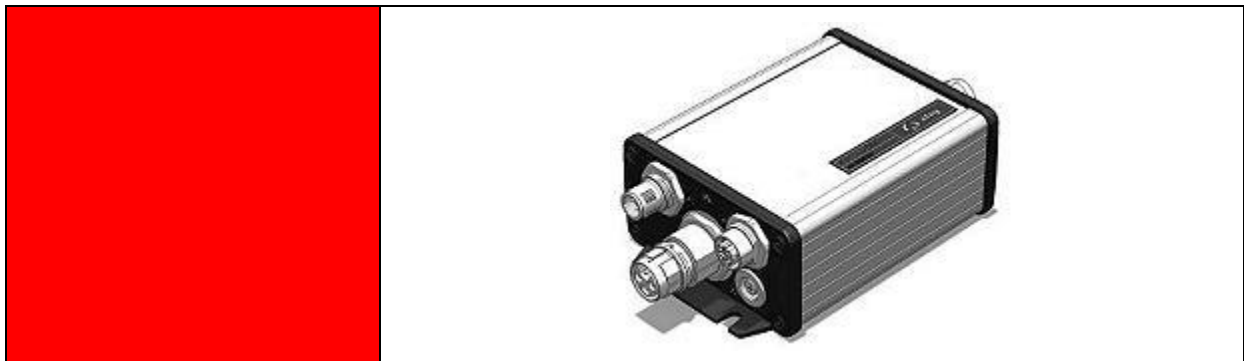


Servo Controller SE-24

- IO Manual



**Complementary document to the
Operating Manual**
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This manual is a complementary document to the operating instructions and applies to:

Type	Order No.
SE-24 I/O	50315434


Assembly and initial start-up may be carried out by qualified personnel and only according to these operating instructions.

Version of this documentation: SE-24 IO Manual vers. 1.3 en. 01.06.2022


 CAUTION	
	<p>As this manual is a complementary document to the operating instructions, it alone is not sufficient to carry out installation and commissioning of the device.</p> <p>Please pay attention to the notes in <i>1.1 Documentation</i></p>

Symbols:


 **DANGER**

	<p>Indicates imminent danger.</p> <p>Disregard of this information can result in death or serious personal injuries (invalidity).</p>
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 **WARNING**

	<p>Indicates a possible dangerous situation.</p> <p>Disregard of this information can result in death or serious personal injuries (invalidity).</p>
---	--

 **CAUTION**

	<p>Indicates a possibly dangerous situation.</p> <p>Disregard of this information can result in damage to property or light to medium personal injuries.</p>
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NOTE


	<p>Indicates general notes, useful operator tips and operating recommendations which don't affect safety and health of the personnel.</p>
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1 General



1.1 Documentation

For the Servo Controllers of the SE-24 series are considerably documentations available. There are main documents and complementary documents.

The documents contain safety instructions that must be followed

Main document:

present	documentation / description
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 Operating Manual <p>Description of the technical data and the functions of the device as well as notes on the plug assignment, installation and operation of the SE-24 servo controller.</p> <p>It is meant for persons who want to get familiar with the SE-24 servo controller.</p>

 CAUTION	
	<p>The operating manual is the main document and must be read by all means before installation and start-up of all devices of the SE-24 series independent of the respective model.</p>



Complementary documents to the operating manual:

present	documentation / description
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 Software Manual Description of the “afagTools” parameterization program.
<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 IO Manual Description of the I/O control of the SE-24 servo controller.
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 Profibus Manual Description of the fieldbus control of the SE-24 servo controller under PROFIBUS-DP.
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 programming example Siemens S7 V5.5 Description to the programming example for Siemens S7 V5.5.
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 programming example Siemens TIA V12.0 Description to the programming example for Siemens TIA V12.0.
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 EtherCAT Manual Description of the fieldbus control of the SE-24 servo controller under EtherCAT.
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 programming example Beckhoff TwinCAT 2 Description to the programming example for Beckhoff TwinCAT 2.
<input type="checkbox"/>	<ul style="list-style-type: none"> ▪ SE-24 CANopen Manual Description of the fieldbus control of the SE-24 servo controller under CANopen.

