



Quick-change pallet system
VERO-S NSE-E mini 90-25
Software manual

Imprint

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1 General

1.1 Validity

This version of the software manual for the VERO-S NSE-E mini 90-25 IOL and VERO-S NSE-E mini 90-25 DIC12 describes the functions for the firmware versions with the main version number 1.0.0. The firmware version can be read out. Information on the corresponding parameter can be found in the chapter ▶ 4.1 [📄 14].

1.2 Applicable documents

- General Terms and Conditions
- Operating manual of the products used
- IO-Link Device Description (IODD)

The documents can be downloaded from www.schunk.com.

1.3 IO-Link Basics

Fieldbus-independent interface

IO-Link is a point-to-point interface for connecting a SCHUNK product (IO-Link device) to a control system (IO-Link master). Via this interface it is possible to transfer parameters, process data and diagnostic data. Parameter data are transferred to the IO-Link device from the master (actuator or sensors). In the opposite direction, the master receives cyclical process data and, if required, service and diagnostic data.

Further information on IO-Link can be found at www.io-link.com.

1.4 Data exchange

Cyclical data exchange

To exchange cyclic process data between an IO-Link device and a controller, the IO-Link data is transferred from the IO-Link master to the previously set address ranges. The user program of the controller accesses the process values via these addresses and processes them. Conversely, the cyclic data exchange is performed from the controller to the IO-Link device.

Acyclical data exchange

The exchange of acyclic data, such as parameters or events, takes place over a specified index and sub-index range. Using the index and sub-index range, targeted access of the device data is possible (e.g. for reparameterization of the device or master during ongoing operation).

1.5 Data types

The data types mentioned in this version of the software manual are designated according to the "IO-Link Interface and System Specification", Annex F, Version 1.1.9, which is available at www.io-link.com. The corresponding designation according to IEC 61131-3 (PLC standard) can be found in the following table:

Description	IO-Link standard	PLC standard IEC 61131-3	Bit length
Logical value	BooleanT	BOOL	1 bit
Integer	IntegerT8	SINT	8 bit
	IntegerT16	INT	16 bit
	IntegerT32	DINT	32 bit
	IntegerT64	LINT	64 bit
Natural number	UIntegerT8	USINT	8 bit
	UIntegerT16	UINT	16 bit
	UIntegerT32	UDINT	32 bit
	UIntegerT64	ULINT	64 bit
Floating-point numbers	Float32T	REAL	32 bit
	Float64T	LREAL	64 bit
Characters	StringT (x)	STRING	x bit



⚠ WARNING

Changes to parameters outside the permitted ranges and manipulation of non-visible and therefore protected parameters can cause damage to the quick-change pallet system or misinterpretation of states and thus lead to an unwanted hazard.

2 Incoming process data (status word)

To determine the current device status and clamping status, as well as the current circuit board temperature of the device and sensor raw values, the following incoming cyclical data is made available:

Byte	Bit *	Bit offset	Sub index	Data type	[Values]: Description
0	7	223	1	BooleanT	[true]: Ready for operation; [false]: otherwise
	6	222	2	BooleanT	[true]: Referenced; [false]: otherwise
	5	221	3	BooleanT	[true]: Actuator active; [false]: otherwise
	4	220	4	BooleanT	[true]: Closed without clamping pin; [false]: otherwise
	3	219	5	BooleanT	[true]: Clamped with clamping pin; [false]: otherwise
	2	218	6	BooleanT	[true]: Open; [false]: otherwise
	1	217	7	BooleanT	[true]: Intermediate position reached; [false]: otherwise
	0	216	8	BooleanT	[true]: Presence detected; [false]: otherwise
1	7	215			
	6	214			
	5	213			
	4	212			
	3	211			
	2	210	14	BooleanT	[true]: Info; [false]: otherwise
	1	209	15	BooleanT	[true]: Warning; [false]: otherwise
	0	208	16	BooleanT	[true]: Error; [false]: otherwise
2-3	-	192	17	UInteger T16	Eventcode
4-7	-	160	18	Float32T	Position (inc)
8-11	-	128	19	Float32T	Speed of rotation (rpm)
12-15	-	96	20	Float32T	Motor current (mA)
16-19	-	64	21	Float32T	Current limit (mA)
20-23	-	32	22	Float32T	Temperature (°C)
24-27	-	0	23	Float32T	Presence sensor raw value (MHz)

* Bit 7 has the function of the **Most Significant Bit (MSB)** and bit 0 that of the **Least Significant Bit (LSB)**.

Further information is provided via the acyclic device data ► 4 [14].

