Software Manual

Electric
Smart Rotary Module

SREH-50-IOL

Translation of the Original Software Manual EN

- SREH-50-IOL ⇨ Order no.: 50503985

Dear Customer

Thank you for choosing our products and placing your trust and confidence in our company!

In this software manual you will find all essential information about your product. Our aim is to provide the required information as concisely and clearly as possible. If, however, you still have any questions on the contents or suggestions, please do not hesitate to contact us. We are always grateful for any feedback.

Our team will also be glad to answer any further question you may have regarding the smart rotary module or other options.

We wish you every success with our products!

With kind regards

Your Afag team

Subject to modifications

The smart rotary modules have been designed by Afag Automation AG according to the state of the art. Due to the constant technical development and improvement of our products, we reserve the right to make technical changes at any time.

Updates of our documentations

Unlike the printed documents, our digital manuals, product data sheets and catalogues are being continuously updated on our website.

Please keep in mind that the digital documents on our website are always the latest versions.

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1 General

The SREH-50-IOL smart rotary module is controlled via an IO-Link interface.

IO-Link is a globally standardised I/O technology (IEC 61131-9 / SDCI) for communicating with sensors and actuators. IO-Link technology provides a simple, uniform and cost-effective point-to-point connection with sensors and actuators.

General information on the IO-Link interface is available at *io-link.com*.

IO-Link Version	1.1.3
Transmission speed	COM3 (230.4 kBaud)
Minimum cycle time	2 ms
Implemented IO-Link profiles and function classes	▪ Common Profile (0x4000) ▪ Locator (0x8101) ▪ Firmware Update (0x0031)

The status of the IO-Link communication is indicated by the LED next to the IO-Link connector.

Status	Blink code
Not connected	LED off
Startup	LED permanently on
Preoperate	Flashing at 2 Hz, 90% duty cycle
Operate	Flashing at 1 Hz, 90% duty cycle

2 Process data

2.1 General

Process data refers to the periodically exchanged data. IO-Link defines the terms for the data direction from the PLC or master view. This means that the "outgoing" process data flows from the PLC to the SREH-50-IOL, the "incoming" data from the SREH-50-IOL to the PLC.

2.2 Outgoing process data

The outgoing process data consists of 6 bytes or 48 bits:

Bit offset	Type	Name, Meaning
47..16	int32	*Target Position*
15..8	uint8	*Motion Parameter Set* (valid values: 0..7)
7		(not used)
6	bit	*Shortest Path*
5	bit	*Relative*
4	bit	*Set Origin*
3	bit	*Reset Error*
2	bit	*Stop*
1	bit	*Move*
0	bit	*Motor On*

2.3 Incoming process data

The incoming process data consists of 7 bytes or 56 bits:

Bit offset	Type	Name, Meaning
55..24	int32	*Actual Position*
23..16	uint8	*Error Code* (error code as bit field)
15..8	uint8	Warning*Code* (warning code as bit field)
7..6		(not used)
5	bit	*Error* (set if at least 1 error is active)
4	bit	*Warning* (set if min. 1 warning active)
3	bit	*Done*
2	bit	*Busy*
1	bit	*Ready*
0	bit	*Motor Off*

2.4 Errors and warnings

In the incoming process data, one byte each is provided for errors and warnings. The coding is done as a bit field, i.e., each set bit corresponds to an active error or an active warning.

In addition, there are the individual bits "Error" and "Warning" in the process data. These are active exactly when at least one error or at least one warning is active.

Sometimes several similar errors or warnings share one bit in the bit field.

The exact cause of the error or warning can be read out via the diagnostic data (➲Chapter 7).

Error bit field:

Bit	Errors and possible causes	Motor is automatically switched off if a fault occurs
7	Device error	yes
6	Final stage/trajectory	yes
5	Temperature error (> 75 °C)	yes
4	Motor voltage	yes
3	Position tracking error	yes
2	Invalid command / communication	partial*
1	Invalid parameter	No
0	Positioning error	No

* Only in case of invalid process data or communication interruption

Warning bit field:

Bit	Warning and possible causes
7	Temperature warning (> 70 °C)
6	Motor voltage
5	Positioning warning
4..0	not used

2.5 Position coding

The coding of the target and actual position is done as a signed 32-bit number in two's complement. One rotation of 360° corresponds to the value 2^{16}.