These documents are available for download on our homepage:

www.afag.com

2 Safety instructions

 CAUTION	
	<p>The safety instructions in the operating manual must be followed.</p> <p>The operating manual is the main document and must be read by all means before installation and start-up of all devices of the SE-24 series independent of the respective model.</p>

3 SE-24 I/O introduction

3.1 Overview of I/O functions and device control

In the I/O version, the SE-24 servo controller is exclusively controlled via digital inputs and outputs.

Seven inputs provide the basic control functions and the corresponding feedbacks are signalled via four outputs.

One output provides the operational readiness of the servo controller and signalling of any occurring error.

One input is used as controller release and one corresponding output as signalling of the active controller release.

One input is available for starting a reference movement and a corresponding output signals that a reference movement has been performed successfully.

Four digital inputs are used for the target selection of the positioning sets stored on the SE-24 servo controller, one input is used as start input and one output signals that the target has been successfully approached.

4 Technical data extract

4.1 Digital inputs and outputs [X2]

Parameter	Value
Digital inputs	
Input voltage Low ($U_{IN\ low}$)	-30 V...5 V
Input voltage High ($U_{IN\ high}$)	9 V...30 V
Input voltage High max. (@ $U_{IN}=30\ V$)	typ. 5.3 mA
Digital Outputs	
Type	plus switching
max. output current	0.7 A
Short-circuit proof	yes

5 Wiring and pin assignment

5.1 Input and output connections [X2]

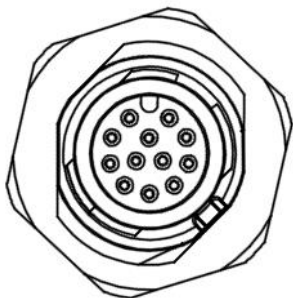


Figure 1: View of the connection [X2]


5.1.1.1 Implementation on device [X22]

- Phoenix Contact: 12 pole sensor-/actuator flush-type plug, SACC-DSI-M12MS-12CON-M16/0,5 Phoenix Contact No.1419700

5.1.1.2 Mating plug [X2]

- SE-24 I/O cable 5 m, Afag No. 50312913

5.1.1.3 Pin assignment of the I/O cable

Pin No.	Designation	Colour assignment	
1	drive_enable/fault_reset	brown	
2	start/stop_ref	blue	
3	start/stop_move	white	
4	reserved	green	
5	pos_nr_bit0	pink	
6	pos_nr_bit1	yellow	
7	pos_nr_bit2	black	
8	pos_nr_bit3	grey	
9	ready	red	
10	drive_enable_ok	violet	
11	ref_valid	grey-pink	
12	move_ok	red-blue	

The functional description of the inputs and outputs can be found in this document in Chapter: *7 Functional description of the inputs and outputs*

6 Configuring targets

This chapter only describes the setting of the targets and the associated parameters. A complete description of the “afag Tools” configuration software can be found in the document:

"SE-24 Software Manual"

The positioning controller is configured using a target table which is stored on the SE-24 servo controller. This contains target positions which can be retrieved via the digital inputs. All targets can be pre-configured. Then only the entry has to be selected and a start command issued for the positioning.



The number of position sets which can be stored for the servo controller SE-24 I/O is 15.

All position sets have the following setting options:

- Target position
- Movement speed
- Acceleration
- Deceleration
- "Current" selection for movement in current mode
- Target current value
- Delay time (start-up delay)
- "Relative positioning" selection for relative positioning

Proceed as follows to set the parameters of the required positioning targets and to store them on the servo controller SE-24:

1. Open the “afagTools” configuration program.
2. Open the “Manual operation” tool:
3. Set the parameters for the positioning targets in the target table and save.

 CAUTION	
	<p>Be careful when you enter the values!</p> <p>An incorrect value can result in unexpected movements, involuntary high speeds and/or forces and approach of unwanted positions.</p> <p>This can result in personal injury and / or damage to property.</p>

6.1 Manual operation



Manual operation

The “Manual operation” tool is the main application tool for the user.

It enables manual operation of the connected servo axis as well as setting, saving and loading of the position-related parameters.