2.1 Status – Byte 0

The current status of the device and the status of the quick-change pallet system is displayed:

Bit	Bit offset	Sub index	Data type	Values: Description
7	223	1	BooleanT	[true]: Ready for operation; [false]: otherwise
6	222	2	BooleanT	[true]: Referenced; [false]: otherwise
5	221	3	BooleanT	[true]: Actuator active; [false]: otherwise
4	220	4	BooleanT	[true]: Closed without clamping pin; [false]: otherwise
3	219	5	BooleanT	[true]: Clamped with clamping pin; [false]: otherwise
2	218	6	BooleanT	[true]: Open; [false]: otherwise
1	217	7	BooleanT	[true]: Intermediate position reached; [false]: otherwise
0	216	8	BooleanT	[true]: Presence detected; [false]: otherwise

The internal sensor system of the quick-change pallet system detects the clamping slide position and the motor current of the actuator, as well as the presence of a pallet. The clamping state of the quick-change pallet system is determined from the command specifications of the outgoing control word, see ▶ 3 [10], and output via the corresponding status bits.

The operational status of the device is indicated by the Boolean value of bit 7 "Ready for operation". The prerequisite is:

- the two 24 V supply voltages L+ and 2L+ are present

Bit 6 "Referenced" indicates the successful execution of a reference run and, if applicable, the loss of the reference, e.g. after an interruption in the power supply during an actuator movement, ▶ 3.1.5 [12].

The Boolean value of bit 5 "Actuator active" indicates the status of the actuator.

Bit 4 "Closed without clamping pin" indicates that the clamping slide position has been overrun with clamping pin during the clamping process. Reason: no clamping pin or a clamping pin that is too small has been inserted.

The clamping status of the quick-change pallet system is indicated by the Boolean value of bit 3 "Clamped with clamping pin". The prerequisites for the value [true] are:

- Previously triggered "Clamping" command (▶ 3.1.3 [12])
- Reaching the internally specified limit-value for the motor current
- The position of the clamping slide is within the range for the clamping position (▶ 4.2 [15], index 342)

Bit 2 "Open" indicates that the clamping slide has reached the open position.

Bit 1 "Intermediate position reached" indicates that the intermediate position clamping slide range has been reached (► 4.2 [□ 15], index 344, 345).

The Boolean value of bit 0 "Presence detected" indicates the detection of the presence of a previously taught workpiece or pallet. The prerequisite for the value [true] is:

- Presence sensor raw value exceeds the associated threshold value (► 4.2 [□ 15], index 101)

Note:

The prerequisite for executing clamping, unclamping and intermediate position movements (► 3.1 [□ 10]) is a successfully referenced and ready-to-operate clamping device (bit 7 and bit 6 each [true]).

2.2 Exception – Byte 1

The occurrence of exception events in the form of information, warnings and errors are displayed:

Bit	Bit offset	Sub index	Data type	Values: Description
2	210	14	BooleanT	[true]: Info; [false]: otherwise
1	209	15	BooleanT	[true]: Warning; [false]: otherwise
0	208	16	BooleanT	[true]: Error; [false]: otherwise

Warnings can be reset with the command "Acknowledge warning", ► 3.1.6 [□ 13]. Errors can be deleted by resolving the cause and rebooting the device.

2.3 Event code – Byte 2-3

Warnings are indicated by a specific code in combination with the occurrence of a warning (byte 1 bit 1 "Warning" [true]):

Bit offset	Sub index	Data type	Values: Description
192	17	UIntegerT16	[0x0001]: Not ready for operation [0x0003]: Not referenced [0x0007]: Determined maximum stroke during referencing invalid

The event code is also reset with the command "Acknowledge warning" (► 3.1.6 [□ 13]). Error and warning messages from the motor control unit are displayed directly in the event code.

2.4 Position – Byte 4-7

The current clamping slide position is displayed in units of Increments (inc), where the zero position represents the completely closed clamping slide position, (see Fig. 3).

Bit offset	Sub index	Data type	Values: Description
160	18	Float32T	[0... Determined maximum stroke during referencing]: Position (inc)

2.5 Rotational speed – Byte 8–11

The current engine speed measured by the engine control unit is displayed in units of (rpm).

Bit offset	Sub index	Data type	Values: Description
128	19	Float32T	[-]: Speed of rotation (rpm)

2.6 Motor current – Byte 12–15

The current motor current measured by the motor control unit is displayed in units of (mA).

Bit offset	Sub index	Data type	Values: Description
96	20	Float32T	[-]: Motor current (mA)

2.7 Current limit – Byte 16–19

The current limit currently set by the logic is displayed in units of (mA).

