 24 V, 4 mA to 8 mA

Monitoring of the lubrication status and lubrication circuit

The lubrication intervals are stipulated by the customer, for example by means of time or distance control. Schaeffler DuraSense is used for monitoring here.

The system determines and outputs the current lubrication parameter (SKW). If the monorail guidance system is inadequately lubricated due to a blocked or torn lubrication line, for example, the lubrication parameter will rise above the usual level.

In addition to monitoring the lubrication status, indirect monitoring of the carriage condition can also be performed through a long-term analysis of the calculated lubrication parameters.

SKW = lubrication parameter
s = distance travelled

Figure 4
Example of a lubrication parameter profile (monitoring of the lubrication circuit)

Legend

① Reference run

② Measurement run

④ Fixed relubrication interval

⑤ Additional relubrication recommended

⑥ Inadequate lubrication

⑦ Adequate lubrication

⑧ Optimum lubrication

⑨ Overlubrication

⑩ Threshold value, defined on the basis of the reference run (in the example: threshold value = 1 500)

⑪ Output signal according to setting:
24 V, 0 V, 8 mA to 20 mA

⑫ Output signal according to setting:
0 V, 24 V, 4 mA to 8 mA

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Output signals

Digital
When the lubrication parameter reaches the preset threshold value, the output signal changes from 0 V to 24 V or from 24 V to 0 V, depending on the setting.

Analogue
The calculated lubrication parameter is output using an output signal in each case in the range from 4 mA to 20 mA. The operator has the option of using this signal to display the lubrication status. In addition, the lubrication parameter threshold values must be programmed in the machine controller and relubrication triggered when they are reached.

Note
When using the analogue output signals, the threshold value must be set and monitored independently in the machine controller.

Saving the lubrication parameters

The user can save the calculated lubrication parameters to a Windows PC, for example. A local network or cloud system is not required for this purpose.

Reference run

Regardless of the selected operating mode, a reference run must be carried out:
- on initial operation
- in the event of changes to the measurement runs, see page 13, as a result of modified movement cycles, for example

During each reference run, the sensor attached to the carriage measures vibration behaviour and transmits the measured analogue data to the PPU, where the data are processed and output as a lubrication parameter (digital or analogue). The threshold value at which lubrication is to be initialised is set on the basis of these data.

The following conditions apply to the reference run:
- duration between 0,7 s and 5 s
- constant velocity
  (recommended: between 0,5 m/s and 1 m/s)
- same cycle (load, duration and velocity) for reference run and measurement runs
- for a new carriage after approx. 100 km in a relubricated state:
  – repeat reference run and apply new threshold values if necessary (running-in behaviour taken into consideration)

Note
For reference runs with acceleration components, please consult Schaeffler.

Measurement runs	During operation, regular measurement runs must be initiated by the PLC. The cycle of the measurement runs (load, duration and velocity) must match the reference run cycle.

The measurement runs can form part of the existing movement sequence or can be set up as additional measurement runs.

The measurement runs provide the data for determining the lubrication parameter.

Note	For measurement runs with acceleration components, please consult Schaeffler.

Storage	Conditions for storing Schaeffler DuraSense:
- storage temperature: −25 °C to +70 °C
- store in original packaging only

Mounting

Plugs and cables

To connect the sensor and pre-processing unit (PPU), plugs and cables are required, which are not included in the scope of delivery:

▶ Taking account of the scope of delivery, see page 8, check which plugs and cables you require in addition to the components included in the delivery.

▶ Procure the necessary plugs and cables, taking into account the information on accessories, see page 34 onwards.

Fitting the pre-processing unit (PPU)

The PPU is fitted as follows:

▶ Determine the mounting position of the PPU. Please note, in this regard, that the PPU must be attached to the moving axis of the monorail guidance system and that the sensor cable is not suitable for drag chain use.

▶ Adjust the length of the sensor cable (delivered condition: 2 m). It can be shortened, or lengthened up to a maximum of 5 m.

▶ Fix the PPU to the mounting position. Use the appropriate screws (M5) and tighten them firmly.

▶ Earth the PPU housing using the housing fixing screws.

▶ Connect the PPU (connector: I/O) and the machine controller (PLC) using the appropriately prepared cable.

▶ Supply the PPU with a 24-V power source (for example PLC). For details on voltage supply, see page 34.
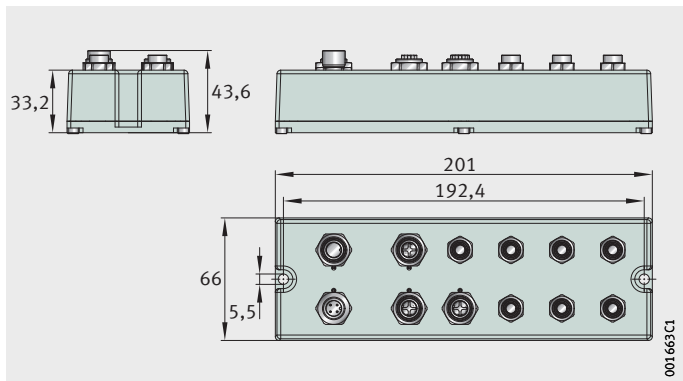
▷ The PPU is fitted.

Figure 5
PPU (mounting dimensions)

Preparing to fit the sensor using a retrofit adapter (optional)

The retrofit adapter is intended for carriages that do not have a suitable thread for fitting the sensor.

It can be used for all standard carriages that are free from damage and show no signs of wear.

The retrofit adapter (cylindrical, diameter = 14 mm) has an internal thread for connecting the sensor.

Ordering designation

Ordering designation for retrofit adapter:
■ DI.DSE.16-0011

Mounting position

Demands on the mounting position of the retrofit adapter:
■ on a side or end face of the carriage
■ between upper and lower raceway
■ flat surface so that the adapter piece can be attached by adhesive to the entire surface of the carriage
■ positioned so that the side surface of the sensor does not come into contact with any other parts or carriage components once it has been fitted

Fitting

The retrofit adapter is fitted as follows:
▶ Determine a suitable mounting position for the retrofit adapter.
▶ Ensure that the carriage and sensor surfaces to be bonded are clean and free of grease.
▶ Stick the retrofit adapter to the mounting position on the carriage using an adhesive that is suitable for bonding metals and for the environmental conditions associated with the application.
▷ Once the adhesive connection has set, a sensor can be mounted on the adapter piece.
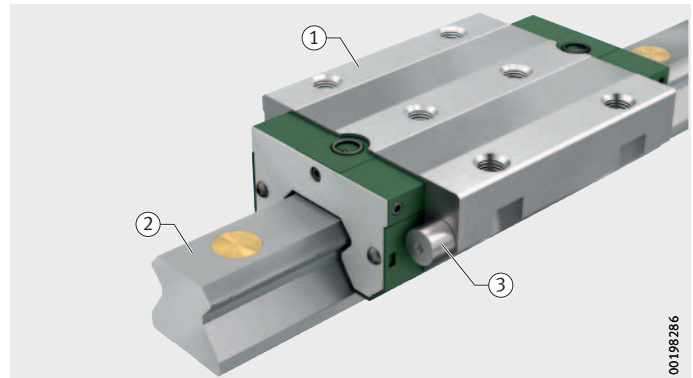

① Carriage
② Guideway
③ Retrofit adapter

Figure 6
Carriage with retrofit adapter

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Fitting the sensor

The sensor is fitted as follows:

▶ Attach the plug to the sensor cable to connect to the PPU. Observe the information on cables and plugs, see page 34 onwards.

