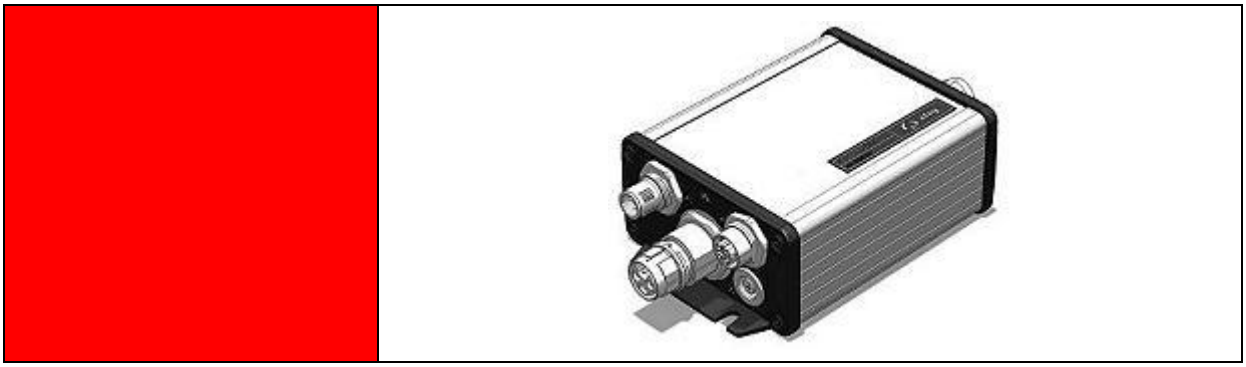
Servo Controller
SE-24

- **CANopen Manual**



Complementary document to the

Operating Manual

This manual is a complementary document to the operating manual and applies to:

Type	Order No.
SE-24 CANopen	50315437

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

Version of this documentation: SE-24-CANopen-Manual vers. 1.2 en. 02.04.2012

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

Symbols:

DANGER	
	**Indicates imminent danger.** **Non-compliance with this information results in death or serious personal injuries (invalidity).**

WARNING	
	Indicates a possible dangerous situation. Non-compliance with this information results in death or serious personal injuries (invalidity).

CAUTION	
	Indicates a possible dangerous situation. Non-compliance with this information results in damage to property or slight to moderate personal injuries.

NOTE	
	Indicates general notes, useful operator tips and operating recommendations which do not affect safety and health of the personnel.

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1 General

1.1 Documentation

This manual is a complementary documentation to the operating manual and describes the field bus interface connection of the SE-24 servo controller under CANopen. It contains a description of setting the physical parameters and communication with the servo controller.

It is intended for persons who are already familiar with the SE-24 servo controller.

It contains safety instructions that must be followed.

More detailed information can be found in the following documents:

Main document:

- **SE-24 Operating Manual**

Description of the technical data and the functions of the device as well as notes for the connector assignments, installation and operation of the SE-24 servo controller.

⚠ CAUTION	
	**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.**

Complementary documents to the operating manual:

- **SE-24 IO Manual**

Description of the I/O control of the SE-24 servo controller.

- **SE-24 Profibus Manual**

Description of the fieldbus control of the SE-24 servo controller under PROFIBUS-DP.

- **SE-24 EtherCAT Manual**

Description of the fieldbus control of the SE-24 servo controller under EtherCAT.

- **SE-24 CANopen Manual**

Description of the fieldbus control of the SE-24 servo controller under CANopen.

- **SE-24 Software Manual**

Description of the “afagTools” parameterization program.

2 Safety instructions

⚠ CAUTION	
	**The safety instructions in the operating manual must be followed.** **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.**

3 CAN Bus

The CAN bus is designed in accordance with High-Speed ISO standard (ISO 11898). The transmission rate is up to 1 Mbit/s.

3.1 CANopen

CANopen denotes the communication protocol for CAN-bus systems. CANopen is based on CAL (**C**AN **A**pplication **L**ayer).

The CANopen protocol is a layer 7 protocol (Application Layer) which is applied on the CAN-bus (ISO 11898). The layers 1 & 2 (Physical Layer/Data Link Layer) are not affected by CAN-bus.

