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Servodyn-D

SERCOS interface Servodyn-D
Parameter and Commissioning Manual

Version 101

Servodyn-D

SERCOS interface Servodyn-D
Parameter and Commissioning Manual

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The fully digital inverter system Servodyn-D

1 Safety instructions

This manual contains information which is required for properly operating the products described here.

It is intended for technically qualified personnel who have been specifically trained in or who have relevant knowledge of measuring technology and automatic control engineering.

1.1 Markings on components

The following symbols are found on various components and are used as warnings to point out possible danger, or to call your attention to important information:

➧ Danger due to high voltage.

➧ Electrostatic sensitive devices!

➧ PE conductor

➧ Screen

1.2 Hazard warnings in the manual

Observe and comply with the safety notes and danger warnings given in this manual (“DANGER”, “CAUTION”, and the highlighted information provided under “Note”) in order to avoid serious injury and property damage.

1.3 Qualified personnel

1.1

! DANGER !

Maintenance and installation of the components to be carried out only by electrotechnicians (VDE 1000-10) under observation of the accident prevention regulations (UVV VBG4, VDE 100, VDE 105) and installation regulations (EN 60204-part1, prEN 50178).

Tampering with the drive components, ignoring warning signs attached to the components, or noncompliance with the warning notes given in this manual can result in serious bodily injury or property damage.

For this reason, only **electrotechnicians** as recognized under VDE 1000-10 who are familiar with the contents of this manual may perform the procedures as authorized in this manual.

Such personnel are

- those who, being well trained and experienced in their field and familiar with the relevant norms, are able to analyse the jobs being carried out and recognise any hazards which may have arisen.
- those who have acquired the same amount of expert knowledge through years of experience that would normally be acquired through formal technical training.

Please note that we offer a comprehensive training program.
Our training centre will be pleased to provide you with further information.

1.4 Proper use

Drive inverters are components to be installed in machines and systems for commercial or industrial use.
If additional measures are taken, they may also be used for applications other than industrial uses.

- ❑ Before putting the drive inverters into operation, ensure that the machine which the inverters are to be installed in meets the stipulations of the machine directive (89/392/EEC) and the EMC directive (89/336/EEC).
- ❑ The inverters themselves meet the safety objectives of the low–voltage directive (73/23/EEC) and the harmonised standards prEN 50178 (VDE 0160) and EN 60146–1–1 (VDE 0558–11).

These products pose no danger to persons or property if they are used in accordance with the handling stipulations and safety notes prescribed for their configuration, mounting, and proper operation.

! DANGER !

The safe and reliable operation of this product requires its proper transport, storage, set-up, and assembly as well as conscientious operation and use.

Ensure that no components are bent and no insulation distances are changed at the inverters. Do not touch any electronic components and contacts.

CAUTION !

Drive inverters contain electrostatically endangered components which can easily be destroyed by improper handling.

! DANGER !

Do not allow built-in electrical components to be destroyed, as this could cause personal injury.

All power supply terminals U, V, W and link terminals C, D carry lethal voltages of up to 375 V DC!

! DANGER !

As a protective measure against dangerous voltages, drives may not be switched on unless all covers have been fitted!

After the drive has been disconnected from the mains, up to 5 minutes may pass until high voltages have reduced to safe levels.

! DANGER !

Allow a discharge time (5 minutes) to pass before working on the power terminals and be sure to check that the DC links have zero voltage!

The power electronics of inverter modules are electrically connected to the mains.

! DANGER !

Use the manufacturer's circuit diagram to check the wiring.
Check the EMERGENCY-STOP chain before switching on!

2 Communication with SERCOS interface

The special capabilities of the fully digital Servodyn-D drives can only be utilised with a compatible digital interface.
The resulting high real-time and synchronisation requirements can be fully met by the open SERCOS interface.

SERCOS = **S**erial **R**ealtime **CO**mmunication **S**ystem
in acc. with EN 41 009, IEC 1491, EN 61 491

SERCOS interface is a serial real–time communication system between the control unit and the drives and was developed as a standardisation proposal in a joint VDW/ZVEI working committee (DIN IEC/TC 44).

SERCOS interface offers the following advantages:

- Ease of installation and commissioning
- Standardised connection system, procedures, formats and weighting facilitate interaction between control units and drives from various manufacturers.
- Fast response times; setpoints and actual values can be processed in the same cycle.
- High immunity to interference due to optical fibres
- Lowest possible number of optical fibres due to ring structure
- Various drive operating modes possible

In addition to the cylic data exchange for setpoints and actual values, drive-internal parameters are entered and diagnostics information displayed via non-cyclic data exchange with standardised data blocks. This takes place via the master or via a diagnostics system.

2.1 Configuration of the interface

SERCOS interface is designed as a ring structure using optical fibres. Each ring links an NC control unit with several drives.

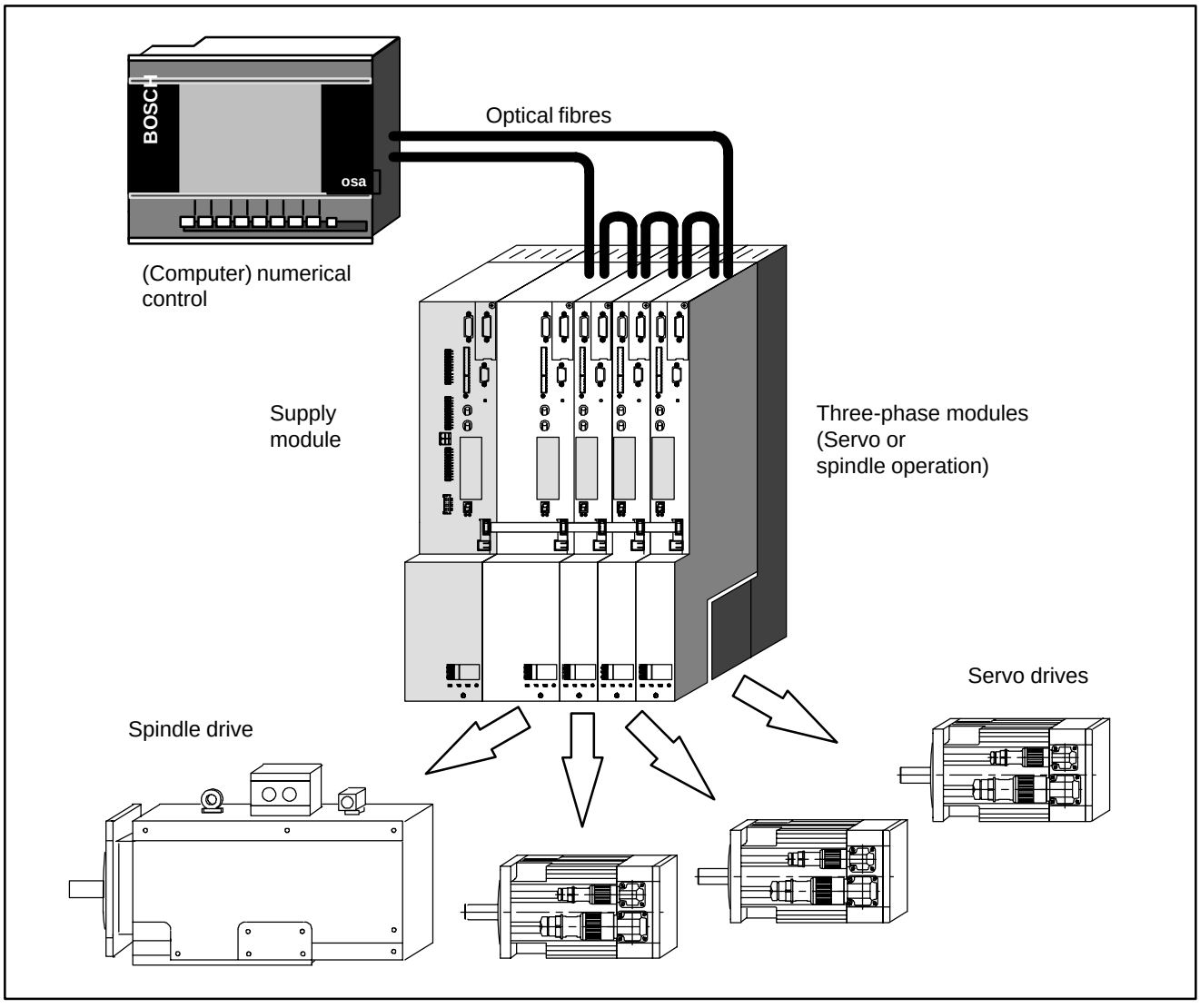


Fig. 2.1: SERCOS interface ring circuit

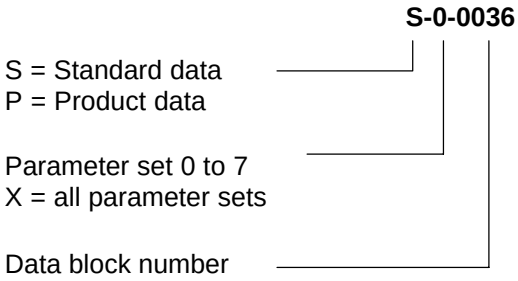
The length of each transmission section may not exceed:

- 60 m with plastic optical fibre
- 250 m with fibre-glass optical fibre

The maximum number of drives is dependent on the required communication cycle time, the preselected operating data range and the data rate. Approximately 8 drives can be connected to an optical fibre ring at a communication cycle time of 1 ms.

2.2 Communication

Data exchange via the SERCOS interface is carried out by the transmission of operating data and commands, each command and piece of operating data being designated with an ident. no.



Communication between drives and control units from different manufacturers cannot be realised without the large number of ident. nos. defined by the SERCOS interface. All SERCOS interface ident. nos. are identified by an “S”, e.g. S-0-0036 (= speed setpoint).
All other drive characteristics are defined by product-specific ident. nos. from the relevant manufacturer. These are identified by a “P”, e.g. P-0-0503 (= waiting time, standstill monitoring).

Communication between the numerical control and the drives takes place via:

- Cyclic data exchange
  for transmission of operating data in every communication cycle. Transmission involves only the operating data with the corresponding ident. no.
- Service channel
  for non-cyclic data which are transferred as required by the master and for configuring the communication and setting of the operating parameters in the control unit and drives.
  All elements of the corresponding ident. nos. can be transferred.

The complete data exchange between the master and the drives takes place in separate telegrams. There are a total of 3 different types of telegram:

- **MST** Master Synchronisation Telegram
- **MDT** Master Data Telegram
- **DT** Drive Telegram

Initialization

After being switched on, the system runs though several communication phases before reaching normal operating mode:

- **Communication phase 0**
  The master issues “Master Synchronisation Telegrams” (MST).
  The drives connected by optical fibres pass on the MSTs to the receiver in the master. If the master has received its own MST 10 times in succession, it switches to communication phase 1.

- **Communication phase 1**
  The master sends a reduced “Master Data Telegram” (MDT) to one drive at a time.
  The drives reply with a reduced “Drive Telegram” (DT). When all drives expected have replied, the master switches to communication phase 2.

- **Communication phase 2**
  The master sends a reduced “Master Data Telegram” (MDT). In addition, non-cyclic transmission to one drive is possible here.
  After the data have been tested for validity and completeness in the drive and all drives have replied, the master switches to communication phase 3.

- **Communication phase 3**
  From this phase on, the master can handle non-cyclic transmissions simultaneously with all drives. This makes this phase suitable for the transmission of the operating parameters to all drives.
  After each drive has checked that error-free operation is possible, the master switches to communication phase 4.

- **Communication phase 4**
  This is the phase for normal operation. Initialisation is complete.

Cyclic data exchange

Cyclic communication in a SERCOS interface ring is controlled by the master:

1. The master sends a **Master Synchronisation Telegram (MST)** as a broadcast to all users. It is received by all drives at the same time and simultaneously synchronises all drives with the NC.
2. All drives send their information in separate **Drive Telegrams (DT)** to the master
3. The master ends the cycle with a **Master Data Telegram (MDT)** containing the required data for all drives. The MDT is received almost simultaneously by all drives, which it provides synchronously with, for example, new setpoints.

When the SERCOS interface cycle time has elapsed, the master starts a new synchronisation telegram. For sequence see fig. 2.2.

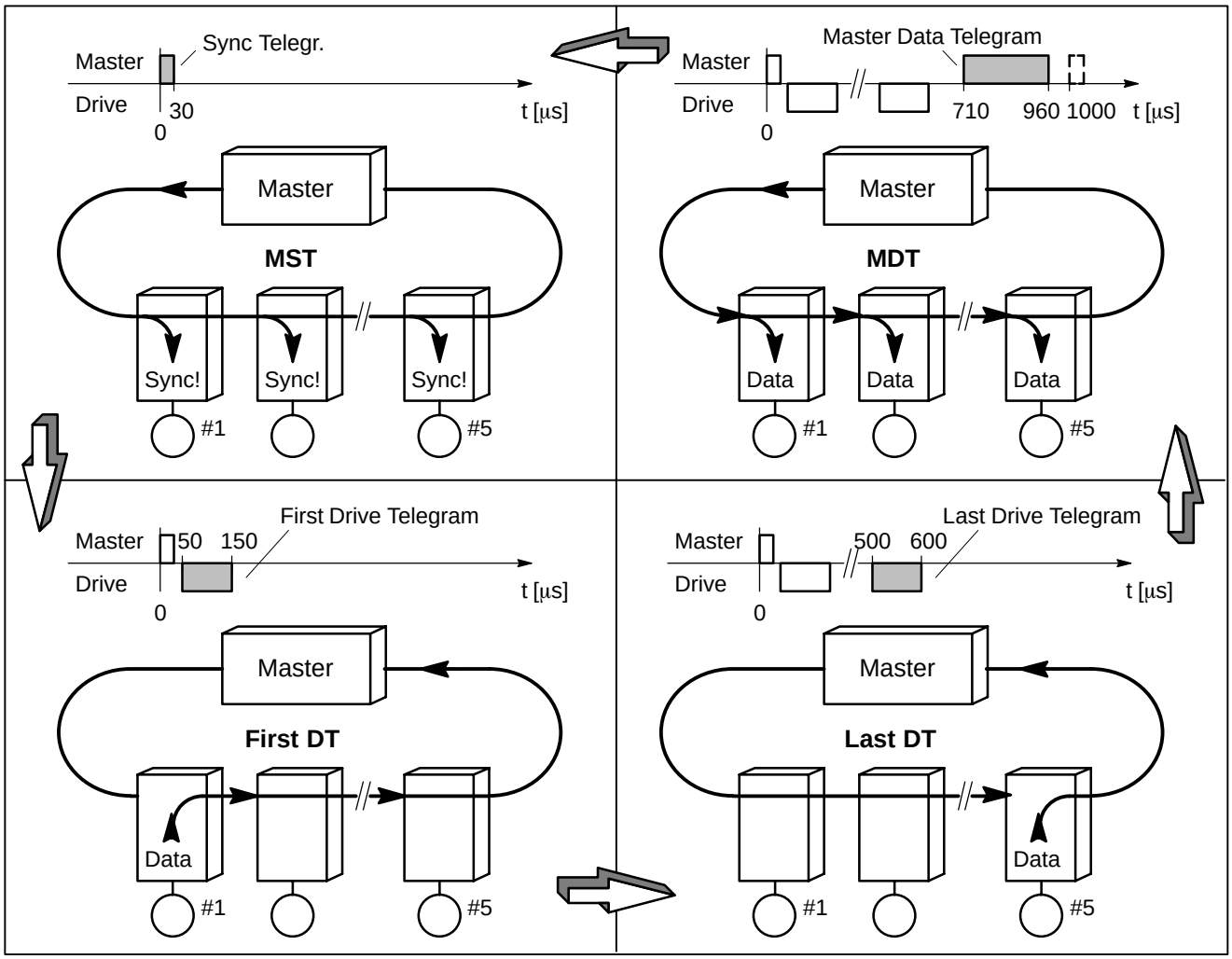


Fig. 2.2: Communication cycle for cylic data exchange

Service channel

The service channel is a non-cyclic, demand-controlled means of data transmission. It is provided with 2 bytes per drive in the Drive Telegram and the Master Data Telegram. The sequence is controlled with control bits in the control field of the MDT and status bits in the status field of the DT.
The master can simultaneously configure one service channel per drive, which facilitate the following operations:

- Initialisation of the SERCOS interface
- Transmission of the entire data contents of an ident. no.
- Transmission of commands
- Changing limit values as necessary
- Changing controller parameters as necessary
- Diagnostics functions

The service channel is controlled solely by the master and is used to load data from drives or transfer data to drives. The drive can only respond.
The data being transferred can be separated into several successive transmission stages if the quantity of data makes this necessary. In contrast to cylic transmission, the drive must not reply in the same cycle: it is possible to wait for 10 cycles to allow the drive to handle other tasks.

2.3 Explanations on the attributes bar

In the following chapters, an ”attributes bar” is shown together with every parameter. Its individual fields have the following meaning:

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

- ”**Changeable**” field:
  Specifies in which phase the parameter can be changed. If nothing is entered here, the parameter can only be read.

- ”**Init**” field:
  Specifies in which phase the parameter has to be initialised in the drive. If nothing is entered here, the drive initialises the parameter itself through its firmware.

- ”**Real–time bit**” field:
  Specifies whether the parameter can be transmitted between the master and the drive in real time. For example, this is necessary for signalling certain events, or for triggering actions.
  ”M → D” means: transfer from master to drive
  ”D → M” means: transfer from drive to master

- ”**Cyclic**” field:
  Specifies whether the prameter can be transmitted cyclically between the master and the drive. This is necessary, e.g., for the transmission of setpoints or actual values.
  ”MDT” means: cyclic transfer from master to drive
  ”DT” means: cyclic transfer from drive to master

- ”**Recovery**” field:
  Specifies whether the parameter can be saved in the drive’s FEPROM.

- ”**Weighting**” field:
  Specifies the weighting parameters used for interpreting the data of the corresponding parameter.

Your notes :

3 Initialisation parameters (Phase 2)

3.1 Phase run-up of Servodyn-D

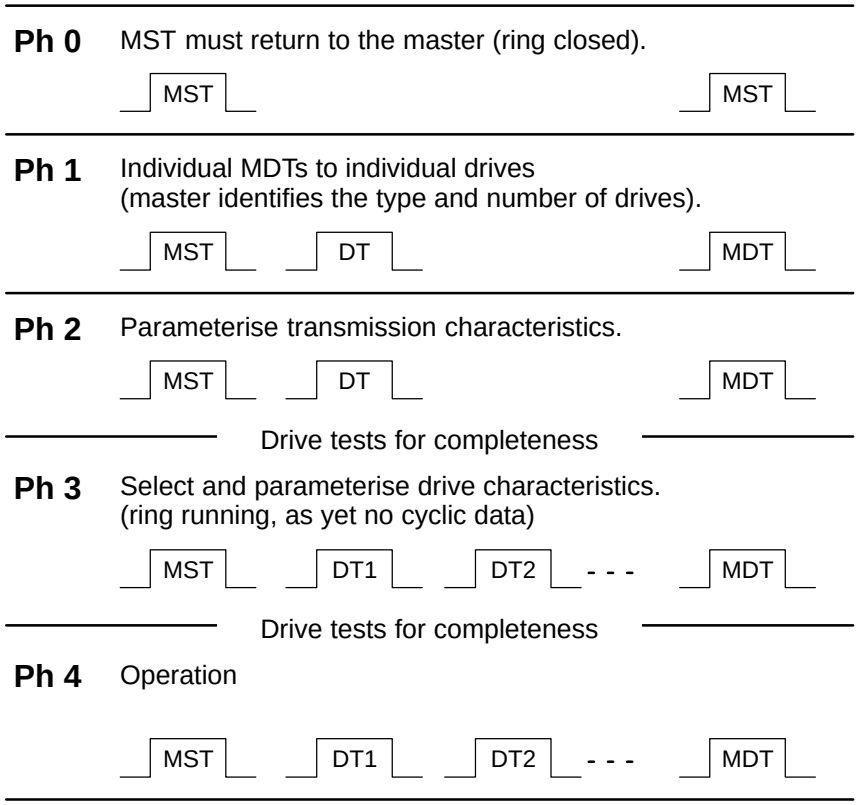


Fig. 3.1: SERCOS interface start–up phases

The initialisation parameters listed in section 3 must be exchanged between the master and the drives in phase 2 and activated in phase 3.

- If no valid parameters have been stored, e.g. for a new Personality Module, the parameters must be transferred while the system runs up.
- If the FEPROM already contains valid parameters, loading the required parameters into the working memory will be sufficient.

S-0-0263 Command "Load working memory"

Phase 2	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This command will load all data necessary for operation (= list S-0-0192, see page 9-41) from the FEPROM into the working memory.

☞ **Note** **This command will replace the parameters currently available in the working memory.**

3.2 Configuration of communication

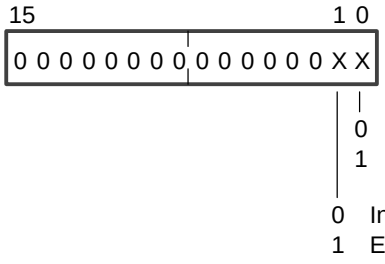
3.2.1 Switching the communication phases

S-0-0127 Switching preparations for comm. phase 3 (Master → Drive)

Phase 2	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The master uses this command to complete transmission of the communication parameters in phase 2.
The command is completed error-free if the drive can follow the inputs of the MST from communication phase 3. After a positive command acknowledgement the NC must delete the command and then proceed to phase 3.

Parameter configuration:



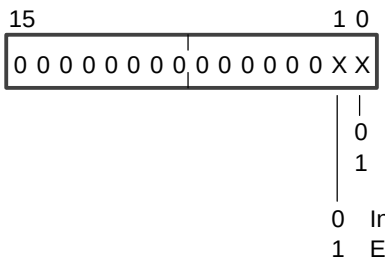
X is assigned the 0 or 1 below it.

S-0-0128 Switching preparations for comm. phase 4 (Master → Drive)

Phase 3	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The master uses this command to complete transmission of the communication parameters in phase 3.
The command is completed error-free if the drive can follow the inputs of the MST from communication phase 4. After a positive command acknowledgement the NC must delete the command and then proceed to phase 4.

Parameter configuration:



X is assigned the 0 or 1 below it.

S-0-0021 List of invalid operating data, communication phase 2

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

S-0-0022 List of invalid operating data, communication phase 3

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

List of operating data ident numbers required to switch over to the next phase, but not yet validly set.

- If commands S-0-0127 or S-0-0128 are acknowledged positively, the list is empty.
- If commands S-0-0127 or S-0-0128 are acknowledged negatively, the ident numbers still required are contained in the list.

3.2.2 Transmission time slots

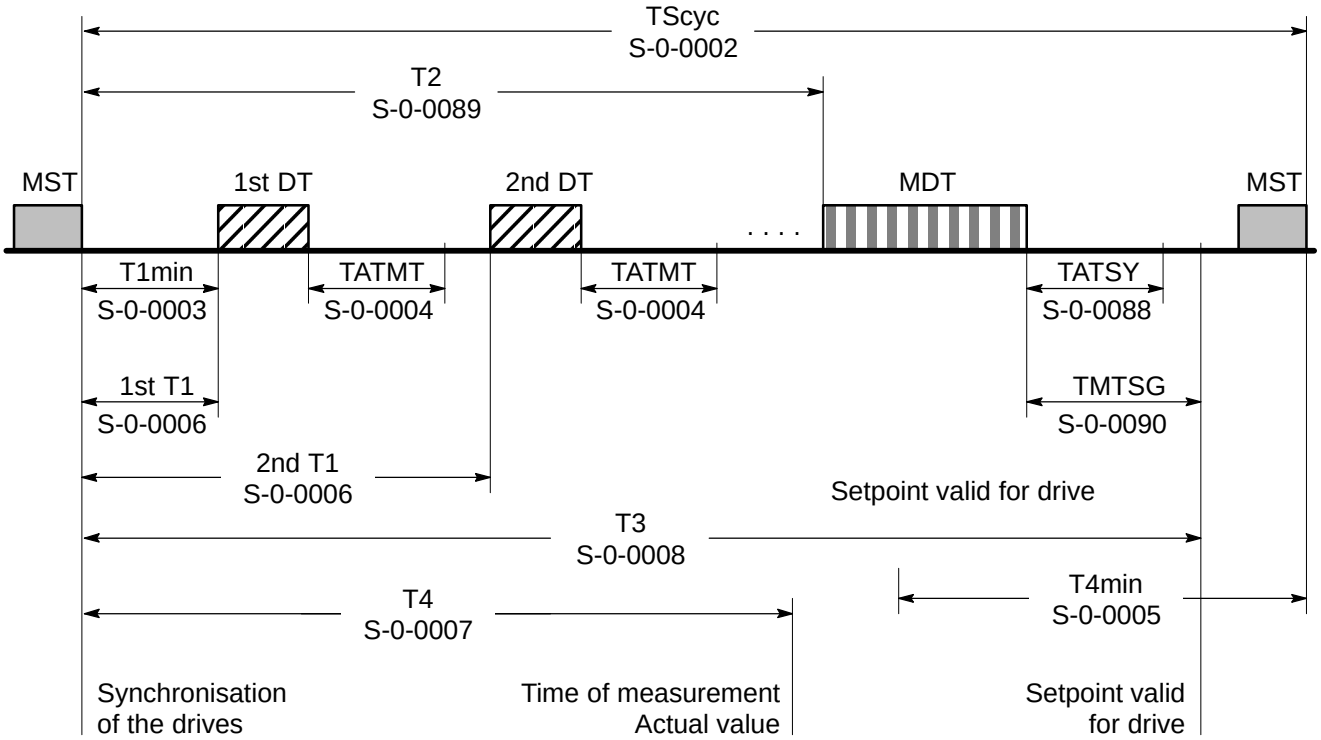


Fig. 3.2: Diagram of transmission time slots

S-0-0002 **SERCOS interface cycle time (TScyc)** **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time between two master synchronisation telegrams (MST).
See fig. 3.2.

Entry: 500 µs, 1...8 ms in integral steps, 10, 12, 14, 16 ms
Entry in master in [µs].

S-0-0001 **NC-cycle time (TNcyc)** **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time between two setpoint inputs of the master.

Entry: Integral multiples of the SERCOS cycle time,
Entry in master in [µs].

S-0-0003 Transmission reaction time drive telegram (T1min) (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Minimum time required by drive between the end of the received MST and the start of drive telegram transmission (DT).
The time required depends on whether preferred telegrams or configured telegrams are to be transmitted in normal operation (see page 3-8). Using this information, the master calculates the time of transmission T1 of the DT.

S-0-0006 Transmission time of drive telegram (T1) (Master → Drive)

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Transmission time of the DT after the end of the MST, valid from communication phase 3.

S-0-0005 Minimum time actual value measurement (T4min) (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Minimum time required by drive between the end of the received MST and the start of the actual value measurement. The master uses this value to determine the time of measurement of the actual values T4 for all drives.

S-0-0007 Time of measurement of actual values (T4)(Master → Drive)

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time of measurement of the actual values at the end of the MST. The same value should be assigned for **all** drives, so that a synchronous actual value measurement is guaranteed.

Entry: $T4 \leqq TScyc - T4min$
Entry in master in [µs].

S-0-0004 Switchover time transmit/receive (TATMT) (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time required by drive after transmitting the DT to be ready to receive the next master data telegram (MDT). Using this information, the master calculates the time of transmission T2 of the MDT.

S-0-0088 Recovery time receive/receive (TATSY) (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time required by drive between the end of the received MDT and readiness to receive the next MST. The master takes this value into account when calculating the time slot for the MDT (transmission time T2).

S-0-0089 Time of transmission Master Data Telegram (T2) (Master → Drive)

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time of transmission of the MDT after the end of the MST.
If not all conditions can be fulfilled during the calculation of T2, either a longer SERCOS interface cycle time TScyc must be selected, or the drives must be divided between several rings.

S-0-0090 Copying time setpoints (TMTSG) (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time required by the drive to provide the setpoints after reception of the MDT.
The time required depends on whether preferred telegrams or configured telegrams are to be transmitted in normal operation. Using this information, the master calculates the time for setpoint valid T3.

S-0-0008 Time for setpoint valid (T3) (Master → Drive)

Phase 2	–	–	–	FEPROM		
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Time after end of MST, at which the drive may access the new setpoint. The same time can be specified for all drives.

S-0-0096 Slave identification (SLKN) (Drive –> Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

A physical SERCOS interface slave may serve one or several drives. This parameter is given an appropriate address for enabling the master to calculate the optimum time slots.

Bits 8 – 15: Own drive address of the slave (1 to 254)
Bits 0 – 7: Next drive address (1 to 254)
– for one drive, the drive's own address is entered
– for several drives, the higher next address of this slave, for the last drive the lowest address of this slave is entered.

Example: Slave with 3 drives (addresses 3, 5, 8)

Slave drive 3

15		0
03		05

Slave drive 5

15		0
05		08

Slave drive 8

15		0
08		03

3.2.3 Telegram configuration

3.2.3.1 General telegram configuration

The entire data exchange of the SERCOS interface takes place in individual telegrams (see fig. 3.3). Every telegram is composed of three sections:

- An administration section at the beginning, consisting of:
  - telegram limitation
  - address field
- The data field with the data sets to be transmitted
- An administration section at the end, consisting of:
  - telegram test field
  - telegram limitation

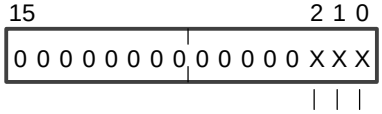
The administration sections are always required for the transmission of a telegram. The data field varies according to the three different types of telegram and the status of the interface.
The parameters to be transmitted in the data field of the master data telegram and the drive telegram are either specified in preferred telegrams or can be set as desired in a freely configurable telegram.

S-0-0015 Telegram type parameters (Master → Drive)

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter can be used to choose between different preferred telegrams and a configurable telegram for master and drive:

Parameter configuration:



X is assigned the 0 or 1 below it.

0 0 0	Preferred telegram 0
0 0 1	Preferred telegram 1
0 1 0	Preferred telegram 2
0 1 1	Preferred telegram 3
1 0 0	Preferred telegram 4
1 0 1	Preferred telegram 5
1 1 0	Preferred telegram 6
1 1 1	Configured telegram

Preferred telegram 0: No cyclic data exchange, transmission via service channel only.

Preferred telegram 2: Speed interface, position measurement in the master

MDT	Speed setpoint S-0-0036
DT	Speed actual value S-0-0040

Preferred telegram 3: Speed interface, position measurement in the drive

MDT	Speed setpoint S-0-0036
DT	Position actual value S-0-0051, S-0-0053

Preferred telegram 4: Position interface (for servo operation only)

MDT	Position setpoint S-0-0047
DT	Position actual value S-0-0051, S-0-0053

Preferred telegram 5: Speed/Position interface (for spindle operation only)

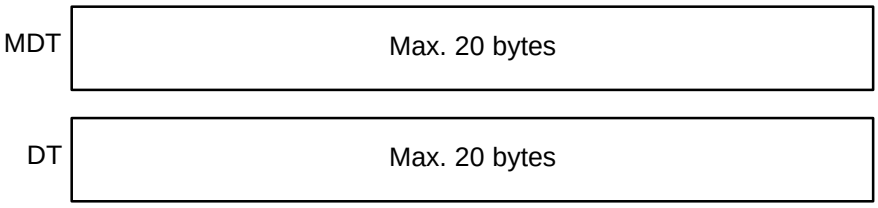
MDT	Position setpoint S-0-0047	Speed setpoint S-0-0036
DT	Position actual value S-0-0051, S-0-0053	Speed actual value S-0-0040

Preferred telegram 6: Speed interface, position measurement in the master, no drive telegram

MDT	Speed setpoint S-0-0036
DT	only with “fixed data set”

Configurable:
Telegram

Composed of cyclic parameters, which may not exceed a total length



3.2.3.2 MDT Configuration

Telegrams from the master are always destination-addressed. The master can address all drives simultaneously with the broadcast address.
The data field is divided into the same amount of drive data sets as drives served by the master (M). The data sets contain all operating data to be transmitted cyclically, and can vary in length depending on the drive. The assignment of every data set to a drive is specified during initialisation.
The fixed part of the data set is always present, while the configurable part of the data set for every drive is specified using initialisation parameters. It contains the sum of all data required cyclically.