▶ Screw the sensor into the thread provided on the carriage or into the thread of the retrofit adapter using a tightening torque of 5 Nm. Use an open-ended torque wrench with a 15 mm jaw width for this purpose.

▶ Connect the plug attached to the sensor cable to one of the inputs CH1 to CH7 of the PPU.

▶ Make a note of which carriage is connected to which channel. We recommend storing this information in the control cabinet so that it is available and accessible at all times.
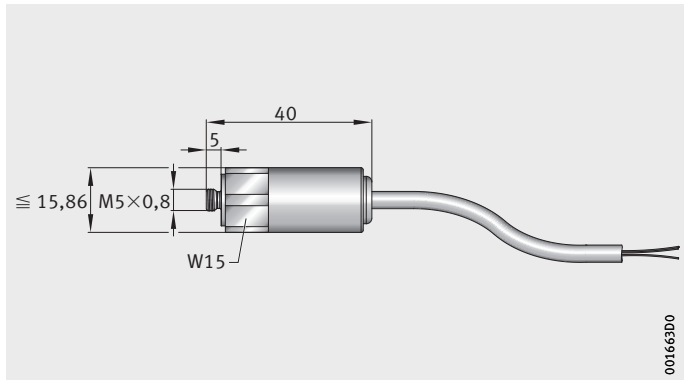
▷ The sensor is fitted.

Figure 7
Sensor (mounting dimensions)

Figure 8
Fitting the sensor

**Setup software
Service Setup Tool (SST)**

The setup software Service Setup Tool (SST) facilitates extensive communication between the PPU and a Windows PC during commissioning and servicing.

Following setup, Schaeffler DuraSense will run in normal operation without setup software SST.

Download

The setup software SST for Schaeffler DuraSense is available to download from Schaeffler under the following link:
- https://www.schaeffler.de/std/1F7D

Start screen

After starting setup software SST, the start screen appears.
If no connection to a PPU is established, only five of the large buttons are displayed, *Figure 10*, page 19. Once a connection to a PPU has been established, all six of these buttons will appear, *Figure 9*.
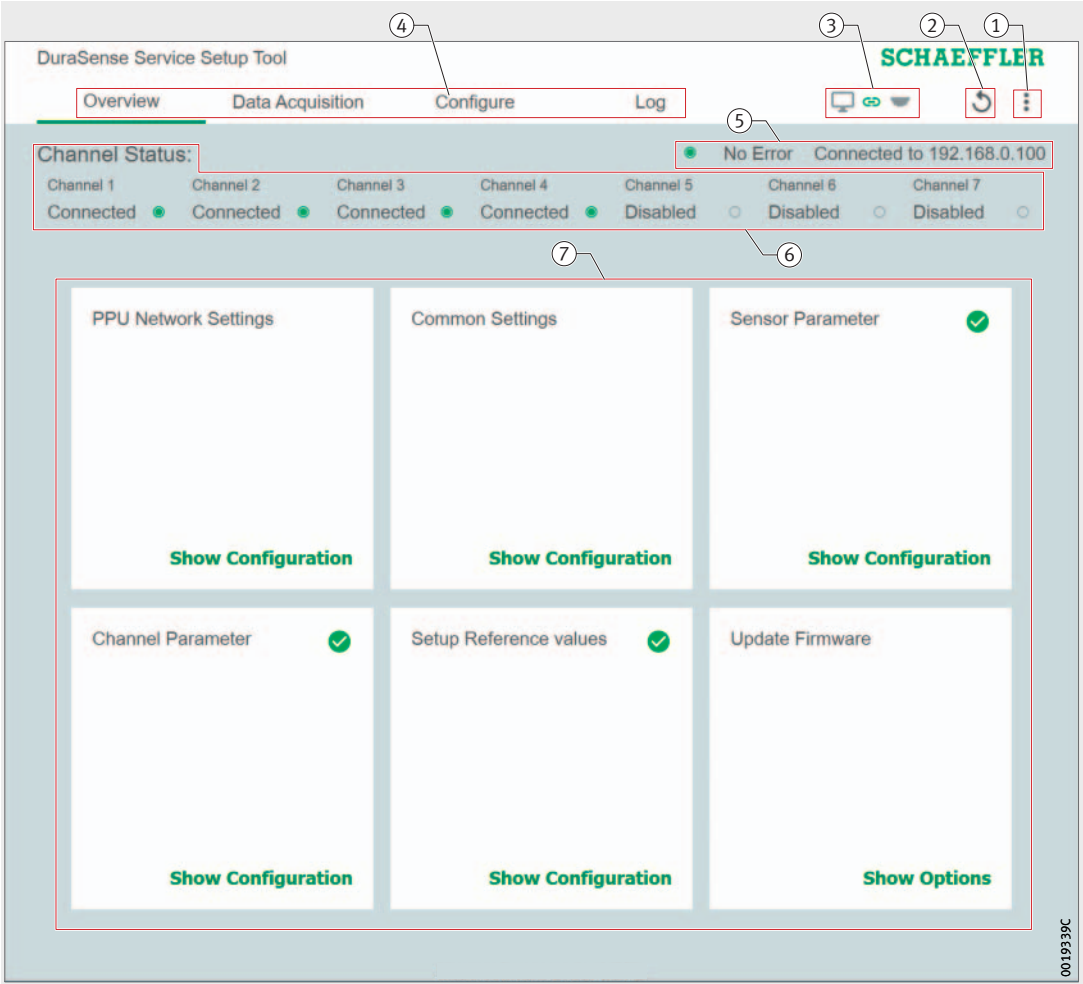

Figure 9
Start screen

Components of the start screen

① General settings

② Restarting the PPU

③ Connection status between PPU and Windows PC

④ Main menus:
  – [**Overview**]:
    start screen
  – [**Data Acquisition**]:
    recording and display of measured values,
    e.g. for the definition of threshold values
  – [**Configure**]:
    configuration
  – [**Log**]:
    display of LPV profile and log file

⑤ Error and connection status

⑥ Channel status

⑦ Buttons, in some cases with status display; these buttons lead
  directly to selected functions or setting options that are arranged
  below [**Configure**]

General settings

The button for general settings is located at the top right of the
program window.