For example:

Coding Hexadecimal	Coding Decimal	Angle of rotation
8000 0000	-2’147’483’648	-2^{15} ·-·360°
FFFF 0000	-65’536	-360°
FFFF FFFF	-1	approx. -0.0055°
0000 0000	0	0°
0000 0001	1	approx. 0.0055°
0001 0000	65’536	360°
7FFF FFFF	2’147’483’647	Approx. 2^{15} - 360º

Values with several bytes are transmitted by IO-Link as big endian. Depending on the IO-Link master and PLC, it may be necessary to reverse the byte order.

With the 32 bits, positions up to $\pm 2^{15}$ revolutions can be transmitted. However, with relative and "shortest path" operations (➲ section 3.4), the module can also be moved beyond this range. In this case, the output actual position overflows. Such an overflow can also occur when the flange is moved from the outside.

3 Control system

3.1 State machine

The module implements the state machine shown in the figure.

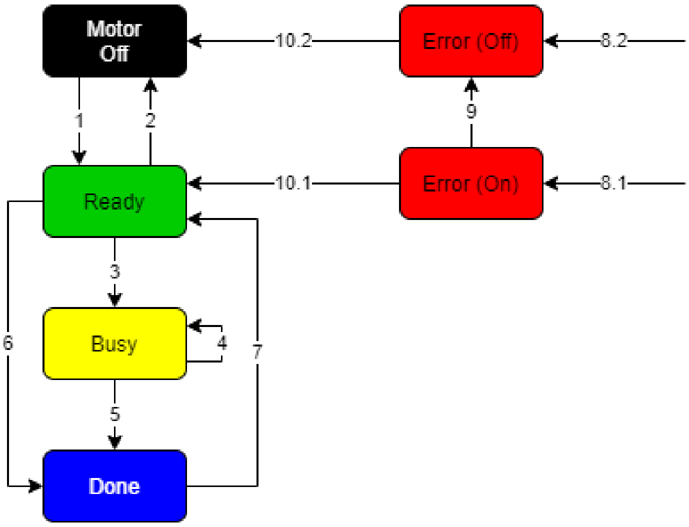

Fig. 1 Illustration of state machine

The status of the module is displayed via the LED band and via the process data bits.

In the following description of the LED band, it is assumed that the module has loaded the default configuration. The function of the LED band can also be reduced or switched off completely via the configuration. See ➲section 6.2, index 83.

Status	Process data bits						LED-Band	Description
	Motor Off	Ready	Busy	Done	Error	Warning		
Motor Off	1	0	0	0	0		Off	Motor switched off
Ready	0	1	0	0	0		green	Motor switched on and ready
Busy	0	0	1	0	0		yellow	Operation is executed
Done	0	0	0	1	0		blue	Command successfully completed
Error (On)	0	0	0	0	1		red	Error condition with motor switched on
Error (Off)	1	0	0	0	1		red	Fault condition with motor switched off
Any status with active warning						1	orange	see text below

"Warning" is not a state. Warnings can be active in any status. As soon as at least one warning is active, the process data bit *Warning* is set - regardless of the status.

The display of the warning via the LED band takes the form of an orange light or flashing:

- In the *Motor Off* state, the band lights up permanently orange
- In the Ready, Busy and Done states, the band flashes orange once per second for 200 ms. The rest of the time, the band lights up in the colour of the respective state.
- In the error states *Error (On)* and *Error (Off)*, an additionally active warning is not displayed on the LED band.

3.2 Control bits

The following process data bits are important for controlling the state machine:

Motor On **Move** **Stop** **Error Reset** **Set Origin**

Transition	Description
1	**Switch on motor** By setting *Motor On* = 1, the motor is switched on. The Move, *Error Reset* and *Set Origin* bits must be set to 0 during this time.
2	**Switch off motor** By setting *Motor On* = 0, the motor is switched off.
3	**Start Moving** Setting *Move* = 1 starts the movement. Before starting, all parameters must be set correctly: - *Target Position* - *Motion Parameter Set* - Bits *Relative* and *Shortest Path* These parameters may not be changed after the start until the module changes to the *Busy* state. Furthermore, the *Stop* bit should be set to 0, otherwise the journey will be stopped immediately. I.e., the module changes directly to the *Done* state without moving.
4	**Stop Moving** Setting *Stop* = 1 recalculates the trajectory so that it stops as soon as possible. This is done while maintaining the acceleration and jerk selected at the beginning of the operation. The module remains in the *Busy* state until it is stopped.
5	**Moving is finished** As soon as an operation is successfully completed, the module changes to the *Done* state