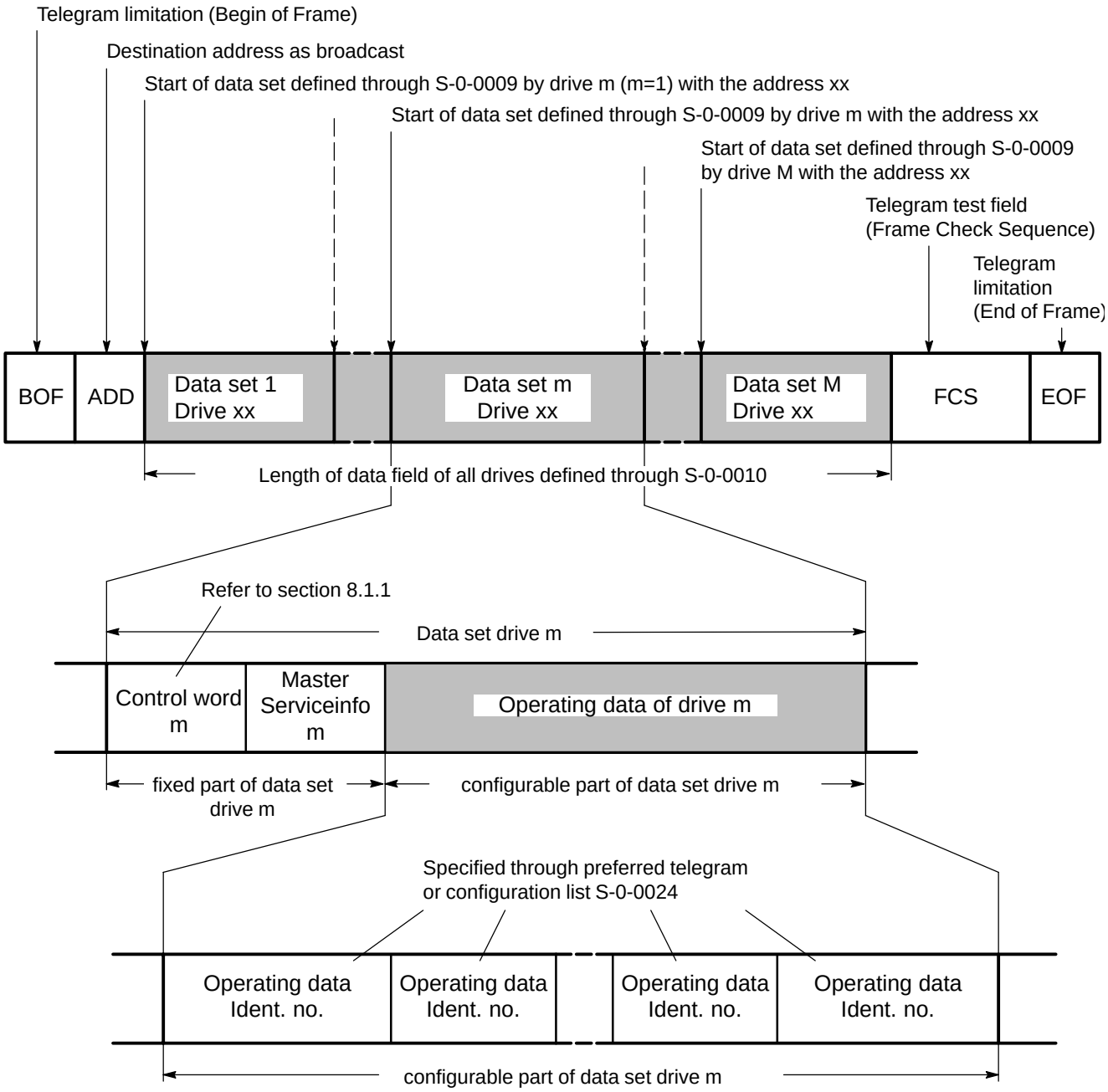


Fig. 3.3: Configuration of Master Data Telegram

S-0-0009 Start adress Master Data Telegram (Master → Drive)

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Start address of the data set for the respective drive in the MDT, expressed as a byte position.

S-0-0010 Length – Master Data Telegram (Master → Drive)

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

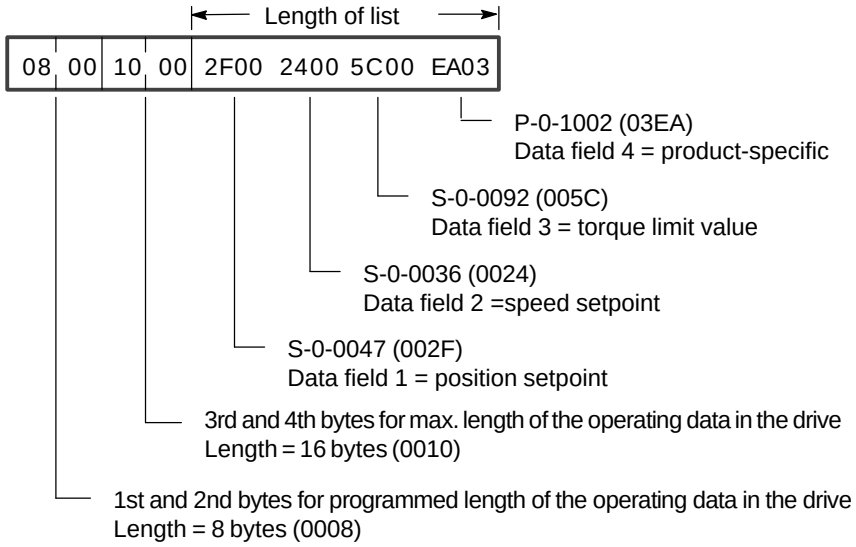
Length of the MDT with the data sets of all drives, expressed in bytes.

S-0-0024 Configuration list MDT (Master → Drive)

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Individual specification of the freely configurable MDT.
Only parameters contained in the list of configurable data (S-0-0188) may be selected.

Example (variable length):



S-0-0188 List of configurable data in the MDT (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

List of ident numbers of operating data that can be cyclically processed as setpoints by the drive.
These can be seen in the attributes list in the manual.

S-0-0186 Length of the configurable data set in the MDT (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Maximum data set length in bytes, which the drive can process in the configurable MDT.

3.2.3.3 DT Configuration

Telegrams from the drive are source-addressed.
The data field contains only one data set with the operating data to be cyclically transmitted to the master. The data set can vary in length, depending on the application of the drive.
The fixed part of the data set is always present, while the configurable part of the data set for every drive is specified using intialisation parameters. It contains the sum of all data required cyclically.

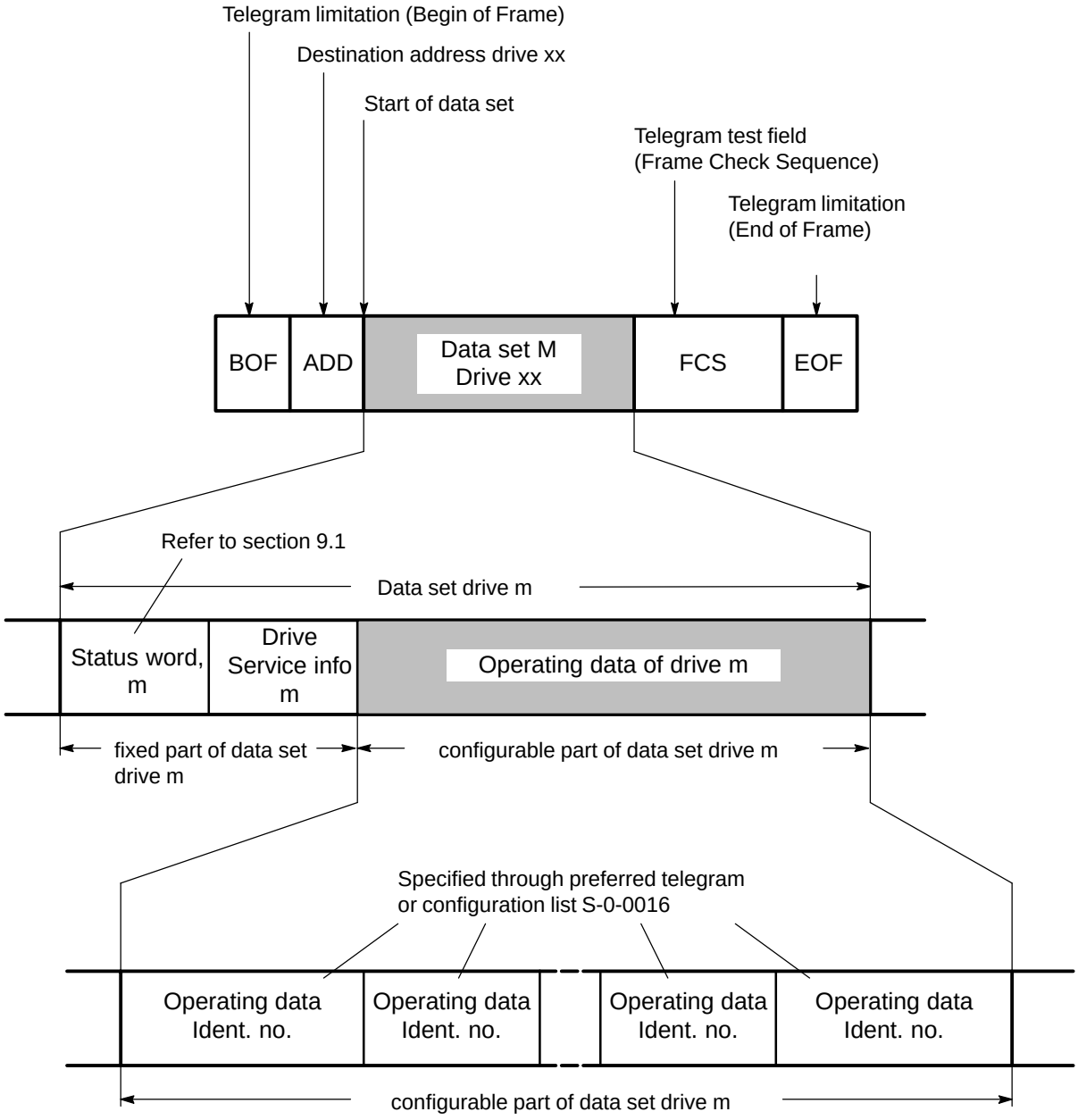


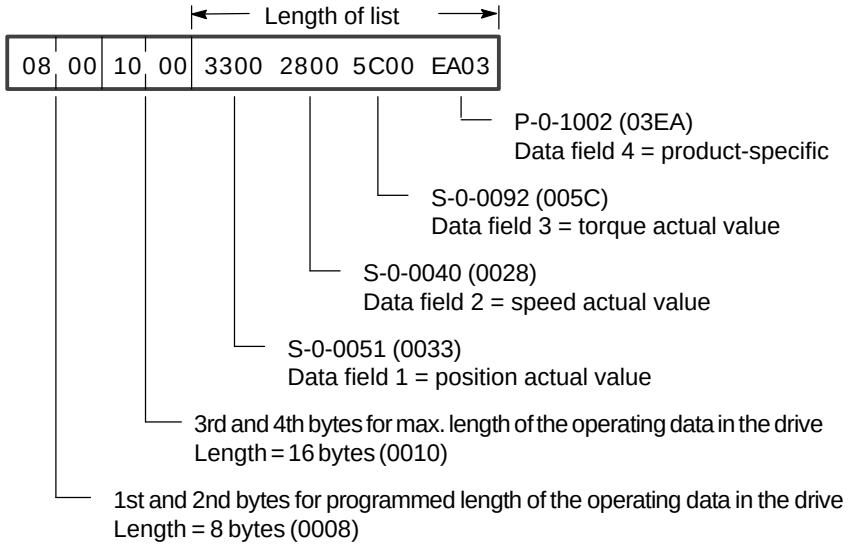
Fig. 3.4: Drive telegram configuration

S-0-0016 Configuration list DT **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Individual specification of the freely configurable DT.
Only parameters contained in the list of configurable data (S-0-0187) may be selected.

Example (variable length):



S-0-0187 List of configurable data in the DT **(Drive → Master)**

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

List of ident numbers of operating data that can be cyclically provided as actual values by the drive.
These can be seen in the attributes list in the manual.

S-0-0185 Length of the configurable data set in the DT **(Drive → Master)**

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Maximum data set length in bytes, which the drive can process in the configurable DT.

3.3 Drive operating modes

The operating mode of the drive is specified by the control word in the MDT, whereby it is possible to switch between one main operating mode and three secondary modes.
In many cases, switch-over can take place during operation for drive modules with spindle function, whereby the switch-over phase takes several SERCOS interface cycles.

☞ **Note** **The main operating mode and all secondary modes must be programmed. If this is not the case, the drive stops in phase 2 when starting and reports the missing/invalid operating data in S-0-0021.**

S-0-0032 **Main operating mode** **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

S-0-0033 **Secondary mode 1** **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

S-0-0034 **Secondary mode 2** **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

S-0-0035 **Secondary mode 3** **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

An operating mode must be programmed for every ident. number S-0-0032 to S-0-0035:

Parameter configuration:

X is assigned the 0 or 1 below it.
r = reserved

15	14	7	6	5	4	3	2	1	0	
X	X	r	r	r	r	r	r	r	r	
0		0	0	0	0	0	0	0	0	no operating mode defined
0		0	0	0	0	0	0	0	1	– not assigned –
0		X	X	0	0	0	0	1	0	Speed control
0		X	X	X	X	X	0	1	1	Position control with motor encoder
0		X	X	X	X	X	1	0	0	Position control with external encoder
0		X	X	X	X	X	1	0	1	– not assigned –
0		0	0	0	0	0	1	1	0	– Reserved –
0		0	0	0	0	0	1	1	1	Operating mode without control
						0				Position control with following error
						1				Pos. control without following error (Feed–forward control)
0		0	0	0	0					no more complex operating mode
0		0	0	0	1					Interpolation in the drive
0		0	0	1	0					– not assigned –
0		0	0	1	1					– Reserved –
0		0	1	0	0					Synchronous operation (for spindle drive only)
0		1	0	0	0					Electronic gear boxes (for servo drive only)
	0									cyclic setpoint input
	1									Setpoint input via service channel
0										operating mode specified by SERCOS interface
1										operating mode specified by manufacturer in the bits 14 to 1

☞ **Note** **Bits 3, 4 and 5 are of relevance for position control only.**

3.3.1 Operating modes for servo function

Observe the following for operating mode changes in the servo function:

- For position control, and for interpolation in the drive, the encoder is specified during initialisation. The encoder cannot be switched over during operation.
- For speed control, the encoder for the command “Drive–controlled referencing” is specified in the referencing parameter S-0-0147.
- The feed–forward control (= bit 3, position control without following error) can be switched on during position control and also during additional interpolation in the drive.

Main operating mode S-0-0032	Possible secondary modes S-0-0033, S-0-0034, S-0-0035,
Speed control	– Speed control – Position control with motor encoder – Position control with ext. encoder
Position control with motor encoder	– Position control with motor encoder – Interpolation with motor encoder – Speed control
Position control with ext. encoder	– Position control with ext. encoder – Interpolation with ext. encoder – Speed control
Interpolation with motor encoder	– Interpolation with motor encoder – Position control with motor encoder
Interpolation with external encoder	– Interpolation with external encoder – Position control with ext. encoder

Interpolation = Position control with additional interpolation in the drive

3.3.2 Operating modes for spindle function

Observe the following for operating mode changes in the spindle function:

- Switching over from spindle to C-axis takes place by switching over from speed control to position control.
- The encoder is fixed for the C-axis, the encoder cannot be switched over.
- The position encoder for the command “spindle orientation” is specified in the spindle positioning parameter S-0-0154.
- Feed-forward control for C-axis (= bit 3, position control without following error) can be switched on during position control and also during additional interpolation in the drive.

Main operating mode S-0-0032	Possible secondary modes S-0-0033, S-0-0034, S-0-0035,
Speed control	– Speed control – Position control with motor encoder – Interpolation with motor encoder – Position control with ext. encoder – Interpolation with external encoder
Position control with motor encoder	– Position control with motor encoder – Interpolation with motor encoder – Speed control
Position control with ext. encoder	– Position control with ext. encoder – Interpolation with external encoder – Speed control
Interpolation with motor encoder	– Interpolation with motor encoder – Position control with motor encoder – Speed control
Interpolation with external encoder	– Interpolation with external encoder – Position control with ext. encoder – Speed control

Interpolation = Position control with additional interpolation in the drive

3.4 Weightings

3.4.1 Weighting – position data

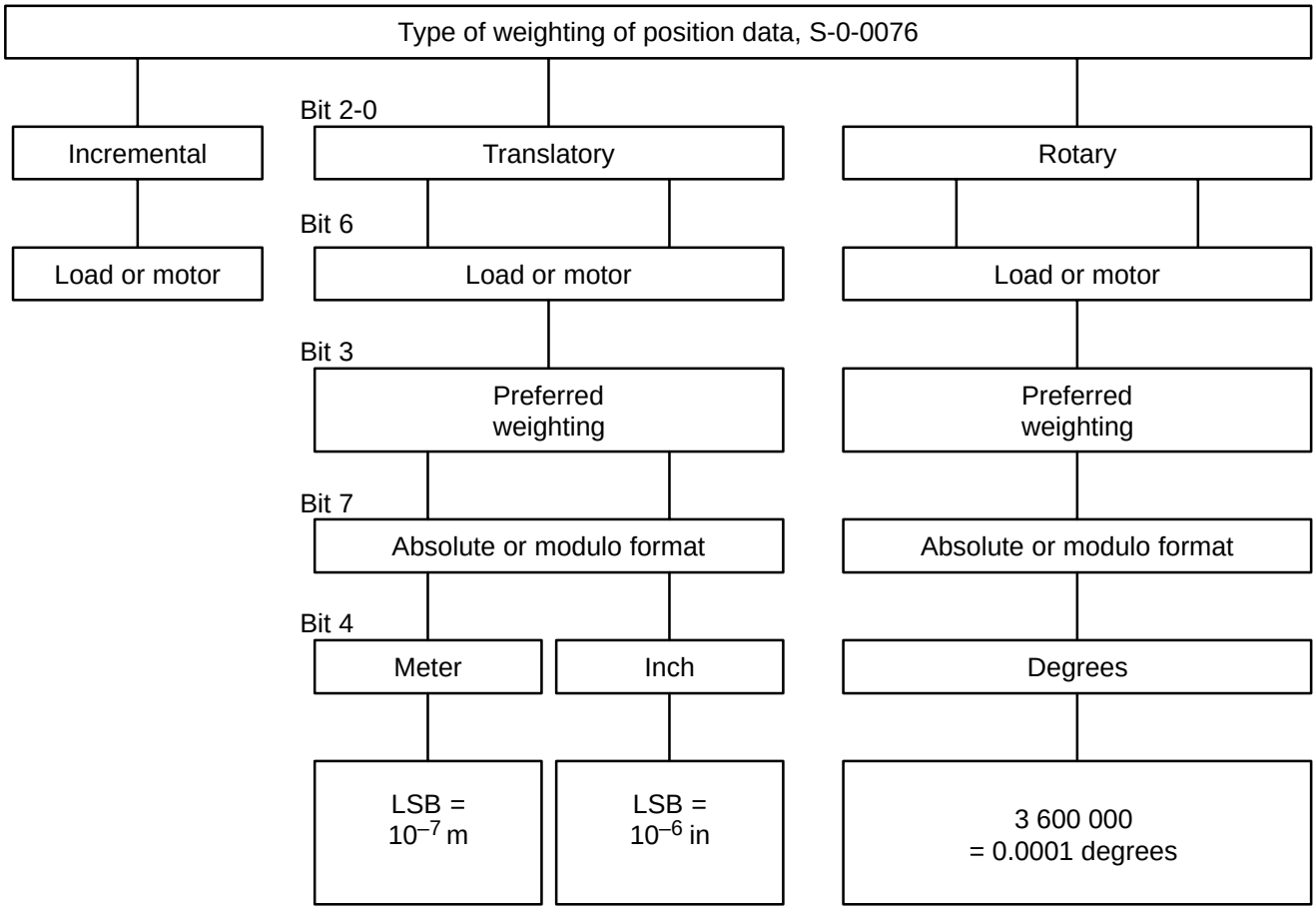


Fig. 3.5: Types of weighting of the position data

Incremental weighting 1 LSB = 1 increment

Translatory weighting The following preferred weightings are specified:

1. Metric: 1 LSB = 1 x 10^{-7} m
2. Imperial: 1 LSB = 1 x 10^{-6} in

Rotary weighting The following preferred weighting is specified:

$$1\ \text{LSB} = \frac{360\ \text{degrees}}{3\ 600\ 000} = 0.001\ \text{angular degree}\ (= 1 \times 10^{-4})$$

S-0-0076 Type of weighting for position data (Master → Drive)

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The type of weighting is specified for incremental, translatory or rotary position data, see fig. 3.5.

Parameter configuration:

X is assigned the 0 or 1 below it.
r = reserved

15 7 6 5 4 3 2 1 0

r r r r r r r X X X X X X X X

Bit 2-0: Type of weighting

X X 0 0 0 0 0 0 Incremental weighting
X X X X 0 0 0 1 Translatory weighting
X X X 0 0 0 1 0 Rotary weighting

0 **Bit 3: Preferred weighting**

Bit 4: Translatory unit of measure

0 Meter [m]
1 Inch [in]

Bit 4: Rotary unit of measure

0 Angular degree
1 – Reserved –

0 **Bit 5: – Reserved –**

Bit 6: Data reference

0 at the motor shaft
1 at the load

Bit 7: Processing format

0 Absolute format
1 Modulo format

S-0-0077 Weighting factor of translatory position data

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the weighting factor for the internal interpretation of the translatory position data by the drive.

$$1\ LSB = S\text{-}0\text{-}0077 \times 10^{Exponent}$$

Since the preferred weighting is permanently set in bit 3 of weighting type S-0-0076, this parameter is determined depending on the unit of measure (S-0-0076, bit 4) and cannot be overwritten.

S-0-0078 Weighting exponent of translatory position data

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the weighting exponent for the internal interpretation of the translatory position daty by the drive.

$$1\ \text{LSB} = \text{factor} \times 10^{\text{S-0-0078}}$$

Since the preferred weighting is permanently set in bit 3 of weighting type S-0-0076, this parameter is determined depending on the unit of measure (S-0-0076, bit 4) and cannot be overwritten.

S-0-0079 Rotary position resolution

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the internal resolution of 1 revolution (360 degrees). It thus determines the weighting of the LSB of all rotary position data.

$$1\ \text{LSB} = \frac{360\ \text{degrees}}{\text{rotary position resolution} = 3\ 600\ 000}$$

Since the preferred weighting is permanently set in bit 3 of weighting type S-0-0076, this parameter cannot be overwritten.

3.4.2 Speed data weightings

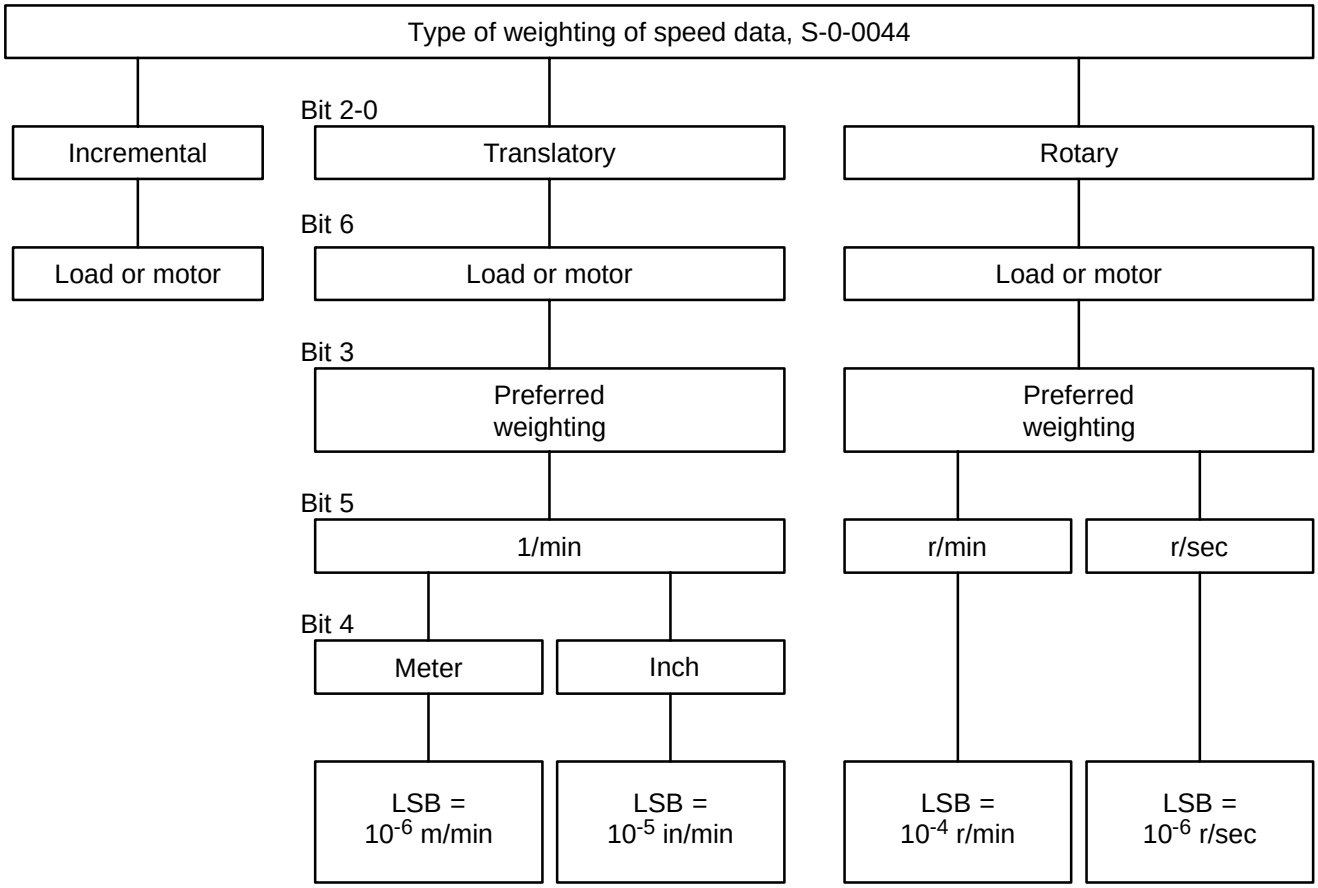


Fig. 3.6: Types of weighting for speed data

Incremental weighting 1 LSB = 1 increment

Translatory weighting The following preferred weightings are specified:

1. Metric: 1 LSB = 1 x 10^{-6} m/min
2. Imperial: 1 LSB = 1 x 10^{-5} in/min

Rotary weighting The following preferred weightings are specified:

1. Minute: 1 LSB = 1 x 10^{-4} r/min
2. Second: 1 LSB = 1 x 10^{-6} r/sec

S-0-0044 **Type of weighting for speed data** **(Master → Drive)**

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The type of weighting is specified for incremental, translatory or rotary speed data, see fig. 3.6.

Parameter configuration:

15 6 5 4 3 2 1 0

r r r r r r r r X X X X X X X

X is assigned the 0 or 1 below it.
r = reserved

Bit 2-0: Type of weighting

X 0 0 0 0 0 0 Incremental weighting
X X X 0 0 0 1 Translatory weighting
X X 0 0 0 1 0 Rotary weighting

0 **Bit 3: Preferred weighting**

Bit 4: Translatory unit of measure

0 Meter [m]
1 Inch [in]

Bit 4: Rotary unit of measure

0 Revolution [r]
1 – Reserved –

Bit 5: Unit of time

0 Minute [min]
1 Second [s]

Bit 6: Data reference

0 at the motor shaft
1 at the load

S-0-0045 **Weighting factor of speed data**

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Since the preferred weighting is permanently set in bit 3 of weighting type S-0-0044, this parameter is determined depending on the unit of measure (S-0-0044, bit 4) and cannot be overwritten.

$$1\ LSB = S\text{-}0\text{-}0045 \times 10^{Exponent}$$

S-0-0046 **Weighting exponent of speed data**

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter cannot be overwritten, see S-0-0045.

$$1\ LSB = factor \times 10^{S\text{-}0\text{-}0046}$$

3.4.3 Weighting – torque data

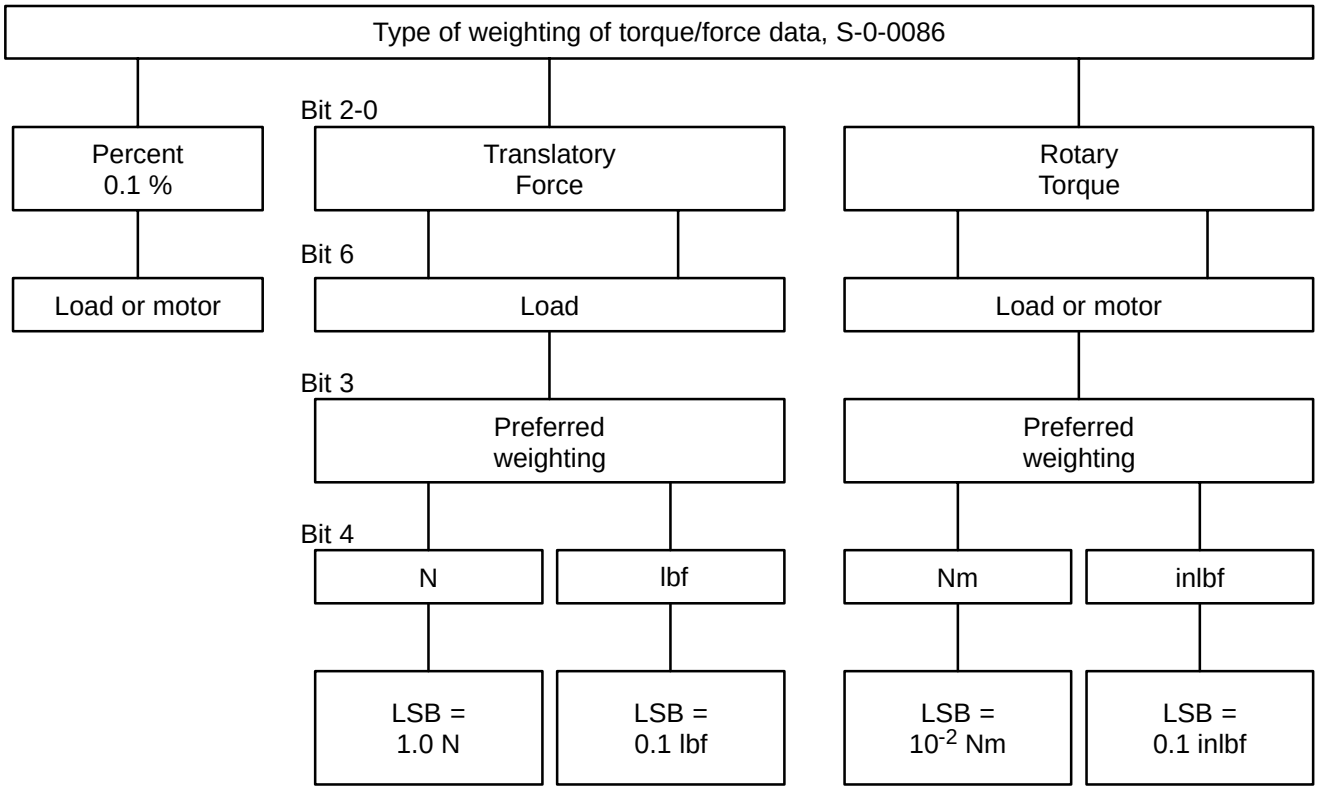


Fig. 3.7: Types of weighting of the torque/force data

Weighting in percent 1 LSB = 0.1 % of motor torque at standstill

Force data weighting The following preferred weightings are specified:

1. N: 1 LSB = 1 x 10^{-0} N = 1 N
2. lbf: 1 LSB = 1 x 10^{-1} lbf = 0.1 lbf

Torque weighting The following preferred weightings are specified:

1. Nm: 1 LSB = 1 x 10^{-2} Nm = 0.01 Nm
2. inlbf: 1 LSB = 1 x 10^{-1} inlbf = 0.1 inlbf

S-0-0086 Type of weighting - torque/force data

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The type of weighting is specified for percentage, translatory or rotary (torque) data, see fig. 3.7.