Manual operation: SE-24 PROFIBUS NodeID=127, 5G-50_Pos_IB5.pos

File

Enable Disable STOP Homing

Actual application status

Status (hex) **0001h**

Status bits

- 0 Ready
- 1 Enabled
- 2 Homing done
- 3 Move OK
- 4 ACK

Actual device status

Status (hex) **0200h**

Error code **0**

Status bits

- 0 Enabled
- 1 Error
- 2 Warning
- 3 Moving
- 4 Target reached
- 5 Limit active
- 6 Following error
- 7 Homing done
- 8 Toggle bit
- 9 Command toggle bit
- 10 Command error
- 11 Stop or halt
- 12 Limit - current
- 13 Limit - velocity
- 14 Limit - position
- 15 Limit - svelocity

Actual values

Current **-4** mA

Velocity **0** mm/s

Trg. position **4700** um

Act. position **4700** um

PosFollowingErr **0** um

Settings

Pos. window um

Pos. window time ms

Curr. window mA

Curr. window time ms

Curr. gating time ms

Moving data sets

	Position	Velocity	Acceleration	Deceleration	Current	Delay	Relative positioning	
	um	mm/s	mm/s ²	mm/s ²	%	ms		
1.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
2.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
3.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
4.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
5.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
6.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
7.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
8.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
9.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
10.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
11.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
12.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
13.	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
14.	<input type="text" value="0"/>	<input type="text" value="200"/>	<input type="text" value="2000"/>	<input type="text" value="2000"/>	<input type="checkbox"/>	<input type="text" value="0"/>	<input type="checkbox"/>	Set
15.	<input type="text" value="20000"/>	<input type="text" value="20"/>	<input type="text" value="200"/>	<input type="text" value="200"/>	<input checked="" type="checkbox"/>	<input type="text" value="50"/>	<input type="checkbox"/>	Set

Store in device

Reverse mode

Pos. 1 <--> Pos. 2

Pos. 1 <--> Pos. 2

Jog

Velocity mm/s

Acceleration mm/s²

Polling OK: The parameters have been saved in the device.

6.1.1 Settings

NOTE	
	<p>The values in the “Settings” area only refer to the “Move OK” signal which corresponds to the “move_ok” interface signal.</p> <p>Detailed information about the functions can be found in the function description of the SE-24 operating manual in the “Functional description” chapter.</p>

Settings

Pos. window <input style="width: 50px;" type="text" value="100"/> um	Curr. window <input style="width: 50px;" type="text" value="100"/> mA
Pos. window time <input style="width: 50px;" type="text" value="50"/> ms	Curr. window time <input style="width: 50px;" type="text" value="50"/> ms
	Curr. gating time <input style="width: 50px;" type="text" value="200"/> ms

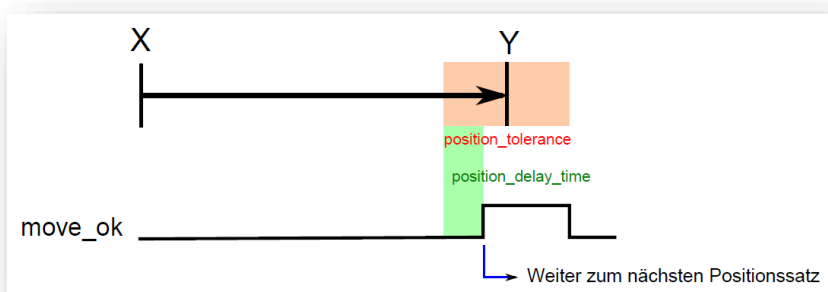
Settings for the “Move OK” signal in positioning mode.