Tran-sition	Description
6	**Set zero point** By setting *Set Origin* = 1, the current position is set as the zero point. The state changes directly to *Done*. See also section 4.3.2
7	**Finalise command** By resetting *Move* or *Set Origin* to 0, the command is completed and the module changes to the *Ready* state.
8.1 / 8.2	**If an error occurs**, the module changes to the error state. If the motor was switched on when the error occurred and the error does not require switching off, the motor remains switched on (8.1). Otherwise, it is or remains switched off (8.2).
9	**Switching off in the event of a fault** The module can be switched off in the event of an error by setting *Motor On* = 0. However, it is not possible to switch on in the event of a fault.
10.1 / 10.2	**Reset error** Setting *Error Reset* = 1 resets the error. Important: Transition 10.2 (reset error with motor off) is only possible if *Motor On* = 0.

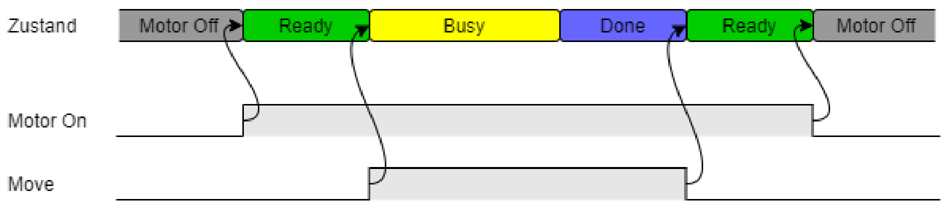

Fig. 2 Example process data bits

3.3 Handling errors and warnings

If an occurring error requires it (➲sections 2.4 and 7.2), the motor is automatically switched off. If the motor is switched on when the error occurs and the error does not require switching off, the motor remains switched on.

The motor can be switched off at any time in the event of an error by setting the *Motor On* process data bit to 0. Switching on is not possible in the error state, regardless of the error. To switch on the motor, the error must first be reset.

Errors can be reset via the process data bit *Error Reset*. If the motor is switched off, the *Motor On* process data bit must also be set to 0 to reset the error.

Warnings cannot be actively reset. They disappear automatically as soon as the cause is eliminated.

3.4 Position mode

Different driving modes can be selected via the process data bits *Relative* and *Shortest Path*. The mode determines how the target position is interpreted.

Shortest Path	Rela-tive	Mode
0	0	**Absolute** The target position is interpreted as an absolute value.
0	1	**Relative** The target position is interpreted as a relative position. To prevent small positioning errors from adding up, the last target position is used as the start position instead of the actual position. Exception: During the first drive after switching on the motor or after a positioning error, the actual position is used as the initial value.
1	0	**Shortest Path** In this mode, only the 16 least significant bits of the target position are used, i.e., the angle within one revolution. The higher-order bits (i.e., the whole revolutions) are set by the SREH-50-IOL in such a way that a maximum travel of ±180° results. Important: As a result, the actual position output after moving can deviate from the target position by a multiple of 360°. Example: The module is at 300°. A move command with *shortest path* to the target position 20° is started. Instead of 20°, the module moves to the angle 380° (20° + 360°).
1	1	This combination is not allowed.

3.5 Parameter sets (Motion Parameter Sets)

3.5.1 Introduction

Eight parameter sets can be defined via the acyclic data. When starting a movement, it is no longer necessary to enter all parameters via the process data, but only one of the predefined parameter sets is selected.

For mapping the parameter sets described here to IO-Link ➲Section 6.1, indices 64 ... 71.

The support tool *'PerfectCycle'* for the design of the smart rotary module is available on the website www.afag.com .

3.5.2 Terms

The following figure schematically shows the sequence of a positioning process. The green curve (A) shows the target trajectory calculated by the rotation module. The actual position is shown in black (B).