Parameter configuration:

X is assigned the 0 or 1 below it.
r = reserved

15 6 5 4 3 2 1 0

r r r r r r r r X X X X X X X

Bit 2-0: Type of weighting

X 0 0 0 0 0 0	Weighting in percent
X 0 X 0 0 0 1	Translatory weighting (force)
X 0 X 0 0 1 0	Rotary weighting (torque)

Bit 3: Preferred weighting

0

Bit 4: Unit of measure for force

0	Newton [N]
1	pound-force [lbf]

Bit 4: Unit of measure for torque

0	Newtonmeter [Nm]
1	inch pound-force

Bit 5: – Reserved –

0

Bit 6: Data reference

0	at the motor shaft
1	at the load

S-0-0093 Weighting factor of torque/force data

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Since the preferred weighting is permanently set in bit 3 of weighting type S-0-0086, this parameter is determined depending on the unit of measure (S-0-0086, bit 4) and cannot be overwritten.

$$1\ LSB = S\text{-}0\text{-}0093 \times 10^{Exponent}$$

S-0-0094 Weighting exponent of torque/force data

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter cannot be overwritten, see S-0-0093.

$$1\ LSB = factor \times 10^{S\text{-}0\text{-}0094}$$

3.4.4 Weighting - acceleration data

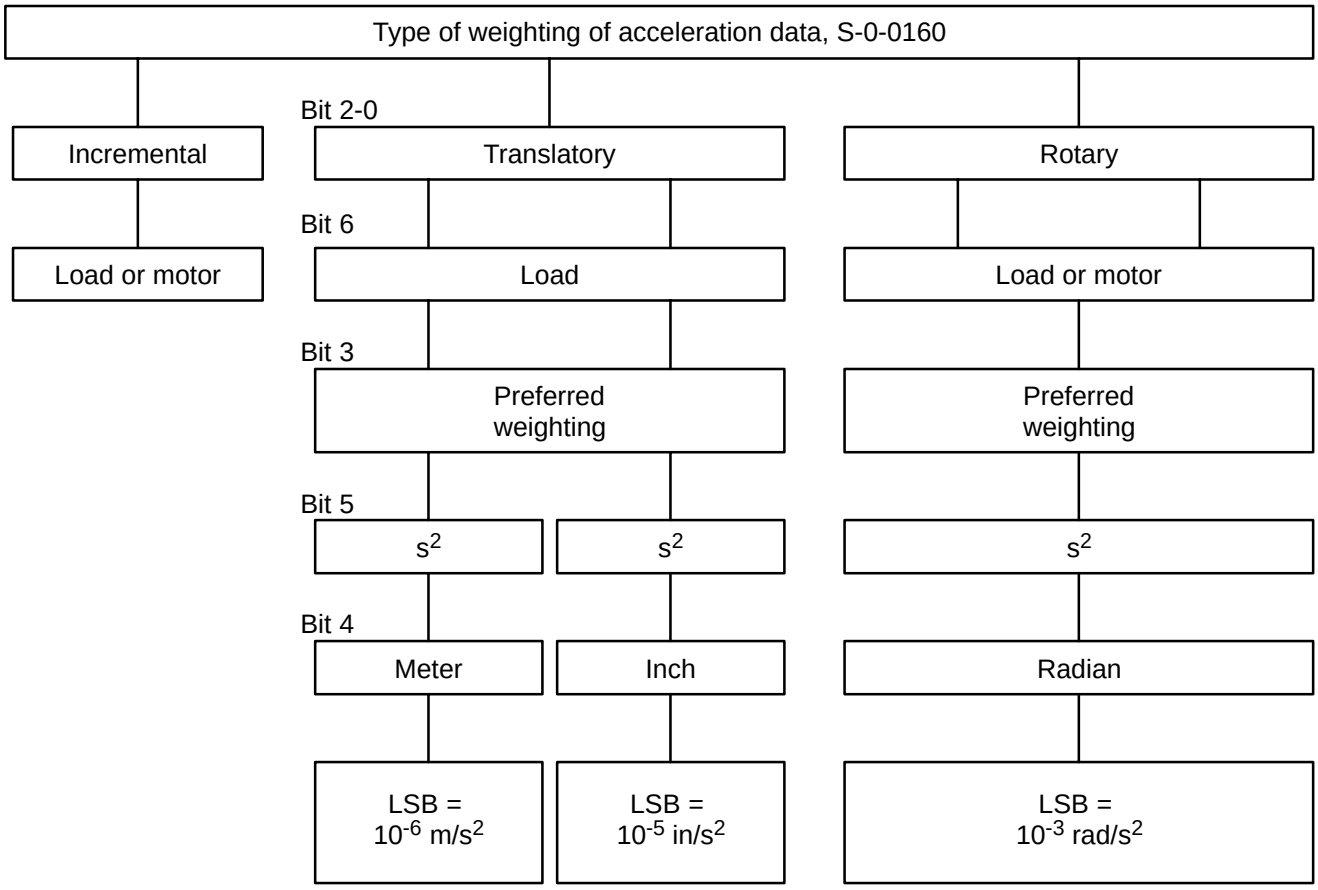


Fig. 3.8: Types of weighting of the acceleration data

Incremental weighting 1 LSB = 1 increment

Translatory weighting The following preferred weightings are specified:

1. Metric: 1 LSB = 1 x 10^{-6} m/s^2
2. Imperial: 1 LSB = 1 x 10^{-5} in/s^2

Rotary weighting The following preferred weighting is specified:

Radian: 1 LSB = 1 x 10^{-3} = 0.001 rad/s^2

S-0-0160 Type of weighting of acceleration data

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The type of weighting is specified for incremental, translatory or rotary acceleration data, see fig. 3.8.

Parameter configuration:

X is assigned the 0 or 1 below it.
r = reserved

15							6	5	4	3	2	1	0
r	r	r	r	r	r	r	r	X	X	X	X	X	X

Bit 2-0: Type of weighting

X	0	0	0	0	0	0	Incremental weighting
X	0	X	0	0	0	1	Translatory weighting
X	0	0	0	0	1	0	Rotary weighting

Bit 3: Preferred weighting

0

Bit 4: Translatory unit of measure

0	Meter [m]
1	Inch [in]

Bit 4: Rotary unit of measure

0	Radian [rad]
1	– Reserved –

Bit 5: Unit of time

0	Second [s]
1	– Reserved –

Bit 6: Data reference

0	at the motor shaft
1	at the load

S-0-0161 Weighting factor of acceleration data

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Since the preferred weighting is permanently set in bit 3 of weighting type S-0-0160, this parameter is determined depending on the unit of measure (S-0-0160, bit 4) and cannot be overwritten.

$$1\ LSB = S\text{-}0\text{-}0161 \times 10^{Exponent}$$

S-0-0162 Weighting exponent of acceleration data

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter cannot be overwritten, see S-0-0161.

$$1\ LSB = factor \times 10^{S\text{-}0\text{-}0162}$$

3.5 Encoder adaptation

❑ **Position interface**
In the SERCOS interface operating mode position interface, the type of position encoder is specified in the parameters for the operating mode (see section 3.3):

S-0-0032 to **S-0-0035** **Main/Secondary operating modes**
Bit 0-2: Position actual value 1 = motor encoder
Position actual value 2 = external encoder

❑ **Speed interface, servo mode**
In the operating mode speed interface, the type of position encoder for referencing is specified in the referencing parameter:

S-0-0147 **Referencing parameter**
Bit 3: Referencing with motor encoder
Referencing with external encoder

❑ **Speed interface, spindle orientation**
In the operating mode speed interface, the type of position encoder for spindle orientation is specified in the spindle positioning parameter:

S-0-0154 **Spindle positioning parameter**
Bit 3: Spindle orientation with motor encoder
Spindle orientation with external encoder

3.5.1 Motor encoder for servomotor

S-0-0116 **Motor encoder resolution** **(Drive → Master)**

–	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Divisions per revolution of the motor encoder

The data are read from the electronic rating plate of the motor and cannot be changed:

- ○ SF and DU motors with STG/MTG: 2 048 Divisions/Rev.
- ○ DU motors with gear encoder: 256 Divisions/Rev.

S-0-0256 Multiplication of motor encoder

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Factor by which the signals of the motor encoder can be multiplied in the drive. Divisions/Rev. x multiplication = impulses per motor revolution

Entry: 2 ... 512

Default setting: 4

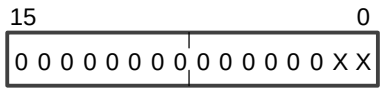
P-0-0006 Position encoder type – motor encoder (Drive → Master)

Phase 2	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The encoders integrated in the motor are single-turn absolute value encoders (STG) or multi-turn absolute value encoders (MTG). This parameter is used to specify the evaluation of the absolute value encoder:

- A multi-turn encoder can be declared an absolute value encoder for one **axis**.
  The axis then no longer requires referencing.
- A single-turn encoder can be declared an absolute value encoder for one **rotary axis**.
  The rotary axis then no longer requires referencing.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 no absolute value encoder
1 absolute value encoder

3.5.2 Spindle motor encoder

P-0-1026 Multiplication of spindle motor encoder

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Factor by which the signals of the spindle motor encoder can be multiplied in the drive.
Divisions/Rev. x Multiplication = Impulses per motor revolution

Entry: 2 ... 512

Default setting : 4

3.5.3 External encoder (option for direct measuring system)

S-0-0115 Type of position encoder **(Master → Drive)**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Adaptation to different external encoders

Parameter configuration:

15 4 3 2 1 0

r r r r r r r r r r X X X X X

X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Type of encoder

0 Rotary encoder (S-0-0117)
1 Linear encoder (S-0-0118)

Bit 1: Distance coded measuring system

0 No distance coded reference mark
1 Distance coded reference marks (S-0-0165)

Bit 2: Measuring system resolution

0 Metric:
1 Inch

Bit 3: Direction of movement

0 not inverted
1 inverted

Bit 4: Number of reference marks

0 One reference mark
1 Several reference marks

S-0-0117 Rotary encoder resolution (external encoder) **(Master → Drive)**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Number of divisions per encoder revolution.

Entry: $0 \ldots 2^{31}$
Weighting 1 division/Encoder revolution

S-0-0257 **Multiplication of external encoders** **(Master → Drive)**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Factor by which the signals of the external encoder can be multiplied in the drive. S-0-0117 * multiplication = impulses per encoder revolution

Entry: 1 ... 4

Default setting: 1

☞ **Note** **S-0-0257 affects the type of weighting of the position data S-0-0076.**

S-0-0118 **Linear encoder resolution** **(Master → Drive)**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Linear encoder resolution $\left[\frac{\text{divisions}}{\text{mm}}\right]$ or $\left[\frac{\text{divisions}}{\text{Inch}}\right]$ depending on S-0-0115, bit 2

Entry: $0 \ldots 2^{31}$

S-0-0165 **Distance coded reference dimension-1**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

For a measuring system with distance coded reference marks, the larger distance between two reference marks is programmed.

Entry: $0 \ldots 2^{31}$
Weighting in accordance with number of divisions of measuring system.

3.6 Feedrate constant

S-0-0123 **Feedrate constant** **(Master → Drive)**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The rotary motor movement is converted to a translatory movement via the feedrate constant. The translatory displacement from one spindle revolution is entered.

Example: Ball castor spindle with 10 mm spindle pitch:
Feedrate constant = 10.0000 mm/rev.
(Entry with 4 decimal places)

Default setting: 1 mm/revolution

3.7 Gearbox adaptation

The drive calculates the transmission ratio of a gearbox from:

$$\text{Transmisssion ratio} = \frac{\text{input revolutions}}{\text{output revolutions}}$$

☞ **Note** **If no gear box exists, parameters S-X-0121 and S-X-0122 must be set to “1”.**

S-X-0121 **Load gearbox input revolutions**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The input revolutions must be entered as integers.

Entry: $0 \ldots 2^{31}$
Weighting 1 Input revolution

Default setting: 1

S-X-0122 **Load gearbox output revolutions**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The output revolutions must be entered as integers.

Entry: $0 \ldots 2^{31}$
Weighting 1 Output revolution

Default setting: 1

4 Parameters for servo function

☞ **Note** **The initialisation of controller parameters and limit values described in chapter 4 takes place in the SERCOS interface phase 3.**

4.1 SERCOS interface operating modes

The drive is adapted to the application with the following parameters. All parameters are preset in the drive. They can be changed by the master, as long as the data are not unchangeably stored in the drive.

Different operating modes can be selected in the servo function for DM modules with SERCOS interface. The operating mode is specified in the parameters S-0-0032 to S-0-0035, in coordination with master and drive (see section 3.3).

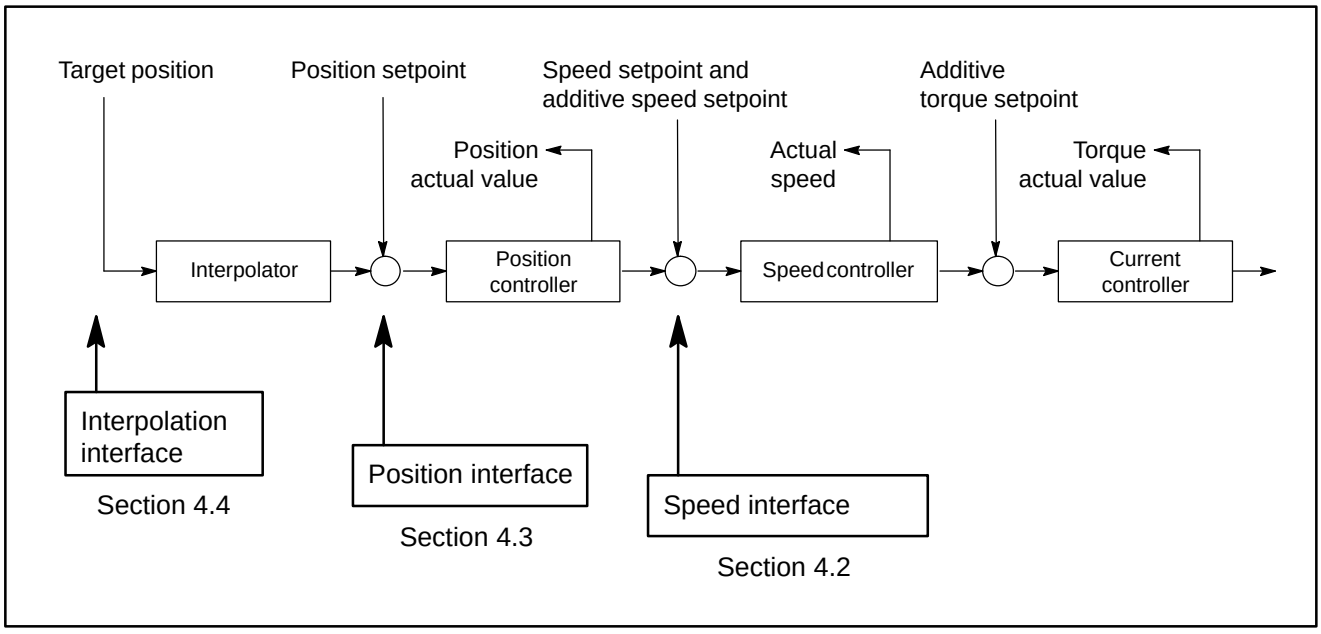


Fig. 4.1: SERCOS interface operating modes

4.2 Speed interface

The parameters described below refer to speed and current controllers for all operating modes of the servo function.

4.2.1 Setting the speed controller

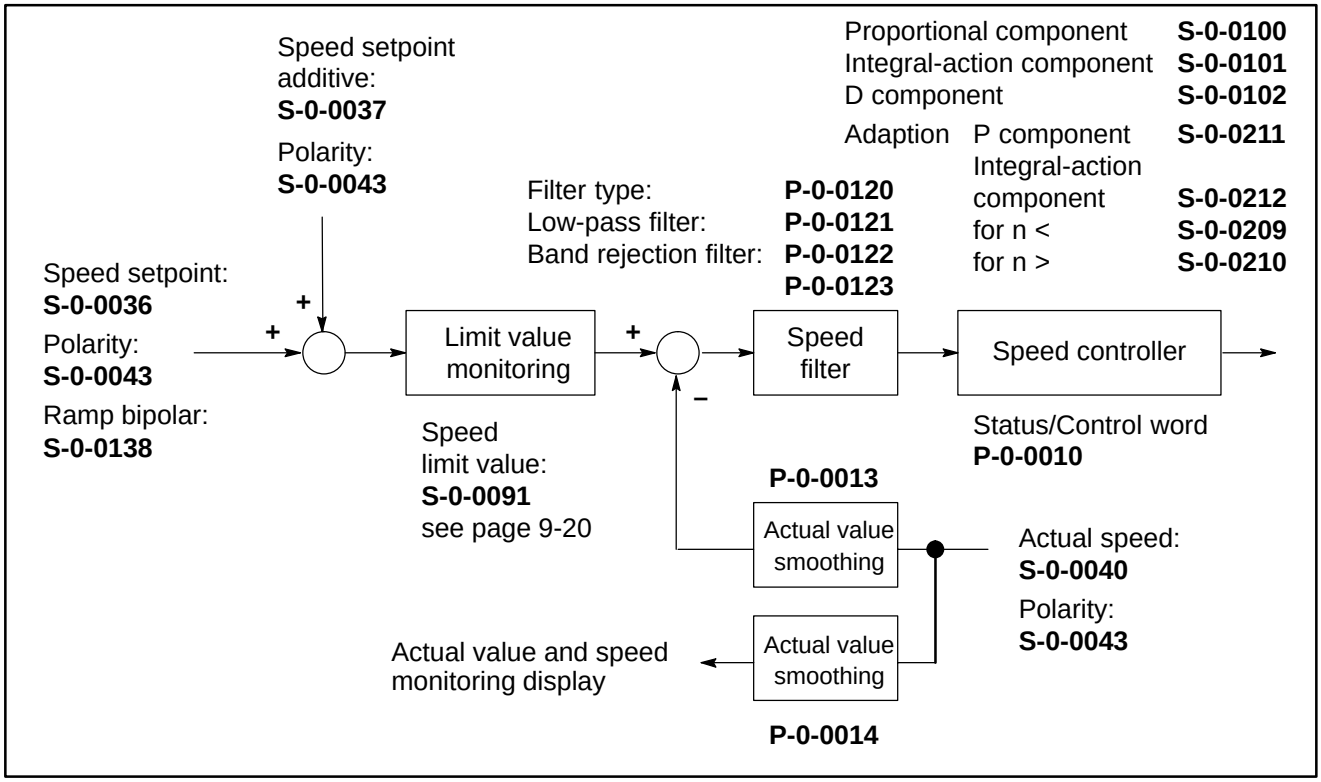


Fig. 4.2: Changeable parameters of the speed controller

S-0-0036 Speed setpoint

Phase 3,4	–	–	MDT	–	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Cyclically transferred setpoints in the speed control operating mode.

Entries: -2^{31} ... $+2^{31}$
For weighting, see section 3.4.2, S-0-0044.

S-0-0138 Acceleration bipolar

Phase 3,4	–	–	–	FEPROM	Accel.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Adjustable ramp for speed setpoint, valid for both directions of rotation.

Preferred translatory or rotary weighting, see section 3.4.4.

S-0-0037 Speed setpoint additive

Phase 3,4	–	–	MDT	–	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Cyclically transferred additional setpoint, added up in the drive to speed setpoint S-0-0036.

Entries: -2^{31} ... $+2^{31}$
For weighting, see section 3.4.2, S-0-0044.

S-0-0040 Actual speed

–	–	–	DT	–	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The speed actual value is additionally transferred to the master via this parameter. The polarity can be adjusted in S-0-0043.

For weighting, see section 3.4.2.

P-X-0013 Actual value smoothing interval of speed controller

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Defines whether the drive should calculate a mean value from the arriving actual values **for internal further processing**. A maximum of 16 cycles can be taken into account. The entry of "1" turns mean value calculation off.

Entries: 1 ... 16

P-0-0014 Actual value smoothing interval monitoring

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Influences the speed actual values for the following monitoring purposes and without influencing the servo loop:

- for all evaluations in connection with the actual speed:
  $n_{act} = n_{set}$, $n_{act} = 0$ and $n_{act} < nx$ (see section 9.2.5)
- for actual value displays

By making appropriate entries, mean value calculation as well as a first order filter can be activated.

Entries:
- > 1: Mean value calculation for 16 cycles (fixed)
- 1: no influence on actual values
- < 1: First order filter with a time constant according to entry with the following formula:

$$\frac{1}{(\text{entry})} * 250 \quad \text{in } [\mu s]$$

S-0-0043 Speed polarities

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The polarities of the speed setpoint and speed actual value within the controlled system remain unchanged, they can only be adjusted at the input and output.
With a positive polarity and a positive speed setpoint, a clockwise rotation from the point of view of the motor shaft is specified.

Parameter configuration:

X is assigned the 0 or 1 below it.
r = reserved

15												2	1	0
r	r	r	r	r	r	r	r	r	r	r	r	X	X	X

Bit 0: Speed setpoint
0 Positive polarity
1 Negative polarity

Bit 1: Speed setpoint additive
0 Positive polarity
1 Negative polarity

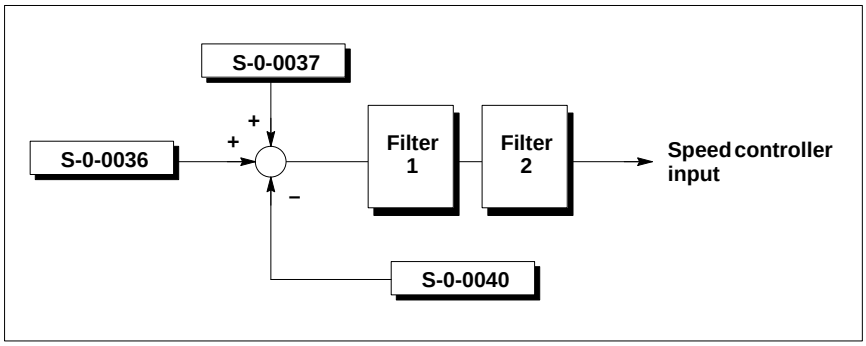
Bit 2: Actual speed
0 Positive polarity
1 Negative polarity

P-0-0120 Speed filter: selection of filter type

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The drive has 2 2nd order digital filters connected in series which are inserted directly upstream the speed controller.
Each of the 2 filters can be parameterised as a low pass filter or as a band rejection filter. Furthermore, every filter can be completely switched off.

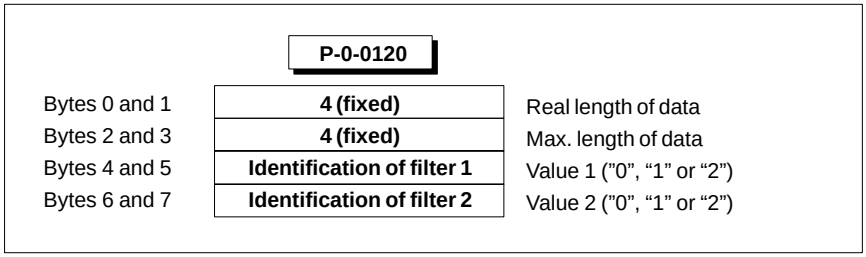
Thus, the speed controller of the drive can be optimised precisely to the requirements of your respective application.



With P-0-0120 you can define the type of every individual filter. For this purpose, you may use the following identifications:

”0”: filter off
”1”: low pass filter
”2”: band rejection filter

The structure of P-0-0120 is shown in the following figure:



P-0-0121 Speed filter: Limit frequency of low pass filter

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

For the filters configured as low pass filters in P-0-0120, the limit frequency is entered in Hz in P-0-0121. As a result, the signal range above the specified frequency will be attenuated with –20 dB per decade.
Any value entered will be used only if the corresponding filter was configured as low pass filter.

P-0-0121

Bytes 0 and 1	**4 (fixed)**	Real length of data
Bytes 2 and 3	**4 (fixed)**	Max. length of data
Bytes 4 and 5	**Limit frequency of filter 1**	
Bytes 6 and 7	**Limit frequency of filter 2**	

P-0-0122 Speed filter: Quality of band rejection filter

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

For the filters configured as band rejection filters in P-0-0120, the quality is entered in P-0-0122 and the center frequency is entered in Hz in P-0-0123. As a result, the signal range will be reduced by more than –40 dB at the specified frequency.
The quality determines the slope of the filter edge. The higher the quality, the narrower is the band of the suppressed frequency range.

Any value entered in P-0-0122 and P-0-0123 will be used only if the corresponding filter was configured as a band rejection filter in P-0-0120.

P-0-0122		**P-0-0123**
4 (fixed)	Bytes 0 and 1	**4 (fixed)**
4 (fixed)	Bytes 2 and 3	**4 (fixed)**
Quality of filter 1	Bytes 4 and 5	**Center frequency of filter 1**
Quality of filter 2	Bytes 6 and 7	**Center frequency of filter 2**

P-0-0123 Speed filter: Center frequency of band rejection filter

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

See P-0-0122.

S-X-0100 P-component of speed controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In the case of many applications, the default setting of the P-component is adequate. If an adaptation is necessary, the P-component is adjusted to the transient response of the speed actual value (see fig. 4.3).

Entries: 0 ... 400.0

S-X-0101 Integral-action component, speed controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In the case of many applications, the default setting of the integral action component is adequate. If an adaptation is necessary, the integral-action component is adjusted to the transient response of the speed actual value (see fig. 4.3).

Entries: 10 ... 2^{15} ms
The correction time is switched off by entering the maximum value 2^{15}.

S-0-0102 D-component, speed controller

Phase 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In the case of many applications, the default setting of the D-component is adequate. If an adaptation is necessary, the D-component is adjusted to the transient response of the speed actual value (see fig. 4.3).

Entries: 0 ... 1.0 ms

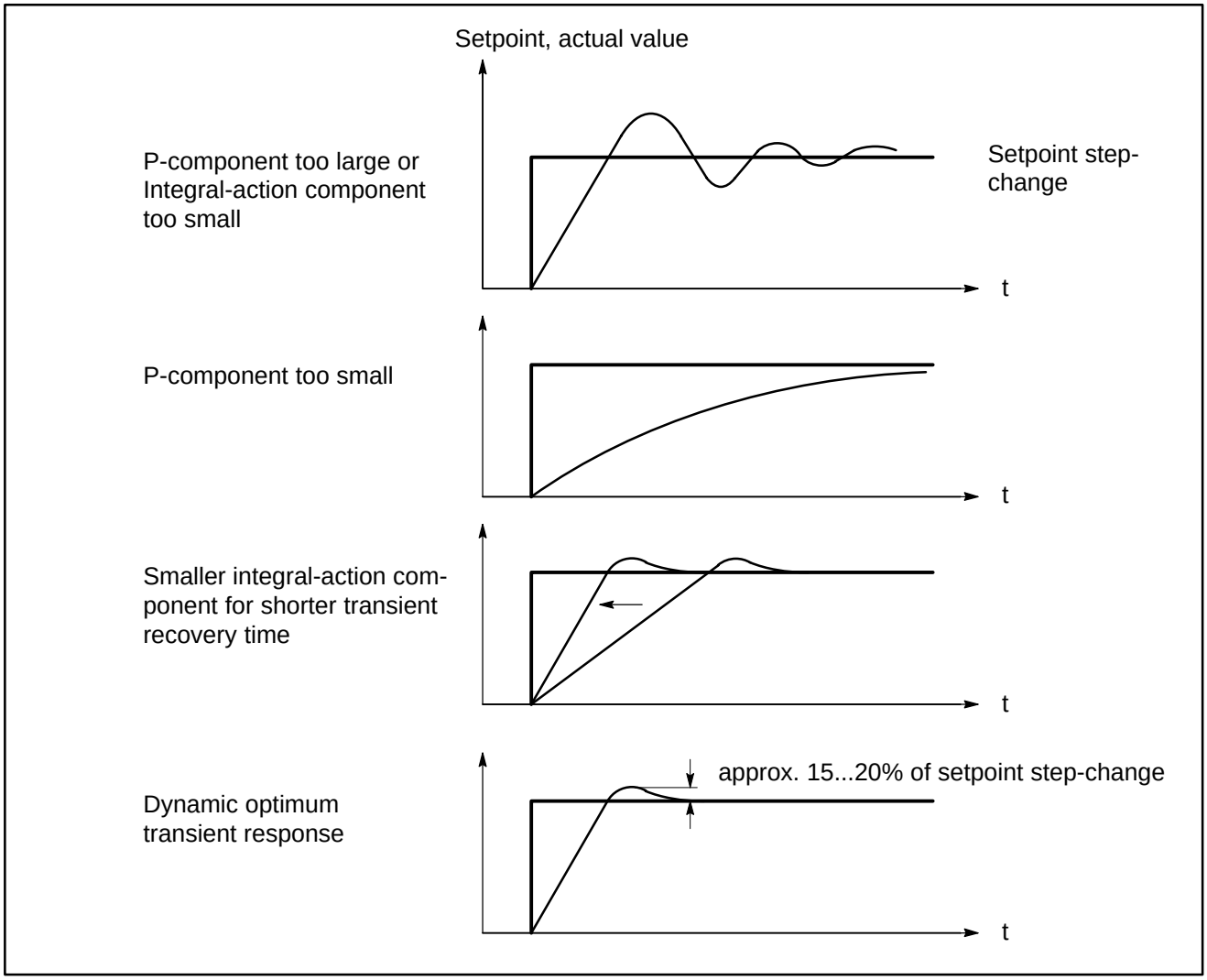


Fig. 4.3: Speed controller adjustment

Adaption of the speed controller

For the P-component and the integral-action component of the speed controller, a linear increase/decrease proportional to the speed can be specified in a programmable speed range. The programmable speed range is determined by the lower and upper adaption limit.

S-X-0209 Lower adaption limit, speed controller

Phase 3, 4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Below: P-component ≡ adapted value (S-0-0211)
Integral-action component ≡ adapted value (S-0-0212)

Above: The P-component and integral-action component change linearly with the speed, until they reach the preset value at the upper limit.

Entries: 0 ... $+2^{31}-1$

S-X-0210 Upper adaption limit, speed controller

Phase 3, 4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Below: Starting at the adapted value, the P-component and integral-action component change linearly with the speed.

Above: P-component ≡ preset value (S-0-0100)
Integral-action component ≡ preset value (S-0-0101)

Entries: 0 ... $+2^{31}-1$

S-X-0211 Adaption of P-component, speed controller

Phase 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Percentual change of preset P-component.
The change is effective below the lower adaption limit, levels out between lower and upper adaption limits and has no effect above the upper adaption limit.