The CANopen communication profiles for the various applications are managed by CiA (**C**AN **i**n **A**utomation).

The service elements provided by the Application Layer enable the implementation of a distributed network application. These service elements are described in "CAN Application Layer (CAL) for Industrial Applications".

Each device in a CANopen network has a fixed node ID (module number, 1-127).

The servo controller "SE-24 CANopen" supports the following CiA standards:

- CiA DS 201-207 CAL – CAN Application Layer for Industrial Applications
- CiA DS 301 Version 4.0 CANopen Application Layer and Communication Profiles
- CiA DS 402 Version 2.0 Device Profile Drives and Motion Control

3.2 Objects

Data exchange with a "SE-24 CANopen" slave is performed using clearly defined process data objects (PDO). These are described in Chapter: *5.4 Control* .

The COB-IDs (**C**ommunication **Ob**ject **Id**entifier) are predefined:

PDO	COB-ID	PDO	COB-ID
TxPDO1:	180h+Node-ID	RxPDO1:	200h+Node-ID
TxPDO2:	280h+Node-ID	RxPDO2:	300h+Node-ID

NOTE	
	"Tx" = sent from the slave (transmit) "Rx" = received by the slave (receive)

3.3 Documentation about CAN and CANopen

CAN (**C**ontroller **A**rea **N**etwork) is a standard developed by CiA (**C**AN **i**n **A**utomation) Hersteller- und Nutzerorganisation e.V. The description of the field bus system can be found in the following standards:

ISO 11898-2 (CAN transmission technology)

EN 50325-4 (CANopen protocol)

Further information, contact addresses etc. can be found at www.can-cia.org.

More detailed documentation for the use of CAN:

1. CAN Specification 2.0, Part A & Part B

2. High Layer Protocol CANopen

3. “CANopen”
   Holger Zeltwanger
   VDE Verlag
   ISBN 3-8007-2448-0

4 Wiring and pin assignment

4.1 Pin assignment

The CANopen connection on the SE-24 servo controller is implemented as a 5 pole M12 plug or socket (a-coded).

4.1.1.1 CANopen IN [X2a]

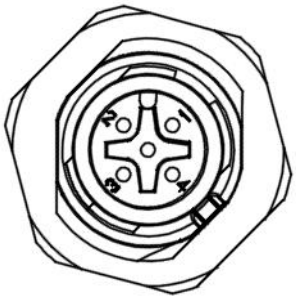


Figure 1: View of the connection [X2a]

X2a, CANopen IN		
Flush-type plug, 5 pole M12, A-coded Phoenix: 1419645 SACC-DSI-M12MS-5CON-M16/0.5		
Pin	**Designation**	**Specification**
1	Shield	
2	n.c.	
3	CAN_GND	Data ground
4	CAN_H	CAN high
5	CAN_L	CAN low

4.1.1.2 CANopen OUT [X3a]

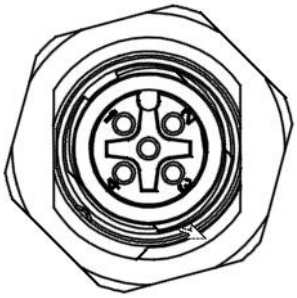


Figure 2: View of the connection [X3a]

X3a, CANopen OUT		
Flush-type socket, 5 pole M12, A-coded Phoenix: 1419658 SACC-DSI-M12FS-5CON-M16/0.5		
Pin	**Designation**	**Specification**
1	Shield	
2	n.c.	
3	CAN_GND	Data ground
4	CAN_H	CAN high
5	CAN_L	CAN low

NOTE	
	CAN cabling When constructing the CAN network, strictly follow the advice of the current literature or the following information and instructions to obtain a stable and fault-free system. In the case of cabling not having been done properly, faults can occur on the CAN during operation which result in the servo controller switching off with an error message for safety reasons.