Bit offset	Sub index	Data type	Values: Description
64	21	Float32T	[-]: Current limit (mA)

2.8 Temperature – Byte 20–23

The circuit board temperature of the device currently measured by the motor control unit is displayed in units of (°C).

Bit offset	Sub index	Data type	Values: Description
32	22	Float32T	[-]: Temperature (°C)

2.9 Presence sensor raw value – Byte 24–27

The current raw value of the presence sensor is displayed in units of (MHz).

Bit offset	Sub index	Data type	Values: Description
0	22	Float32T	[-]: Presence sensor raw value (MHz)

CAUTION

Bit values of unassigned bits are always set as 0: [false].

3 Outgoing process data (control word)

The following cyclical process data from the master is received by the NSE-E mini 90-25 quick-change pallet system and processed accordingly to execute commands:

Byte	Bit *	Bit offset	Sub index	Data type	[Values]: Description
0	7	7	1	BooleanT	[true]: Teach to clamping pin; [false]: otherwise
	6	6			
	5	5			
	4	4	4	BooleanT	[true]: Move to intermediate position; [false]: otherwise
	3	3	5	BooleanT	[true]: Clamping; [false]: otherwise
	2	2	6	BooleanT	[true]: Release; [false]: otherwise
	1	1	7	BooleanT	[true]: Referencing; [false]: otherwise
	0	0	8	BooleanT	[true]: Acknowledge warning; [false]: otherwise

* Bit 7 has the function of the **Most Significant Bit (MSB)** and bit 0 that of the **Least Significant Bit (LSB)**.

3.1 Commands – Byte 0

Commands are executed by setting (positive flank) the corresponding bit to the value 1: [true].

CAUTION

For correct execution of the commands, no more than one command may be set at the same time.

CAUTION

Unassigned bits must always be set as 0: [false].

3.1.1 Bit 7: Teaching on clamping pin

With this command, the clamping slides move from the "Open" position to the clamping pin, build up the pull-in force according to the data sheet and move back to the "Open" position. After successful movement, the position (inc) of the clamping pin determined in this way is adopted as the value for the acyclic parameter index 342 "Clamping position" (inc), ▶ 4.2 [15].

The quick-change pallet system starts the teaching movement as soon as the value of bit 7 "Teaching on clamping pin" changes from 0: [false] to 1: [true] and the following preconditions are met:

- No further command bits set
- Clamping device is ready for operation and referenced, i.e. status bit 7 "Ready for operation" and status bit 6 "Referenced" both show the value 1: [true].
- No warning and no error pending

The actuator stops as soon as the value of bit 7 changes from 1: [true] to 0: [false].

Control word Byte 0 – Teaching on clamping pin command

Bit	Bit offset	Sub index	Data type	Do not execute	Execute
7	79	1	BooleanT	0: [false]	1: [true]