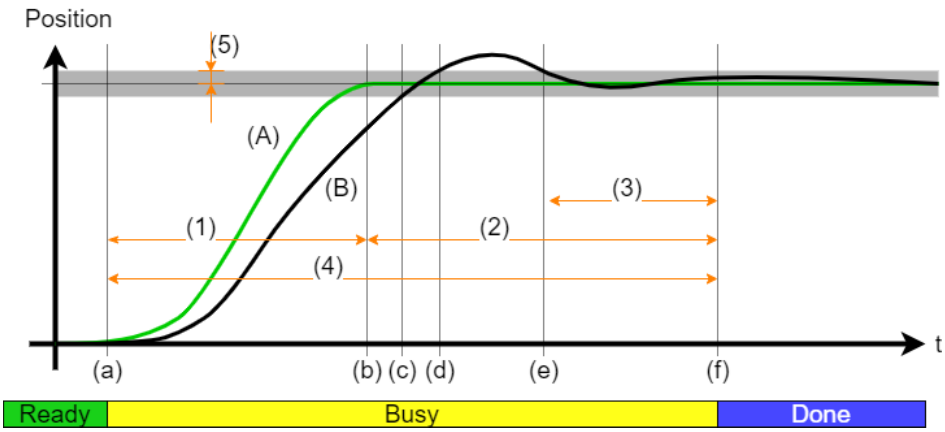

Fig. 3 Terms used in the positioning process

The following terms are used in connection with the parameter sets:

(1) **Travel time**: Duration of the target trajectory. The complete positioning process takes longer because the position must still be adjusted afterwards.

(2) **Settling time**: After the target position has theoretically been reached, the module needs this additional time to adjust the position to the desired tolerance [see (5)].

(3) **Waiting time:** This is how long the actual position must be within the tolerance window [see (5)] before the position is found to be stable and the positioning process is thus considered complete.

(4) **Positioning time:** Total time from start to completion of the travel command. Sum of travel time and settling time.

(5) **Position tolerance:** Half the width of the tolerance window, i.e. maximum permissible deviation between actual and target position.

A positioning process could, for example, proceed as follows:

(a) The positioning process is started.

(b) The target trajectory is completed. However, the position is not yet stable.

(c) The position is within the tolerance window for the first time. The clock starts to run.

(d) The tolerance window is left again before the waiting time has expired. The clock is stopped again.

(e) The tolerance window is reached again. The clock is reset and starts running again.

(f) he waiting time has expired. This means that the position was within the tolerance window long enough and is therefore considered good. The movement is considered complete.

3.5.3 Speed

The maximum achievable speed depends on the motor voltage. The maximum adjustable value can be reached at the nominal voltage of 24 V. With lower motor voltage, the maximum possible speed decreases proportionally to the voltage. In this case, too high a speed will lead to a position tracking error.

3.5.4 Acceleration

The acceleration is given as a percentage of the maximum possible acceleration $\alpha_{100\%}$. This depends on the load mass moment of inertia J_{Load} and is calculated according to the following formula:

$$\alpha_{100\%} = \frac{\mathrm{M}}{\mathrm{J_{intern}} + \mathrm{J_{Load}}}$$

$$M = 0.485 \text{ Nm}$$

$$J_{intern} = 0.115 \cdot 10^{-3} \text{ kgm}^2$$

The set value applies equally to the acceleration and deceleration phases.

3.5.5 Jerk

The jerk is given as a percentage of the maximum permissible jerk. A jerk of 100% corresponds to the jerk at which the maximum possible acceleration $\alpha_{100\%}$ is reached within 10 milliseconds.

3.5.6 Load

Mass moment of inertia of the load mounted on the module

3.5.7 Position tolerance and waiting time

These parameters together determine the accuracy of a positioning operation. They correspond to the values (5) and (3) in Fig. 3.

If the waiting time is too short, it can happen that the tolerance window is left after the position has already been found to be good. This is indicated by a warning (➲section 7.3, index 115.3). The warning disappears automatically as soon as the next movement is started or the motor is switched off.

3.5.8 Settling-Timeout and Timeout Enable

The timeout indicates the maximum duration of a control process, i.e. the "settling time" according to ➲section 3.5.2. The travel time is not included in this calculation. The settling time starts as soon as the target is theoretically reached. The positioning is considered complete as soon as point (d) in the above Fig. 3 is reached.

If the time runs out before point (d) is reached, the module reports an error.