Entries: 10 ... 5000.0
Weighting 0.1 %

Example:

Preset P-component	(S-X-0100):	50
Lower adaption limit	(S-X-0209):	3 rpm
Upper adaption limit	(S-X-0210):	8 rpm
Adapted P-component	(S-X-0211):	150 %

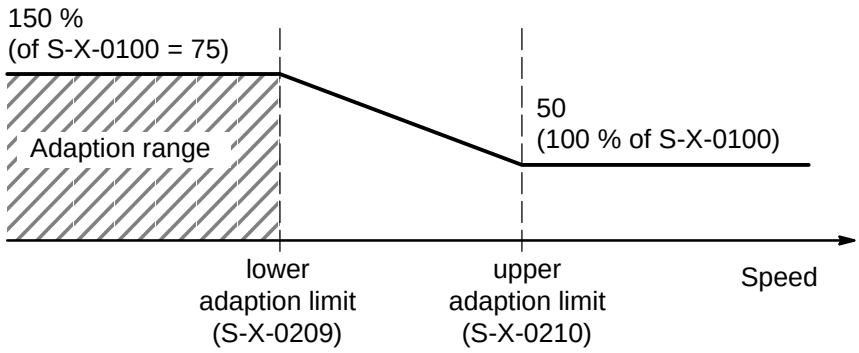


Fig. 4.4: Adaption of the speed controller

S-X-0212 Adaption of integral-action component, speed controller

Phase 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Percent change of preset integral-action component (S-0-0101).
The change is effective below the lower adaption limit, levels out between lower and upper adaption limits and has no effect above the upper adaption limit.
The same adaption limits are effective as for the P-component.

Entries: 10 ... 5000.0
Weighting 0.1 %

P-0-0010 Speed controller control/status word

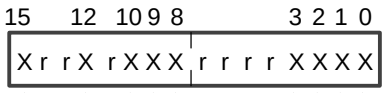
Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The control signals and the corresponding status signals of the drive are combined in this parameter.

❑ **Control word:**
The fine interpolation of the setpoints for the current and speed controllers can be switched off. This can be advantageous for optimising the drive.
Furthermore, the standard stalling monitoring function (plausibility check of n-controller) can be switched off if necessary in special cases.

❑ **Status word:**
The status word contains various confirmations of the drive.
They are output by the drive when the drive is switched off with the error message ”Plausibility error of speed controller” (S-0-0129 bit 0, display ”F96”).
The status bits of P-0-0010 set in this case provide for more detailed diagnostics of the error message.

Parameter configuration



X is assigned the 0 or 1 below it
r = reserved

Bit 0: Current fine interpolation
0 no interpolation
1 linear fine interpolation (factory setting)

Bit 1: Speed fine interpolation
0 no interpolation
1 linear fine interpolation (factory setting)

Bit 2: Acceleration monitoring
0 stalling errors are not detected
1 stalling monitoring (factory setting)

Bit 3: DAC output (only for developer)
0 special signals on OM4
1 DAC signals on OM4 (factory/operation setting)

Bit 8: Current not reached
$I < 80\ \%\ I_{set}$ after M_{limit} has been active for 5 ms

Bit 9: Acceleration too low
$A < 50\ rad/s^2$, after M_{limit} has been active for 20 ms

Bit 10: Inverted acceleration
acceleration in wrong direction after M_{limit} has been active for 5 ms

Bit 12: Controller limit of n-controller
0 negative controller limit reached
1 positive controller limit reached

Bit 15: Synchronisation
synchronisation error between speed and position controller

4.2.2 Setting current controller

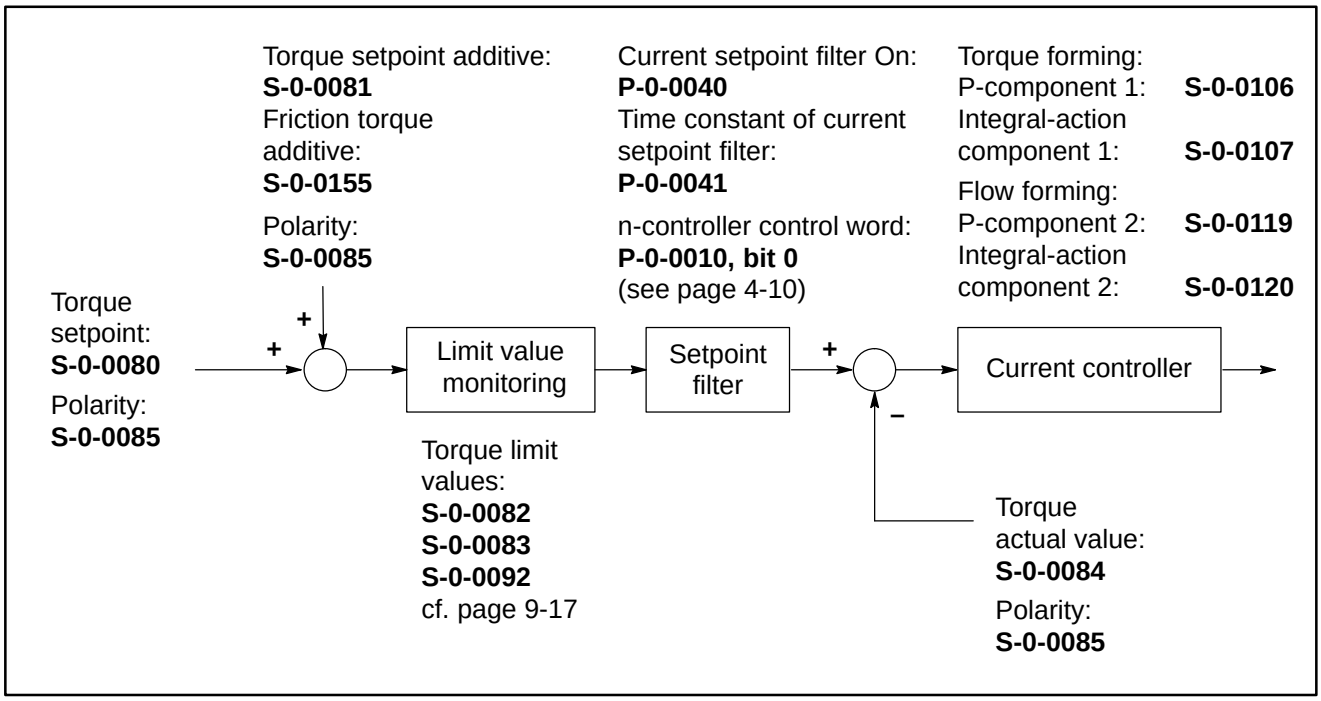


Fig. 4.5: Changeable parameters of the current controller

S-0-0080 Torque setpoint

–	–	–	DT	–	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The torque setpoint is additionallly transferred to the master via this parameter. The polarity can be adjusted in S-0-0085.

For weighting, see section 3.4.3.

S-0-0081 Torque setpoint additive

Phase 3,4	–	–	MDT	–	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Cyclically transferred additional setpoint, added up in the drive to torque setpoint S-0-0080.

Entries: -2^{15} ... $+2^{15}-1$
For weighting, see section 3.4.3, S-0-0086.

S-0-0084 Torque actual value

–	–	–	DT	–	Torque	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The torque actual value is additionallly transferred to the master via this parameter. The polarity can be adjusted in S-0-0085.

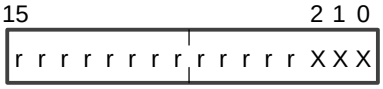
For weighting, see section 3.4.3.

S-0-0085 Torque polarities

Phase 2	–	–		FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The polarities of torque setpoints and torque actual value within the controlled system remain unchanged, they can only be adjusted at the input and output.
With a positive polarity and a positive torque setpoint, a clockwise rotation from the point of view of the motor shaft is specified.

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Torque setpoint
0 Positive polarity
1 Negative polarity

Bit 1: Torque setpoint additive
0 Positive polarity
1 Negative polarity

Bit 2: Torque actual value
0 Positive polarity
1 Negative polarity

The parameters for the current controller are subdivided into:

- ❑ Group 1: Torque-forming current
- ❑ Group 2: Field current (flow-forming current)

S-0-0106 P-component 1, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The P-component 1 affects the torque-forming current. In the case of most applications, the default setting can remain unchanged.

Entries: 0 ... 200.00

S-0-0107 Integral-action component 1, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The integral-action component 1 affects the torque-forming current. In the case of most applications, the default setting can remain unchanged.

Entries: 70 ... 6500 µs

S-0-0119 P-component 2, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The P-component 2 affects the field current. In the case of most applications, the default setting can remain unchanged.

Entries: 0 ... 200.00

S-0-0120 Integral-action component 2, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The integral-action component 2 affects the field current. In the case of most applications, the default setting can remain unchanged.

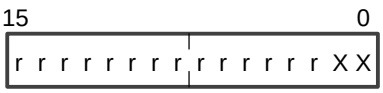
Entries: 70 ... 6500 µs

P-0-0040 Current setpoint filter ON

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter activates a first-order current setpoint filter instead of the standard linear fine interpolation of the current setpoints.
Thus, the P component of the current controller (S-0-0106) can be increased to further improve the controller properties.
The filter time constant can be changed in parameter P-0-0041.

Parameter configuration



X is assigned the 0 or 1 below it
r = reserved

0 linear fine interpolation
1 1st order filter

☞ **Note** **The standard linear fine interpolation can be switched off with bit 0 of P-0-0010.**

P-0-0041 Time constant of current setpoint

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Defines the time constant of the current setpoint filter.

Entries: 0 ... 3000 [µs]

4.2.3 Error correction

S-X-0155 Friction torque compensation

Phase 3, 4	–	–	–	FEPROM	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter is used to compensate for the static friction for acceleration from standstill and for reversing the direction of rotation.
The compensation value must receive the same sign as the torque setpoint and is additively superimposed to it.

Weighting and preferred weighting in accordance with section 3.4.3.

4.3 Position interface

The parameters described below refer to the position controller. They must also be adjusted in the position interface operating mode.

4.3.1 Setting the position controller

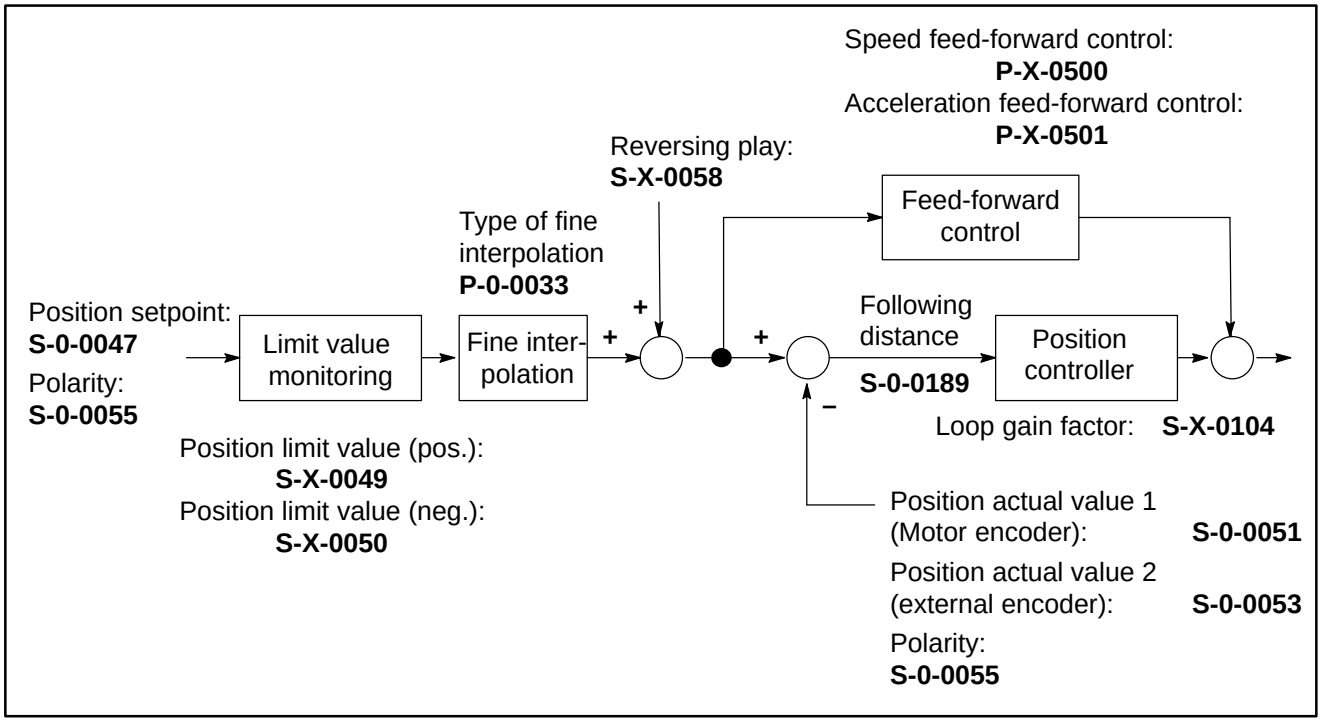


Fig. 4.6: Changeable parameters of the position controller

S-0-0047 Position setpoint

Phase 3,4	–	–	MDT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Cyclically transferred setpoints in the position control operating mode.

Entries: -2^{31} ... $+2^{31}$ -1
For weighting, see section 3.4.1, S-0-0076.

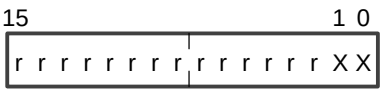
P-0-0033 Type of fine interpolation

Phase 2,3	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter determines the fine interpolation in the drive between receipt of two position setpoints:

- With **contour-optimised** fine interpolation, the contour defined by the setpoints is adhered to as precisely as possible.
- With **jerk-optimised** fine interpolation, the specified position changes are performed as smoothly as possible.

Parameter configuration



X is assigned the 0 or 1 below it
r = reserved

0 1	Contour-optimised fine interpolation
1 0	Jerk-optimised fine interpolation

S-0-0051 Position actual value 1 (motor encoder)

–	–	–	DT	–	Motor position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The position actual value of the motor encoder is additionallly transferred to the master via this parameter. The polarity can be adjusted in S-0-0055.

For weighting, see section 3.4.1.

S-0-0053 Position actual value 2 (external encoder)

–	–	–	DT	–	Ext. position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The position actual value of an external encoder is additionallly transferred to the master via this parameter. The polarity can be adjusted in S-0-0055.

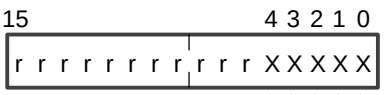
For weighting, see section 3.4.1.

S-0-0055 Position polarities

Phase 2,3 (bit 4 in phase 4)	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter determines the polarity at the interface when reading position actual values and position setpoints. The encoder polarity remains unchanged.
In addition, the position limit value is activated:

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Position setpoint
0 Positive polarity
1 Negative polarity

Bit 1: Position setpoint additive
0 Positive polarity
1 Negative polarity

Bit 2: Position actual value 1
0 Positive polarity
1 Negative polarity

Bit 3: Position actual value 2
0 Positive polarity
1 Negative polarity

Bit 4: Position limit value
0 not active
1 active

S-0-0189 Following distance

–	–	–	DT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the current following distance, i.e. the difference between the position setpoint and the position actual value:

S-0-0189 = S-0-0047 – S-0-0051 (or S-00053)

For weighting, see section 3.4.1 .

S-X-0104 Loop gain factor of position controller

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This factor specifies the loop gain of the position control circuit over the entire speed range.

Entries: 0 ... 655.35
Weighting 0.01 (m/min)/mm

4.3.2 Feed-forward control

Through the feed-forward control of feedrate and acceleration, the position control operating mode is achieved without following errors.

P-X-0500 Feedrate feed-forward control

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The feedrate feed-forward control is used to reduce the following error between position setpoint and actual value in stationary mode.
100 % ≙ Following distance “0”

Entries: 0 ... 110 %

P-X-0501 Acceleration feed-forward control

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The acceleration feed-forward control is used to reduce the following error when accelerating or braking.
100 % ≙ Following distance “0”, the value to be set should be determined via the following error display of the diagnostics programme DSS-D.

Entries: 0 ...500

4.3.3 Position controller monitoring

S-X-0049 Position limit value positive

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Maximum path in positive direction. The limit value is active only if it has been activated in the position polarity parameter (S-0-0055) **and** all position data refer to the reference point.
If the limit value is exceeded, the drive sets an error message in the diagnostics class 1.

Weighting and preferred weighting in accordance with section 3.4.1.

S-X-0050 Position limit value negative

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Maximum path in negative direction. The limit value is active only if it has been activated in the position polarity parameter (S-0-0055) **and** all position data refer to the reference point.
If the limit value is exceeded, the drive sets an error message in diagnostics class 1.

Weighting and preferred weighting in accordance with section 3.4.1.

S-X-0057 Positioning window

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The positioning window is used to determine the maximum permissible following error, for which the drive outputs the message “In-Position” (S-0-0336, see section 9.2.9). The message takes place if the amount of the difference between the position setpoint and the position actual value (= following error) is smaller than the positioning window.
The message “In-Position” can be assigned to a real-time status bit in the drive status word and transferred to the NC for further processing, depending on the operating mode.

Weighting and preferred weighting in accordance with section 3.4.1.

S-X-0261 Positioning window rough

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “positioning window rough” is used to determine the maximum permissible following error, for which the drive outputs the message “In-Position rough” (S-0-0341, see section 9.2.9). The message takes place if the amount of the difference between the position setpoint and the position actual value (= following error) is smaller than the “positioning window rough”.

The message “In-Position rough” can be assigned to a real-time status bit in the drive status word and transferred to the NC for further processing, depending on the operating mode.

Weighting and preferred weighting in accordance with section 3.4.1.

S-0-0159 Monitoring window

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Monitoring of speed setpoint by evaluating the deviation between the position actual value and the position setpoint. When the monitoring window (% of maximum speed) is exceeded, the drive sets the error message ’excessive controller deviation’ in diagnostics class 1 (see page 9-3).
100 % ≙ maximum speed in acc. with S-0-0091

Entries: 0 ... 500 %

Default setting: 120 %

S-X-0103 Modulo value

Phase 3	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The modulo value specifies the position from which a modulo calculation must be performed, if the position weighting was set to modulo format.

Weighting and preferred weighting in accordance with section 3.4.1.

S-0-0060 – S-0-0067 Position switching points

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

If the position actual value reaches or exceeds the respective preset position switching point, the corresponding bit is set in the position switching point parameter (S-0-0059).

S-0-0060	Position switching point 1
S-0-0061	Position switching point 2
S-0-0062	Position switching point 3
S-0-0063	Position switching point 4
S-0-0064	Position switching point 5
S-0-0065	Position switching point 6
S-0-0066	Position switching point 7
S-0-0067	Position switching point 8

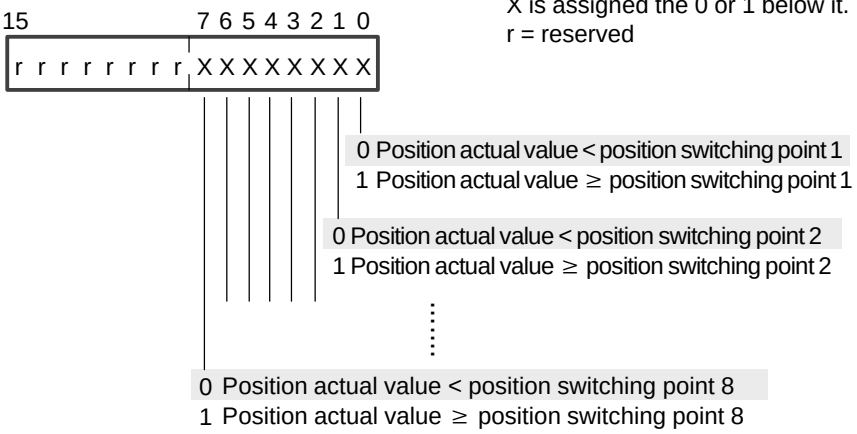
Weighting and preferred weighting in accordance with section 3.4.1.

S-0-0059 Position switching point parameter

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Status of the position switching points:

Parameter configuration:



4.4 Interpolation interface

The parameters described below refer to interpolation. They must also be adjusted in the interpolation interface operating mode.

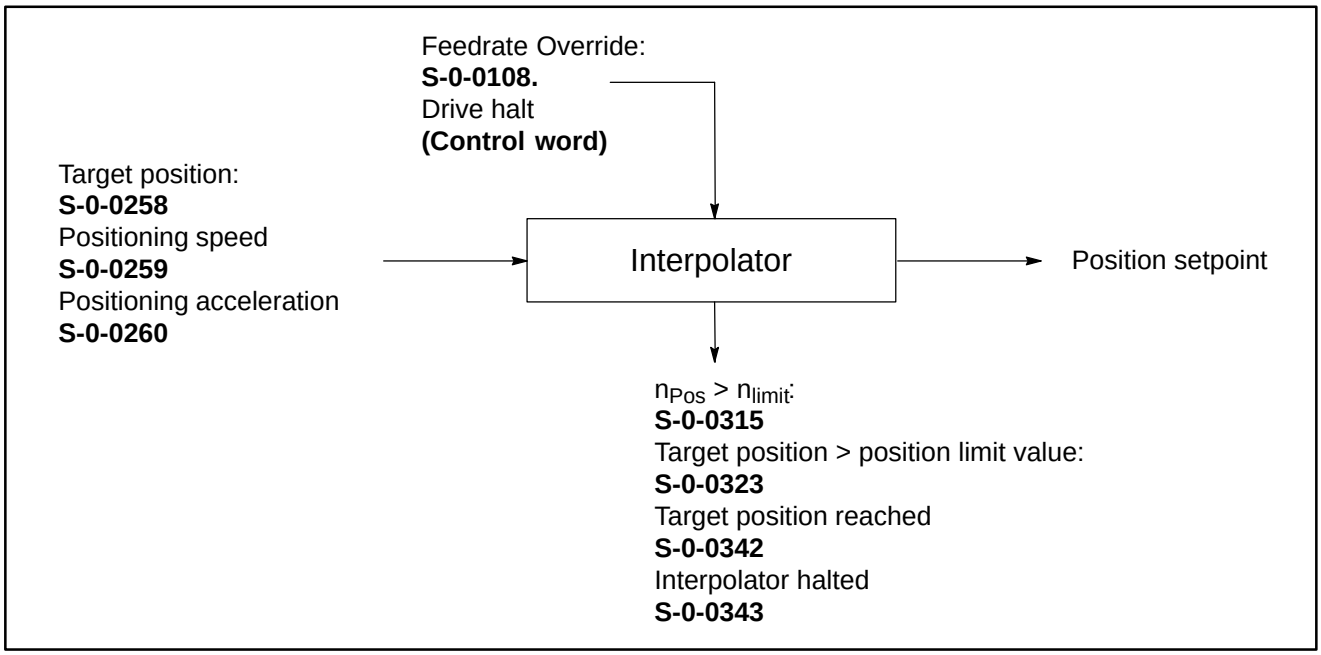


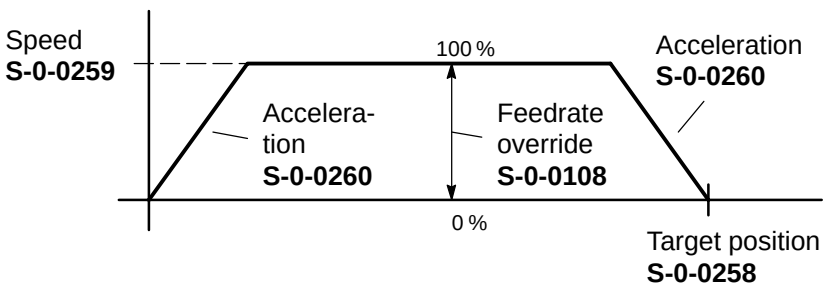
Fig. 4.7: Changeable parameters of the drive interpolator

S-0-0258 Target position

Phase 3,4	–	–	MDT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The target position is the position setpoint for the drive.
The drive approaches the target position, taking into account the positioning speed S-0-0259 and the positioning acceleration S-0-0260.

Entries: -2^{31} ... $+2^{31}-1$
Weighting and preferred weighting in accordance with section 3.4.1.



S-X-0259 Positioning speed

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The target position is approached at the positioning speed.

Entries: 0 ... 90% n_{max}
Weighting and preferred weighting in accordance with section 3.4.2.

S-X-0260 Positioning acceleration

Phase 3,4	–	–	–	FEPROM	Accel.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The positioning acceleration causes acceleration to the positioning speed.

Weighting and preferred weighting in accordance with section 3.4.4.

S-0-0108 Feedrate Override

Phase 3,4	–	–	MDT	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Effective only for drive-controlled traverse commands.
The feedrate override has a multiplying effect on the speed setpoints calculated by the drive.

Entries: 0.01 ... 635.35 %

4.4.1 Interpolator monitoring

S-0-0315 Positioning speed > n_{limit}

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

A warning message in diagnostics class 2 is set if the positioning speed (S-0-0259, see above) exceeds the speed limit value (S-0-0091, see page 9-20).

S-0-0323 Target position outside the position limit values

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

A warning message in diagnostics class 2 is set if the target position (S-0-0258, see above) exceeds one of the position limit values (S-0-0049, 00050, see page 4-20).

4.5 Referencing

4.5.1 Configuration

In order to make the axis positions known to the master, the axes must be referenced. The reference point may be specified with a reference point switch or with the absolute position of an absolute encoder.

S-0-0147 Referencing parameter

Phase 2,3	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

For drive-controlled referencing, only bits 0, 1, 2, 3, 5 and 6 are active. For NC-controlled referencing, only bits 1, 3 and 4 are active.

Parameter configuration:

X is assigned the 0 or 1 below it.
r = reserved

15							7	6	5	4	3	2	1	0
r	r	r	r	r	r	r	X	X	X	X	X	X	X	X

Bit 0: Referencing direction

0 positive (clockwise rotation from the point of view of the shaft)
1 negative (counterclockwise rotation)

Bit 1: Position encoder reference mark

0 first zero mark after positive edge of the reference point switch
1 first zero mark after negative edge of the reference point switch

Bit 2: Reference point switch

0 connected to NC
1 connected to drive

Bit 3: Referencing

0 with motor encoder
1 with external encoder

Bit 4: Evaluation in the drive

0 Reference point switch and reference enable
1 reference enable only

Bit 5: Evaluation of reference point switch

0 is evaluated
1 is not evaluated

Bit 6: Evaluation of position encoder reference mark

0 is evaluated
1 is not evaluated

Bit 7: Position after drive-controlled referencing

0 drive in any position
1 drive on reference point

An encoder selected in the operating mode is used for referencing. If no encoder is specified, bit 3 in the referencing parameter applies.

Referencing with motor encoder

S-X-0052 Reference dimension, position actual value 1

Phase 3	–	–	–	FEPROM	Motor position encoder	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance between machine zero point and reference point of the motor measuring system.

Weighting and preferred weighting in accordance with section 3.4.1.

S-X-0150 Reference dimension, offset 1

Phase 3	–	–	–	FEPROM	Motor position encoder	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance between position encoder reference mark 1 of the motor encoder and the position actual value 1 reference dimension.

Weighting and preferred weighting in accordance with section 3.4.1.

P-0-0504 Cam position status

Phase 4	–	–	–	FEPROM	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The position distance between the reference point switch and the encoder mark is stored in this parameter:

0 : Init

1 : critical range (< ¼ rotation)

2 : critical range (> ¾ rotation)

3 : uncritical range

Procedure:

- For initial start-up, set value to “0”
- After the first referencing, **store** the value in the drive with the command “Save working memory” (S-0-0264).
- Do not change the value any more, except when starting up again after a change in the cam position.

Exception: Motor with absolute encoder

If the encoder integrated in the motor is to be evaluated as an absolute encoder, P-0-0006 must be set to “1”.
Referencing is then no longer necessary. The drive calculates its position from the encoder position and the absolute dimension offset 1 (S-0-0177) and is referenced immediately after start.

The encoder signals of multi-turn absolute encoders of rotary axes must not overflow.
In order to transmit the absolute position, it is subdivided into:

- the absolute value within one revolution, and
- the absolute dimension-revolution offset 1.

P-0-0031 Absolute dimension-revolution offset 1

Phase 3,4	Phase 3	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance between the machine zero in terms of an absolute number of revolutions, in the case of rotary axes with a multi-turn absolute encoder.

P-0-0032 Command ”Determine offset in revolution”

Phase 3,4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

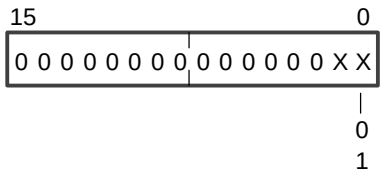
Command for output of the absolute dimension-revolution offset 1 (P-0-0031) in case of rotary axes with a multi-turn absolute encoder.

P-0-0006 Position encoder type – motor encoder

Phase 2	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

see also page 3-29.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 no absolute encoder
1 absolute encoder

S-0-0177 Absolute dimension, offset 1

Phase 3, 4	–	–	–	FEPROM	Motor position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance from machine zero point to zero point of the motor encoder with absolute measurement.

Weighting and preferred weighting in accordance with section 3.4.1.

Referencing with external encoder

S-X-0054 Reference dimension, position actual value 2

Phase 3	–	–	–	FEPROM	External position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance between machine zero point and reference point of the external measuring system.

Weighting and preferred weighting in accordance with section 3.4.1.

S-X-0151 Reference dimension, offset 2

Phase 3	–	–	–	FEPROM	External position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance between position encoder reference mark 2 of the external encoder and the reference dimension position actual value 2.

Weighting and preferred weighting in accordance with section 3.4.1 .

Exception: Distance coded measuring system

S-0-0178 Absolute dimension, offset 2

Phase 3, 4	–	–	–	FEPROM	External position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance from machine zero point to zero point of the external encoder with absolute measurement.

Weighting and preferred weighting in accordance with section 3.4.1.

4.5.2 NC-controlled referencing

NC-controlled referencing, during which the master generates the traverse movement to search for the marker, consists of three partial commands:

- Search for relevant marker position
- Calculate shift to referenced actual value system
- Shifting to reference system

The **reference point switch** should be connected to the drive, since a better dead time is thus achieved. The master can read the parameter reference point switch S-0-0400 for checking.

If the reference point switch is connected to the master, it must be reported to the drive in the reference enable S-0-0407. In this case, the drive may only evaluate the reference enable (S-0-0147, Bit 4 = 1, see page 4-25).

Search for marker position

S-0-0146 Command “NC-controlled referencing”

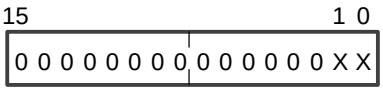
Phase 4	–	–	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The command starts the search for the marker in the drive. When the marker is reached, the position actual value is stored in the marker position A (S-0-0173) and the bit “Reference marker detected” (S-0-0408) is set. This applies for all encoder types with markers, including gear encoders as motor encoders.
The absolute encoders integrated in the SF motors have no markers, however, they generate a reference mark when they traverse the reference point switch. The next time the reference mark is detected, the absolute position is evaluated and the marker position A is determined. In order to be able to use the critical range around the zero point of the absolute value for referencing as well, the position of the reference point switch is stored in the parameter cam position status (P-0-0504).
The cam position status must be stored after first referencing with the command “Save working memory” (S-0-0264). When restarting with a change in the cam position, the cam position status must be reset to “0” and saved.

With a distance coded measuring system, a second marker is sought and stored in the marker position B (S-0-0174).

If the reference point lies within one revolution, e.g. for a rotary axis, the reference point can be detected without a cam. This is set in the referencing parameter S-0-0147 with bit 5 = 1.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

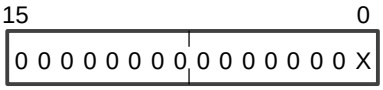
0 Interrupt execution of command
1 Enable execution of command

S-0-0400 Reference point switch

Phase 2, 3, 4	–	M → D	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The external signal of the reference point switch can be assigned to a real-time status bit via this ident. no. (S-0-0305).
For NC-controlled referencing, the reference point switch only applies if the reference enable S-0-0407 is available.