3.1.2 Bit 4: Move to intermediate position

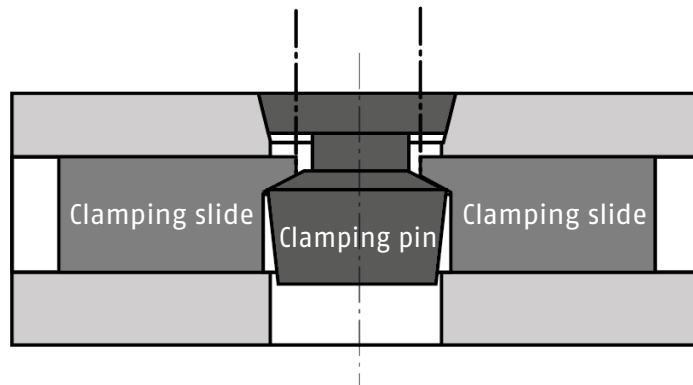


Fig. 1: Clamping position

Distance between clamping position and intermediate position

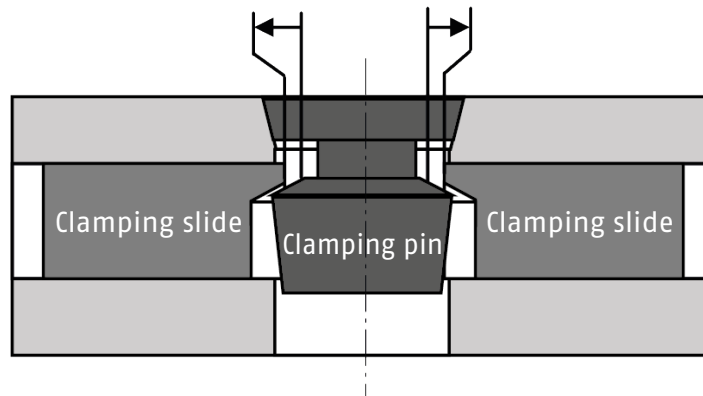


Fig. 2: Intermediate position

The intermediate position is a position between "clamped with clamping pin" and "open". It serves as a pre-position in which the clamping slides already engage over the clamping pin, but no pull-in force is built up yet (Fig. 2). The intermediate position can be set with the acyclic parameter Index 344 "Distance: Clamping position to intermediate position (inc)". The calculated value of the "intermediate position" can be queried via an acyclical parameter (index 345). The calculation takes place when the "Move to intermediate position" command is triggered.

The quick-change pallet system starts moving the clamping slides to the intermediate position as soon as the value of bit 4 changes from 0: [false] to 1: [true] and the following preconditions are met:

- No further command bits set
- Clamping device is ready for operation and referenced, i.e. status bit 7 "Ready for operation" and status bit 6 "Referenced" both show the value 1: [true].
- No warning and no error pending

The actuator stops as soon as the value of bit 4 changes from 1: [true] to 0: [false].

Control word Byte 0 – Move to intermediate position command

Bit	Bit offset	Sub index	Data type	Do not execute	Execute
4	4	4	BooleanT	0: [false]	1: [true]

3.1.3 Bit 3: Clamping

During the clamping movement, the clamping slides move towards each other until the current limit set internally by the logic is reached. The next step is to check whether the current clamping slide position (inc) is in the clamping range "Clamped with clamping pin", ▶ 2.1 [7]. If this is the case, status bit 3 "Clamped with clamping pin" is set to the value 1: [true].

The quick-change pallet system starts the clamping movement as soon as the value of bit 3: "Clamping" changes from 0: [false] to 1: [true] and the following preconditions are met:

- No further command bits set
- Clamping device is ready for operation and referenced, i.e. status bit 7 "Ready for operation" and status bit 6 "Referenced" both show the value 1: [true].
- No warning and no error pending

The actuator stops as soon as the value of bit 3 "Clamping" changes from 1: [true] to 0: [false].

Control word Byte 0 – Clamping command

Bit	Bit offset	Sub index	Data type	Do not execute	Execute
3	3	5	BooleanT	0: [false]	1: [true]

3.1.4 Bit 2: Release

During this operation, the clamping slides are released from the clamping state and move to the open end position.

The quick-change pallet system starts with the release operation as soon as the value of bit 2 "Release" changes from 0: [false] to 1: [true] and the following preconditions are met:

- No further command bits set
- Clamping device is ready for operation and referenced, i.e. status bit 7 "Ready for operation" and status bit 6 "Referenced" both show the value 1: [true].
- No warning and no error pending

The actuator stops as soon as the value of bit 2 changes from 1: [true] to 0: [false].

Control word Byte 0 – Release

Bit	Bit offset	Sub index	Data type	Do not execute	Execute
2	2	6	BooleanT	0: [false]	1: [true]

3.1.5 Bit 1: Referencing

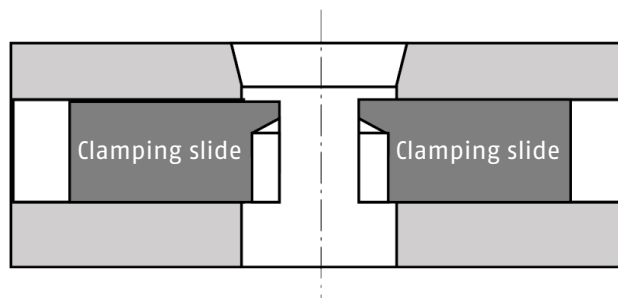


Fig. 3: Zero position

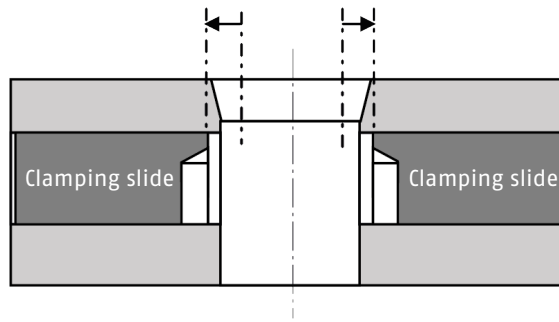


Fig. 4: Maximum stroke

During referencing, the clamping slides move to the respective mechanical end stops. The zero position (smallest mechanical distance between the clamping slides), (Fig. 3) and the value for "Determined maximum stroke during referencing (inc)" (corresponds to the maximum clamping slide stroke), (Fig.4). This is adopted as the new acyclic parameter value for index 350, assuming that this has been compared with the value "Expected maximum stroke during referencing (inc)" (acyclic parameter index 351) has passed the internal plausibility check, see ▶ 4.2 [15].