The *Timeout Enable* parameter can be used to activate or deactivate the timeout function.

4 Position measurement

4.1 Multiturn

The SREH-50-IOL has an absolute encoder with a 4-fold multiturn. This means that after a voltage interruption, the absolute position can be detected within 4 revolutions.

The multiturn also works if the module is moved when it is switched off.

When switched on, the actual position is calculated to be in the range -720° to +720°.

As long as the module only moves within this range, no information is lost when it is switched off. If the module continues to rotate, the actual position at switch-on is off by a multiple of 4 revolutions.

Example: Before switching off, the module is at 1080° (3 rotations). After switching back on, the value -360° is output as the actual position.

4.2 Positive direction of rotation

The positive direction of rotation can be configured. As delivered, the positive direction is defined as clockwise rotation when looking at the flange from above:

Fig. 4 Illustration configuration of the direction of rotation

The positive rotation direction is set via the IO-Link configuration data, index 82 (➲section 6.1).

Make sure that the positive direction of rotation is set first during commissioning and that the zero offset is set afterwards. Otherwise, the zero-point shifts when the positive direction of rotation is changed.

4.3 Zero offset

4.3.1 Definition

The module offers the possibility to set a zero offset . This is set to the value '0' in the delivery state. This results in the zero position as shown in the picture:

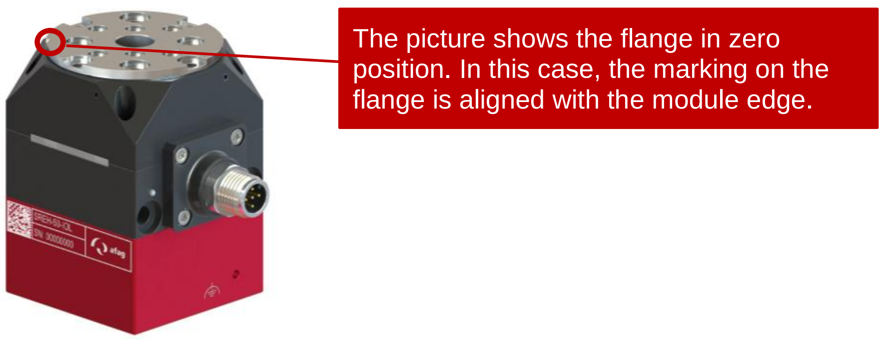

Fig. 5 Illustration zero offset with value '0'

4.3.2 Set zero point

There are two possibilities for setting the zero point:

- **About the process data**

  The current position can be set as the zero position via the *Set Origin* process data bit. For this, the module must be in the "*Ready"* status (➲section 3.2). When this command is executed, the actual position jumps to '0' without the flange rotating. However, the zero offset is only stored volatile for the time being and is therefore lost when the voltage is interrupted. To permanently store the zero offset, the *Store Origin* command must then be executed (➲section 6.6). This persistently saves the zero-position set with *Set Origin* into the configuration data.

- **Directly via the configuration data:**

  When writing to the configuration data (➲section 6.1, index 86), the zero offset is permanently stored and directly applied.

4.3.3 Initialise zero offset

Initialising the zero-point position is done in the following situations

- Automatically when the module is switched on
- Automatically when the zero offset (index 86) is written
- Manually via the *Init Position Origin* function (➲section 6.6)

When initialising the zero point, a multiple of 4 revolutions is added or subtracted to the stored zero-point offset, resulting in an actual position in the range ±720° (➲section 4.1).

5 Connection interruption and invalid outgoing process data

If the module detects an interruption of the IO-Link connection when the motor is switched on, the motor is automatically switched off and the module goes into the corresponding error state. When the motor is switched off, an interruption in the connection does not result in an error.

IO-Link offers the possibility to inform a device whether the outgoing process data is valid via the master commands *DeviceOperate* and *ProcessDataOutputOperate* defined in the IO-Link specification.

As long as the outgoing process data is marked as invalid, it will be ignored by the smart rotary module; it is therefore not possible to control the module. When the state changes from valid to invalid, the module behaves as if the connection is interrupted: If the motor is switched on, it is switched off and the unit goes into the error state. If the motor is switched off, nothing happens.