Positioning window	<p>This value corresponds to the tolerance for the positioning window and is placed as a symmetric +/- value around the target position.</p> <p>Comment: Double the value corresponds to the “position_tolerance” value in Figure 2: Positioning mode.</p>
Positioning window - time	<p>This value sets the delay time from the moment when the actual position value is in the positioning window until the “Move OK” signal is triggered.</p> <p>Comment: This value corresponds to the “position_delay_time” in Figure 2: Positioning mode.</p>
<p>Comment: The “Move OK” signal is triggered when the delay time for the position in the positioning window has passed.</p>	

X = position_value (actual position) Y = target_position (target position)

Current = maximum current (from configuration)

Figure 2: Positioning mode



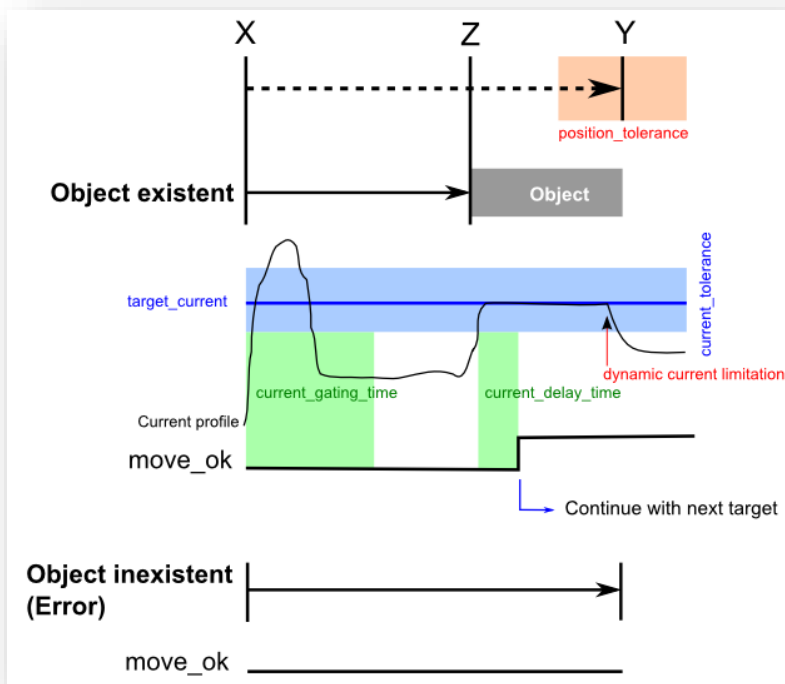
Settings for the “Move OK” signal in current mode.

Current window	<p>This value corresponds to the tolerance for the current window and is placed as a symmetric +/- value around the target current.</p> <p>Comment: Double the value corresponds to the “current_tolerance” value in Figure 3: Current mode.</p>
Current window - time	<p>This value sets the delay time from the moment when the actual current value is in the current window until the “Move OK” signal is triggered.</p> <p>Comment: This value corresponds to the “current_delay_time” value in Figure 3: Current mode.</p>
Current gating time	<p>This value fades out the starting current when a movement is started.</p> <p>After start-up, the “Move OK” signal is not triggered although the current is within the current window.</p> <p>Comment: This value corresponds to the “current_gating_time” value in Figure 3: Current mode.</p>
<p>Comment: The “Move OK” signal is triggered after the current fade out time and the delay time for the current in the current window have passed.</p>	

X = position_value (actual position) Y = target_position (abortion position)

Current = target_current

Figure 3: Current mode



6.1.2 Positioning sets

Moving data sets									
Position	Velocity	Acceleration	Deceleration	Current	Delay	Relative positioning			
um	mm/s	mm/s ²	mm/s ²	%	ms				
1.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
2.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
3.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
4.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
5.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
6.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
7.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
8.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
9.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
10.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
11.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
12.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
13.	0	0	0	<input type="checkbox"/>	0	0	<input type="checkbox"/>	Set	
14.	0	200	2000	2000	<input type="checkbox"/>	0	200	<input type="checkbox"/>	Set
15.	20000	20	200	200	<input checked="" type="checkbox"/>	50	200	<input type="checkbox"/>	Set

Store in device

A maximum of 15 moving data sets with the following contents can be stored on the SE-24 servo controller:

Position	<p>Target position</p> <p>The target position value is interpreted as an absolute or relative value depending on the “Relative positioning” option.</p> <p>Comment 1: Depending on the application, the value is displayed in the following units: <i>translatory: [μm] (um) rotary: [°/1000]</i></p> <p>Comment 2: For operation in current mode, this position must be behind the impact on the object.</p>
Velocity	<p>Target movement speed</p> <p>Comment: Depending on the application, the value is displayed in the following units: <i>translatory: [mm/s] rotary: [°/s]</i></p>
Acceleration	<p>Target acceleration</p> <p>Comment: Depending on the application, the value is displayed in the following units: <i>translatory: [mm/s²] rotary: [°/s²]</i></p>
Deceleration	<p>Target deceleration (braking acceleration)</p> <p>Comment: Depending on the application, the value is displayed in the following units: <i>translatory: [mm/s²] rotary: [°/s²]</i></p>

Current (option selection)	If this option is activated, current mode will be applied to this moving data set, otherwise the positioning mode will be maintained.
Current (value)	Target current value in % Comment: <i>This value is only active if current mode was selected for this moving data set by clicking the “Current” option.</i>
Delay	This value is the approach delay for this moving data set.
Relative positioning (option selection)	If this option is activated, the target position value will be interpreted as a relative value. Otherwise the value is absolute related to the reference point.
Set	The corresponding moving data set is started when this button is clicked. Comment: <i>The function is only active when controller enable was activated and a valid reference run was executed.</i>

CAUTION



A movement is triggered by pressing the “Set” button.

Store in device	The input values are saved permanently on the servo controller after pressing this button.
-----------------	--

NOTE



Changes are only maintained after a restart of the controller if they were stored by clicking the “Store in device” button.

7 Functional description of the inputs and outputs

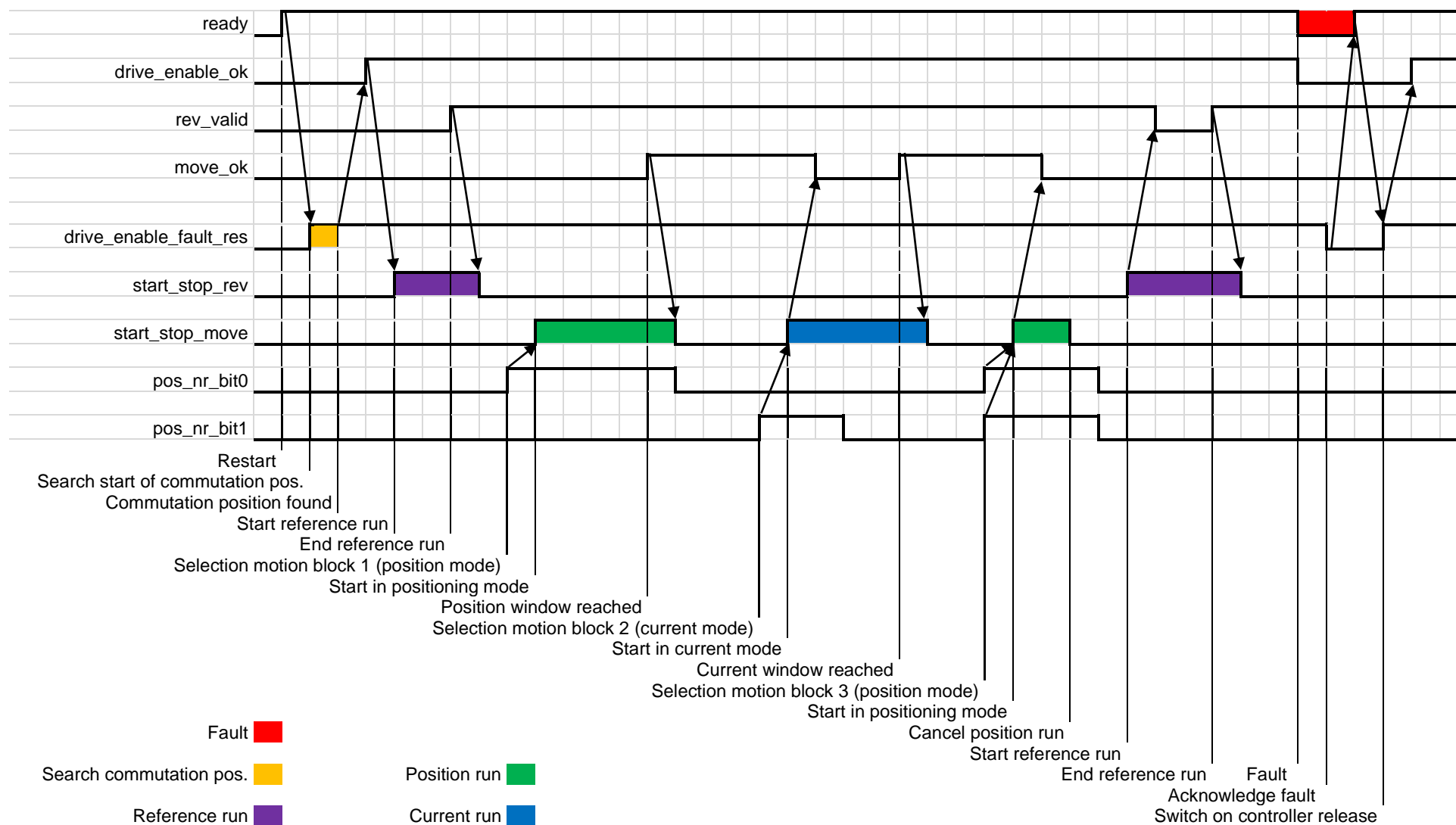
7.1 Signal description of the output data of the SE-24 servo controller