Specially defined speeds and forces are specified for the reference run. Referencing must be carried out if status bit 6 "Referenced" displays the value 0: [false] in the operational state, e.g. if the 24 V voltage supply was interrupted during a movement.

CAUTION

Before a reference run, make sure that there are no clamping pins in the module and that the clamping slides can move freely.

The quick-change pallet system starts the reference run as soon as the value of bit 1 "Referencing" changes from 0: [false] to 1: [true] and the following preconditions are met:

- No further command bits set
- Clamping device is ready for operation, i.e. status bit 7 shows the value 1: [true].
- No warning and no error pending

The actuator stops as soon as the value of bit 1 "Referencing" changes from 1: [true] to 0: [false].

After a successful reference run and passing the plausibility check, status bit 6 "Referenced" shows the value 1: [true], ▶ 2.1 [7].

Control word Byte 0 – Referencing command

Bit	Bit offset	Sub index	Data type	Do not execute	Execute
1	1	7	BooleanT	0: [false]	1: [true]

3.1.6 Bit 0: Acknowledge warning

The event code can be reset and warnings can be acknowledged with this command. If there are no warning-triggering conditions, the exception bit 1 "Warning" then changes from the value 1: [true] to 0: [false].

Control word Byte 0 – Acknowledge warning

Bit	Bit offset	Sub index	Data type	Do not execute	Execute
0	0	8	BooleanT	0: [false]	1: [true]

4 Acyclical data

Identification data, monitoring values, parameters and diagnostic information including events and error messages are transmitted acyclically from the IO-Link master on request and can be changed depending on the applicable access rights.

4.1 Identification data

The following acyclic data is provided for identification:

Index	Name	Data type	Access rights *	[Values] description
16	Vendor name	StringT (64)	ro	[SCHUNK SE & Co. KG]
17	Vendor text	StringT (64)	ro	[Hand in hand for tomorrow]
18	Product name	StringT (64)	ro	{Produkt name e.g.: VERO-S NSE-E mini 90-25 IOL}
19	Product ID	StringT (64)	ro	{ID number}
20	Product text	StringT (64)	ro	[Electromechanical quick-change pallet system]
21	Serial number	StringT (16)	ro	{Alphanumeric serial number}
22	Hardware revision	StringT (64)	ro	[HW-V{Version}] (Electronics)
23	Firmware revision	StringT (64)	ro	[HW-V{Version}]
24	Application-specific tag	StringT (32)	rw	{empty textfield for usage specific identification}

* ro (read only), rw (read and write)

4.2 Parameters

The following acyclical data is provided for setting communication, motor and sensor parameters:

Index	Name	Data type	Access rights *	[Values] description
100	Presence sensor raw value (MHz)	Float32T	ro	Raw value of the presence sensor in MHz
101	Presence sensor threshold value (MHz)	Float32T	rw	Threshold value determined during teaching of the presence sensor for status bit 0 "Presence detected" in units of MHz, ▶ 7.3 [□ 21].
102	Presence sensor threshold value factory setting (MHz)	Float32T	rw	Factory setting for index 101 in MHz
103	Presence sensor teach command	UInteger8	wo	[0]: No command [1]: Start teaching process: pallet absent [2]: Start teaching process: pallet present [255]: Set factory setting
104	Presence sensor teach response	UInteger8	ro	[0]: No message [1]: Teaching active [3]: Teaching successful [4]: Error
310	Command interface (0= IOL, 1=digital inputs)	IntegerT32	rw	Only relevant for NSE-E mini 90-25 DIC12 with digital interface: Selection of the interface via which commands are accepted: [0]: IO-Link interface only [1]: digital inputs only [Otherwise]: IO-Link interface and digital inputs
342	Clamping position (inc)	IntegerT32	rw	Value determined for the clamping position when teaching on clamping pin, ▶ 3.1.1 [□ 10].
344	Distance: Clamping position to intermediate position (inc)	IntegerT32	rw	Specified value for the relative distance of the clamping position to the intermediate position (index 345), ▶ 3.1.2 [□ 11].
345	Intermediate position (inc)	IntegerT32	rw	Target position calculated from index 342 and 344 for the "Move to intermediate position" command, ▶ 3.1.2 [□ 11].