4.1.2 Bus cable for CANopen

The following cables of the company Phoenix Contact should be used for the CANopen connection:

Bus system cable, CANopen/DeviceNet, 5 pole, PUR halogen-free, violet RAL 4001, shielded, straight M12-SPEEDCON plug, A-coded, on straight M12-SPEEDCON socket, A-coded

Phoenix Contact CANopen cables

CANopen cable	Order No.	Length in m
	1518258	0,3
	1518261	0,5
	1518274	1
	1518287	2
	1518290	5
	1518300	10
	1518313	15

4.1.3 Termination and bus terminating resistors

Every bus segment of a CAN network must be fitted with bus terminating resistors to minimise cable reflections, ensure almost constant load behaviour on the bus and to set a defined equilibrium rest potential on the cable. The termination is done at the beginning and at the end of a bus segment.

Due to the high protection class, the CAN module of the SE-24 servo controller has no integrated terminating resistors.

Therefore, an M12 connector terminating resistor should be used.

The following bus terminating resistor from the company Phoenix Contact should be used for the CAN-bus termination:

Phoenix Contact CANopen terminating resistor

CANopen terminating resistor

Type	Article No.
SAC-5P-M12MS CAN TR	1507816

NOTE	
	Defective or incorrect bus termination is a frequent cause of faults.

5 CAN interface connection

5.1 Introduction

A number of steps are necessary to create a functioning CAN interface connection. Some of these settings should or must be executed before the activation of the CAN communication. This chapter provides an overview of the corresponding steps.

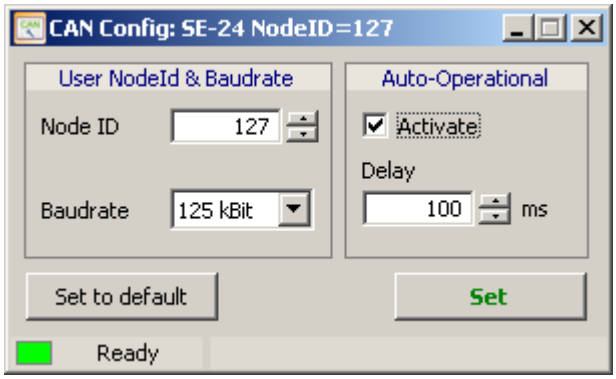
Data are transmitted via so-called PDOs (**P**rocess **D**ata **O**bject). The data are assigned fixed (mapped) on the slave (in this case the SE-24). Therefore, on the slave side, only the device address (Node-ID) and the transmission speed (baud rate) and on the master side only how many data items and the arrangement of the data have to be specified.

5.2 Setting CAN parameters (Node-ID and Baud Rate)

Proceed as follows to set the CAN node address (node ID) and the communication speed (baud rate):

1. Open the “afagTools” configuration program.
2. Select the “CAN Config” tool:

3. Set the node ID and the baud rate in the following window and confirm with “Set”:



4. **Important:** Changes are only applied when the controller is restarted.

5.3 Baud rate

The default transmission speed of the SE-24 servo controller is 125 kBit/s and can be set up to maximum 1 MBit/s.

5.4 Control

Two registers are required for operation of the SE-24: the status register which contains the ACTUAL values of the drive, and the control register where the TARGET values are entered.

The signals are described and specified on the following pages.

5.4.1 Status register (actual values)

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

Object		Description
ready	*BOOL*	This signal is set if the drive is ready for operation and can be energised. If there is a fault in the drive, this signal and also the "drive_enable_ok" signal are reset. The "ready" signal will not be set again until the error has been acknowledged by resetting the "drive_enable/fault_res" signal.
drive_enable_ok	*BOOL*	Power output stage and control are active.
ref_valid	*BOOL*	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.
move_ok	*BOOL*	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. **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”.
error_no	*INT16*	Display of the error which has occurred.
position_value **[µm]** **[°/1000]**	*INT32*	Actual position
current_value **[mA]**	*INT32*	Actual motor current

5.4.1.2 Output telegram of the SE-24 servo controller

TX PDO 1 (8 bytes)