6 Acyclic data

6.1 General

The following sub-chapters list the acyclic data accessible via IO-Link. For the units, a distinction is made between the raw unit and the display unit:

Raw unit: Indicates in which unit the data is transmitted via IO-Link, i.e. to which value an LSB corresponds.

Display unit: Specifies the unit in which the values are displayed on a graphical user interface. The conversion factors are stored in the IODD. Whether the values are actually displayed in this unit or whether the raw values are displayed instead depends on the tool or IO-Link master used.

6.2 Configuration

Access authorization: Reading and writing

Index	Sub-index	Data type	Raw unit	Display unit	Description
64..71					**Motion parameter sets 0..7** For a description of the parameter sets ➲Section 3.5.
	1	uint16	0.1°/s	°/s	**Maximum speed** Value range: 0.1°/s .. 4300 °/s Default: 30°/s (parameter sets 0) or 3000°/s (parameter sets 1..7)
	2	uint16	0.1%	%	**Acceleration factor** Value range: 0.1% .. 100% Default: 100%
	3	uint16	0.1%	%	**Jerk factor** Value range: 0.1% .. 100% Default: 100%
	4	uint16	gcm^2	gcm^2	**Load (mass moment of inertia)** Value range: 0 .. 15’000 gcm^2 Default: 0 gcm^2
	5	uint16	$2^{-19}\cdot 360°$	°	**Position tolerance** Value range: full uint16 range Default: 0.1°
	6	uint16	0.1 ms	ms	**waiting time** Value range: 0 .. 5s Default: 25 ms
	7	uint16	0.1 ms	ms	**Settling-timeout** Value range: 0 .. 5s Default: 100 ms
	8	uint8			**Settling-timeout active** 0: inactive 1: active (default)

Index	Sub-index	Data type	Raw unit	Display unit	Description
81					**Position limit** Operation commands that would lead to an actual position outside of these limits will not be executed. This is independent of whether the operation is absolute, relative or *shortest path*.
	1	int32	$2^{-16} \cdot 360°$	°	**Minimum** Value range: full int32 range Default: 0
	2	int32	$2^{-16} \cdot 360°$	°	**Maximum** Value range: full int32 range Default: 360°
	3	uint8			**Position limitation active/inactive** 0: inactive (default) 1: active
82		uint8			**Positive direction of rotation** 0: Clockwise (default) 1: Counterclockwise ➲Section 4.2
83		uint8			**LED band mode** 0: completely off 1: On (default; description ➲Section 3.1) 2: Display only errors and warnings: Error → lights up red Warning, no error → lights up orange - Otherwise → off
85					**Valid range of motor voltage** If the voltage is outside this range, the module will give a voltage warning when the motor is switched off. When the motor is switched on, a voltage outside the range will cause a fault; the motor will be switched off, which prevents the voltage from dropping or rising further.
	1	uint16	mV	V	**Minimum** Value range: 16 V .. 23 V Default: 18V
	2	uint16	mV	V	**Maximum** Value range: 25 V .. 32 V Default: 30V
86		int32	$2^{-16} \cdot 360°$	°	**Position zero** Value range: -720° .. 720° Default: 0°
87					**Position tracking error monitoring**
	1	uint16			**Max. position tracking error** Value range: 0.1° .. 90° Default: 1°
	2	uint8			**Position tracking error monitoring active** 0: inactive 1: active (default)

6.3 Diagnostic data (persistent)

Access authorization: Read only

Indices 96, 97 and 98 cannot be reset.

Index	Sub-index	Data type	Raw unit	Display unit	Description
96		uint32	1	1	**Number of rotations**
97					**Operating hours counter**
	1	uint32	min	h	**Total operating time**
	2	uint32	min	h	**Operating time with motor switched on**
	3	uint32	min	h	**Operating time with moving motor**
98					**Maximum temperature ever measured**
	1	uint32	min	h	**Operating time** (total) at the moment the temperature was measured
	2	uint8	0.5°C	°C	**Temperature**
99	1, 2				**Maximum temperature (resettable)** As index 98, but this temperature can be reset by the user (➲section 6.6)
100		uint32	min	h	**Total operating time** (see subindex 97.1) with active temperature warning active. Reset: ➲Section 6.6

6.4 Diagnostic data (volatile)

Access authorization: Read only

The indices 32 to 41 are standard parameters according to the IO-Link or Common Profile specification. For a more detailed description, please refer to these specifications.