Menu for general settings

Button	Function
⁝	Opens the menu for general settings: ☐ [**Language**]: selection of language for setup software SST ☐ [**License**]: information about the licence ☐ [**About**]: information about the program version and current system ☐ [**Scaling**]: adjust the font size

Commissioning

Preparation

A Windows PC is needed for commissioning:

▶ Ensure that you have administrator rights. These are necessary for adjusting the IP address.

▶ Download the Service Setup Tool (SST) software from the Schaeffler homepage to the Windows PC, see page 17.

▶ Connect the Windows PC to the PPU using an Ethernet cable. For details on the Ethernet connection, see page 37.

Prior to initial connection: Adjusting the IP address of the Windows PC

The PPU is delivered with the IP address 192.168.000.100. In order that the Windows PC can be connected to the PPU, its Ethernet interface must be in the same IP number range.

Adjusting the IP address:

▶ Assign an IP address between 192.168.000.001 and 192.168.000.254 to the Ethernet interface of the Windows PC, but excluding IP address 192.168.000.100.

Following initial connection (optional): Adjusting the IP address of the Windows PC and PPU

Once the Windows PC has been connected to the PPU, the IP address can be changed if necessary:

▶ Find out from the responsible IT contact within your company which IP number range can be used for communication between the PPU and the Windows PC.

▶ Assign an IP address from this number range to the PPU and the Ethernet interface of the Windows PC.

Connecting setup software SST to the PPU

Connecting setup software SST to the PPU:

▶ Start the setup software SST.

▶ In the top right hand corner, select the [**Connect to Device**] button, *Figure 10*, to open the PPU connection dialog box, *Figure 11*, page 20.


Figure 10
Start screen,
[**Connect to Device**]
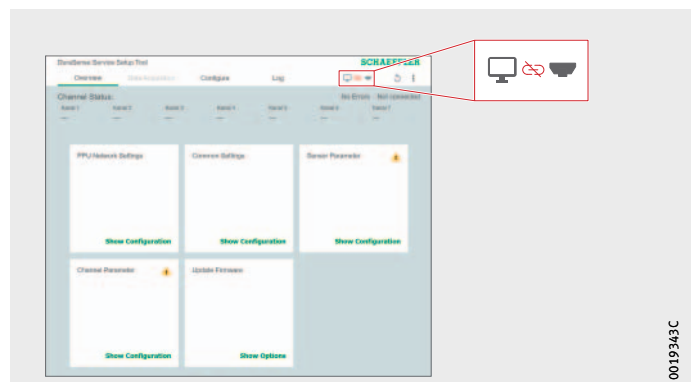
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▶ Under [**Enter network interface**], select the Ethernet connection that is set on the Windows PC, *Figure 11*.

▶ Click [**Refresh List**] to view all available PPUs. Alternatively, you can also enter the IP address of the PPU manually.

▶ Select the PPU that is to be set up (in unconfigured state: [**DuraSense module**]) and press [**Connect**].
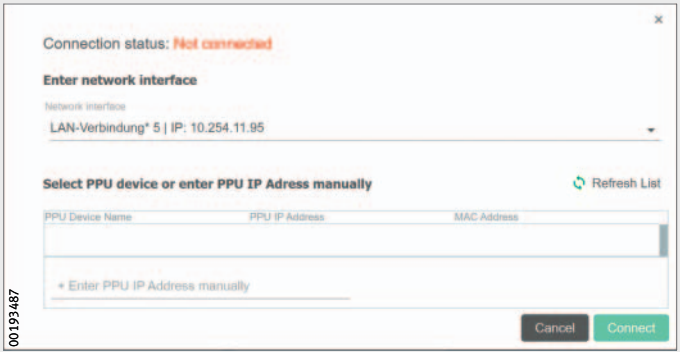
Connection status The current connection status between setup software SST and the PPU is permanently displayed.

Button
[**Connect to Device**]

Button	Function
(icon green) (icon red)	Connection status between PPU and Windows PC: ▪ green = connected ▪ red = not connected The connection can be established or broken by clicking the relevant button.

Restart It may be necessary to restart the PPU if malfunctions occur.
In the event of a restart, the data last saved are used.

Button
[**Restart PPU**]

Button	Function
(icon)	Restart the PPU and then update the connection to the Windows PC

Configuration	The following areas are summarised under the [**Configure**] tab, *Figure 12*:

- device settings
- network settings
- configuration of the measurement channels
- read out product information
- update firmware
- reset (network settings, factory settings)

Reading out and saving configurations	Configurations must be read and saved using the corresponding buttons, *Figure 12*:

① [**Read Config from PPU**]

② [**Write Config to PPU**]

In the event of changes, such as new reference and measurement runs due to a modified motion cycle, the existing configuration of the PPU must be read out first. The [**Read Config from PPU**] button is used for this purpose.

Once the configuration has been changed, it must be saved in the PPU. The [**Write Config to PPU**] is used for this purpose.
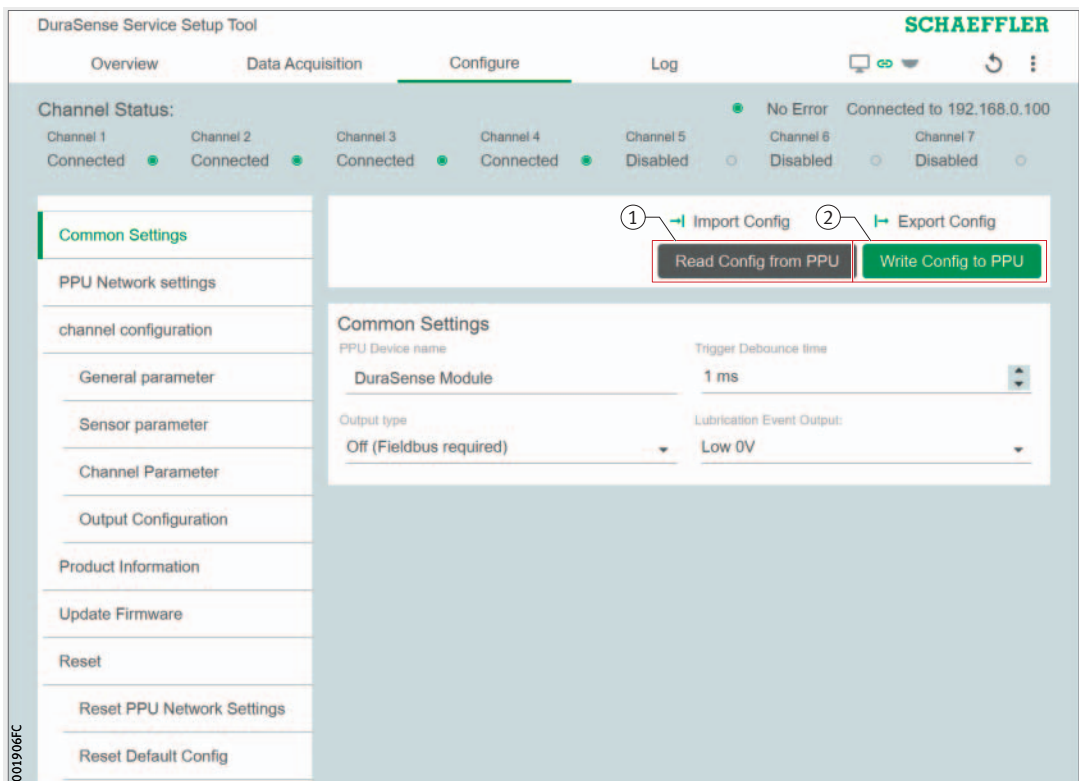