Parameter configuration:



X is assigned the 0 or 1 below it.

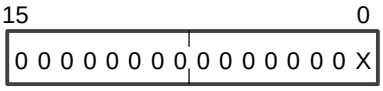
0 Switch not actuated
1 Switch actuated

S-0-0407 Reference enable

Phase 3,4	–	M → D	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The reference enable can be assigned to a real-time status bit (S-0-0305) via this ident. no.
The drive only evaluates the reference enable if the command “NC-controlled referencing” is active.

Parameter configuration:



X is assigned the 0 or 1 below it.

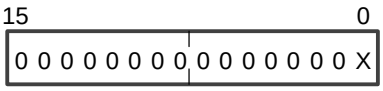
0 Enable not available
1 Enable is available

S-0-0408 Reference mark located

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “reference mark located” message can be assigned to a real-time status bit via this ident. no. (S-0-0305).
The drive only sets this parameter for NC-controlled referencing, if reference enable S-0-0407 is available and the marker has been reached. At the same time, the drive saves the current, unreferenced position actual value in the corresponding marker position S-0-0173 or S-0-0174.
Drive-controlled referencing does not set this parameter.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Reference mark not detected
1 Reference mark detected

S-0-0173 Marker position A

–	–	–	–	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

If the drive identifies the encoder marker during referencing, it saves the current, unreferenced position actual value in marker position A.

Weighting and preferred weighting in accordance with section 3.4.1.

S-0-0174 Marker position B

–	–	–	–	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With a distance coded measuring system, a second marker is sought and stored in marker position B (S-0-0174).
Marker position B is also required in order to be able to calculate the absolute positon relative to the zero point of the measuring system.

Weighting and preferred weighting in accordance with section 3.4.1.

Calculation of shift

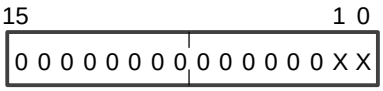
S-0-0171 Command “Calculate shift”

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

By setting and enabling this command, the drive calculates the shift between the old and new (referenced) setpoint/actual value system, from the parameters:

- Reference dimension, position actual value
- Reference dimension, offset
- Marker position

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

The encoder for which the shift is to be calculated is selected in the referencing parameter S-0-0147, Bit 3.

The following parameters apply, depending on the encoder system:

	Motor encoder	External encoder	Distance coded measuring system
Reference dimension, position actual value 1/2	S-0-0052	S-0-0054	–
Reference dimension, offset 1/2	S-0-0150	S-0-0151	–
Absolute dimension offset 1/2	(S-0-0177 for absolute encoder)	–	S-0-0178
Shift parameters	S-0-0175	S-0-0176	S-0-0176
Marker position A/B	S-0-0173	S-0-0173	S-0-0173 and S-0-0174

Incremental

1. The drive calculates the distance from the machine zero point
   = reference dimension position actual value 1/2 + reference dimension offset

2. The drive calculates the shift 1/2
   = distance to the machine zero point – marker position A

and enters them in the shift parameters S-0-0175 and S-0-0176.

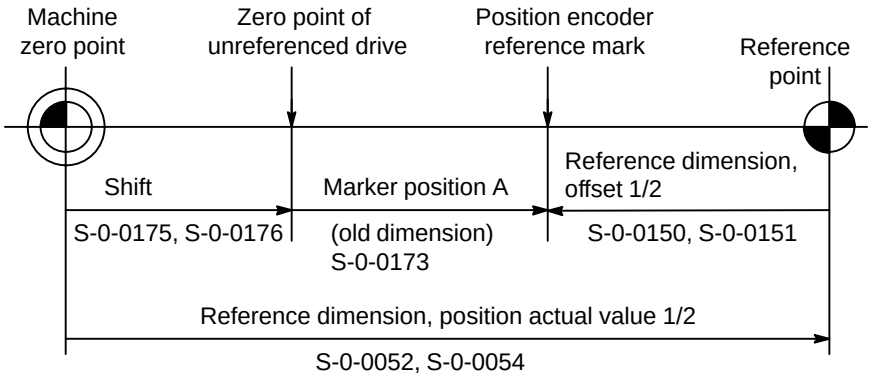


Abb. 4.8: Shift, incremental measuring system

Distance coded

1. The drive calculates the distance from the machine zero point from the marker position A, marker position B and the absolute offset dimension.

2. The drive calculates the shift 1/2
   = distance to the machine zero point – marker position A

   and enters them in the shift parameters S-0-0175 and S-0-0176.

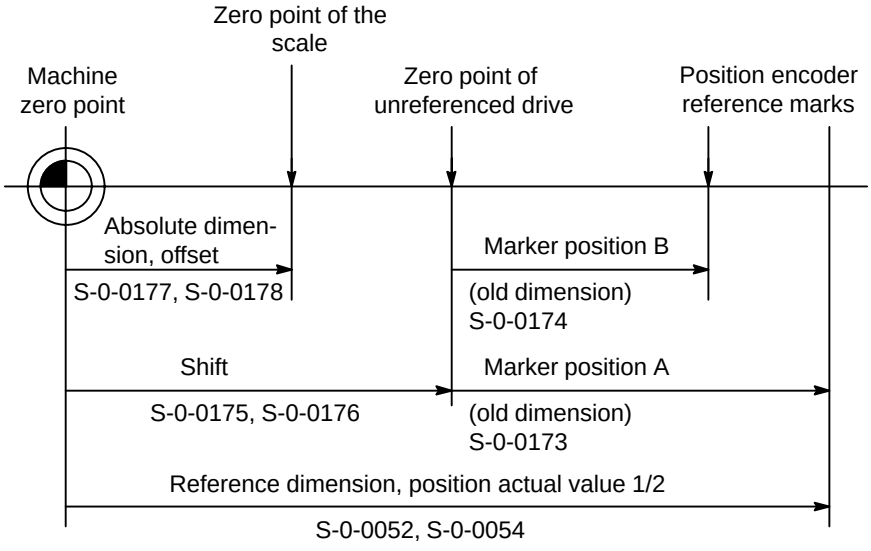


Abb. 4.9: Shift, distance coded measuring system

S-0-0175 Shift parameter 1

Phase 3,4	–	–	–	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The difference between the old position system and the referenced position system, calculated with the command “Calculate shift”, is saved by the drive in shift parameter 1, if the motor encoder is selected.

Weighting and preferred weighting in accordance with section 3.4.1.

S-0-0176 Shift parameter 2

Phase 3,4	–	–	–	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The difference between the old position system and the referenced position system, calculated with the command “Calculate shift”, is saved by the drive in shift parameter 2, if the external encoder is selected.

Weighting and preferred weighting in accordance with section 3.4.1.

Shifting to the reference system

S-0-0172 Command “Shift to reference system”

Phase 4	–	–	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

By setting and enabling this command, the drive switches to the referenced position actual value system and reports this in the bit “Position actual values status” (S-0-0403).
In order to be able to inform the master of this shift in real time, the bit “Position actual values status” can be assigned to a real-time status bit.

While the command is active, the master shifts to the referenced position setpoint system and reports this in the bit “Position setpoints status” (S-0-0404). In order to be able to inform the drive of this shift in real time, the bit “Position setpoints status” must be assigned to a real-time status bit.
The bit “position setpoints status” must be set by the NC, independent of the operating mode.

The command is correctly ended by the drive when the bits “position actual values status” and “position setpoints status” are set. No sequence is specified.

Parameter configuration:

15 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X

X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

S-0-0403 Position actual values status

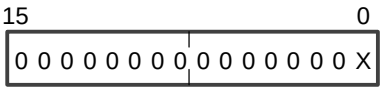
–	–	D → M	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

When switching over the position actual values to the coordinate system based on the machine zero point, bit 0 is set by the drive. The master thus receives an indication that the drive will refer all position actual values to the machine zero point from now on.
Bit 0 is cleared, if:

- “Shift to reference system” (S-0-0172) or
- “Drive-controlled referencing” (S-0-0148) is started or
- the drive loses its reference to the machine zero point.

This parameter can be assigned to a real-time status bit.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Position actual values are relative
1 Position actual values refer to the machine zero point

S-0-0404 Position setpoints status

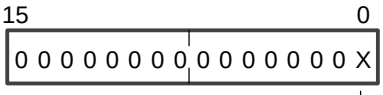
Phase 2, 3, 4	–	M → D	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

When switching over the position setpoints to the coordinate system based on the machine zero point, bit 0 is set by the master. The drive thus receives an indication that the master will refer all position setpoints to the machine zero point from now on.
At the same time, the new position setpoint is entered in the cyclic data by the master.
Bit 0 is cleared, if:

- “Shift to reference system” (S-0-0172) is activated.

This parameter can be assigned to a real-time status bit.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Position setpoints are relative
1 Position setpoints refer to the machine zero point

Example: Procedure for NC-controlled referencing

1. Start command “NC-controlled referencing” (S-0-0146),
   Start reference interpolator in the master
2. If the reference mark has been detected (S-0-0408), stop reference interpolator in the master. Delete command “NC-controlled referencing”.
3. Start command “Calculate shift” (S-0-0171).
   When the shift values have been calculated (S-0-0175, S-0-0176), delete the command.
4. Start command “Shift to reference system” (S-0-0172).
   When position actual values status (S-0-0403) has been set, and thus the axis has been referenced, delete the command.

4.5.3 Drive-controlled referencing

The same basic functions are used for drive-controlled referencing as for NC-controlled referencing.

- Search marker
- Calculate shift
- Shift to reference system

Control of these functions and movement generation are started by a single command and executed by the drive.
The position actual value status (S-0-0403) is set as a result.

- The **position measuring system** is connected to the drive and position actual value measurement takes place in the drive.
- The **reference point switch** must be connected directly to the drive.

S-0-0148 Command “Drive-controlled referencing”

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With this command, the drive detaches itself from the position setpoints and generates its own position specifications. For this, it uses the parameters referencing speed S-0-0041 and referencing acceleration S-0-0042.
The functions:

- Search marker
- Calculate shift
- Perform shift to reference system

are executed independently by the drive. If bit 7 in the referencing parameter is set, the drive approaches the reference point.

S-X-0041 Referencing speed

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter required for drive-controlled referencing.

Entries: 0 ... 90% n_{max}
Weighting and preferred weighting in accordance with section 3.4.2.

S-X-0042 Referencing acceleration

Phase 3,4	–	–	–	FEPROM	Accel.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter required for drive-controlled referencing. The referencing acceleration is symmetrically effective in both directions

Weighting and preferred weighting in accordance with section 3.4.4.

Example: Procedure for drive-controlled referencing with motor encoder STG/MTG

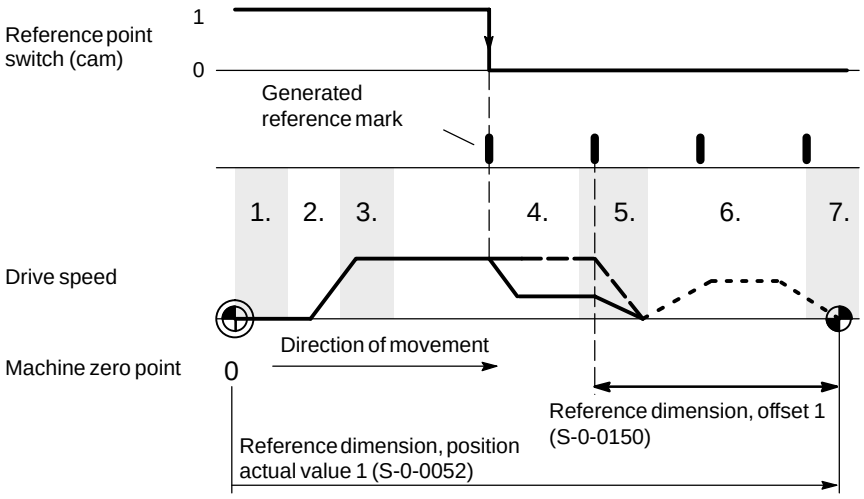


Abb. 4.10: Sequence diagram for drive-controlled referencing

1. Command “drive-controlled referencing” is set and enabled, after the master has assigned real-time bits to the necessary control and status signals via the service channel.
2. The drive switches to internal position control, deletes the position actual values status (S-0-0403) and ignores the cyclic setpoint input.
3. Taking into account the referencing direction input in referencing parameter S-0-0147, the drive accelerates with the referencing acceleration S-0-0042 to the referencing speed S-0-0041.
   Through the signal change at the reference point switch specified in S-0-0147, the drive recognises the absolute encoder position within one revolution.
4. The drive decelerates with the referencing acceleration until it has come to a stop.
   At the same time, it calculates the position actual value from the encoder position, the position actual value 1 reference dimension and the offset 1 reference dimension and finally sets the position actual values status (S-0-0403, see page 4-35).

5. One of the following two options may be set in bit 7 of referencing parameter S-0-0147:
   - □ The drive automatically outputs new position setpoints in order to bridge the reference dimension offset 1 and to approach the reference point, or
   - □ the axis remains near the position encoder reference mark and afterwards the master starts to traverse from this point.

   The master reads the position setpoint of the drive (S-0-0047) through the service channel and sets its setpoint system to this position setpoint.
   The master deletes the command “Drive-controlled referencing” and the drive follows the masters setpoints.

6. Reference point of the axis.

If drive-controlled referencing is interrupted, the position actual values status is not set, since the position actual value was not based on the reference mark.

☞ **Note** **If the position distance between the reference point switch and the encoder marker is in the critical range (< ¼ revolution, > ¾ revolution), see page 4-26):**

- ○ **save value after first referencing in the drive with the command ”save working memory” (S-0-0264), or**
- ○ **change position of reference point switch**

4.5.4 Deleting reference point

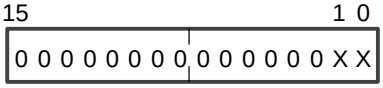
The machine-related position actual values can be set to “0” with the command “delete reference point”, so that they no longer refer to the machine zero point.
Condition:
The signals drive-enable and drive-on are set to ”0”.

S-0-0191 Command “Delete reference point”

Phase 2, 3, 4	–	–	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

By setting and enabling this command, the position actual value S-0-0403 is deleted in the drive.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

4.6 Changing the coordinate system

S-0-0197 Command “Set coordinate system”

Phase 4	–	–	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

When this command is activated, the drive ignores position setpoints and accepts the programmed coordinate start value S-0-0198 as drive-internal position setpoint.
In addition, the drive converts all absolute position data (measured values, position limit values, etc.), based on the coordinate start value.
The bits “position actual values status” (S-0-0403) and “position setpoints status” (S-0-0404) are not changed by this command.

The command is correctly ended when all conversions have taken place and the the drive coordinate system has been set to the coordinate start value. The master must set its coordinate system to that of the drive and then deletes this command. After the command has been deleted, the drive accepts the position setpoint from the master again.
The command is ended with an error, if the drive detects an error in the conversion.

Parameter configuration:

15 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X

X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

S-0-0198 Coordinate start value

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The coordinate system of the drive is set to the value programmed here with the command “Set coordinate system”.

Entries: -2^{31} ... $+2^{31}-1$
Weighting and preferred weighting in accordance with section 3.4.1.

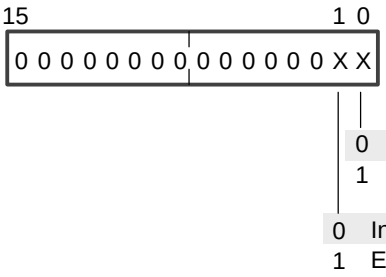
S-0-0199 Command “Shift coordinate system”

Phase 4	–	–	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

With this command, the drive ignores the position setpoints and adds the programmed coordinate shift value S-0-0275 to the drive-internal position setpoint.
Furthermore, the drive modifies all absolute position data (measured values, position limit values, etc.), with this coordinate shift value.
The bits “position actual values status” (S-0-0403) and “position setpoints status” (S-0-0404) are not changed by this command.

The command is correctly ended when all conversions have taken place and the the drive coordinate system has been recalculated. The master must set its coordinate system to that of the drive and then deletes this command. After the command has been deleted, the drive accepts the position setpoint from the master again.
The command is ended with an error, if the drive detects an error in the conversion.

Parameter configuration:



X is assigned the 0 or 1 below it.

S-0-0275 Coordinate shift value

Phase 3,4	–	–	–	FEPROM	Position	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The coordinate system of the drive is shifted to the value programmed here with the command “Shift coordinate system”.

Weighting and preferred weighting in accordance with section 3.4.1.

4.7 Endless axis

During a program block, the endless axis first travels to the modulo value S-0-0103. A modulo calculation is then performed on the end position. If the end position lies outside the limits 0° ≦ end position < 360°, it is always transformed to the range 0° ≦ end position < 360° again. This means that the endless axis can be traversed in one and the same direction as often as necessary.

Modulo format

Therefore, for endless axes, the processing “modulo” format must be set in the parameter type of weighting for position data S-0-0076 with bit 7 = 1 (see page 3-20).

S-X-0103 Modulo value

Phase 3	–	–	–	FEPROM	Position	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The modulo value specifies the position from which a modulo calculation must be performed. The NC performs the calculation.

Entries: $0 \ldots +2^{31}-1$
Weighting and preferred weighting in accordance with section 3.4.1.

The drive identifies the modulo calculation by the difference between the position setpoints k and k–1, if the difference > 0.5 revolutions.

☞ **Note** **The speed of the endless axis must be < 0.5 revolutions/NC cycle, so that the drive can identify the modulo calculation.**

4.8 Controlled modulo axis

In contrast to the endless axis, the modulo calculation is performed at standstill for a controlled modulo axis.
The master activates the command “Return to modulo range” for the drive, at standstill. It is only effective if the processing format “absolute” is set in the parameter type of weighting for position data S-0-0076 with bit 7 = 0.

S-0-0276 Command “Return to modulo range”

Phase 4	–	–	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The drive calculates the positive and negative position setpoints and actual values with the modulo value S-0-0103 to produce a new positive position setpoint and actual value.

While the command is active, the drive ingores the cyclic setpoint input. The master accepts the new position setpoint from the drive and ends the command. The drive then accepts the setpoints defined for the selected operating mode again.

5 Parameters for the spindle function

☞ **Note** **The initialisation of controller parameters and limit values described in chapter 5 takes place in the SERCOS interface phase 3.**

5.1 SERCOS interface operating modes

The drive is adapted to the application with the following parameters. All parameters are preset in the drive. They can be changed by the master, as long as the data are not unchangeably stored in the drive.

Different operating modes can be selected in the spindle function for DM modules with SERCOS interface and specified in the parameters S-0-0032 to S-0-0035 (see section 3.3).
In spindle mode, the drive is operated with the speed interface.

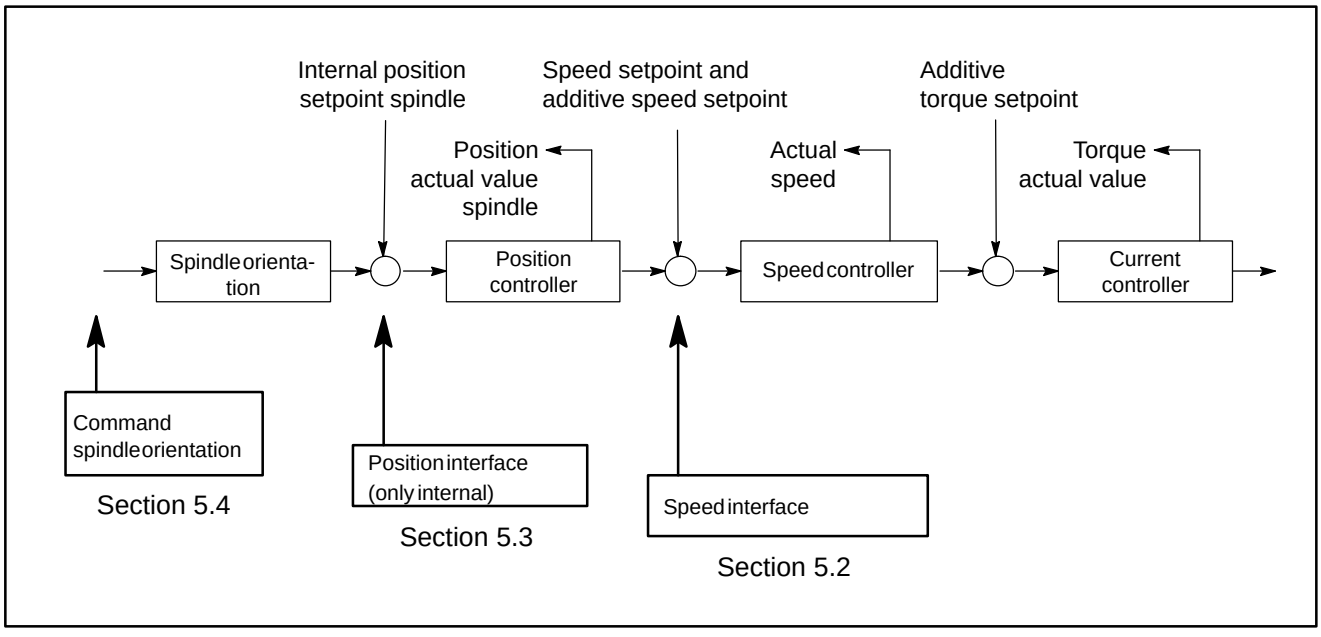


Fig. 5.1: SERCOS interface operating modes

5.2 Speed interface

The parameters described below refer to speed and current controllers for all operating modes of the spindle function.

5.2.1 Setting the speed controller

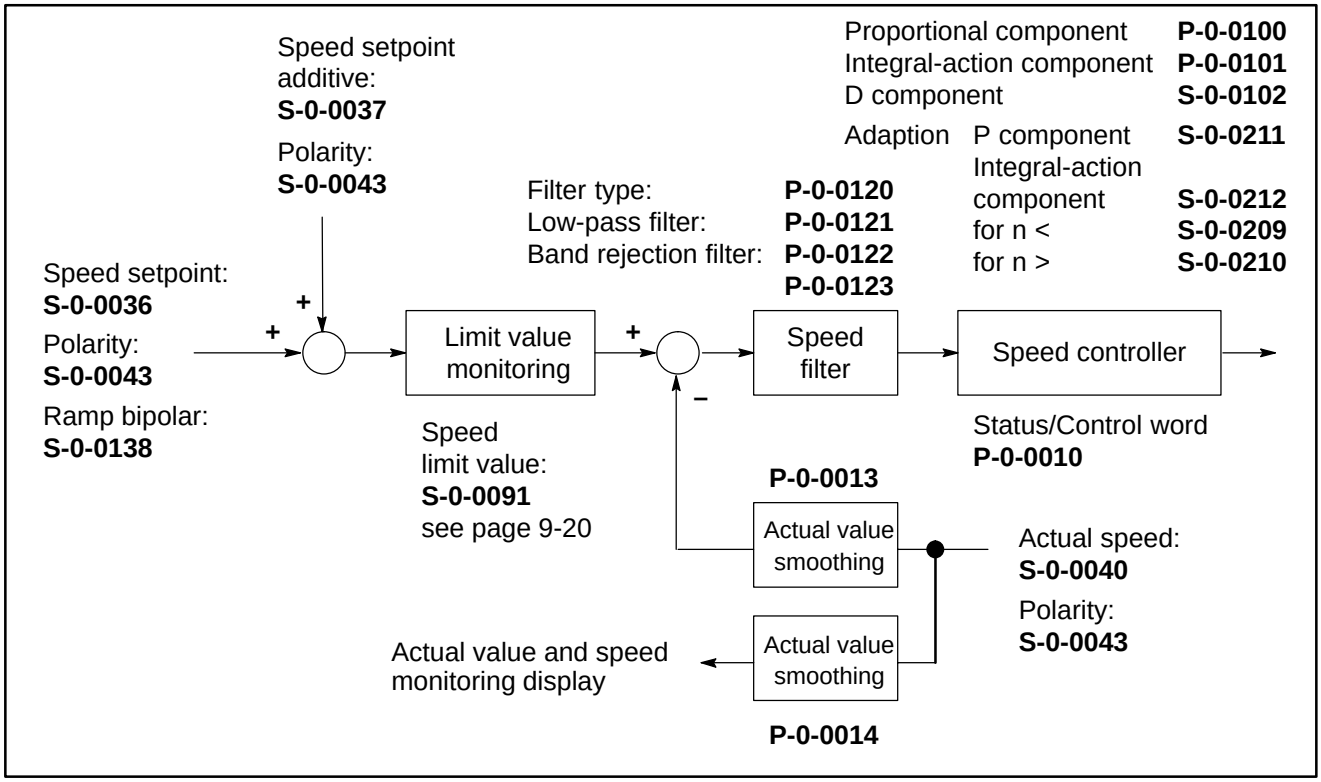


Fig. 5.2: Changeable parameters of the speed controller

S-0-0036 Speed setpoint

Phase 3,4	–	–	MDT	–	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Cyclically transferred setpoints in the speed control operating mode.

Entry: -2^{31} ... $+2^{31}$
For weighting, see section 3.4.2, S-0-0044.

S-0-0138 Acceleration bipolar

Phase 3,4	–	–	–	FEPROM	Accel.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Adjustable ramp for speed setpoint, valid for both directions of rotation.

Preferred translatory or rotary weighting, see section 3.4.4.

S-0-0037 Speed setpoint additive

Phase 3,4	–	–	MDT	–	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Cyclically transferred additional setpoint, added up in the drive to speed setpoint S-0-0036.

Entry: -2^{31} ... $+2^{31}$
For weighting, see section 3.4.2, S-0-0044.

S-0-0040 Actual speed

–	–	–	DT	–	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The speed actual value is additionally transferred to the master via this parameter. The polarity can be adjusted in S-0-0043.

For weighting, see section 3.4.2.

P-X-0013 Actual value smoothing interval of speed controller

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Defines whether the drive should calculate a mean value from the arriving actual values **for internal further processing**. A maximum of 16 cycles can be taken into account. The entry of "1" turns mean value calculation off.

Entry: 1 ... 16

P-0-0014 Actual value smoothing interval monitoring

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Influences the speed actual values for the following monitoring purposes and without influencing the servo loop:

- for all evaluations in connection with the actual speed:
  $n_{act} = n_{set}$, $n_{act} = 0$ and $n_{act} < nx$ (see section 9.2.5)
- for actual value displays

By making appropriate entries, mean value calculation as well as a first order filter can be activated.

Entry:
- > 1: Mean value calculation for 16 cycles (fixed)
- 1: no influence on actual values
- < 1: First order filter with a time constant according to entry with the following formula:

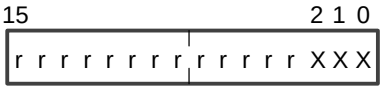
$$\frac{1}{(\text{entry})} * 250 \quad \text{in } [\mu s]$$

S-0-0043 Speed polarities

Phase 2	Phase 2	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The polarities of the speed setpoint and speed actual value within the controlled system remain unchanged, they can only be adjusted at the input and output.
With a positive polarity and a positive speed setpoint, a clockwise rotation from the point of view of the motor shaft is specified.

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Speed setpoint
0 Positive polarity
1 Negative polarity

Bit 1: Speed setpoint additive
0 Positive polarity
1 Negative polarity

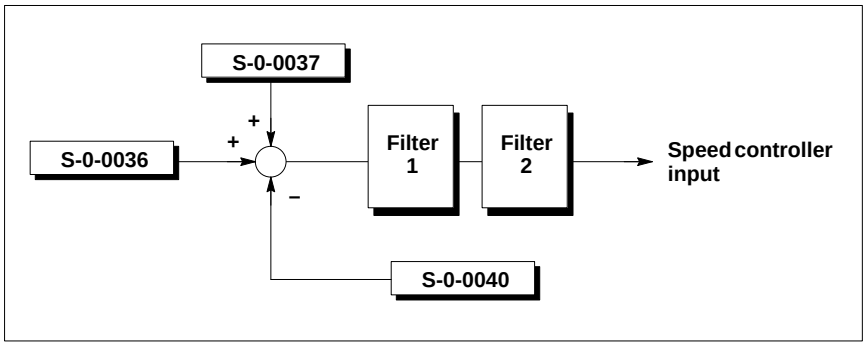
Bit 2: Actual speed
0 Positive polarity
1 Negative polarity

P-0-0120 Speed filter: selection of filter type

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The drive has 2 2nd order digital filters connected in series which are inserted directly upstream the speed controller.
Each of the 2 filters can be parameterised as a low pass filter or as a band rejection filter. Furthermore, every filter can be completely switched off.

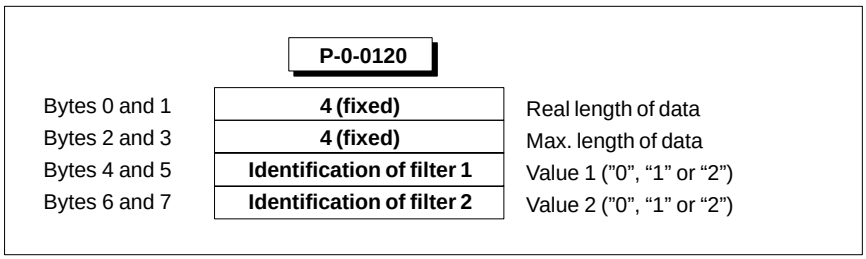
Thus, the speed controller of the drive can be optimised precisely to the requirements of your respective application.



With P-0-0120 you can define the type of every individual filter. For this purpose, you may use the following identifications:

”0”: filter off
”1”: low pass filter
”2”: band rejection filter

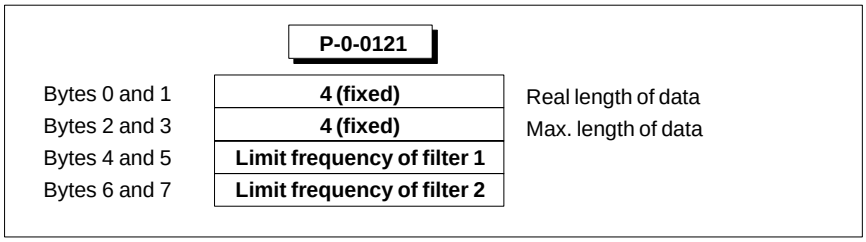
The structure of P-0-0120 is shown in the following figure:



P-0-0121 Speed filter: Limit frequency of low pass filter

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

For the filters configured as low pass filters in P-0-0120, the limit frequency is entered in Hz in P-0-0121. As a result, the signal range above the specified frequency will be attenuated with –20 dB per decade.
Any value entered will be used only if the corresponding filter was configured as low pass filter.

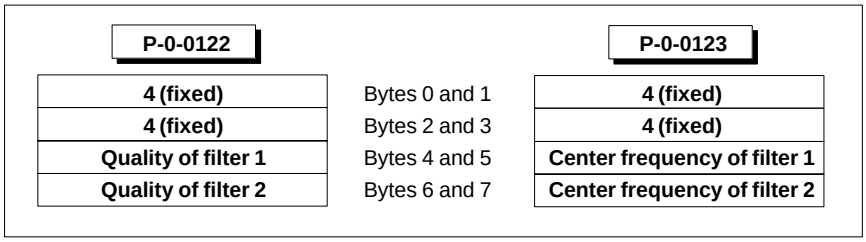


P-0-0122 Speed filter: Quality of band rejection filter

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

For the filters configured as band rejection filters in P-0-0120, the quality is entered in P-0-0122 and the center frequency is entered in Hz in P-0-0123. As a result, the signal range will be reduced by more than –40 dB at the specified frequency.
The quality determines the slope of the filter edge. The higher the quality, the narrower is the band of the suppressed frequency range.

Any value entered in P-0-0122 and P-0-0123 will be used only if the corresponding filter was configured as a band rejection filter in P-0-0120.