Index	Name	Data type	Access rights *	[Values] description
350	Referenced maximum stroke (inc)	IntegerT32	ro	Referenced maximum stroke during the last successful referencing, ▶ 3.1.5 [12]. After restarting the module, the value 0 is initially displayed.
351	Expected maximum stroke for plausibility check (inc)	IntegerT32	rw	Maximum stroke expected for plausibility check during reference run.
360	Clamping cycle counter	IntegerT32	rw	Total amount of clamping operations performed "Clamped with clamping pin".

* ro (read only), rw (read and write), wo (write only)

There are additional parameters not shown here, including those for setting the motor control. It is not necessary to change these settings for normal operation.



⚠ WARNING

Changes to parameters outside the permitted ranges and manipulation of non-visible and therefore protected parameters can cause damage to the quick-change pallet system or misinterpretation of states and thus lead to an unwanted hazard.

5 Digital in- and outputs

For the NSE-E mini 90-25 DIC12 variant, it is possible to select the interface via which the commands (► 3.1 [□ 10]) are accepted by the device.

The selection can be made by setting the value of the acyclic parameter index 310 "Command interface", ► 4.2 [□ 15]:

- [0]: IO-Link only
- [1]: only digital inputs (DIs)
- [Otherwise]: IO-Link and digital inputs

Access to the acyclical parameters and the output of the status word via IO-Link as well as the switching of the digital outputs (DOs) always takes place, regardless of the command interface selected.

The following values are set as standard on delivery:

- [0] for NSE-E mini 90-25 IOL versions
- [1] for NSE-E mini 90-25 DIC12 versions

The pin assignment of the connector on the module is described in the operating instructions.

5.1 Digital inputs

The quick-change pallet system can receive commands as described in ► 3.1 [□ 10] via the digital inputs.

If a voltage of $0 \leq U_{DI} < 8.2 \text{ V}$ is applied to L- (GND), the module detects the value 0: [false] at the input. If a voltage of $24 \text{ V} \geq U_{DI} \geq 8.2 \text{ V}$ is applied, the module detects the value 1: [true] at the input.

Digital input status			
DI-1	DI-2	DI-3	Command
1	0	0	Release
0	1	0	Move to intermediate position
0	0	1	Clamp
1	1	1	Referencing *

* the inputs must be switched simultaneously (within 100 ms) from 0: [false] to 1: [true].

The commands are identical to the commands in ► 3 [□ 10].

5.2 Digital outputs

The module provides information about the current device status via the digital outputs.

0: [false] means that $U_{D0} = 0$ V against L- (GND) is present at the output.

1: [true] means that $U_{D0} = 24$ V against L- (GND) is present at the output.

Digital output status				
D0-1	D0-2	D0-3	D0-4	Status
1	0	0	0	Ready for operation and referenced
1	1	0	0	Open
1	0	1	0	Clamped with clamping pin
1	0	0	1	Presence detected
1	1	1	0	Intermediate position reached

6 LED status

In addition to the parameters described regarding device status and clamping status (► 5.2 [18]), the LED on the side of the quick-change pallet system indicates the following clamping statuses and device statuses by lighting up accordingly:

LED	Clamping slide	Presence
green	clamped with clamping pin	detected
red	clamped with clamping pin	not detected
no signal	opened	any
red	closed without clamping pin	any
red	undefined	any
flashing red / green	Intermediate position reached	any
1x red and 1x green flashing	boot procedure	Boot procedure
flashing red	device error / connection setup / no IO-Link connection *	device error / connection setup / no IO-Link connection *

* Only active if parameter Command Interface (Index 310) has the value: 0 (= IOL)

7 Teaching in the sensors

The integrated clamping slide sensor of the quick-change pallet system is referenced at the factory and taught to a reference clamping pin. The presence sensor system has also been taught at the factory and to a reference pallet. Acyclical parameters and threshold values have been determined accordingly and these have already been described at the factory.

7.1 Referencing (clamping slide sensor system)

Due to a loss of power during an actuator movement, the clamping slide sensor of the quick-change pallet system may lose its reference. This is indicated by the Boolean value [false] of status bit 6 "Referenced" and / or by the status of the digital outputs (DO-1: 0 [false]). It is then necessary to execute the "Referencing" move command, ▶ 3.1.5 [12].

For the NSE-E mini 90-25 DIC12 version, the command can optionally also be set via the digital inputs, ▶ 5.1 [17].

CAUTION

Before performing a reference run, make sure that there is no clamping pin in the module and that the clamping slides can move freely.