Figure 12
[**Configure**]

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Device settings   The settings in the [**Common Settings**] area apply to the entire PPU and affect all channels:
▶ Perform the settings required for your particular application, see *table* and *Figure 13*.

Setting options under
[**Common Settings**]

Field	Setting option
[**PPU Device name**]	Unique name of the PPU
[**Trigger Debounce time**]	Time to debouncing of trigger signal (standard: 1 ms; can be maintained)
[**Output type**]	Choice of ☐ [**Digital**] (output signal 0 V or 24 V) ☐ [**Analog**] (output signal between 4 mA and 20 mA) ☐ [**Off (Fieldbus required)**]
[**Lubrication Event Output**]	☐ For digital [**Output type**]: Setting: Signal for relubrication at 0 V or 24 V; signal monitoring by machine controller must correspond to SST setting ☐ For analogue [**Output type**]: No setting possible

Figure 13
[**Common Settings**]
(screenshot)
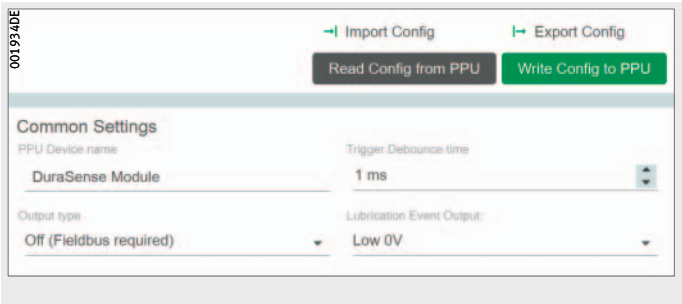
Network settings   In the [**PPU Network Settings**] area, you can assign a new IP address and a new net mask to the PPU:
▶ Perform the settings required for your particular application, see *table* and *Figure 14*, page 23.
▶ Make a note of the new IP address, to enable future access to the PPU.

If you have adjusted the IP address of the PPU, you will also need to make a corresponding adjustment to the IP address of the Windows PC used.

The network settings can be reset in the [**Reset**] area.

Setting options under
[PPU Network Settings]

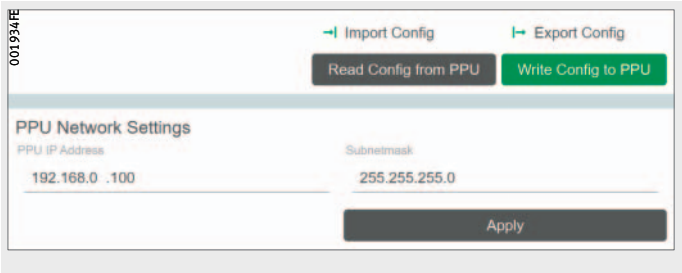| Field	Setting option
[**PPU IP**]	Adjust the IP address of the PPU: ☐ Insert the IP address assigned by your IT department.
[**Net mask**]	No adjustment required

Figure 14
[**PPU Network Settings**]
(screenshot)

Configuration
of the measurement channels

For the settings in the [**Channel Configuration**] field, see *table* and *Figure 15*, page 24:

▶ Activate the channel or channels used by selecting the green button in each case.

▶ Deactivate the unused channel or channels by selecting the green button in each case.

▶ Adjust the names of the individual channels under [**General parameter**].

▶ Select the respective connected sensor type under [**Sensor parameter**].

▶ Perform the appropriate settings for your application under [**Channel parameter**].

The settings under [**Output Configuration**] are performed at a later stage, when defining the threshold values, see page 26.

Setting options under
[Channel Configuration]

| Area	Field	Setting option
[**General parameter**]	[**Channel name**]	Name of channel, freely selectable
[**Sensor parameter**]	[**Sensor**]	Sensor type
[**Channel parameter**]	[**Device Family**]	Monorail guidance system type
	[**Design Size**]	Monorail guidance system size
	[**Version**]	Monorail guidance system version
	[**Design Model**]	Carriage design
	[**Lubrication Type**]	Lubricant
	[**Variant**]	Filter parameter set for determining the lubrication parameter (standard = 0)

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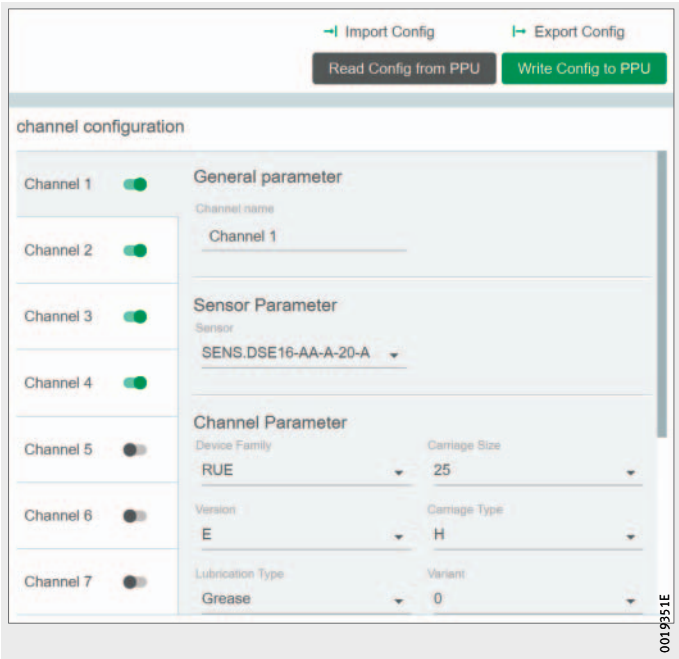
Figure 15
[**Channel Configuration**]
(screenshot)

Saving the configuration

Write settings to PPU:
▶ Now select the [**Write Config to Device**] button, *Figure 15*,
to save the selected settings on the PPU.