P-0-0123 Speed filter: Center frequency of band rejection filter

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

See P-0-0122.

P-X-1011 P-component of speed controller, spindle

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In the case of many applications, the default setting of the P-component is adequate. If an adaptation is necessary, the P-component is adjusted to the transient response of the speed actual value (see fig. 5.3).

Entry: 0 ... 400.0

P-X-1012 Integral-action component, speed controller, spindle

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In the case of many applications, the default setting of the integral action component is adequate. If an adaptation is necessary, the integral-action component is adjusted to the transient response of the speed actual value (see fig. 5.3).

Entry: 10 ... 2^{15} ms
The correction time is switched off by entering the maximum value 2^{15}.

S-0-0102 D-component, speed controller

Phase 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In the case of many applications, the default setting of the D-component is adequate. If an adaptation is necessary, the D-component is adjusted to the transient response of the speed actual value (see fig. 5.3).

Entry: 0 ... 1.0 ms

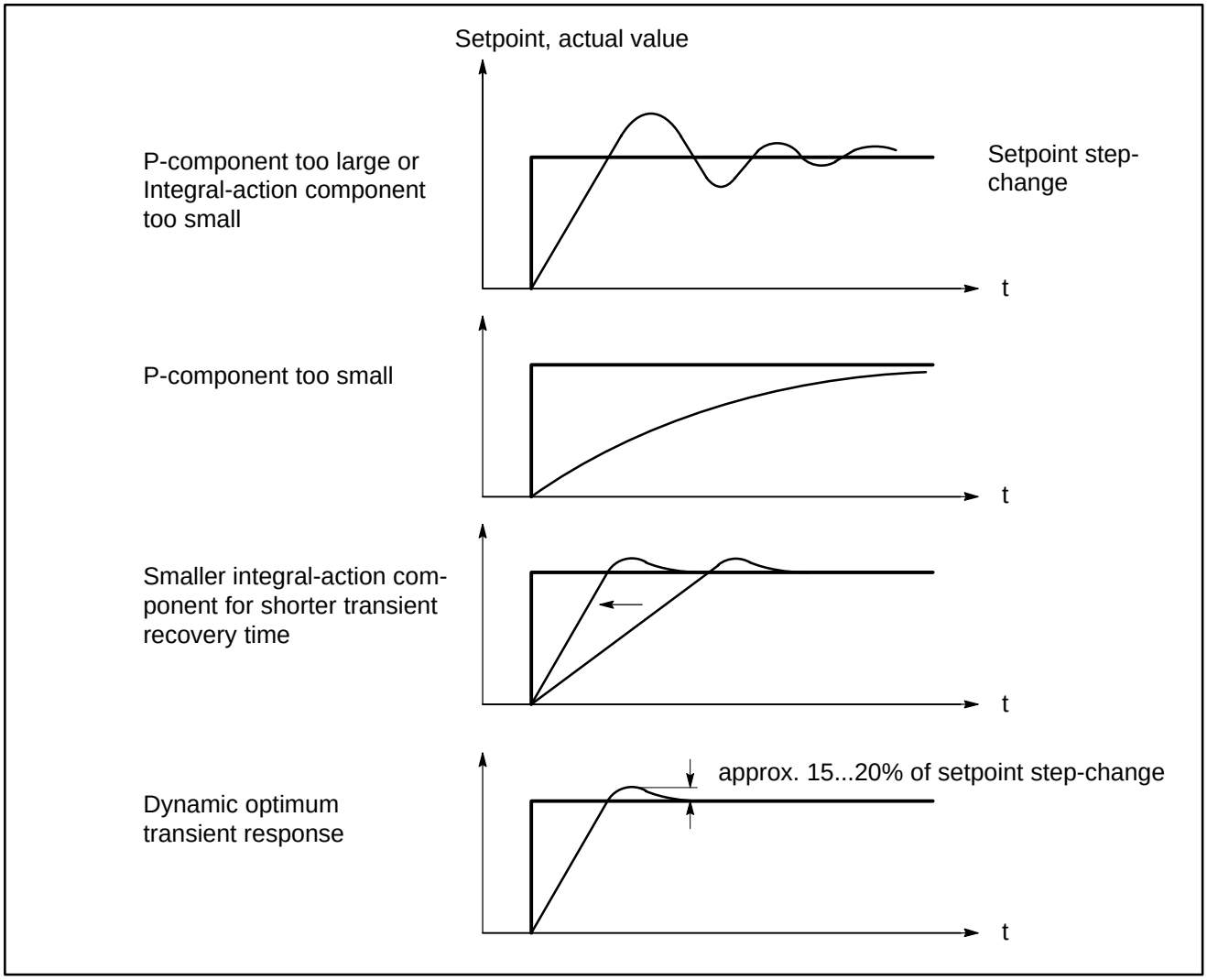


Fig. 5.3: Speed controller adjustment

Adaption of the speed controller

For the P-component and the integral-action component of the speed controller, a linear increase/decrease proportional to the speed can be specified in a programmable speed range. The programmable speed range is determined by the lower and upper adaption limit.

S-X-0209 Lower adaption limit, speed controller

Phase 3, 4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Below: P-component ≡ adapted value (S-0-0211)
Integral-action component ≡ adapted value (S-0-0212)

Above: The P-component and integral-action component change linearly with the speed, until they reach the preset value at the upper limit.

Entry: 0 ... $+2^{31}-1$

S-X-0210 Upper adaption limit, speed controller

Phase 3, 4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Below: Starting at the adapted value, the P-component and integral-action component change linearly with the speed.

Above: P-component ≡ preset value (S-0-0100)
Integral-action component ≡ preset value (S-0-0101)

Entry: 0 ... $+2^{31}-1$

S-X-0211 Adaption of P-component, speed controller

Phase 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Percentual change of preset P-component.
The change is effective below the lower adaption limit, levels out between lower and upper adaption limits and has no effect above the upper adaption limit.

Entry: 10 ... 5000.0
Weighting 0.1 %

Example:

Preset P-component	(S-0-0100):	50
Lower adaption limit	(S-0-0209):	3 rpm
Upper adaption limit	(S-0-0210):	8 rpm
Adapted P-component	(S-0-0211):	150 %

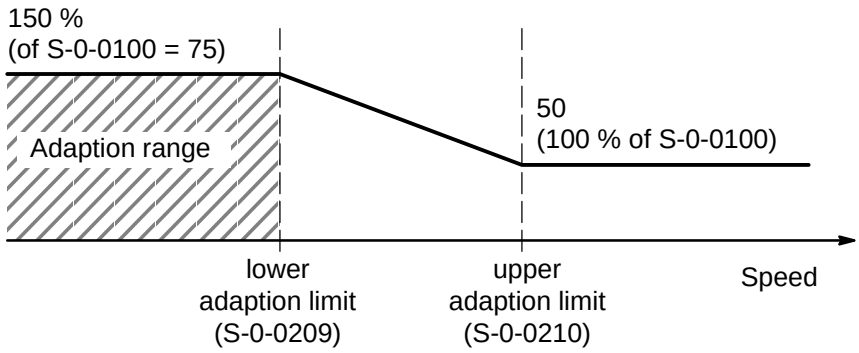


Fig. 5.4: Adaption of the speed controller

S-X-0212 Adaption of integral-action component, speed controller

Phase 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Percent change of preset integral-action component (S-0-0101).
The change is effective below the lower adaption limit, levels out between lower and upper adaption limits and has no effect above the upper adaption limit.
The same adaption limits are effective as for the P-component.

Entry: 10 ... 5000.0
Weighting 0.1 %

P-0-0010 Speed controller control/status word

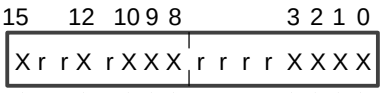
Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The control signals and the corresponding status signals of the drive are combined in this parameter.

❑ **Control word:**
The fine interpolation of the setpoints for the current and speed controllers can be switched off. This can be advantageous for optimising the drive.
Furthermore, the standard stalling monitoring function (plausibility check of n-controller) can be switched off if necessary in special cases.

❑ **Status word:**
The status word contains various confirmations of the drive.
They are output by the drive when the drive is switched off with the error message ”Plausibility error of speed controller” (S-0-0129 bit 0, display ”F96”).
The status bits of P-0-0010 set in this case provide for more detailed diagnostics of the error message.

Parameter configuration



X is assigned the 0 or 1 below it
r = reserved

Bit 0: Current fine interpolation
0 no interpolation
1 linear fine interpolation (factory setting)

Bit 1: Speed fine interpolation
0 no interpolation
1 linear fine interpolation (factory setting)

Bit 2: Acceleration monitoring
0 stalling errors are not detected
1 stalling monitoring (factory setting)

Bit 3: DAC output (only for developer)
0 special signals on OM4
1 DAC signals on OM4 (factory/operation setting)

Bit 8: Current not reached
$I < 80\ \%\ I_{set}$ after M_{limit} has been active for 5 ms

Bit 9: Acceleration too low
$A < 50\ rad/s^2$, after M_{limit} has been active for 20 ms

Bit 10: Inverted acceleration
acceleration in wrong direction after M_{limit} has been active for 5 ms

Bit 12: Controller limit of n-controller
0 negative controller limit reached
1 positive controller limit reached

Bit 15: Synchronisation
synchronisation error between speed and position controller

5.2.2 Setting current controller

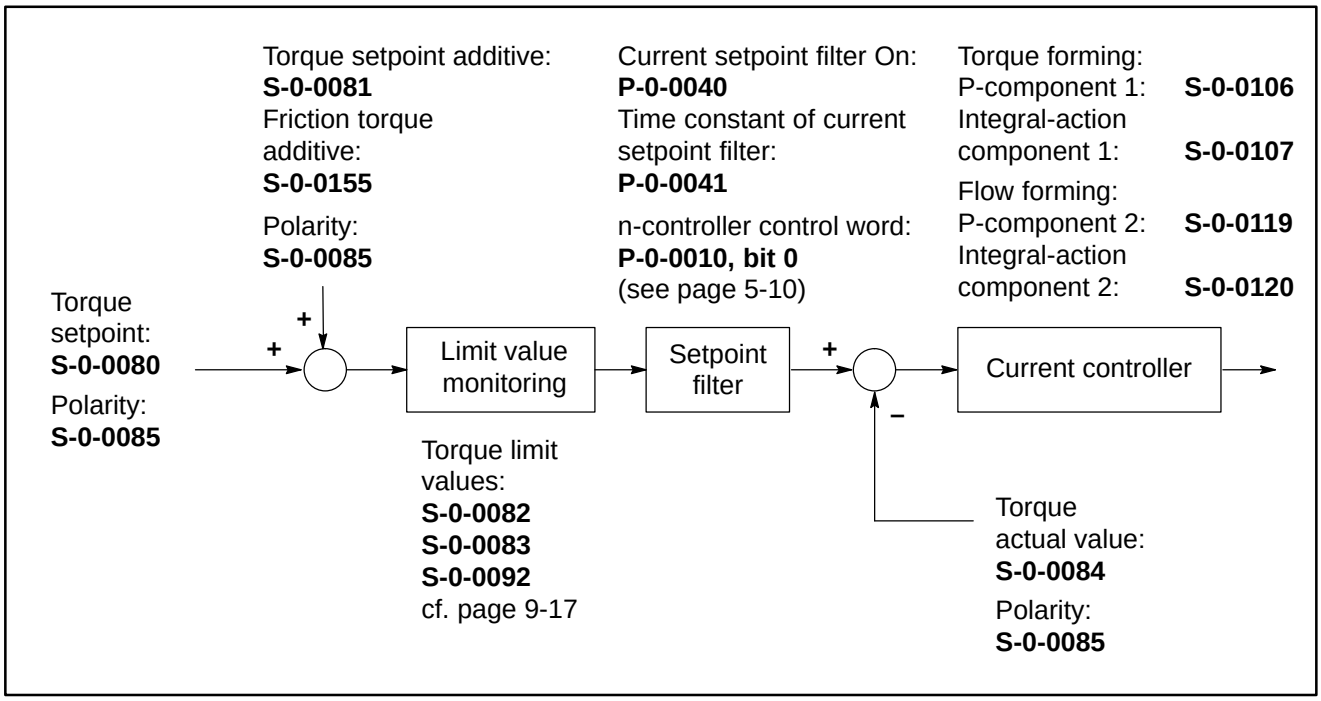


Fig. 5.5: Changeable parameters of the current controller

S-0-0080 Torque setpoint

–	–	–	DT	–	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The torque setpoint is additionallly transferred to the master via this parameter. The polarity can be adjusted in S-0-0085.

For weighting, see section 3.4.3.

S-0-0081 Torque setpoint additive

Phase 3,4	–	–	MDT	–	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Cyclically transferred additional setpoint, added up in the drive to torque setpoint S-0-0080.

Entry: -2^{15} ... $+2^{15}-1$
For weighting, see section 3.4.3, S-0-0086.

S-0-0084 Torque actual value

–	–	–	DT	–	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The torque actual value is additionallly transferred to the master via this parameter. The polarity can be adjusted in S-0-0085.

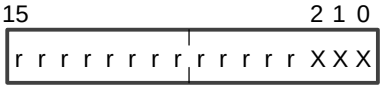
For weighting, see section 3.4.3.

S-0-0085 Torque polarities

Phase 2	–	–		FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The polarities of torque setpoints and torque actual value within the controlled system remain unchanged, they can only be adjusted at the input and output.
With a positive polarity and a positive torque setpoint, a clockwise rotation from the point of view of the motor shaft is specified.

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Torque setpoint
0 Positive polarity
1 Negative polarity

Bit 1: Torque setpoint additive
0 Positive polarity
1 Negative polarity

Bit 2: Torque actual value
0 Positive polarity
1 Negative polarity

The parameters for the current controller are subdivided into:

- ❑ Group 1: Torque-forming current
- ❑ Group 2: Field current (flow-forming current)

S-0-0106 P-component 1, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The P-component 1 affects the torque-forming current. In the case of most applications, the default setting can remain unchanged.

Entry: 0 ... 200.00

S-0-0107 Integral-action component 1, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The integral-action component 1 affects the torque-forming current. In the case of most applications, the default setting can remain unchanged.

Entry: 70 ... 6500 µs

S-0-0119 P-component 2, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The P-component 2 affects the field current. In the case of most applications, the default setting can remain unchanged.

Entry: 0 ... 200.00

S-0-0120 Integral-action component 2, current controller

Phase 3, 4	–	–	–	FEPROM	Controller	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The integral-action component 2 affects the field current. In the case of most applications, the default setting can remain unchanged.

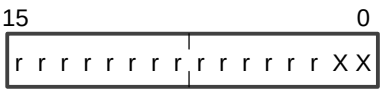
Entry: 70 ... 6500 µs

P-0-0040 Current setpoint filter ON

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter activates a first-order current setpoint filter instead of the standard linear fine interpolation of the current setpoints.
Thus, the P component of the current controller (S-0-0106) can be increased to further improve the controller properties.
The filter time constant can be changed in parameter P-0-0041.

Parameter configuration



X is assigned the 0 or 1 below it
r = reserved

0 linear fine interpolation
1 1st order filter

☞ **Note** **The standard linear fine interpolation can be switched off with bit 0 of P-0-0010.**

P-0-0041 Time constant of current setpoint

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Defines the time constant of the current setpoint filter.

Entry: 0 ... 3000 [µs]

5.2.3 Error correction

S-X-0155 Friction torque compensation

Phase 3, 4	–	–	–	FEPROM	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter is used to compensate for the static friction for acceleration from standstill and for reversing the direction of rotation.
The compensation value must receive the same sign as the torque setpoint and is additively superimposed to it.

Weighting and preferred weighting in accordance with section 3.4.3.

5.3 Position controller for spindle function

The parameters of the position controller act internal to the drive, cyclic position setpoints are inhibited.

5.3.1 Setting the position controller

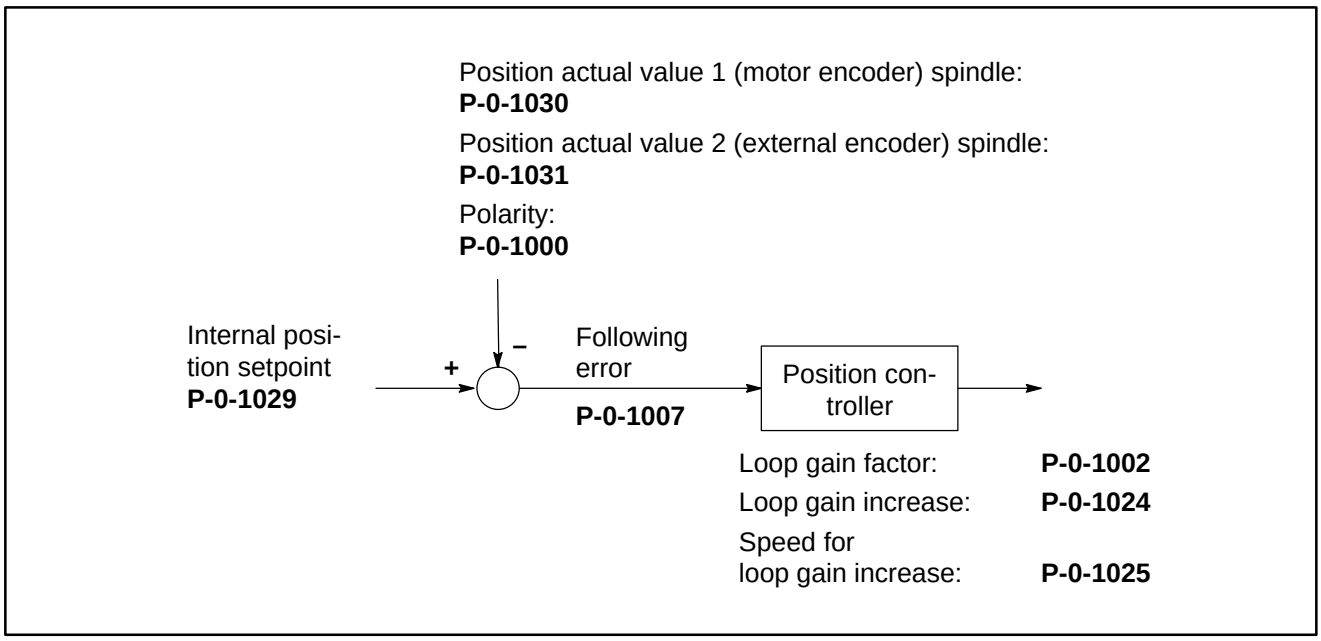


Fig. 5.6: Parameters of the position controller

P-0-1029 Internal position setpoint, spindle

Phase 3,4	–	–	MDT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The internal position setpoint in spindle mode can be read.

P-0-1030 Position actual value 1 (motor encoder), spindle

–	–	–	DT	–	Motor position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The position actual value of the motor encoder is additionallly transferred to the master via this parameter. The polarity can be adjusted in P-0-1000.

For weighting, see section 3.4.1.

P-0-1031 Position actual value 2 (external encoder), spindle

–	–	–	DT	–	Ext. position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The position actual value of an external encoder is additionallly transferred to the master via this parameter. The polarity can be adjusted in P-0-1000.

For weighting, see section 3.4.1.

P-0-1000 Position polarities, spindle

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter determines the polarity at the interface when reading position actual values. The encoder polarity remains unchanged:

Parameter configuration:

15 4 3 2 1 0

r r r r r r r r r r X X X X X

X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Position setpoint
0 Positive polarity
1 Negative polarity

Bit 1: Position setpoint additive
0 Positive polarity
1 Negative polarity

Bit 2: Position actual value 1
0 Positive polarity
1 Negative polarity

Bit 3: Position actual value 2
0 Positive polarity
1 Negative polarity

Bit 4: Position limit value
0 not active
1 active

P-0-1007 Following distance, spindle

–	–	–	DT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The drive stores the current difference between the position setpoint and the position actual value relevant for control in this parameter. The value can only be read.

P-X-1002 Loop gain factor of position controller, spindle

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This factor specifies the loop gain of the position control circuit over the entire speed range.

Entry: 0 ... 655.35
Weighting 0.01 (1000/min)

P-X-1024 Loop gain increase, spindle

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Value by which the loop gain factor is multiplied, effective below the speed specified in P-0-1025.

Entry: 0 ... 100.0
1 $\triangleq$ no change

P-X-1025 Speed loop gain increase, spindle

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Speed limit up to which the loop gain increase specified in P-0-1024 is active.

Entry: 0.0000 ... n_{max}

5.3.2 Position controller monitoring

P-X-1001 Positioning window, spindle

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The positioning window spindle is used to determine the maximum permissible following error, for which the drive outputs the message “In-Position” (S-0-0336, see section 9.2.9). The message takes place if the amount of the difference between the position setpoint and the position actual value (= following error) is smaller than the positioning window spindle.
The message “In-Position” can be assigned to a real-time status bit in the drive status word and transferred to the NC for further processing, depending on the operating mode.

Weighting and preferred weighting in accordance with section 3.4.1.

P-X-1023 Positioning window rough, spindle

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “positioning window rough, spindle” is used to determine the maximum permissible following error, for which the drive outputs the message “In-Position rough” (S-0-0341, see section 9.2.9). The message takes place if the amount of the difference between the position setpoint and the position actual value (= following error) is smaller than the “positioning window rough, spindle”.
The message “In-Position rough” can be assigned to a real-time status bit in the drive status word and transferred to the NC for further processing, depending on the operating mode.

Weighting and preferred weighting in accordance with section 3.4.1.

P-X-1006 Monitoring window, spindle

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Monitoring of speed setpoint by evaluating the deviation between the position actual value and the position setpoint. When the monitoring window (% of maximum speed) is exceeded, the drive sets the error message ’excessive controller deviation’ in diagnostics class 1 (see page 9-3).
100 % $\triangleq$ maximum speed in acc. with S-0-0091

Entry: 0 ... 500 %

Default setting: 120 %

P-X-1028 Modulo value spindle

Phase 3	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The modulo value specifies the position from which a modulo calculation must be performed, if the position weighting was set to modulo format.

Weighting and preferred weighting in accordance with section 3.4.1.

5.4 Spindle orientation

Spindle orientation is carried out with the command "Position spindle" when the spindle has been referenced (S-0-0403 bit 0 = 1, see page 4-35).
If the command is called up with out referencing, the spindle will try to reference first.

S-0-0152 Command "Position spindle"

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Following this command, the drive first tries to reach the spindle positioning speed S-0-0222 by decelerating from a higher speed or accelerating from a lower speed or from standstill.

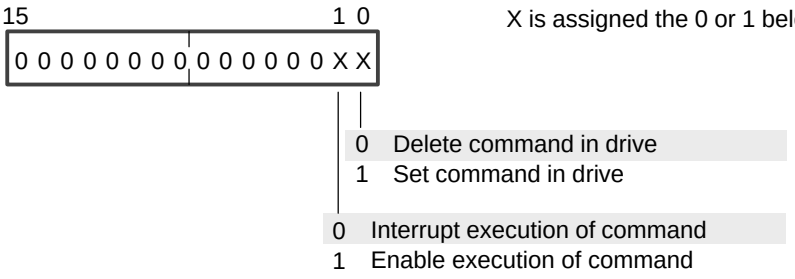
In the case of speeds ≦ spindle positioning speed, the drive immediately switches to internal position control and

- performs absolute movement to the spindle angular position S-0-0153, or
- performs incremental movement according to the spindle path S-0-0180.

During command execution, the cyclic speed setpoints are not active. Changes of the spindle position or spindle path through the service channel are however accepted.

When the command has been deleted, the drive switches back to the operating mode specified in the control word.

Parameter configuration:



S-0-0154 Spindle positioning parameter

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The spindle positioning parameter determines:

- the direction of rotation for spindle orientation from standstill
- the traversing method for spindle orientation:
  - absolute movement to the spindle angular position (section 5.4.1), or
  - incremental movement according to spindle path (section 5.4.2)
- active encoder

Parameter configuration

X is assigned the 0 or 1 below it
r = reserved

15											3	2	1	0
r	r	r	r	r	r	r	r	r	r	r	X	X	X	X

Bit 0, 1: Direction of rotation

0 0	clockwise
0 1	counter-clockwise
1 X	shortest path

Bit 2: Angle/Path

0	spindle angular position
1	spindle path

Bit 3: Encoder

0	motor encoder
1	external encoder

S-X-0222 Spindle positioning speed

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Speed for performing spindle orientation. From a higher speed the drive decelerates to the positioning speed, from standstill it accelerates to the positioning speed.

Entry: 0 ... $+2^{31}-1$, weighting 10^{-4} rpm

P-0-1003 Closing speed of the position controller

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Speed limit below which the drive closes the internal position control loop and decelerates to the selected position with the command ”Position spindle”.

Entry: 0 ... $+2^{31}-1$, weighting 10^{-4} rpm

P-X-1027 Orientation acceleration

Phase 3,4	–	–	–	FEPROM	Accelera-tion	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Adjustable acceleration ramp for spindle orientation, valid for both directions of rotation.

Entry: ????
For translatory or rotary preferred weighting, see section 3.4.4.

S-0-0153 Spindle angular position

Phase 3,4	–	–	MDT	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Value of the absolute angular position with respect to the reference point in connection with the commands ”Position spindle” and ”Drive-controlled synchronous operation”.

Entry: -2^{31} ... $+2^{31}-1$
Weighting and preferred weighting in accordance with section 3.4.1.

S-0-0180 Spindle path

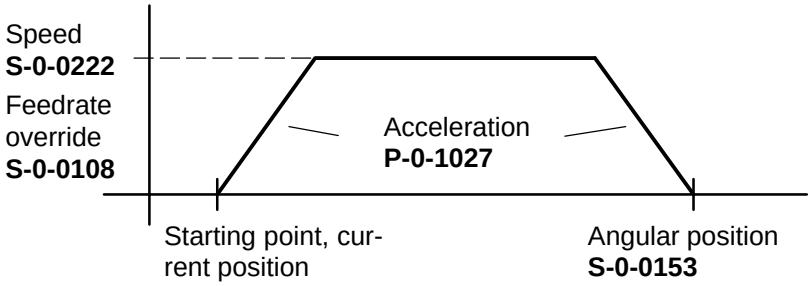
Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Incremental value added up by the drive to the absolute position setpoint P-0-1029. Thus, the spindle can be traversed for a certain number of revolutions. This value is only active in combination with the command ”Position spindle”.

Entry: -2^{31} ... $+2^{31}-1$
Weighting and preferred weighting in accordance with section 3.4.1 .

5.4.1 Absolute spindle orientation to spindle angular position

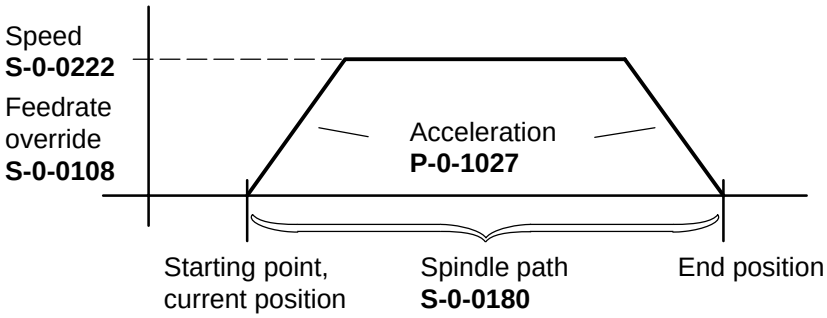
❑ **From standstill**
The specified angular position is traversed to by an absolute movement within one revolution.



❑ **From the rotating movement**
The spindle is decelerated with maximum acceleration S-0-0138 (see page 5-2). Below the spindle positioning speed, the drive switches to internal position control and decelerates with the orientation acceleration P-0-1027 to the specified angular position.

5.4.2 Incremental spindle orientation along spindle path

This function permits traversing to a defined end position **from standstill only**. The spindle path is traversed by an incremental movement from the starting point.
From a rotary movement, only the next possible position would be traversed to.



5.5 Spindle referencing

S-0-0403 Position actual values status

–	–	D → M	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

When switching over the position actual values to the coordinate system based on the machine zero point, bit 0 is set by the drive. The master thus receives an indication that the drive will refer all position actual values to the machine zero point from now on.
Bit 0 is cleared, if:

- ○ “Shift to reference system” (S-0-0172) or
- ○ “Drive-controlled referencing” (S-0-0148) is started or
- ○ spindle referencing parameter, bit 5 = 1 (P-0-1013) is set, or
- ○ the drive loses its reference to the machine zero point.

This parameter can be assigned to a real-time status bit.

Parameter configuration:

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

X is assigned the 0 or 1 below it.

0 Position actual values are relative
1 Position actual values refer to the machine zero point

P-X-1004 Reference dimension offset 1, spindle

Phase 3,4	–	–	–	FEPROM	Motor position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance between the machine zero point and the reference mark of the motor encoder.

Weighting and preferred weighting in accordance with section 3.4.1 .

P-X-1005 Reference dimension offset 2, spindle

Phase 3,4	–	–	–	FEPROM	Ext. position encoder	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Distance between the machine zero point and the reference mark of an external encoder.

Weighting and preferred weighting in accordance with section 3.4.1 .

5.5.1 Perform referencing

For referencing, the encoder selected for the operating mode is used.

Directly with motor encoder (no gearbox between motor and load)

- ❑ With integrated **single-turn absolute encoder (STG)**
  After DM start-up, the spindle has been automatically referenced.
- ❑ With integrated **gear encoder**
  The spindle has been automatically referenced after one spindle revolution.

With external encoder

The spindle has been automatically referenced after one spindle revolution.

Indirectly with motor encoder (gearbox between motor and load)

The spindle is referenced via a reference point switch, controlled by referencing parameter P-0-1013.

- ○ With referencing parameter spindle bit 5 = 1, the spindle searches the reference point switch in the referencing direction (bit 0)
- ○ With a **positive edge** of the reference point switch, the spindle then traverses backward at referencing speed, crosses the reference point switch, and then searches the positive edge.
- ○ With a **negative edge** of the reference point switch, the spindle immediately searches the negative edge at referencing speed.
- ○ With an integrated **gear encoder** the spindle then searches the next zero mark and references.
- ○ With an integrated **single-turn absolute encoder (STG)** the spindle references immediately. In the cam position status parameter (P-0-1015), the encoder zero mark is output for the reference point switch.

P-0-1013 Referencing parameter, spindle

Phase 2,3	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter controls the sequences for spindle referencing.
Bit 5 = 1 starts spindle referencing.

Parameter configuration

X is assigned the 0 or 1 below it.
r = reserved

15								5				1	0
r	r	r	r	r	r	r	r	r	X	r	r	X	X

Bit 0: Referencing direction

0 positive (clockwise rotation from the point of view of the shaft)

1 negative (counterclockwise rotation)

Bit 1: Position encoder reference mark

0 first zero mark after positive edge of the reference point switch

1 first zero mark after negative edge of the reference point switch

Bit 5: Evaluation of reference point switch

0 reference point switch not active

1 reference point switch active (= function ON)

P-X-1014 Referencing speed, spindle

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The spindle searches the reference point switch at referencing speed.

Entry: 0 ... 90% n_{max}
Weighting and preferred weighting in accordance with section 3.4.2 .

P-X-1015 Cam position status, spindle

Phase 4	–	–	–	FEPROM	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

The position distance between the reference point switch and the encoder zero mark is stored in this parameter:

0 : Init

1 : critical range (< ¼ rotation)

2 : critical range (> ¾ rotation)

3 : uncritical range

Procedure:

- For initial start-up, set value to “0”
- After the first referencing, **store** the value in the drive with the command “Save working memory” (S-0-0264).
- Do not change the value any more, except when starting up again after a change in the reference point switch.

P-0-1016 Cam position, spindle

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Contains the position of the reference mark for diagnostics purposes.