Status Bits *[MPU status register (5101:01)]*

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ready	drive_enable_ok	ref_valid	move_ok													error_nr (16-bit) *[Error register (3001:00)]*															

32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
position_value (µm, °/1000, 32-bit)								*[Actual position (3762:01)]*																							

TX PDO 2 (4 bytes)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
current_value (mA, 32-bit)								*[Current – actual filtered value (3262:01)]*																							

5.4.2 Control register (target values)

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

Object		Description
drive_enable / fault_res	*BOOL*	This signal is assigned twice. Controller release = Hi-active / error acknowledgement = Lo-active LOW => motor is not energised, errors are acknowledged. Change 0=>1, if there is no error, the motor will be energised during a change from LOW to HIGH and remains controlled until an error occurs or the signal is set to LOW. If this input is set the first time after a restart, the offset angle of the commutation position is first determined (only for motors **without** Hall encoder). Change 1=>0, if there is an error, the controller will try to acknowledge the pending errors. This is only possible if the cause for the error has been rectified.
start/stop_ref	*BOOL*	A rising edge causes a reference run to be executed. A falling edge aborts the reference run. 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.
start/stop_move	*BOOL*	A rising edge signals that a new movement order should be undertaken and started. In case of a falling edge the SE-24 is stopped quickly. This input has no influence during a reference run. 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.
mode	*BOOL*	Operating mode: position / current mode LOW = position controller mode HIGH = current controller mode
pos_nr	*INT4*	Position set (binary) which should be approached. The position sets (1-15) are preconfigured with the “Positioning sets” tool window in the “Manual operation" tool of the “afag Tools” configuration software. **Caution: When the movement is made using the position sets, the values of the "mode", "move_relative", "target_position", "velocity", "deceleration", "acceleration" and "target_current" objects are ignored.**

jog_pos		*BOOL*	When the input is set the drive accelerates with the acceleration set for the Jog mode to a pre-parameterized positive movement speed. In case of a falling edge at this input, the drive brakes to a standstill with the deceleration set for the quick-stop. This input has no effect during the reference-, position or current run.
jog_neg		*BOOL*	When the input is set the drive accelerates with the acceleration set for the Jog mode to a pre-parameterized negative movement speed. In case of a falling edge at this input, the drive brakes to a standstill with the deceleration set for the quick-stop. This input has no effect during the reference-, position or current run.
move_relativ		*BOOL*	Change between absolute and relative. LOW=absolute, HIGH=relative
target_position	**[µm]** **[°/1000]**	*INT32*	Target position The position target value is interpreted as an absolute or relative position depending on the “move_relative” signal.
velocity	**[mm/s]** **[°/s]**	*INT16*	Target movement speed
acceleration	**[mm/s^2]** **[°/s^2]**	*INT16*	Target acceleration
deceleration	**[mm/s^2]** **[°/s^2]**	*INT16*	Target deceleration
target_current	**[%]**	*INT16*	Target current value The moment target value is determined by the higher level control system (in % of the positive current limiting). It defines the moment with which the drive should move.

5.4.2.2 Input telegram of the SE-24 servo controller

RX PDO 1 (8 bytes)

Control Bits *[MPU control register (5101:02)]*

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
drive_enable / fault_res	start/stop_ref	start/stop_move	mode	pos_nr_bit0	pos_nr_bit1	pos_nr_bit2	pos_nr_bit3	jog_pos	jog_neg	move_relative					

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
target_position (µm, °/1000, 32-bit)								*[MPU target position (5102:01)]*																							

48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
velocity (mm/s, °/s, 16-bit)								*[MPU velocity (5102:02)]*							

RX PDO 2 (6 bytes)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
acceleration (mm/s^2, °/s^2, 16-bit)								*[MPU acceleration (5103:02)]*								deceleration (mm/s^2, °/s^2, 16-bit)								*[MPU deceleration (5104:01)]*							

32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
target_current (%, 16-bit)								*[MPU target current (5103:01)]*							