Reference run

The reference run is carried out as follows:
▶ Select the [**Data Acquisition**] tab, *Figure 16*.
▶ Activate the green button for [**Reference Run**].
▶ Carry out a reference run via the PLC with the specified conditions,
see page 12. Select the [**Start**] button to start the reference run.

Figure 16
[**Data Acquisition**]

Separate threshold value for each carriage

The lubrication parameter is determined by a multitude of influencing factors. As each carriage results in a different lubrication parameter, the setting of blanket threshold values for multiple carriages is not permitted.

NOTICE

Threshold values that are not appropriate to the carriage will result in an incorrectly assessed lubrication state of the monorail guidance system. Carry out a separate reference run with each carriage and assign a separate threshold value in each case. ◁

Adjusting the velocity of the reference run

The result of the reference run is displayed, *Figure 17*.

The lubrication parameter should be between 30 and 20 000. If this is not the case, the velocity of the reference run must be adjusted. If the lubrication parameter is too low, the reference run must be carried out at a faster rate. If it is too high, the reference run must be carried out at a slower rate. This may necessitate exceeding or falling below the recommended velocity for a reference run, see page 12.
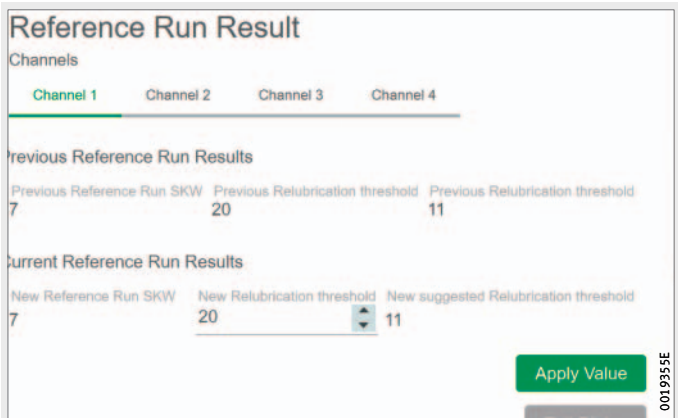

Figure 17
Result of the reference run

Schaeffler DuraSense

Threshold values
The system suggests threshold values based on the results of the reference runs, *Figure 17*, page 25. These must be verified for each active channel and adjusted if necessary, *Figure 18* and *Figure 19*, page 27:

▶ Under [**Channel Configuration**], select the [**Output Configuration**] area.

▷ Depending on the type of output signal (digital or analogue) selected in the [**Output type**] input field under [**Common Settings**], various setting options are available, *Figure 18* and *Figure 19*, page 27.

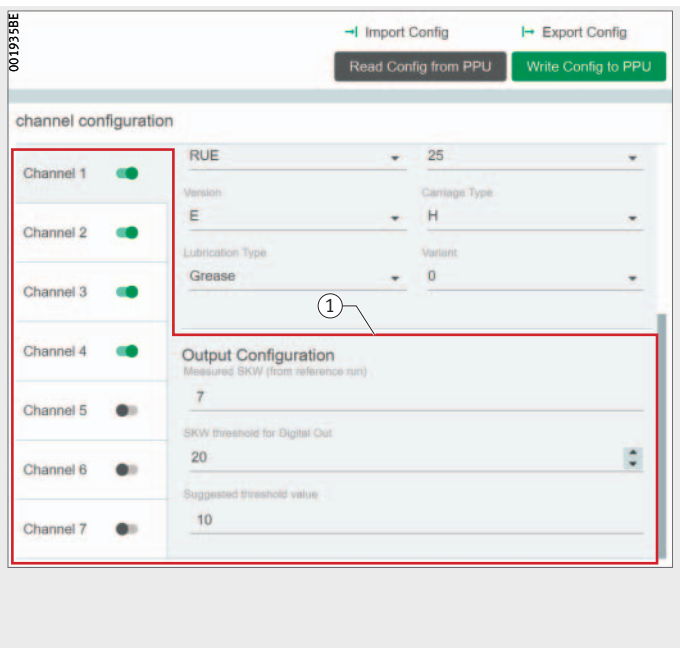**Digital output signal**
The system calculates a suggested threshold value [**Suggested threshold value**] from the measured lubrication parameter [**Measured SKW (from reference run)**], *Figure 18*. The suggested threshold value should be accepted in the [**SKW threshold for Digital Out**] input field.

The threshold value can be adjusted by the customer. The higher the threshold value, the greater the time interval between lubrication requirement messages. The lower the threshold value, the smaller the time interval between lubrication requirement messages.

Selection of the relubrication value:

▶ Select the [**SKW Limit for Digital Out**] relubrication value, taking note of the following recommendation, see page 28.

① Channel selection and input fields for adjusting the threshold values

Figure 18
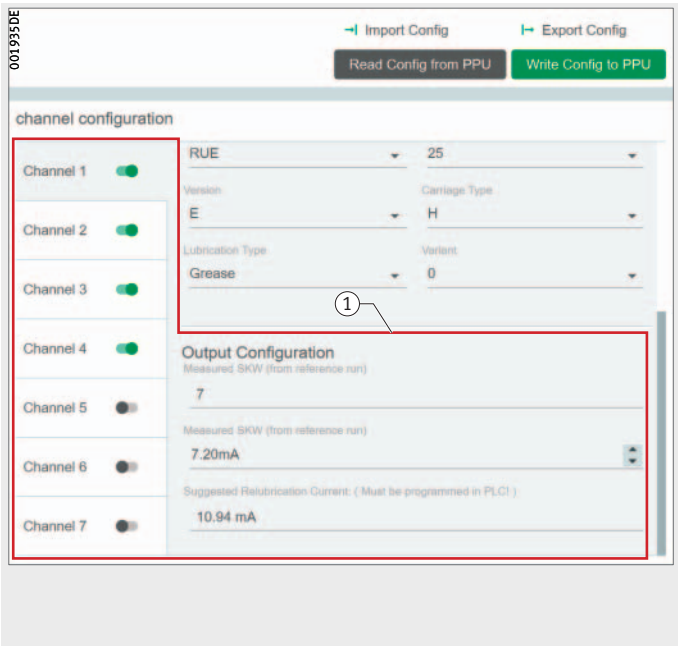[**Output Configuration**] for digital output signal (screenshot)

Analogue output signal The current intensity 4,8 mA is assigned to the measured lubrication parameter [**Measured SKW (from reference run)**], *Figure 19*.

It is possible to change the current intensity value (4,8 mA) manually and thus assign a new current intensity to the measured lubrication parameter. The lubrication parameter profile is displayed in a range of 4,8 mA to 20 mA. As the measured values generally increase during the measurement runs, it is not usually necessary to adjust the standard value 4,8 mA. However, the measured value may occasionally reduce after the guidance system has been run in. In this case, the current intensity (4,8 mA) must be rescaled (up) in order that the entire lubrication parameter profile can be displayed.