7.2 Teach clamping pin (clamping slide sensor)

It is possible to teach the position of the clamping pin again. To do this, insert a pallet with a clamping pin into the module and select the "Teaching on clamping pin" movement command, see ▶ 3.1.1 [10].

7.3 Teaching presence sensor system

The quick-change pallet system has an automated teach-in routine that can be used to determine a threshold value for the presence sensor and thus overwrite the acyclical parameter value (index 101). The material and position-dependent presence sensor can thus be taught to a specific pallet.

The following procedure must be carried out for successful teaching:

- Set the pallet to the absent state
- Set the teach command by writing the acyclic parameter to index 103 with the value:
 - [1]: Start teach process: pallet absent
- Set the pallet to the present state and clamp
- Set teach command by writing the acyclic parameter to index 103 with the value:
 - [2]: Start teach process: Pallet present

The status of the teach process can be queried via the acyclical parameter "Presence sensor teach response" on index 104. In the case of an error, the described procedure must be repeated in full.

Load factory settings:

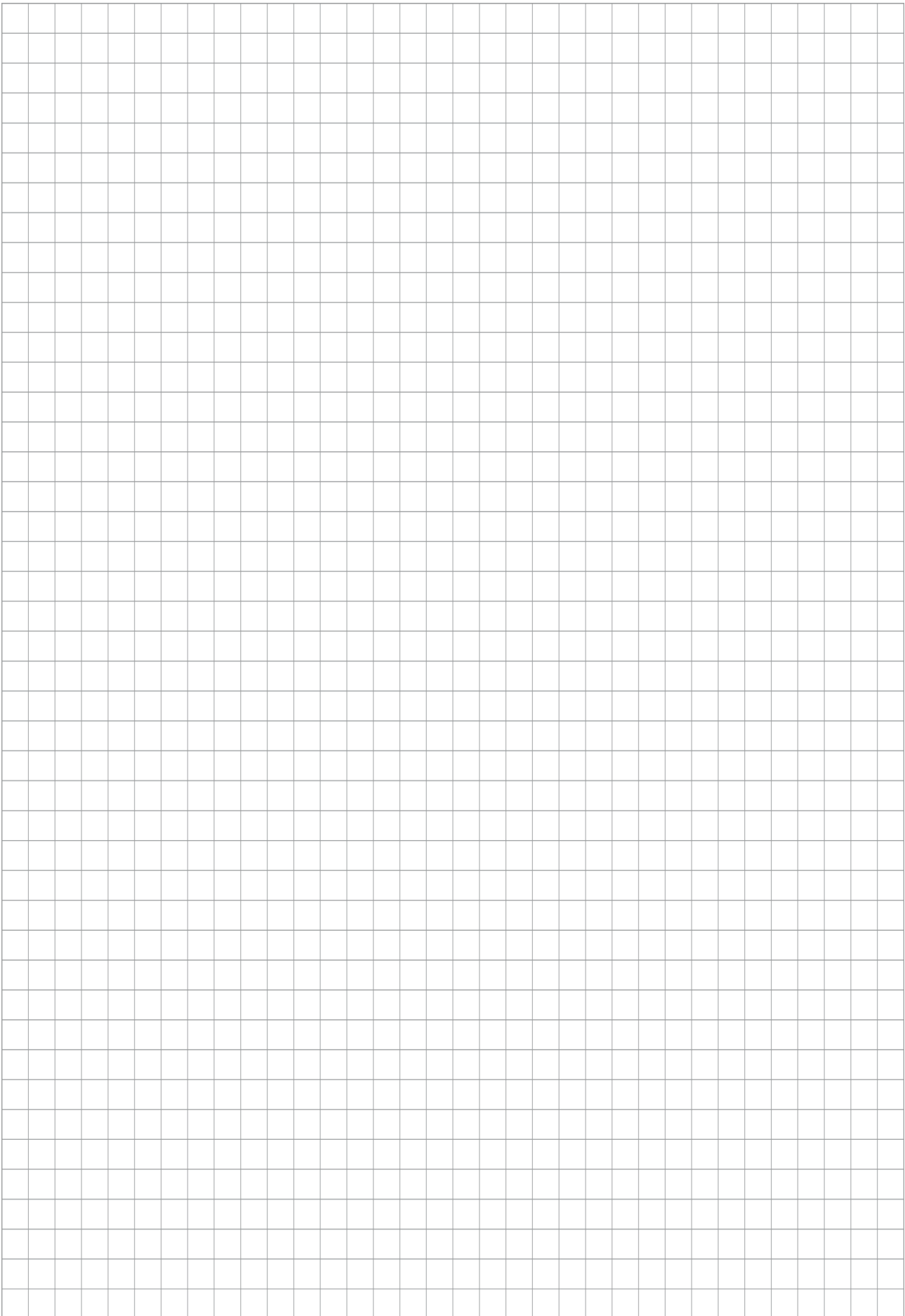
The value stored as the "Threshold value factory setting" parameter at index 102 can be set with the Teach command:

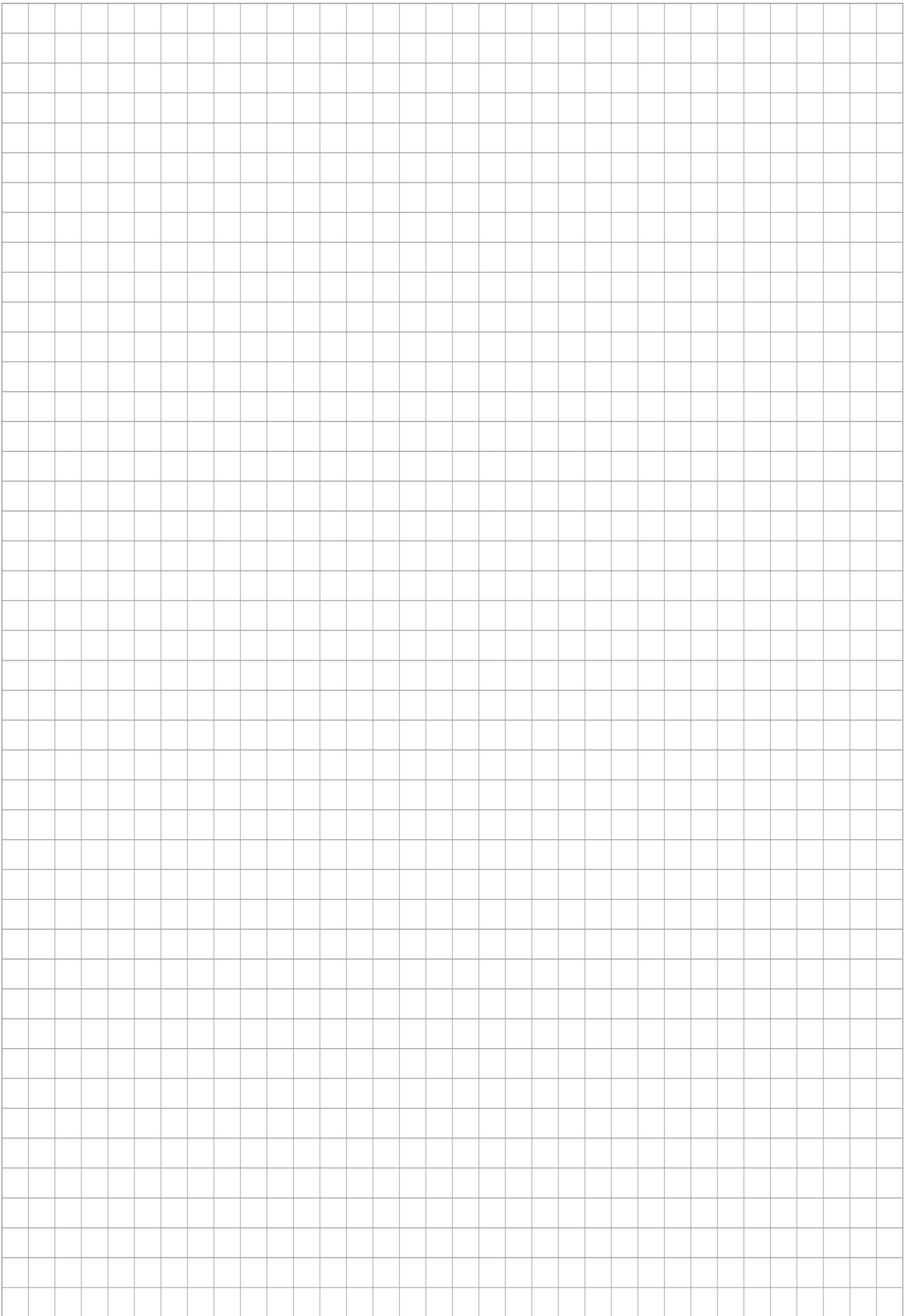
- [255]: Set factory settings

can be described as the new threshold value of the presence sensor.

CAUTION

The raw value signal of the presence sensor and therefore the detection distance depend on the material. When using different target materials (e.g. aluminum and steel pallets), it is therefore important to ensure that the material with the smallest raw value signal is taught in. This ensures that the other pallet materials are also detected when approaching.







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