5.5.2 Deleting reference point

The machine-related position actual values can be set to “0” with the command “delete reference point”, so that they no longer refer to the machine zero point.
Condition:
The signals drive-enable and drive-on are set to ”0”.

S-0-0191 Command “Delete reference point”

Phase 2, 3, 4	–	–	–	–	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

By setting and enabling this command, the position actual value S-0-0403 is deleted in the drive.

Parameter configuration:

15 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X

X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

5.6 Oscillation

In order to improve gear level changes, an oscillating rotary movement of the spindle can be defined which is directly controlled by the drive.

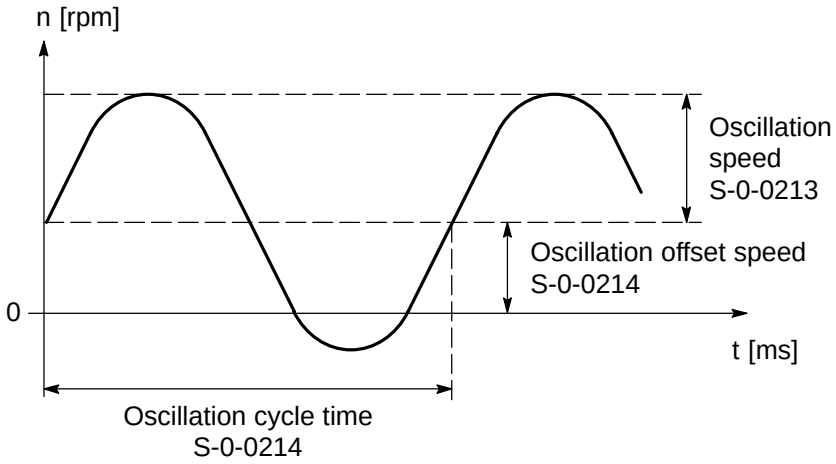
S-0-0190 Command "Drive-controlled oscillation"

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

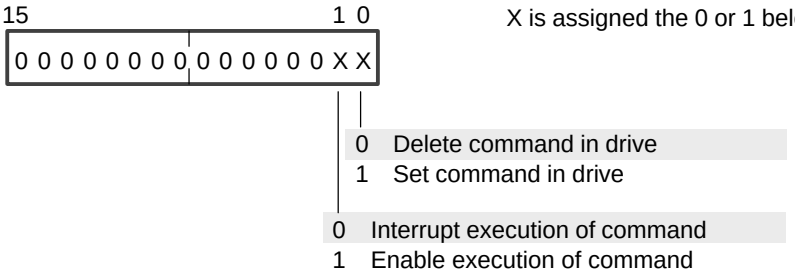
This command initiates an oscillating rotary movement of the drive which is determined by:

- the oscillation speed S-0-0213
- the oscillation offset speed S-0-0214
- the oscillation cycle time S-0-0215.

The cyclic speed setpoints are not active until the command is deleted.



Parameter configuration:



X is assigned the 0 or 1 below it.

☞ **Note** **For as long as the command "Position spindle" (S-0-0152) is active, "Drive-controlled oscillation" is not possible. The drive will output an error message.**

S-0-0213 Oscillation speed

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The oscillation speed limits the maximum speed of the drive in both directions during oscillation.

Entry: 0 ... 0.9 n_{max} [rpm]

S-0-0214 Oscillation offset speed

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The offset speed can be superimposed to the oscillating speed.

Entry: 0 ... 0.9 n_{max} [rpm]

S-0-0215 Oscillation cycle time

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

During the oscillation cycle time, the drive performs a complete oscillating movement.

Entry: 5 x position cycle ... 6553.5 [ms]

5.7 Changing gear levels

Servodyn-D drives offer the capability of changing to a selectable parameter set. Thus, it is possible to change over the gear level and/or other parameters.
In total, parameter sets 0...7 are available, see description of ident. number on page 2-3.

Through the service channel, the SERCOS master can access the ident. numbers of all parameter sets, regardless of the current parameter set.

S-0-0216 Command "Change parameter set"

Phase 3,4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With this command, the drive changes to the parameter set programmed in the parameter set preselection (S-0-0212).

Parameter configuration:

15 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X

X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

S-0-0219 List of ident. numbers for parameter set

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The list of ident. numbers contains all data that can be changed in the parameter sets:

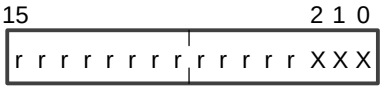
- list **S-0-0219** contains all existing parameters
- lists **S-X-0219** with **X = 1...7** contain all parameters that differ from parameter set 0 in the respective parameter set.

S-0-0217 Parameter set preselection

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The parameter set preselection serves to program the parameter set changed to with command S-0-0216.

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

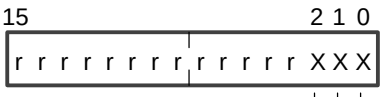
0 0 0	Parameter set 0
0 0 1	Parameter set 1
0 1 0	Parameter set 2
0 1 1	Parameter set 3
1 0 0	Parameter set 4
1 0 1	Parameter set 5
1 1 0	Parameter set 6
1 1 1	Parameter set 7

S-0-0254 Current parameter set

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Using this parameter, the currently active parameter set of the drive can be queried. The parameter set preselection can already be programmed for one of the next parameter sets.

Parameter configuration

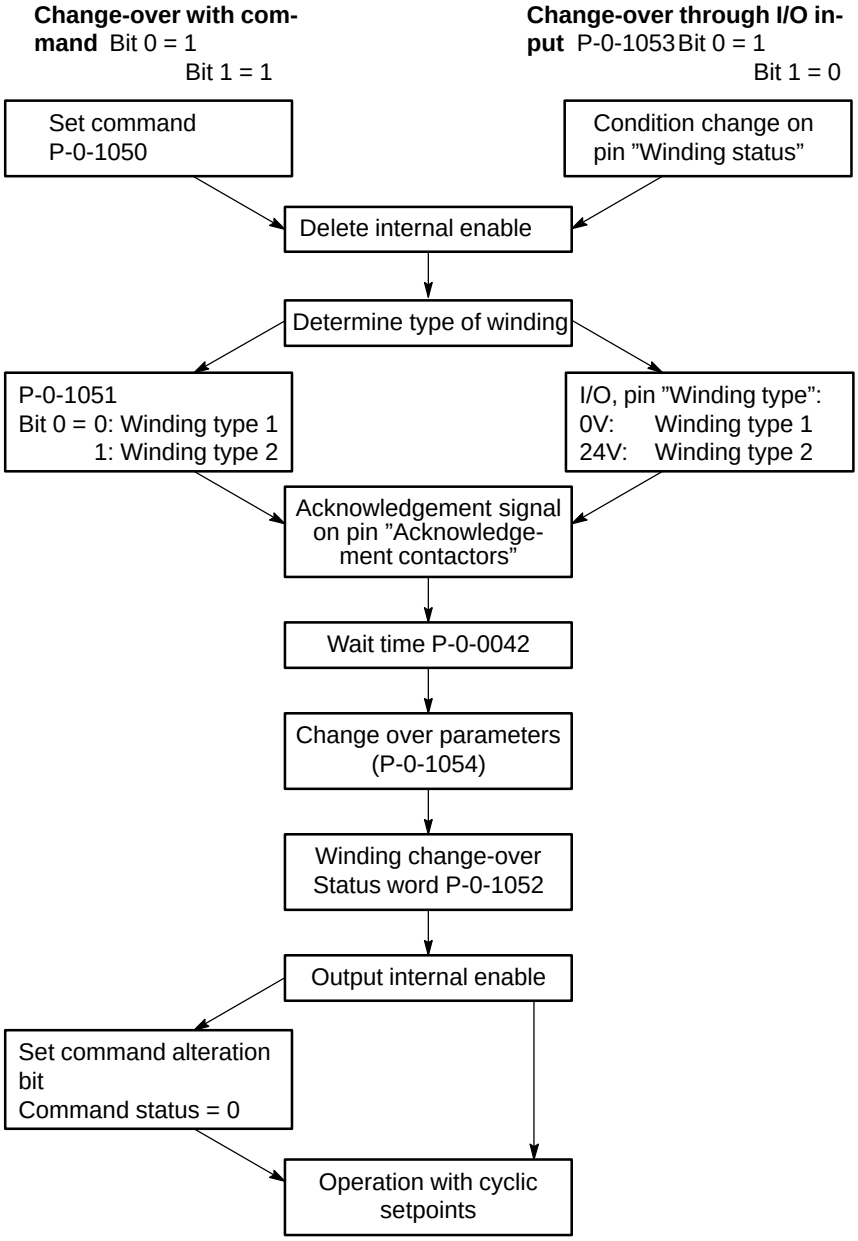


X is assigned the 0 or 1 below it.
r = reserved

0 0 0	Parameter set 0 active
0 0 1	Parameter set 1 active
0 1 0	Parameter set 2 active
0 1 1	Parameter set 3 active
1 0 0	Parameter set 4 active
1 0 1	Parameter set 5 active
1 1 0	Parameter set 6 active
1 1 1	Parameter set 7 active

5.8 Winding change-over

Using the winding change-over feature, an asynchronous motor can be operated with variable winding circuits, an hence different characteristics. The inverter changes over between the corresponding parameter sets. For each parameter set, different gear levels can be additionally selected. Change-over is alternatively by a command or a programmable input:

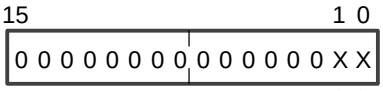


P-0-1050 Command "Winding change-over"

Phase 3,4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

When this command has been given, the drive starts changing over the winding, depending on the winding change-over preselection P-0-1051 and the winding change-over control word P-0-1053.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

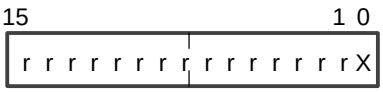
0 Interrupt execution of command
1 Enable execution of command

P-0-1051 Winding change-over preselection

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter seves to preselect the winding type with the corresponding parameter set for the next winding change-over.

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

0 winding type 1
1 winding type 2

P-0-1053 Winding change-over control word

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The control word determines the type of winding change-over.

Parameter configuration

15 2 1 0

r r r r r r r r r r r r r X X X

X is assigned the 0 or 1 below it.
r = reserved

0 0 No winding change-over
0 1 Change-over with command (P-0-1050 and P-0-1051)
1 0 No winding change-over
1 1 Change-over with programmable input

1 Evaluate acknowledgement signal of contactors
0 No evaluation of acknowledgement signal

P-0-0042 Winding change-over wait time

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

If necessary, a wait time can be defined between reception of the acknowledgement signal of the contactors and setting of the internal enable by the drive.

Entry: 0...32.8 ms,
Factory setting: 20 ms

P-0-1054 Winding change-over addressing mode

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

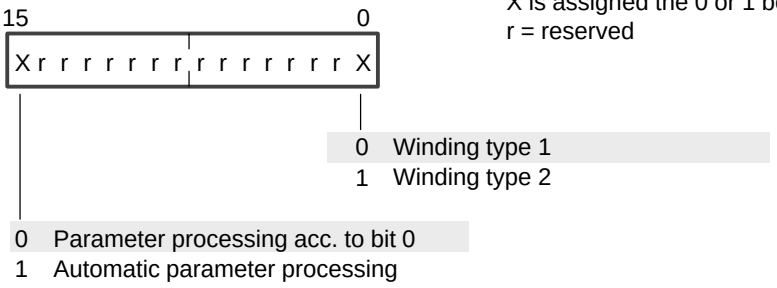
The following parameters to be changed for winding change-over are available once for each winding type:

Ident. no.	Parameter	see page
S-x-0091	Bipolar speed limit value	9-20
S-x-0100	P component of speed controller	4-7
S-x-0101	Integral action component of speed controller	4-7
S-x-0102	D component of speed controller	4-7
S-x-0106	P component 1 of current controller	4-14
S-x-0107	Integral action component 1 of current controller	4-14
S-x-0109	Motor peak current	9-47

Ident. no.	Parameter	see page
S-x-0111	Motor zero-speed current	9-48
S-0-0113	Maximum motor speed (n_{max})	9-48
S-0-0119	P component 2 of current controller	4-14
S-0-0120	Integral action component 2 of current controller	4-14
S-x-0126	Torque threshold Md_x	9-18
S-0-0158	Output threshold P_x	9-25
P-x-1002	Loop gain factor of position controller, spindle	5-18
P-x-1011	P component of speed controller, spindle	5-7
P-x-1012	Integral action component of speed controller, spindle	5-7
P-x-0013	Actual value smoothing interval	
P-x-1024	Loop gain increase, spindle	5-18
P-x-1025	Speed loop gain increase, spindle	5-18
P-x-1027	Orientation acceleration	5-23
P-0-0027	Braking current limitation	8-7
P-0-0040	Setpoint filter ON	
P-0-0041	Time constant for current setpoint	

In automatic operation, the parameters will always be processed which belong to the current winding change-over.

Parameter configuration

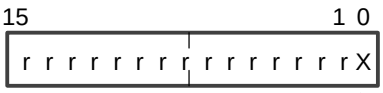


P-0-1052 Winding change-over status word

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The currently active winding type can be queried with this parameter. The winding change-over preselection can already programmed for another winding type.

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

0 Winding type 1
1 Winding type 2

5.9 Synchronous spindle operation

S-0-0223 Command "Drive-controlled synchronous operation"

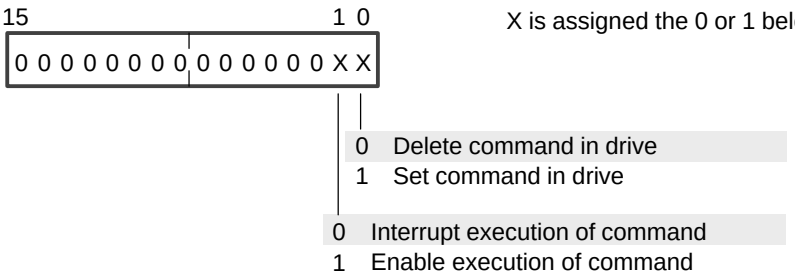
Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This command is used to synchronise the spindle to a master spindle. The type of synchronisation is defined in the synchronous operation parameter S-0-0225.

The cyclic speed setpoints are not active until the command is deleted again.

- In the event of an error in diagnostics class 1 of the **synchronised spindle**, synchronous operation is cancelled.
- In the event of an error in diagnostics class 1 of the **master spindle**, synchronous operation is retained.

Parameter configuration:



S-0-0224 Synchronisation setpoint source

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The synchronisation setpoint source defines the setpoints or actual values of the master spindle to be used as setpoints by the synchronised spindle.

- Setpoints from SERCOS interface message:
  - speed setpoint S-0-0036 (see page 4-2)
  - position setpoint P-0-1029 (see page 5-16)
- Actual values from external encoder
  - external spindle speed actual value P-0-1008 (see page 5-40)
  - actual position value 2 of spindle P-0-1031 (see page 5-17)

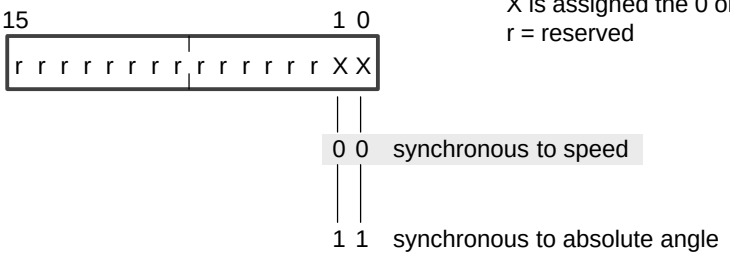
S-0-0225 Synchronous operation parameter

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Defines the type of spindle synchronisation activated with the command ”Drive-controlled synchronous operation”:

- **Speed synchronisation**
  Synchronous operation with a programmable speed transmission ratio, monitoring via a synchronous run window for speed (S-0-0183) and the synchronous run error limit of speed (S-0-0184). See section 5.9.1 .
- **Absolute angle synchronisation**
  Determination via synchronous position offset (S-0-0230) and spindle angular position (S-0-0153), see section 5.9.2 .

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

5.9.1 Speed synchronisation

The master spindle and synchronised spindles can be operated synchronously with any transmission ratio.
The transmission ratio is calculated from the ratio between the master spindle revolutions and the synchronised spindle revolutions:

$$\text{Transmission ratio} = \frac{\text{master spindle revolutions}}{\text{synchronised spindle revolutions}}$$

S-0-0226 Master spindle revolutions

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entry: -2^{31} ...$+2^{31}-1$ [rpm], integers

S-0-0227 Synchronised spindle revolutions

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

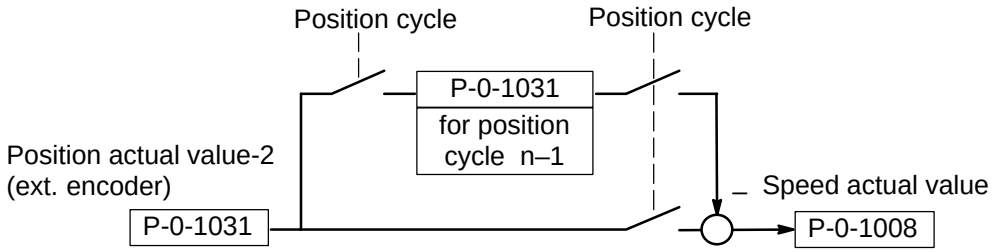
Entry: -2^{31} ...$+2^{31}-1$ [rpm], integers

Monitoring

P-0-1008 External speed actual value of spindle

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The drive stores the current spindle speed, calculated from the position difference of an external encoder, in this parameter. This value is the setpoint for speed synchronisation and can only be read.



S-X-0183 Synchronous run window for speed

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Difference between n_{set} of the master spindle and n_{act} of the the synchronised spindle permitted for synchronous operation.
The drive sets the message Speed-synchronous run. This message can be assigned to a real-time status bit in the drive status word and transferred to the NC for further processing.

Entry: 0 ... 90 % n_{max}

Translatory preferred weightings

1. Metric: 1×10^{-6} m/min ≙ 1 LSB
2. Imperial: 1×10^{-5} in/min ≙ 1 LSB

Rotary preferred weightings:

1. Minute: 1×10^{-4} rpm ≙ 1 LSB
2. Second: 1×10^{-6} rev/sec. ≙ 1 LSB

S-X-0184 Synchronous run error limit for speed

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Max. admissible difference between nset of the master spindle and nact of the synchronised spindle. If this value is exceeded, the Synchronous run error message is set. This message can be assigned to a real-time status bit in the drive status word and transferred to the NC for further processing.

Entry: 0 ... 90 % n_{max}

Translatory preferred weightings

1. Metric: 1×10^{-6} m/min ≙ 1 LSB
2. Imperial: 1×10^{-5} in/min ≙ 1 LSB

Rotary preferred weightings:

1. Minute: 1×10^{-4} rpm ≙ 1 LSB
2. Second: 1×10^{-6} rev/sec. ≙ 1 LSB

S-0-0326 Speed-synchronous run message

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

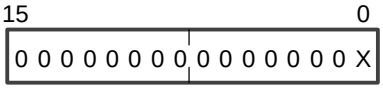
With this ident. no., the message ”Speed-synchronous run” can be assigned to a real-time status bit (S-0-0305).

The message is set if the difference between:

- n_{set} of the master spindle, and
- n_{act} of the synchronised spindle

is **within** the programmed speed-synchronous run window S-0-0183.

Parameter configuration



X is assigned the 0 or 1 below it.

0 no speed-synchronous run
1 speed-synchronous run reached

S-0-0327 Speed-synchronous run error message

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

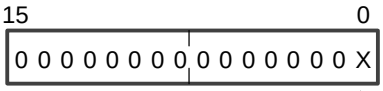
With this ident. no., the "Speed-synchronous run error" message can be assigned to a real-time status bit (S-0-0305).

The message is set when the difference between

- n_{set} of the master spindle, and
- n_{act} of the synchronised spindle

is **outside** the programmed "Synchronous run error limit for speed" S-0-0184.

Parameter configuration



X is assigned the 0 or 1 below it.

0	Speed-synchronous run error limit not exceeded
1	Speed-synchronous run error limit exceeded

5.9.2 Angle synchronisation

The master spindle and the synchronised spindle can be operated synchronously with any angular displacement. For angle-synchronous spindle operation, the position control loop is closed.

S-X-0230 Synchronisation offset

Phase 3	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The synchronisation offset describes the angular displacement between the reference points of the master spindle and the synchronised spindle.

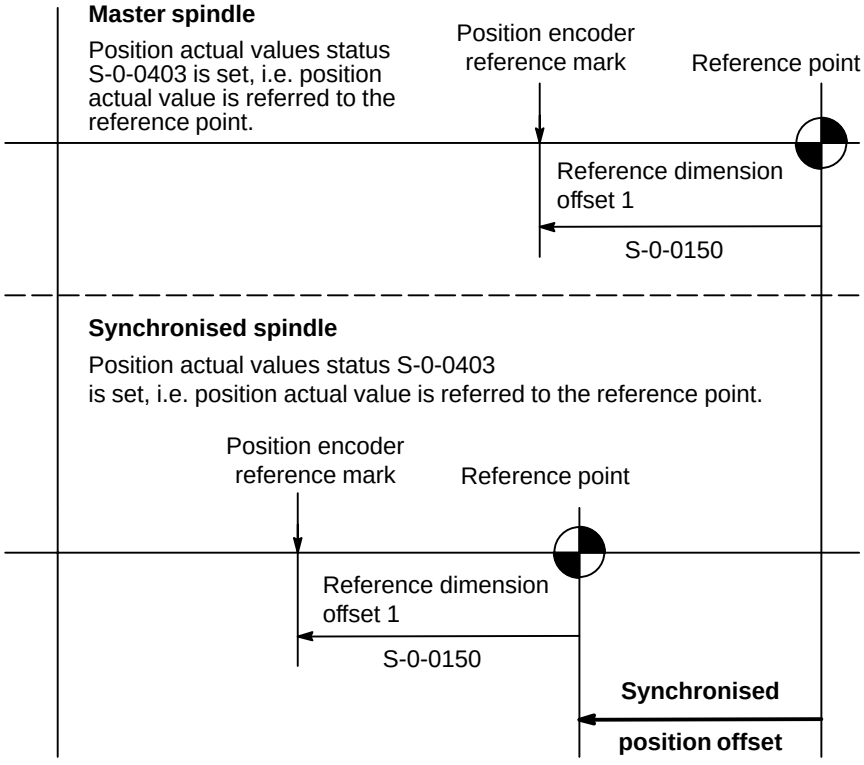


Fig. 5.7: Synchronised position offset

Entry: -2^{31} ... $+2^{31}-1$

Translatory preferred weightings

1. Metric: 1×10^{-7} m $\triangleq$ 1 LSB
2. Imperial: 1×10^{-6} in $\triangleq$ 1 LSB

Rotary preferred weightings:

$$\frac{360 \text{ deg.}}{3\,600\,000} = 0.001 \text{ angular degrees } (= 1 \times 10^{-4}) \triangleq 1 \text{ LSB}$$

S-X-0268 Angular displacement

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The angular displacement is added to the position setpoint as an offset. Thus, a displacement between the master spindle and the synchronised spindle can be adjusted for angle-synchronous operation.

Entry: -2^{31} .... $+2^{31}-1$

Feed-forward control

The feed-forward control of the synchronised spindle reduces the following error between the master spindle and the synchronised spindle. Feed-forward control is always active in synchronous operation.

P-X-1009 Feedrate feed-forward control, spindle

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The feedrate feed-forward control is used to reduce the following error in stationary mode.
100 % $\triangleq \times$ Following distance “0”

Entry: 0 ... 110 %

P-X-1010 Acceleration feed-forward control, spindle

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The acceleration feed-forward control is used to reduce the following error when accelerating or braking.
100 % $\triangleq \times$ Following distance “0”, the value to be set should be determined via the following error display of the diagnostics programme DSS-D.

Entry: 0 ...500

Monitoring

S-X-0228 Synchronous run window, position

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Difference between the position setpoint of the master spindle and the position actual value of the synchronised spindle permitted for synchronous operation.
The drive sets the message position-synchronous run. This message can be assigned to a real-time status bit in the drive control word and transferred to the NC for further processing.

Entry: 0 ... L_{max}

Translatory preferred weightings

1. Metric: 1×10^{-7} m $\triangleq$ 1 LSB
2. Imperial: 1×10^{-6} in $\triangleq$ 1 LSB

Rotary preferred weightings:

$$\frac{360 \text{ deg.}}{3\,600\,000} = 0.001 \text{ angular degrees } (= 1 \times 10^{-4}) \triangleq 1 \text{ LSB}$$

S-X-0229 Synchronous run error limit, position

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Maximum permitted difference between the position setpoint of the master spindle and the position actual value of the synchronised spindle. If this value is exceeded, the message Synchronous run error is set. This message can be assigned to a real-time status bit in the drive status word and transferred to the NC for further processing.

Entry: 0 ... L_{max}

Translatory preferred weightings

1. Metric: 1×10^{-7} m $\triangleq$ 1 LSB
2. Imperial: 1×10^{-6} in $\triangleq$ 1 LSB

Rotary preferred weightings:

$$\frac{360 \text{ deg.}}{3\,600\,000} = 0.001 \text{ angular degrees } (= 1 \times 10^{-4}) \triangleq 1 \text{ LSB}$$

S-0-0308 Position-synchronous run message

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With this ident. no., the message ”Position-synchronous run” can be assigned to a real-time status bit (S-0-0305).

The message is set if the difference between:

- the position setpoint of the master spindle, and
- the position actual value of the synchronised spindle

is **within** the programmed position-synchronous run window S-0-0228.

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

X is assigned the 0 or 1 below it.

0 no position-synchronous run
1 position-synchronous run reached

S-0-0309 Position-synchronous run error message

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With this ident. no., the ”Position-synchronous run error” message can be assigned to a real-time status bit (S-0-0305).

The message is set when the difference between

- the position setpoint of the master spindle, and
- the position actual value of the synchronised spindle

is **outside** the programmed ”Synchronous run error limit for position” S-0-0229.

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

X is assigned the 0 or 1 below it.

0 Synchronous run error limit not exceeded
1 Synchronous run error limit exceeded.

6 Parameters for C-axis function

6.1 Functions

The C-axis function comprises the complete set of servo functions with the following restrictions:

- The C-axis is a rotary axis
- The valid encoder is determined by the operating mode. It cannot be swiched over separately.

The C-axis function is activated by changing the operating mode in the control word of the MDT, bits 8–9. These bits serve to change over from the main operating mode S-0-0032 to one of the three secondary modes S-0-0033 – S-0-0035.

The following secondary mode must be specified:

- Position control with motor encoder
  for applications without a gearbox, or
- Position control with external encoder.

Change-over is confirmed by the actual operating mode in the drive status word of the DT, bits 8–9.

6.1.1 Drive-controlled C-axis change-over

The master changes the drive to a secondary mode (e.g. bit 8 = 1 in the MDT control word).
The drive is uncoupled from the cyclic speed setpoint.
Depending on the referencing status, the axis may take one of the following positions:

Referenced axis:
After change-over, the axis is in the position specified with the position setpoint S-0-0047.

Non-referenced axis:
After change-over, the axis may be in any position.

Axis to be referenced without reference point encoder.
The standing spindle starts referencing with a search speed of 120 rpm. Change-over is initiated after referencing.

6.1.2 NC-controlled C-axis change-over

The drive is uncoupled from the cyclic speed setpoint and changes to position control. It accepts the cyclic position setpoints S-0-0047 from the NC. The control unit must ensure that the position setpoint can be accepted without a setpoint step-change. Otherwise, setpoint errors will be signalled.

6.2 C-axis referencing

The C-axis is referenced like a servo axis. The following options are available:

- ❑ Command ”Drive-controlled referencing”, P-0-0148, see page 4-37
- ❑ Command ”NC-controlled referencing”, S-0-0146, see page 4-29
- ❑ Referencing without reference point switch, S-0-0147, bit 5 = 1, see page 4-25.
  With motor encoder directly, i.e. no gearbox between the motor and the load:
  - □ With integrated **single-turn absolute encoder (STG)**
    After DM start-up, the spindle has been automatically referenced.
  - □ With integrated **gear encoder**
    The spindle has been automatically referenced after one spindle revolution.

7 Parameters for servo and spindle functions

7.1 Basic settings

P-0-0001 Operating frequency of the power output stage

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

High operating frequencies result in low noise, but also in lower output currents.
Thus, the operating frequency must be designed according to the motor–module assignment, i.e. the drive configuration.

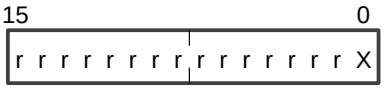
Entries: 2000 / 4000 / 8000 / 8001 Hz
With 8001 Hz: 16 kHz actual current measurement.

P-0-0017 Sync Enable

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Using this parameter, the cycle frequency of a supply module without a SERCOS interface is synchronised to the cycle frequency of the connected inverter modules.

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

0 no synchronisation
1 VM-synchronised

☞ **Note** **Synchronisation may only be enabled in one inverter of the entire drive set. In any case, it must be set once.**

P-0-0028 Positive hardware limit switch

–	–	D → M	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

see P-0-0029.

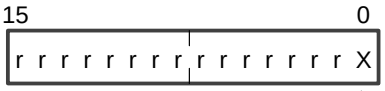
P-0-0029 Negative hardware limit switch

–	–	D → M	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Both parameters are images of the limit switch inputs:

- X06.6 (IN2) for positive traversing direction, and
- X06.7 (IN3) for negative traversing direction.

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

0 limit switch not exceeded
1 limit switch exceeded (IN = 24V)

Effect with IN = 24V:

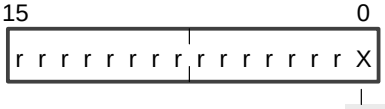
→ S-0-0011 Diagnostics class 1, bit 13 is set

P-0-0030 Hardware limit switch, polarity parameter

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The limit switch input can be selected active high or low.

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

0 active high: limit switch responds with 24V
1 active low: limit switch responds with 0V

P-0-0026 Flow reduction

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In order to reduce no-load losses of the motor, the magnetic flow is reduced depending on the load with this parameter.

Parameter configuration:

15 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X

X is assigned the 0 or 1 below it.

0 flow reduction off
1 flow reduction on

0 active with speed control
1 active with speed and position control

P-X-0035 Dead time compensation

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter compensates the operating times of the power output stage by a voltage precontrol of pulse width modulation.

Settings > 0 are recommended for special cases only.
They lead to an improved current controller gain in the torque zero crossing while having a negative effect on the sinusoidal shape of the output current.

Entries: 0 ... 100 %

7.2 Option: Analog outputs OM 04

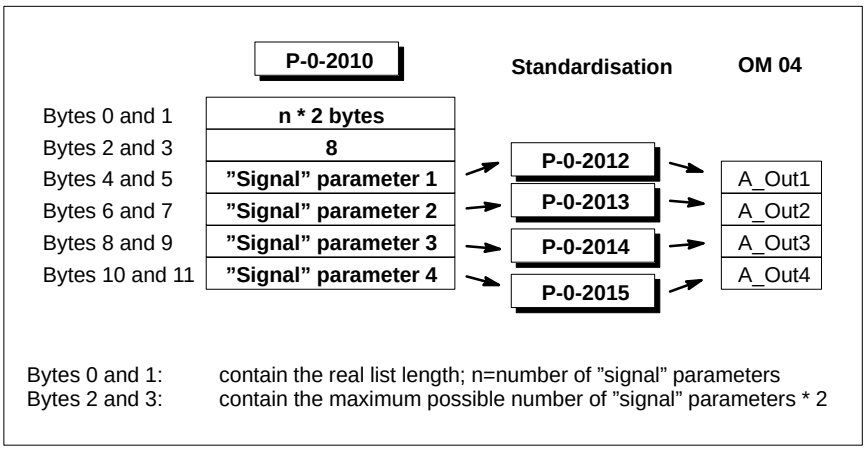
Analog output of the internal signals of the drive is possible through the OM 04 circuit board with an integrated D/A converter (voltage range: ± 10 V; resolution: 12 bits; output resistor: 100 Ω).