A [**Suggested Relubrication Current**] threshold value is calculated from the set value and suggested. The suggested threshold value must be transferred to the machine controller:

▶ Transfer the suggested threshold value to the machine controller, taking note of the following recommendation.

① Channel selection and input fields for adjusting the threshold values

Figure 19
[**Output Configuration**]
for analogue output signal
(screenshot)

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Recommendation	We recommend carrying out relubrication when the relubrication value suggested by the system is reached for both digital and analogue output signals.
Note	Slightly increasing the relubrication value results in more economical lubricant use. Slightly lowering the value will offer added security in terms of the lubrication state.

NOTICE Increasing the reference value can lead to lubricant starvation. Only increase the reference value following careful investigation and observe the actual lubricant consumption. ◁

Operation Schaeffler DuraSense can also be operated in the following modes:
- lubrication appropriate to requirements, see page 10
- monitoring of the lubrication status and lubrication circuit, see page 11

Measurement runs Schaeffler DuraSense measurement runs must be initiated by your PLC.

Details on the framework conditions of the measurement runs can be found on page 13.

v = travel velocity
t = time

① Trigger signal by PLC
② Measurement run as part of a working cycle

Figure 20
Measurement run in working cycle (example)

Lubrication parameter   The measured lubrication parameter (SKW) usually has a fluctuating profile.
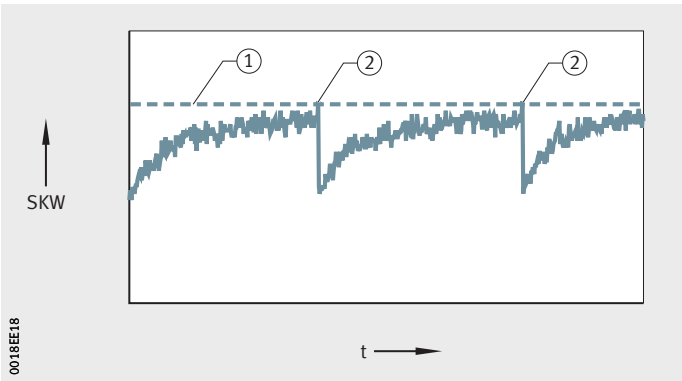
Lubrication parameter after relubrication   The lubrication parameter drops significantly in the event of rerelubrication, *Figure 21*.

A measurement run should be carried out after lubrication to check lubricant entry. A time offset of several minutes must be taken into account, depending on the lubrication system and lubricant used (e.g. grease or flowable grease).

SKW = lubrication parameter
t = time

① Threshold value for relubrication
② Timing of relubrication

Figure 21
Actual profile
of the lubrication parameter
(example)

Lubrication parameter following a stoppage   If the monorail guidance system is at a standstill, there will be a fall in the lubrication parameter as lubricant continues to flow into the rolling contact while the system is stationary. The rate of the drop is determined by the lubricant. When operation is resumed, the lubrication parameter will return to the level reached prior to the stoppage after a short period of operation.

Operating temperature   The permissible operating temperature is 0 °C up to +60 °C.

Schaeffler DuraSense

LEDs on PPU
Status display

Item LED		Status display LED	Status	Description
Power	⚪	Off	Not in operation	Operating voltage is not connected
	🟢	On	In operation	Regular operation
I/O	🟢	on	In operation	Regular operation
	☼	Flashing	Error	Troubleshooting measures required
Ethernet	☼	Intermittent flashing	In operation	Data exchange in progress.
FB1 FB2	☼	Intermittent flashing[1]	In operation	Data exchange in progress.

[1] For version PPU.DSE07-C-A-AA
only (version with active fieldbus interfaces).

Lubricants
To enable the correct functioning of Schaeffler DuraSense, the following specifications apply to the lubrication of monorail guidance systems:
- For oil lubrication:
  Of the lubrication oils suggested in Catalogue PF 1, only those with a minimum viscosity corresponding to ISO VG 150 are permitted.
- For grease lubrication:
  All of the greases suggested in Catalogue PF 1 are permitted.

Further information
Detailed information on Schaeffler monorail guidance systems:
- Catalogue PF 1, Monorail guidance systems
  Download at: https://www.schaeffler.de/std/1F7E

Permissible indirect process materials
All indirect process materials that come into contact with Schaeffler DuraSense must first be checked for compatibility with the materials used with Schaeffler DuraSense, see *table*, page 39.

Troubleshooting and rectification

A malfunction of the PPU is indicated in two ways:

- The LED above the I/O output flashes.

- The status signal output via the I/O output (pin 11; status output) changes from 24 V to 0 V.

The log file stored on the PPU can be used to determine the cause of the error.

The procedure is as follows:

▶ Connect a Windows PC equipped with the setup software Service Setup Tool (SST) to the PPU using an Ethernet cable.

▶ Start the setup software SST.

▶ Select the [**Log**] tab, *Figure 22*.

▶ Select the [**Read Log**] tab.

▶ Check the displayed error code, see *table*, page 32, and carry out the corrective actions listed.
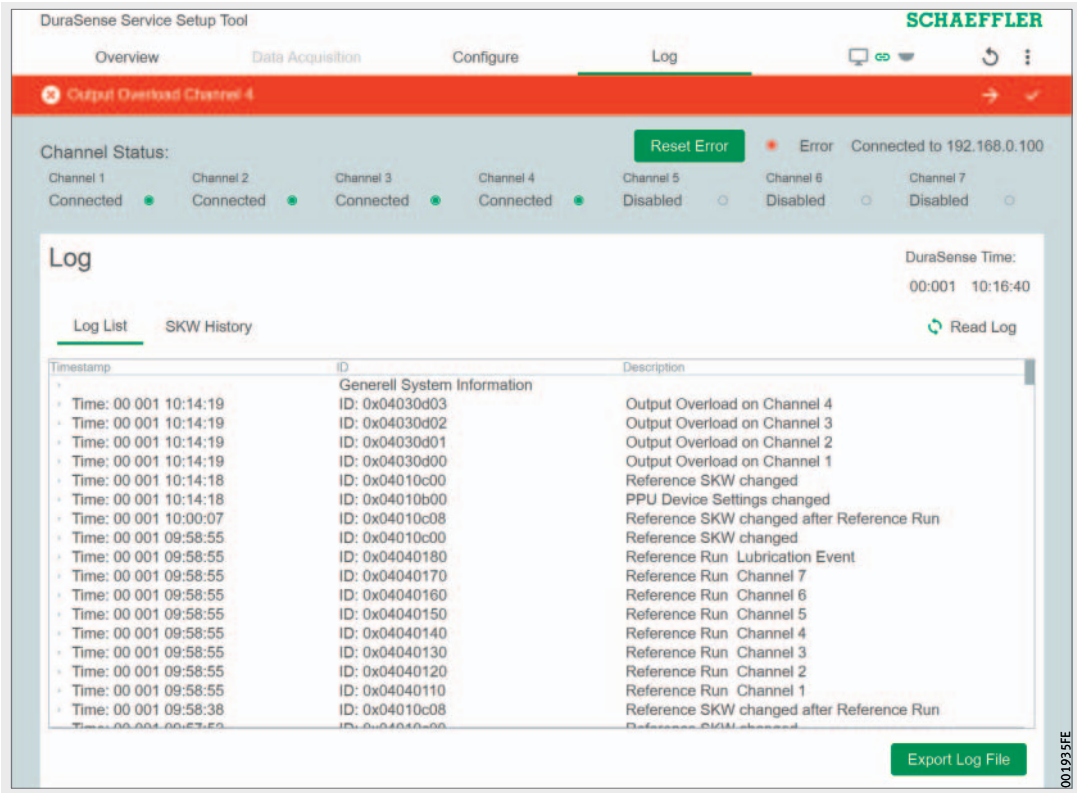