Object	Description
ready	<p>This signal is set when the drive is ready-to-operate and can be energized. If there is a fault in the drive this signal and the “drive_enable_ok” signal will be reset. The signal “ready” is only set after the error was acknowledged by resetting the “drive_enable/fault_res” signal.</p>
drive_enable_ok	<p>Power output stage and control are active.</p>
ref_valid	<p>This signal is set when a valid reference position exists. The signal is not set during an ongoing reference movement. It is set for the first time or once again only after a successfully executed reference movement.</p>
move_ok	<p>This bit is set depending on the traverse mode. In position mode the signal is set when the actual position is within the position window for a longer time than the set delay time. In current mode the bit is set when the actual current value is within the current value window for a longer time than the set delay time.</p> <p>Important: The signal is reset when the “start_move” signal is set. This however happens with a certain delay. Therefore it should be noted that the “move_ok” signal must first be queried for LOW and afterwards for HIGH after a run was started with the signal “start_move”.</p>

7.2 Signal description of the input data of the SE-24 servo controller

Object	Description
drive_enable / fault_res	<p>This signal is assigned twice.</p> <p>Controller release = Hi-active / Error acknowledgement = Lo-active</p> <p>LOW => Motor is not energized, errors are acknowledged.</p> <p>Change 0=>1, if there is no error the motor will be energized during a change from LOW to HIGH and remains controlled until an error occurs or the signal is set to LOW.</p> <p>If this input is only set for the first time after a restart the offset angle of the commutation position will be defined (only for motors without Hall-effect probe).</p> <p>Change 1=>0, if there is an error the controller tries to acknowledge the pending errors. This is only possible after the cause for the error was rectified.</p>
start/stop_ref	<p>A rising edge causes a reference run to be executed.</p> <p>A falling edge aborts the reference run.</p> <p>The sequence is as follows: Setting of the signal "drive_enable/fault_res", wait until the signal "drive_enable_ok" is at HIGH. Then set the signal "start/stop_ref", the reference run is executed. Wait until the signal "ref_ok" is at HIGH, the reference run is terminated. The controller is now ready for positioning.</p>
start/stop_move	<p>A rising edge signals that a new movement order should be undertaken and started.</p> <p>In case of a falling edge the SE-24 is stopped quickly. This input has no influence during a reference run.</p> <p>Precondition is however that no error is pending, that controller release is active and a successful reference run was carried out, i.e. the outputs "ready", "drive_enable_ok" and "ref_valid" must be set.</p>
pos_nr_bit0	<p>Position set (binary) which should be approached. The position sets (1-15) are preconfigured with the tool window "Moving data sets" in the "Manual operation" tool of the "afag Tools" parameterization software.</p>
pos_nr_bit1	
pos_nr_bit2	
pos_nr_bit3	

8 SE-24 I/O signal diagram





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