5.5 Integration in a PLC

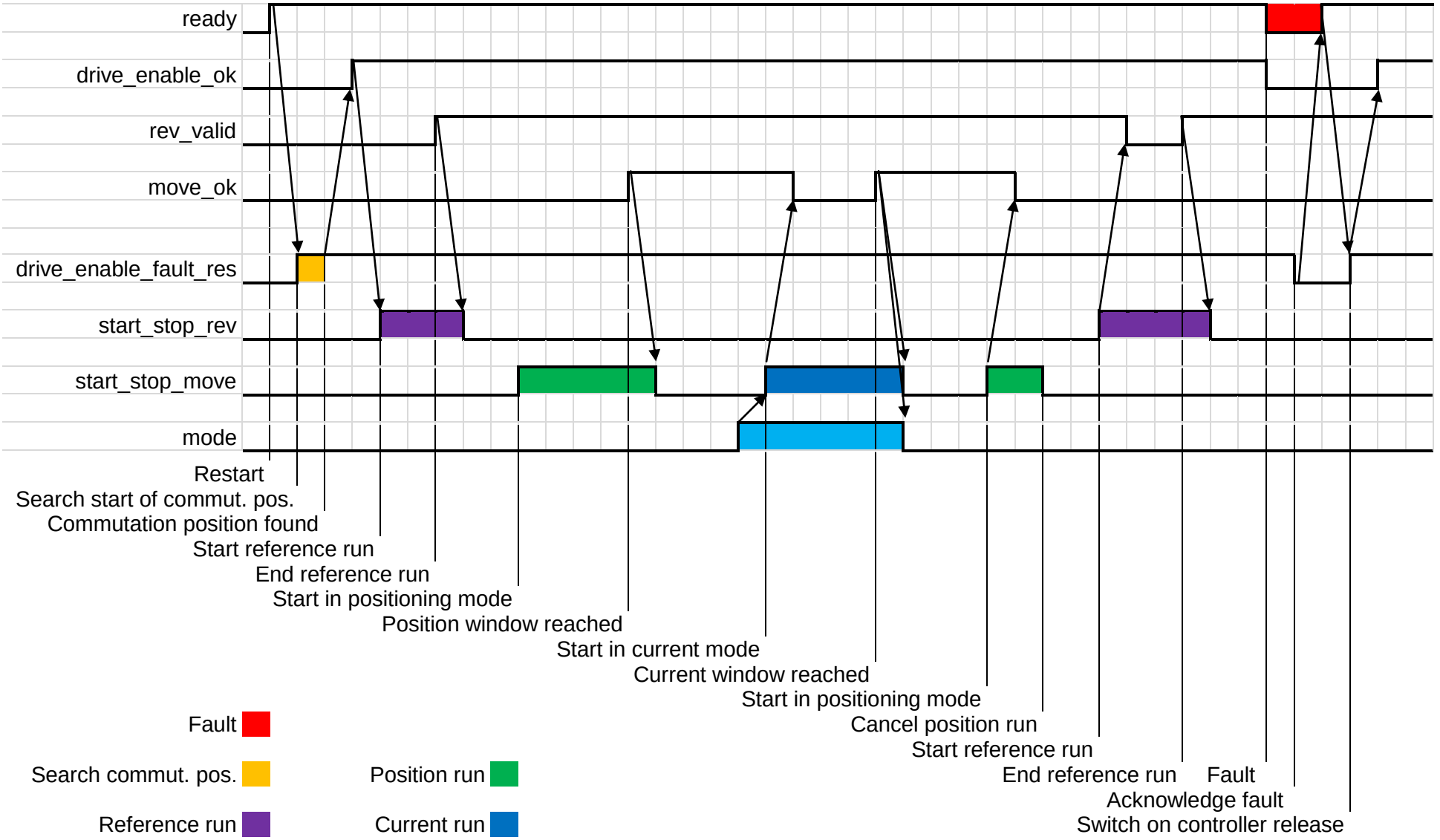
The following EDS file is provided for the integration in a higher level PLC:

SE-24.eds

The assignment of the PDOs to the COB-IDs can be found in Chapter: *3.2 Objects*

The description of the PDOs can be found in Chapter: *5.4 Control*

6 Signal diagram



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