Figure 22
[**Log**]
(example)

Schaeffler DuraSense

Error codes

Error text	Error description	Corrective actions
[**Bias Voltage Threshold Violation. Over Voltage/ Open Circuit: Please check Sensor**]	Bias voltage too low or too high; possible causes: ☐ cable breakage ☐ short circuit ☐ sensor overloads during measurement run	Check sensor cable. Check shielding (on sensor cable, sensor plug and transition from plug to cable). Check measurement run for framework conditions, see page 13.
[**Bias Voltage Threshold Violation. Under Voltage/ Short Circuit: Please check Sensor**]	Bias voltage too low or too high; possible causes: ☐ cable breakage ☐ short circuit ☐ sensor overloads during measurement run	Check sensor cable. Check shielding (on sensor cable, sensor plug and transition from plug to cable). Check measurement run for framework conditions, see page 13.
[**Maximum Trigger Timing Violation (max. 5.0 Seconds)**]	Measuring time (measurement or reference run) > 5 s	Carry out a new measurement or reference run with a duration of 0,7 s to 5 s.
[**Minimum Trigger Timing Violation (min. 0.7 Seconds)**]	Measuring time (measurement or reference run) < 0,7 s	Carry out a new measurement or reference run with a duration of 0,7 s to 5 s.
	Measurement time too short due to debouncing of trigger signal	Increase [**Trigger Debouncetime**], see page 22.
[**Output Overload on Channel**]	Output wired or configured incorrectly	Check device setting for output signal ([**Common Settings**] area, [**Output type**]) field. Check I/O wiring (for commissioning without I/O wiring, the output signal must be set to [**Off (Fieldbus required)**]).
[**No Reference Values Detected**]	Possible causes: ☐ no reference run carried out ☐ result of reference run not stored	Repeat reference run and store the result in the PPU.

Dismounting	Schaeffler DuraSense is dismounted as follows:

Dismounting   Schaeffler DuraSense is dismounted as follows:

▶ Ensure that the controller to which the PPU is connected is in a voltage-free state.

▶ Disconnect the PPU from the voltage supply.

▶ Break the connection between the PPU and controller.

▶ Disconnect the sensors and PPU.

▶ Undo the screws that are used to secure the PPU.

NOTICE

Excessive torsional stress can damage the sensor, sensor cable and the attached plug. Avoid any such stress. ◁

▶ Remove the sensor from the carriage using an open-end wrench (jaw width 15 mm).

▷ Schaeffler DuraSense is dismounted.

Decommissioning   If safe operation of the sensor, PPU or accessories is no longer possible, the system must be taken out of operation and secured against inadvertent operation.

Safe operation is then no longer possible if a component:

◾ shows visible signs of damage

◾ is malfunctioning

◾ was exposed to conditions that contravene storage or operating specifications

Disposal   Schaeffler DuraSense components contain electrical and electronic parts that must be properly disposed of as electrical waste.

Schaeffler DuraSense

Technical data and accessories

NOTICE	Incorrect shielding can distort the transmitted signal and thus impair the function of Schaeffler DuraSense.

Ensure that plugs, cables and the respective transitions are correctly shielded. ◁

Voltage supply

The connector and cable for the PPU voltage supply are not included in the Schaeffler DuraSense scope of delivery.

Connector

Connector requirements:
- ▢ M12, A-coded, 4 pins
- ▢ protection type IP67

Pin assignment

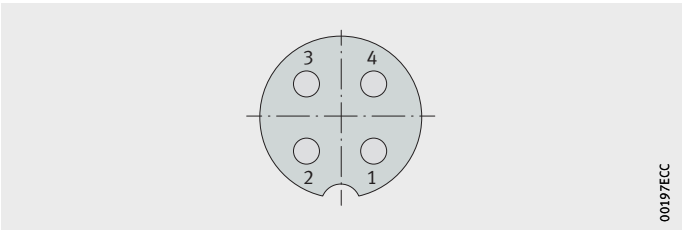| Pin number	Signal
1	24 V DC
2	24 V DC
3	GND
4	GND

Figure 23
Pin numbering of connector

Cable

Cable requirements:
- ▢ connection to a 24-V DC voltage source (e.g. PLC) possible
- ▢ suitable for drag chain use
- ▢ cable diameter 6 mm to 8 mm (depending on the plug)
- ▢ cross-section of conductor 0,75 mm^2
- ▢ use two wires each for voltage and earthing

Connection to the controller (PLC)

The plug and cable for connecting the PPU and PLC are not included in the Schaeffler DuraSense scope of delivery.

Plug

Plug requirements:
- M12, A-coded, 12 pins
- protection type IP67
- shielded

Pin assignment

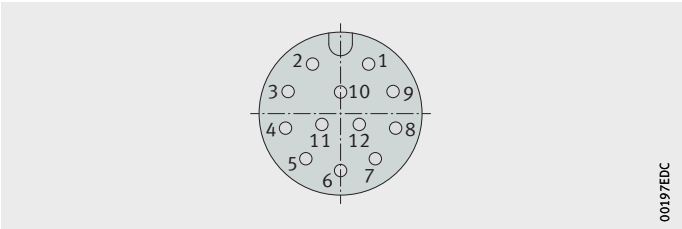| Pin number	Signal
1	GND
2	Analogue –, digital out 1
3	Analogue –, digital out 2
4	Analogue –, digital out 3
5	Analogue –, digital out 4
6	Analogue –, digital out 5
7	Analogue –, digital out 6
8	Analogue –, digital out 7
9	GND
10	Trigger signal (input)
11	Status output
12	GND

Figure 24
Pin numbering of plug

Cable

Cable requirements:
- suitable for drag chain use
- cable diameter 6 mm to 8 mm (depending on the plug)
- cross-section of conductor 0,25 mm^2
- shielded
- maximum cable length 20 m

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Connection to sensors   The plugs for connecting the sensors to the PPU are not included in the Schaeffler DuraSense scope of delivery.