The remaining indices are specific to the SREH-50 IOL.

Index	Sub-index	Data type	Raw unit	Display unit	Description
32		uint16	1	1	Error Counter
36		uint8			Device Status
37		OctetString3[4]			Detailed Device Status
40		record			Image of the process data inputs
41		record			Image of process data outputs
112		uint8	0.5°C	°C	Temperature
113		uint16	mV	V	Motor voltage (voltage between pins 2 and 5 of the M12 connector)
114					Error causes*
	1	uint8			Cause for error bit 7
	..	…			..
	8	uint8			Cause for error bit 0
115					Warning causes*
	1	uint8			Cause for warning bit 7
	2	uint8			Cause for warning bit 6
	3	uint8			Cause for warning bit 5
17343		uint8			Boot mode status according to firmware update profile

*Each sub-index at indices 114 and 115 is assigned to an error or warning bit in the process data (➲Section 2.4).

If the corresponding bit is set in the process data, this subindex gives further information on the cause of the error. The descriptions of the causes are stored in the IODD. For all inactive error or warning bits in the process data, the value at the corresponding subindex is set to 0.

6.5 Identification data

The identification data listed below are defined in the IO-Link specification or in the Common Profile.

Index	Data type	Access	Description
13	uint16[]	r	Profile characteristics
14	string[]	r	Process data input descriptor
15	string[]	r	Process data output descriptor
16	string	r	Manufacturer name “Afag”
17	string	r	Manufacturer's text “www.afag.com”
18	string	r	Product name “Smart Rotary Module SREH-50-IOL”
19	string	r	Product-ID “SREH-50-IOL”
20	string	r	Product text “Smart electrical rotary module with hollow shaft SREH-50-IOL”
21	string	r	Serial number
22	string	r	Hardware revision
23	string	r	Firmware revision
24	string	rw	Application Specific Tag Default: ***
25	string	rw	Function Tag Default: ***
26	string	rw	Location tag Default: ***
17342	string	r	HW ID according to firmware update profile

6.6 System command

The module implements the *system command* according to the IO-Link specification. A command is executed by writing the command number to index 2. The following commands are implemented.

No.	Command
1..6	Functions for **block parameterisation** according to IO-Link specification
80..82	Unlocking for firmware update according to IO-Link Firmware Update Profile
126 127	**Locator Start** **Locator Stop** When the locator function is active, LED band flashes white regardless of the configured LED mode and operating status of the module. This function is used to locate a unit in the installation. After 10 minutes, the function of the LED band automatically switches back to normal, unless the function is stopped beforehand.
129	**Application Reset** Resets the configuration to the factory settings.
131	**Back-To-Box** Resets the configuration to the factory settings. After that, the module stops communicating until the power supply is interrupted and restored. This prevents a master from mistakenly reloading its saved configuration into the module.
160	**Reset maximum temperature** ➲Section 6.3, Index 99
161	**Reset time above critical temperature** ➲Section 6.3, Index 100
170 171	**Apply position zero** **Save position zero persistently** ➲Section 4.3

7 Errors, warnings and remedies

7.1 General

Errors and warnings are mapped in the process data (➲ chapter 2.4). In addition, more detailed information on the active errors and warnings can be read out via indices 114 and 115.

The "Bit" column in the following tables indicates the bit number in the error or warning bit field in the process data. Each bit in these bit fields is assigned a sub-index under index 114 or 115. The exact cause can be read out via this subindex.

7.2 Error

Bit	Index. Subindex	Code	Error cause	Description / Remedy
7	114.1	1	Internal configuration faulty	Contact Afag
6	114.2	1	Output stage overcurrent	
		2	Trajectory error	Contact Afag
		3	Error in the state machine	Contact Afag
		255	Unknown error	Contact Afag
5	114.3	1	Overtemperature (≥ 75 °C)	Check thermal connection Longer pauses between movements Check the mechanical structure
4	114.4	1	Motor voltage too low	The motor voltage has left the valid range when the motor is switched on. When the motor is switched off, this only results in a warning. Check the parameter set, especially the load. Check the motor supply. Check which other units are connected to the motor supply and load it or feedback to it. Possibly set lower/upper voltage limit less restrictively (provided this is permissible for the power supply unit and all other connected loads). In case of overvoltage: Install more capacity on the motor supply or install a chopper
		2	Motor voltage too high	
3	114.5	64	Position tracking error	Check the parameter set, especially the load. Check the motor supply. With reduced motor voltage (< 24V), the maximum achievable speed is reduced proportionally to the voltage. Check that the speed is not set too high. Check mechanical structure (collision, friction)