Each sensor has a 2 m cable, which can be shortened or extended to a maximum length of 5 m by the customer if required.
The sensor cable should be as short as possible, with no turns, and securely laid, with no drag chain routing. The cable has two lines. The minimum bending radius of the cable is 10 mm.

Plug   Plug requirements:
- M8, A-coded, 3 pins
- protection type IP67
- shielded

Pin assignment

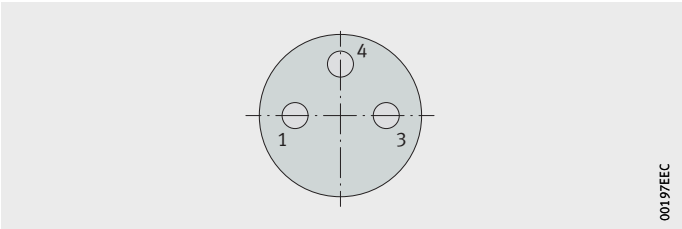| Pin number	Signal	Colour of the line
1	–	–
3	GND	Black
4	V_IEPE	White

Figure 25
Pin numbering of plug

Cable   Cable requirements:
- cable diameter 3,5 mm to 5 mm (depending on the plug)
- cross-section of conductor 0,25 mm^2
- shielded
- minimum bending radius 10 mm

Ethernet connection	The plugs and cable for the Ethernet connection between the Windows PC and PPU are not included in the Schaeffler DuraSense scope of delivery.	

**Plug
(for connection with PPU)**

Plug requirements:
- M12, D-coded, 4 pins
- protection type IP67
- shielded

Pin assignment

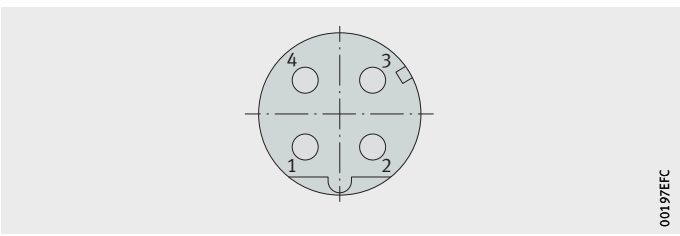| Pin number	Signal
1	TX+
2	RX+
3	TX−
4	RX−

Figure 26
Pin numbering of plug

**Plug
(for connection with Windows PC)**

Plug requirements:
- type RJ45

Pin assignment

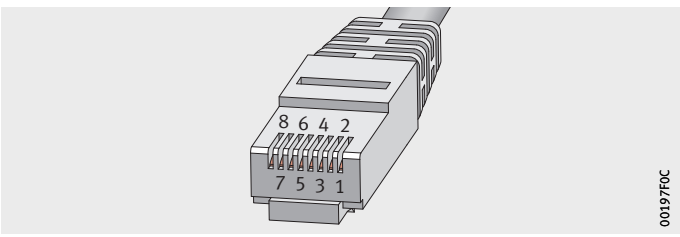| Pin number	Signal
1	TX+
2	TX−
3	RX+
6	RX−

Figure 27
Pin numbering of plug

Cable

Cable requirements:
- suitable for drag chain use
- cable diameter 4 mm to 8 mm (depending on the plug)
- cross-section of conductor 0,14 mm^2 to 0,5 mm^2
- shielded
- twisted pair
- minimum requirement CAT 5e

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Fieldbus connections (Profinet IRT)
The plug and cable for a fieldbus connection of the PPU (version PPU.DSE07-C-A-AA) and PLC are not included in the Schaeffler DuraSense scope of delivery.

Plug
Plug requirements:
- M12, D-coded, 4 pins
- protection type IP67
- shielded

Cable
Cable requirements:
- cable diameter 4 mm to 8 mm (depending on the plug)
- cross-section of conductor $0,14 \text{ mm}^2$ to $0,5 \text{ mm}^2$
- shielded
- twisted pair
- minimum requirement CAT 5e

Outputs of the fieldbus module
The outputs of the fieldbus module react as follows:
- If IOPS = BAD (= CPU in "stop" state):
  - Status change to IDLE. The network is informed that the I/O data of the submodule with IOPS =BAD will be replaced with zeros (deleted). No reading process data are updated in the host interface.
- If the connection is lost from the controller:
  - Status change to WAIT-PROCESS. The network is informed that the I/O data of all submodules will be replaced with zeros (deleted). No process data are updated in the host interface.
- During power-up (power-on without connected controller):
  - The network is informed that the I/O data of all submodules will be replaced with zeros (deleted). No process data are updated in the host interface.

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Technical data Schaeffler DuraSense

Description		Value	Unit
Storage temperature		−25 to +70	°C
Operating temperature		0 to +60	°C
Output	Analogue	4 to 20	m/A
	Digital	0 to 24	V
Mass	Sensor (incl. 2 m cable)	90	g
	PPU	800	g
Sensor dimensions	Diameter	15	mm
	Length	35	mm
Sensor cable	Length	2	m
Protection class	Sensor	IP67	−
	PPU	IP64	−
Power supply DC		24	V

Materials

Component	Material
PPU housing	Pressure diecast aluminium
Sensor housing	High-grade steel
Sensor cable	PUR

Schaeffler DuraSense

SCHAEFFLER

Issued: Version "B" 2021-03

CE

EU Declaration of Conformity
Acc. to EU EMC Directive 2014/30/EU

We hereby declare that the product described below, complies with the relevant fundamental health and safety requirements of the EU directives mentioned below, due to its design and construction as well as in the version we have placed on the market.
This declaration is issued under the sole responsibility of the manufacturer.

Product description: Schaeffler DuraSense

Type / Variant: 094033102-0000 (Sensor)
094033153-0000 (without fieldbus interface)
094972540-0000 (Ethernet IP interface)
094972559-0000 (Profinet interface)
094972567-0000 (Powerlink interface)
094972575-0000 (Ethercat interface)
094972583-0000; (Modbus interface)

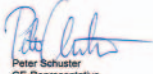**The product complies with following directives and standards:**

➢ RoHS 2011/65/EU

Applied harmonized norms, which are published in the Official Journal of the EU:

➢ EN 61000-6-2 /-4

➢ EN 61000-4-2 /-3/-4/-5/-6

08.10.2021   Peter Schuster
CE-Representative

Schaeffler Technologies AG & Co. KG
Georg Schäfer Str. 30
97421 Schweinfurt

In the event of any modifications that have not been aligned with the manufacturer, this declaration of conformity will become invalid. The safety advice in the instruction manual needs to be considered.
This declaration describes the conformity with the mentioned directives, but does not imply any warranty of characteristics.

PUBLIC

00197F5C

Figure 28
EU Declaration of Conformity