Bit	Index. Subindex	Code	Error cause	Description / Remedy
2	114.6	1	Motor unexpectedly switched off	The motor must not be switched off in the *Busy* and *Done* states.
		2	Operation aborted	The *Move* process data bit must remain set until the *Done* state is reached.
		4	Move command from invalid state	An operation may only be started in the *Ready* state.
		5	SetOrigin from invalid state	Zero setting may only be carried out in the *Ready* state.
		6	Move command and SetOrigin simultaneously	The two bits *Move* and *SetOrigin* must not be set at the same time.
		16	Connection interruption IO-Link	Note: A connection interruption is only considered an error if the motor was switched on before the interruption. Check wiring Check configuration of IO-Link master Check PLC
		17	Process data outputs marked as invalid	Note: Invalid process data outputs are only evaluated as errors if the motor was switched on before the interruption. Check IO-Link master and PLC
1	114.7	1	Invalid target position	The target position is outside the specified range. Check PLC programme. Check position range (index 81). Check that the *Relative* and *Shortest Path* process data bits have been set correctly before starting the movement.
		2	Invalid parameter set	Check whether a valid parameter set (0 to 7) has been selected in the process data. This value must be present at the latest when *Move* is set and at least until the module changes to the *Busy* state.
		3	Relative and *Shortest Path* simultaneously	The two modes are mutually exclusive. Therefore, at most one of the two bits may be set. The bits must be present at the latest when *Move* is set and at least until the module changes to the *Busy* state.
0	114.8	1	Settling-timeout	Check the parameter set, especially the load. Check the motor supply. Check mechanical structure (collision, friction). If necessary, set the timeout in the selected parameter set higher (index 64..71)

7.3 Warnings

Bit	Index. Subindex	Code	Error cause	Remedy:
7	115.1	1	Temperature warning (≥ 70 °C)	See overtemperature (error index 114.3)
6	115.2	1	Motor voltage too low	See voltage error (error index 114.4)
		2	Motor voltage too high	
5	115.3	1	Exit position tolerance window	After the positioning was completed, the tolerance window was left again. This can occur if the waiting time is set too short and therefore the position is found to be stable too early → Increase waiting time in parameter set (index 64..71). Leaving the tolerance window can also be caused by external influences: ▪ Moment acts on the flange ▪ Vibration that cannot be sufficiently compensated (especially in combination with large loads) In this case, ideally remedy the external influence. Depending on the accuracy requirements, the tolerance window may be set less narrow. The warning disappears automatically on the next operation or as soon as the motor is switched off.

8 Device exchange

The SREH-50-IOL implements the "Data Storage" mechanism of IO-Link. This mechanism enables the additional storage of configuration data on a higher level such as IO-Link master or PLC. The IO-Link specification only regulates the exchange of data via IO-Link. The higher level depends on the respective system.

The data storage mechanism enables a master to automatically detect when a unit has been replaced and to automatically configure it. When a unit is replaced, the new unit is thus automatically configured correctly and is immediately ready for use.

Depending on the required accuracy, it may be necessary to recalibrate target positions or zero offsets after replacing the device.

9 Firmware update

The SREH-50-IOL implements the IO-Link firmware update profile. This enables a firmware update via IO-Link, provided the master supports this. Update images are delivered as a file with the extension ***.iolfw**.

For updating, the SREH-50-IOL is put into the so-called boot mode via IO-Link. In this mode, the new firmware can be transferred. The normal unit functions are deactivated in this mode. When the module is in boot mode, the LED band lights up purple regardless of the configuration. After successful completion, the smart rotation module automatically restarts in normal mode and can be used again.

The firmware update can take several minutes. During this time, the connection and power supply should not be interrupted. In the event of a failed update, the smart rotary module will henceforth only start in boot mode. This leaves it possible to start the update again. However, the normal unit functions are no longer available until the update is successful.

The configuration data of the smart rotary module is retained during a firmware update.

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List of figures

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