P-0-2010 DAC channels: configuration list

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter P-0-2010 contains a list of the parameter numbers to be output at OM 04.
Only those signals can be output which have their own parameter number (speed actual value: S-0-0040; speed setpoint: S-0-0036, etc.).
Parameters P-0-2012 to P-0-2015 define a maximum value and a possible offset (= standardisation) for every signal to be output.

☞ **Note** **Unused outputs must be assigned ident. no. S-0-0000**



Bytes 0 and 1: contain the real list length; n=number of "signal" parameters
Bytes 2 and 3: contain the maximum possible number of "signal" parameters * 2

Default settings of P-0-2010:

A_Out1: Speed setpoint (S-0-0036)
A_Out2: Speed actual value (S-0-0040)
A_Out3: Torque setpoint (S-0-0080)
A_Out4: Torque actual value (S-0-0084)

☞ **Note** **The drive updates the digital input data of the D/A converters with every cycle of the respective controller rather than immediately after a change in the digital source signal.**

P-0-2012 DAC channel 1: Maximum value, offset

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Defines the following for ”signal” parameter 1 in P-0-2010:

- the value for which the D/A converter outputs its maximum analog value of +10V,
- the value for which the D/A converter outputs 0V (offset).

Before entering the maximum value and the offset, the ”signal” parameter must have been defined in P-0-2010, because this allows for automatic acceptance of the unit of measure, decimal places, min./max. values etc. to P-0-2012.

☞ **Note** **An incorrect standardisation of the signals can produce a D/A converter overflow!**

Default setting: 10 V = n_N
Offset = 0

P-0-2013 DAC channel 2: maximum value, offset

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

As P-0-2012, but for ”signal” parameter 2 of P-0-2010.

Default setting: 10 V = n_N
Offset = 0

P-0-2014 DAC channel 3: maximum value, offset

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

As P-0-2012, but for ”signal” parameter 3 of P-0-2010.

Default setting: 10 V = 100 %
Offset = 0

P-0-2015 DAC channel 4: maximum value, offset

Phase 2,3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

As P-0-2012, but for ”signal” parameter 4 of P-0-2010.

Default setting: 10 V = 100 %
Offset = 0

8 Drive functions

8.1 Activate/halt drive

8.1.1 Master control commands

The control commands for the drive are contained in the control word of the master data telegram for every drive.
For structure of master data telegram, see page 3-11.

Bit 13 Drive halt

1 Setpoints are effective

1→0 Drive brakes according to the preselected braking ramp (Id. no. 00138) until standstill is reached, and remains in this state while bits 14 and 15 = 1.
See “Halting the drive”, section 8.1.3.

0 Drive halt, setpoints are disabled

0→1 Drive accelerates up to preset setpoint in accordance with the preselected acceleration ramp (Id. no. 00138).

Bit 14 Drive enable

1 Drive enabled

1→0 Immediate torque shutdown, independent of bit 13 and 15. The drive decelerates without control.

0 No enable

Bit 15 Drive on

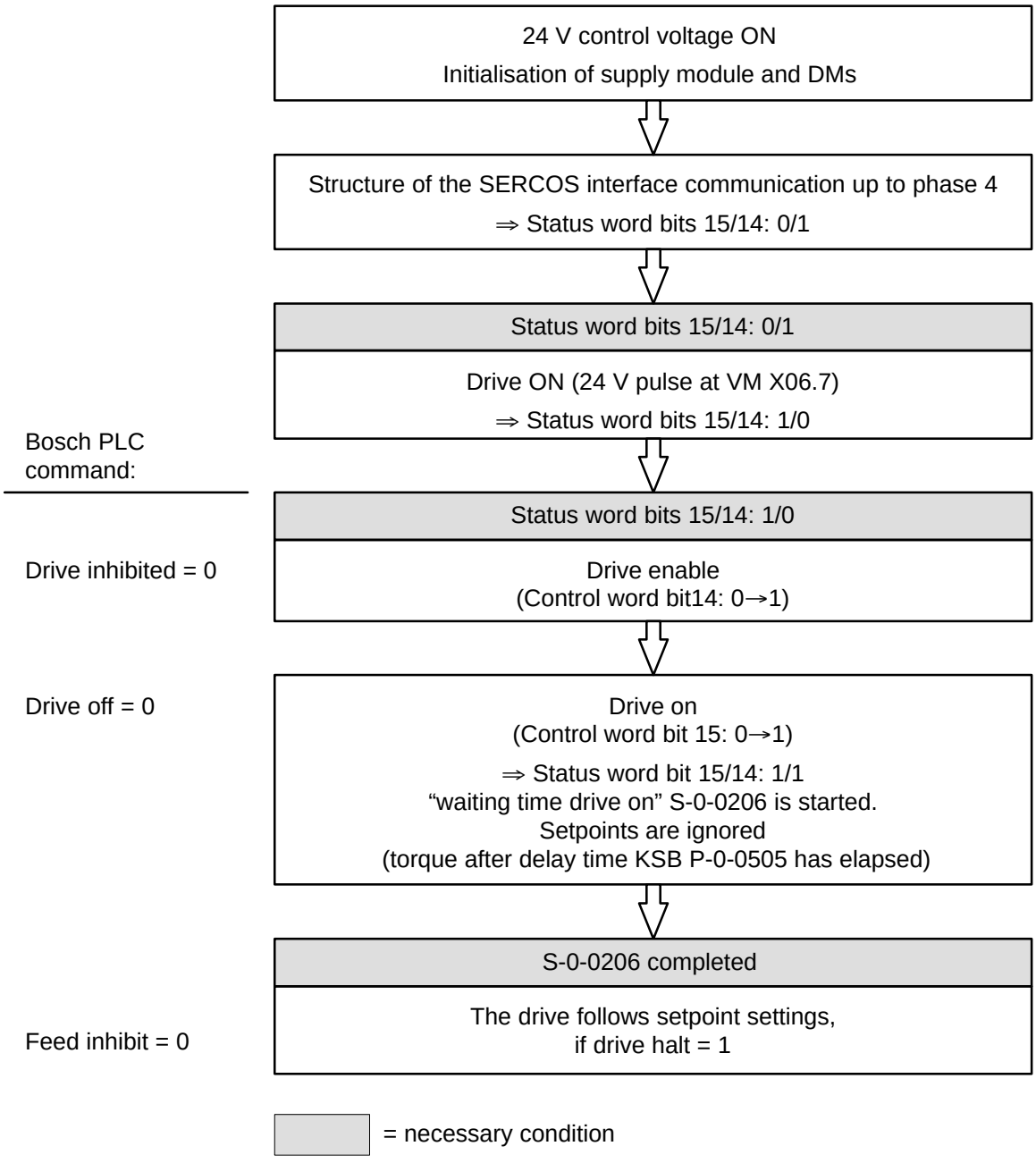
1 Drive on

1→0 Drive brakes to standstill as quickly as possible, torque is then shut down. Only possible as long as bit 14 = 1.

0 Drive off

☞ **Note** **Bits 13, 14 , 15 = 1: Ready for operation, drive follows setpoint inputs.**

8.1.2 Switching drive to “ready”



CAUTION !

In order to avoid inadmissable wear of the holding brake, the waiting time S-0-206 may not elapse before the brake has been completely released.

S-0-0206 Waiting time drive on

Phase 3,4	–	–	–	FEPROM	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

After setting the signals “drive enable” and “drive on” (bits 14 and 15 in the control word), the drive does not follow the setpoint inputs until the waiting time specified here has elapsed.
The torque becomes effective immediately, regardless of this waiting time.

Entries: 0 ... $+2^{16}-1$
Weighting 0.1 ms

P-0-0505 KSB enable delay

Phase 3,4	–	–	–	FEPROM	–	
Change-able	Init	Real-time bit	Cyclic	Recovery	Weighting	

For motors with a holding brake, this parameter must be set to a value > 0. When the signals ”Drive-enable” and ”Drive-on” (bits 14 and 15 of the control word) have been set, the torque does not become active before a mimimum KSB delay time has elapsed.

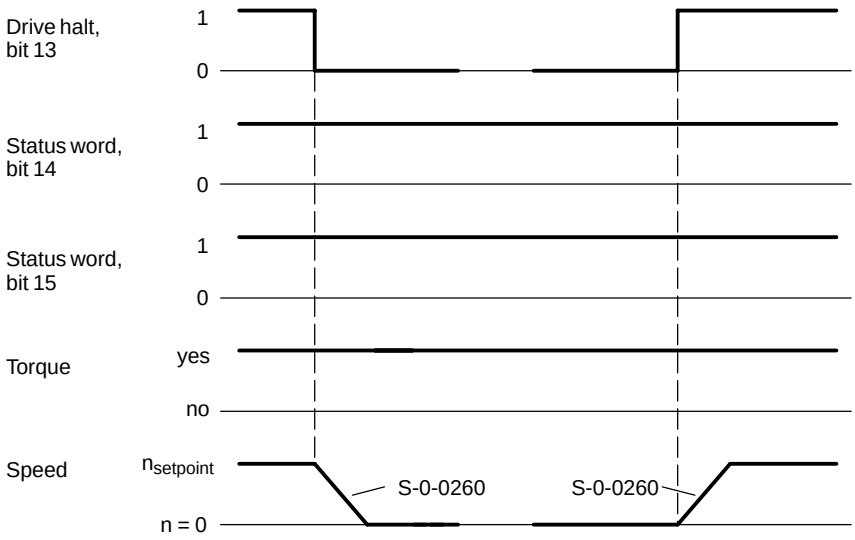
Entries:
0: Delay time off
0...79: 80 ms minimum time
> 80: set value in [ms]

8.1.3 Halting the drive with control

The drive is shut down, in accordance with the acceleration S-0-0138.

Conditions:

- External enable FG provided (24 V at X06.3, DM module)
- Drive enable (Drive control word bit 14 = 1)
- Drive on (Drive control word bit 15 = 1)

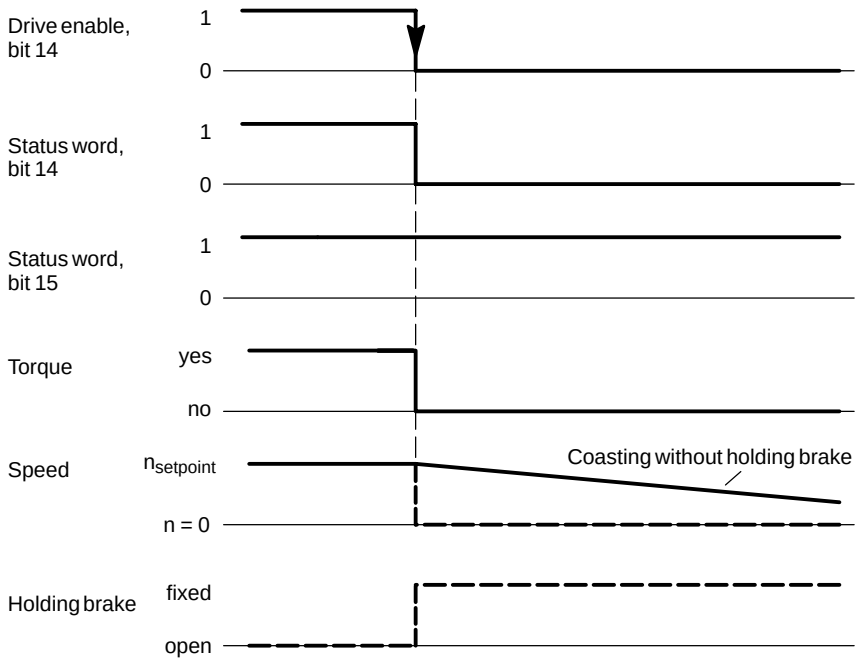


8.1.4 Switching the drive to torque-free state

Undelayed switching to torque-free state

Precondition:

- ○ External enable FG provided (24 V at X06.3, DM module)

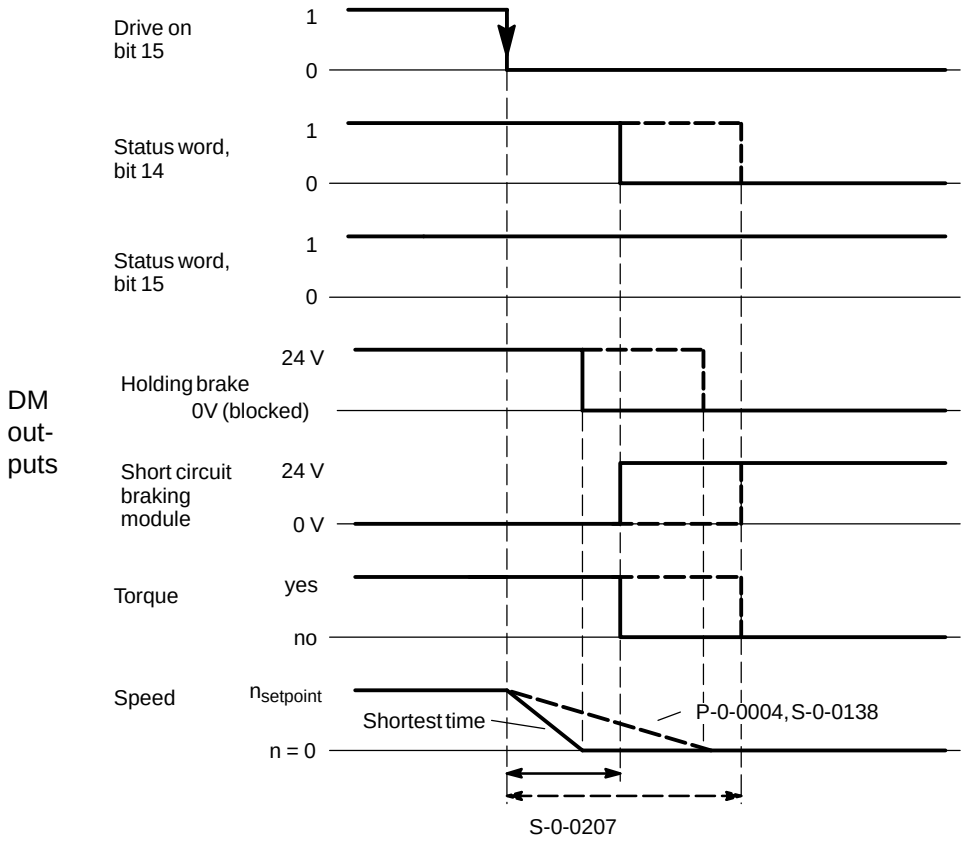


Delayed switching to torque-free state

Precondition:

- External enable FG provided (24 V at X06.3, DM module)
- Drive enable provided (bit 14 = 1)

Delayed switching to torque-free state occurs after an error following EMERGENCY-OFF or when the signal ”Drive on” has been cleared.



CAUTION !

The holding brake is not a working brake and may be operated only when the axis is stationary.

In order to avoid damage to the holding brake, the motor must reach n = 0 before the waiting time S-0-0207 has elapsed.

S-0-0207 Waiting time drive off

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

After the signal “drive on” has been cleared (bit 15 in the control word), the torque is maintained in the drive until the waiting time specified here has elapsed.

Since the holding brake is switched on after the waiting time S-0-0207 has elapsed, the selected waiting time must be at least long enough to allow the motor to reach n = 0 within this time.
The following must be observed:

- required braking time of drive until n = 0, when halting with ramp (P-0-0004), including ramp time
- Switch-off time until brake is blocked.

Entries: 0 ... $+2^{16}-1$
Weighting 0.1 ms

P-0-0004 Halting mode with drive off

Phase 2,3	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter determines how the drive is halted with **delayed** switching to torque-free state.

Parameter configuration:

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X

X is assigned the 0 or 1 below it.

0 0	halting in shortest possible time without ramp
0 1	halting with ramp S-0-0138
1 0	controlled halting by master

P-0-0027 Braking current limitation

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The torque-forming current during halting within the shortest possible time is limited to the specified value by this parameter. Thus, the braking energy converted in the d.c. link can be reduced.

Entries: 0 ... 100 % of the admissible maximum current
(module or motor)

8.2 Axis error compensation

8.2.1 Reversing play

S-X-0058 Reversing play

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The reversing play describes the sum of the batches between drive and load if the direction is reversed, relative to the position data.

Weighting and preferred weighting in accordance with section 3.4.1.

☞ **Note** **With activated axis error compensation in the master, parameter S-X-0058 must be set to “0”.**

8.2.2 Axis error compensation in general

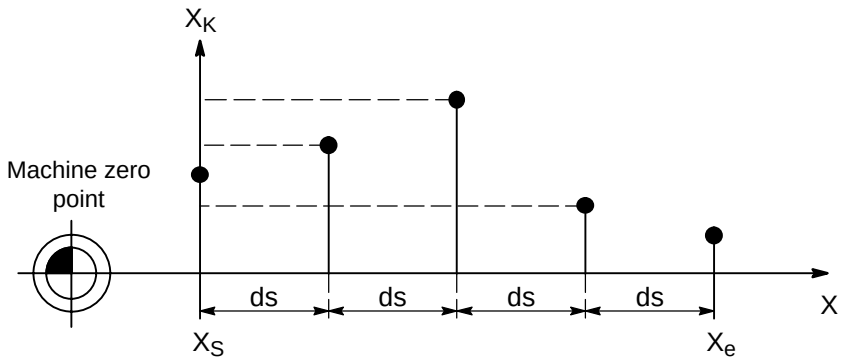
Using the parameters for general axis error compensation, systematic errors in position measurement can be compensated for which may occur with position-controlled axes.

Systematic position errors are caused by:

- Gear and spindle pitch errors with indirect position measurement using motor encoders
- Measuring system errors with direct and indirect position measurement

The correct position actual values are determined by a suitable measuring process, e.g. a laser interferometer, and calculated against the compensation value:
Compensation value = position setpoint - ”correct” position actual value.

Mode of functioning



X_S = Table start position
X_e = Table end position
X_K = Compensation value
ds = Center point distance
X = Position

Fig. 8.1: Axis error compensation

- Determine smallest axis position to be compensated as table start position and enter it in P-0-0056.
- Specify the center point distance so that the whole working range between the table start position and the table end position is covered. Enter value in P-0-0057.

$$ds\ [mm] = \frac{A\ [mm]}{499}$$

ds = center point distance
A = working range

$$A\ [mm] = X_e\ [mm] - X_s\ [mm]$$

- enter compensation values in the compensation value table P-0-0058:
  - Values 1 to 500 for positive direction of motion
  - Values 501 to 1000 for negative direction of motion

  If not all center point distances are needed, the remaining table values must be set to 0.
  Before the table start position, the first compensation value of the table is active, after the table end position the last compensation value will be retained.
- Activate axis error compensation with bit 0 of control word P-0-0055. The compensation values will be immediately activated as soon as the position actual values status S-0-0403 has been set, i.e. when the axis has been referenced.
  High compensation values thus result in a setpoint jump which may cause instable conditions in the position control loop. Such setpoint jumps should be avoided by assigning ”0” to the start position and end position of the compensation value table.
- Load the compensation value tables via the SERCOS interface or DSS-D and save them in the FEPROM of the Personality Module with the command ”Save working memory” (S-0-0264). Thus, they can be easily uploaded after a module change.

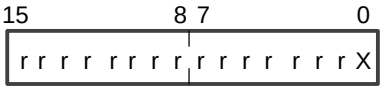
○ For diagnostics purposes, the current compensation value can be output with P-0-0059.

P-0-0055 Axis error compensation: control word

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter initiates axis error compensation when the axis has been referenced.

Parameter configuration:



X is assigned:
0 = no error
1 = error detected
r = reserved

Bit 0: activation

0	no axis error compensation
1	axis error compensation active

P-0-0056 Axis error compensation: compensation table start position

Phase 3	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The start position is the lowest compensated position value which thus defines the beginning of the compensation range. For negative position polarity (S-0-0055), the highest compensated position value must be entered.

Weighting and preferred weighting in accordance with section 3.4.1 .

P-0-0057 Axis error compensation: compensation table center point distance

Phase 3	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter defines the distance between two adjacent table values. The center point distance is identical for the entire working range between the table start position and the table end position:

$$ds\ [mm] = \frac{A\ [mm]}{499}$$

ds = center point distance
A = working range

Entries: 0.0000001 ... 0.1 [m]
0.0001 ... 100 [deg.]
For preferred weighting of position data, see section 3.4.1.

P-0-0058 **Axis error compensation: compensation value table**

Phase 3	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains a list of 1000 values with 4 bytes of data. Compensation values 1 – 500 are designed for positive speed setpoints, values 501 – 1000 for negative speed setpoints.

Entries: –0.005 ... +0.005 mm
For preferred weighting of position data, see section 3.4.1.

Procedure

1. Define table start position.
2. Determine ”ds” center point distance and enter value in P-0-0057.
3. Enter compensation value table in P-0-0058.
4. Activate axis error compensation by setting parameter P-0-0055, bit 0.

P-0-0059 **Axis error compensation: current compensation value**

–	–	–	–	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the current compensation value which can be read for diagnostics purposes.
This value depends on the position polarity parameter S-0-0055.

8.3 Probe function

With the command “probe cycle”, the master initiates the measuring process via a probe connected to the supply module.

The following is possible:

- individual measuring
- multiple, rapid measuring using real-time bits.

If no further measurements are to be performed, the master deletes the command input.

Procedure

- The probe control parameter S-0-0169 specifies the edge: positive, negative or both edges
- The probe enable S-0-0405 enables measurement specifically.
- The parameter S-0-0401 (probe) signals the presence of the selected probe edge. It can be assigned to a real-time status bit.
- When the edge has arrived, the drive writes the measured value in the parameter pertaining to the edge S-0-0130 or S-0-0131 and sets the status parameters S-0-0409 or S-0-0410 (positive/negative measured value latched)
- Parameters S-0-0409 and S-0-0410 (measured value latched) can be assigned to the real-time status bits for rapid measuring. They are, however, also stored in the measured value status S-0-0179.
- In order to initiate the next measuring process, the probe enable must be reset once. The status signals are thus also reset.

S-0-0170 Command “Probe cycle”

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This command intiates the measuring process.

Parameter configuration:

15 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X

X is assigned the 0 or 1 below it.

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

S-0-0169 Probe control parameter

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With this parameter, the active edge is specified for the probe measuring cycle (positive, negative, both edges).

Parameter configuration:

15 ... 1 0

r r r r r r r r r r r r r r X X

X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Probe 1, positive edge

0 positive edge not active
1 positive edge active

Bit 1: Probe 1, negative edge

0 negative edge not active
1 negative edge active

S-0-0405 Probe 1-enable

Phase 4	–	M → D	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “probe 1-enable” is assigned to a real-time status bit (S-0-0305) via this ident. no.
The drive only queries the probe 1-enable if the command “probe cycle” is active. After each measurement, the master must set the enable to “0” and then set it to “1” again for a new measurement.

Parameter configuration:

15 ... 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

X is assigned the 0 or 1 below it.

0 Probe not enabled
1 Probe enabled

S-0-0401 Probe 1

	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “probe 1” is assigned to a real-time status bit (S-0-0305) via this ident. no.
Probe 1 is set when the preselected probe edge arrives, but evaluated by the drive only if the command “probe cycle” is active and the probe enabled (S-0-0405).

Parameter configuration:

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

X is assigned the 0 or 1 below it.

0 probe not actuated
1 probe actuated

S-0-0409 Measured value 1 (positive) latched

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “Measured value 1 (positive) latched” is assigned to a real-time status bit (S-0-0305) via this ident. no.
The bit is only set if:

- command “probe cycle” is active (S-0-0170)
- probe 1 enabled (S-0-0405)
- probe 1 reports positive edge (S-0-0401)

At the same time, the drive saves the current position actual value in the parameter measured value1 positive (S-0-0130).
The bit is deleted again when the master deletes the command “probe cycle” or the probe 1-enable.

Parameter configuration:

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

X is assigned the 0 or 1 below it.

0 Measured value 1 (positive), not latched
1 Measured value 1 (positive) latched

S-0-0410 Measured value 1 (negative) latched

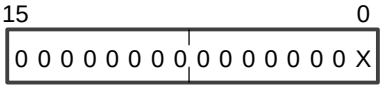
–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “Measured value 1 (negative) latched” is assigned to a real-time status bit (S-0-0305) via this ident. no.
The bit is only set if:

- command “probe cycle” is active (S-0-0170)
- probe 1 enabled (S-0-0405)
- probe 1 reports negative edge (S-0-0401)

At the same time, the drive saves the current position actual value in the parameter measured value1 (negative) (S-0-0131).
The bit is deleted again when the master deletes the command “probe cycle” or the probe 1-enable.

Parameter configuration:



X is assigned the 0 or 1 below it.

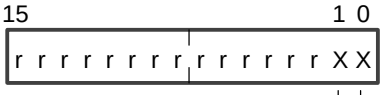
0 Measured value 1 (negative), not latched
1 Measured value 1 (negative) latched

S-0-0179 Measured value status

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

When the drive saves one or more measured values while the command “probe cycle” is active, it sets the corresponding bit in the measured value status at the same time. Both bits are deleted again when the master deletes the probe 1-enable.

Parameter configuration:



X is assigned the 0 or 1 below it.
r = reserved

Bit 0: Measured value 1 (positive) latched
0 not latched
1 latched

Bit 1: Measured value 1 (negative) latched
0 not latched
1 latched

S-0-0130 Measured value 1 (positive)

–	–	–	DT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With a **positive edge** from probe 1 (S-0-0401), the drive saves the position actual value of the active encoder specified in the operating mode (S-0-0032 to S-0-0035) in this parameter during the measuring cycle.
The value can be read out by the master later on.

S-0-0131 Measured value 1 (negative)

–	–	–	DT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

With a **negative edge** from probe 1 (S-0-0401), the drive saves the position actual value of the active encoder specified in the operating mode (S-0-0032 to S-0-0035) in this parameter during the measuring cycle.
The value can be read out by the master later on.

8.4 Parked axis

S-0-0139 Command “Parked axis”

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

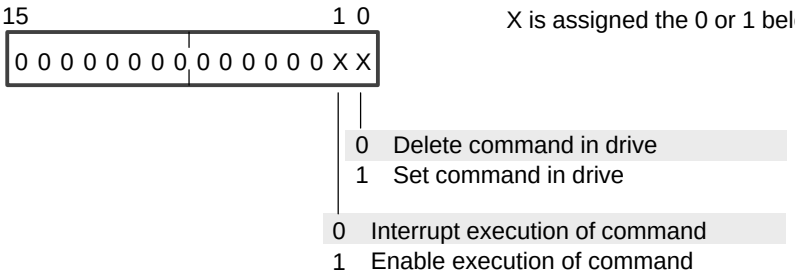
This command switches all monitoring functions related to the measuring system off in the drive.

- Position control
- Measuring loop monitoring (encoder hardware)
- Monitoring of the position window (S-0-0057)

The position actual values status (S-0-0403) is deleted by the drive and it reports no more errors of the diagnostics class 1 (S-0-0011).
When all monitoring functions have been switched off, the command alteration bit is set in the data status for acknowledgement to the master.

When the command is deleted, all above-named monitoring functions are switched back on and the drive must perform referencing in order to be able to relate the position actual values to the reference point again.

Parameter configuration:



8.5 Traverse to fixed stop

S-0-0149 Command “Traverse to fixed stop”

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This command is for clamping a part.
The drive receives a position input “within” the part, so that a lag arises which the position controller cannot eliminate. Therefore, all controller monitoring functions are switched off in the drive in every operating mode, otherwise they would lead to an error message in diagnostics class 1 when the drive is blocked by the fixed stop.

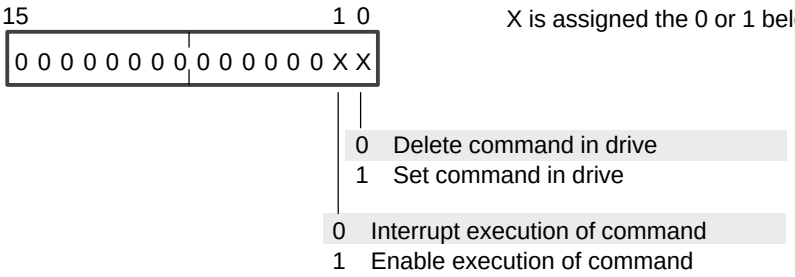
The command is acknowledged by setting the command alteration bit in the data status, if:

- all controller monitoring functions has been switched off
- $|M_d| \geq |M_{dlimit}|$
- $n_{act} = 0$ (is monitored by the master while the command is running)

If the running command is interrupted, the controller monitoring functions are not switched off.

Before deleting the command, the master must accept the position actual value to its position setpoint. After the command has been deleted, the controller monitoring functions are reactivated

Parameter configuration:



9 Diagnostics parameters of the SERCOS interface

9.1 Drive status word

S-0-0135 Drive status

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to display the drive status on the master's monitor through the service channel as part of the drive telegram. For structure of DT, see page 3-13.

Parameter configuration

15 0

X X X X X 0 X X X X X 0 0 X X X

X is assigned the 0 or 1 below it.

0/1 **Bit 0: Transmission handshake**

Bit 1: Busy
0 step has been completed
1 processing step

0/1 **Bit 2: Error in service channel**

Bit 5: Alteration bit commands
0 no change in command status
1 change in command status

Bits 6/7: Real-time status bits
0/1 real-time status bit 1 (S-0-0304)
0/1 real-time status bit 2 (S-0-0306)

Bits 8–9: Actual mode
0 0 drive in main mode (defined by S-0-0032)
0 1 drive in secondary mode 1 (defined by S-0-0033)
1 0 drive in secondary mode 2 (defined by S-0-0034)
1 1 drive in secondary mode 3 (defined by S-0-0035)

0/1 **Bit 11: Alteration bit diagnostics class 3** (S-0-0013)

0/1 **Bit 12: Alteration bit diagnostics class 2** (S-0-0012)

Bit 13: Error in diagnostics class 1 (S-0-0011)
0 no errors
1 drive interlocked because of error

Bits 14–15: Ready
0 0 drive not ready for power connection (internal check not yet completed)
0 1 drive ready for power connection
1 0 drive control unit and power supply ready, drive without torque
1 1 drive operating: "Drive enable" and "Drive on" have been set and are active, drive has torque.

☞ **Note:**
Bit 15 changes from 1 → 0 only in the event of EMERGENCY OFF.

9.2 Status information

S-0-0095 Diagnostics

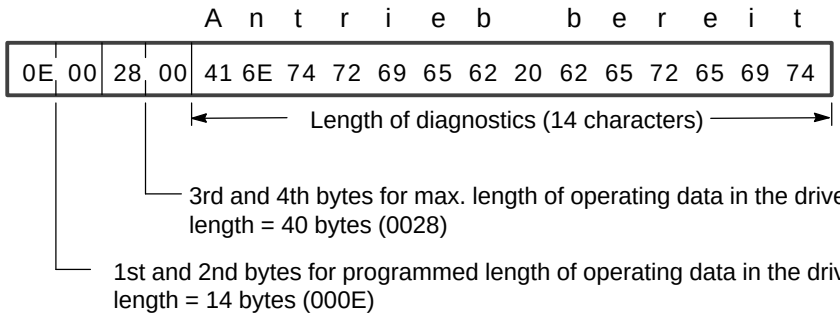
–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The diagnostics parameter contains the current operating status of the drive. The following clear text messages are generated by the drive and displayed by the master:

- status
- current warning
- the error with the highest priority

Examples of ”Drive ready” status:

Parameter configuration (variable length)



S-0-0134 Master control word

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter provides for additional support for commissioning and troubleshooting of the SERCOS interface ring by displaying the master control word on the master’s monitor through the service channel.

9.2.1 Diagnostics classes

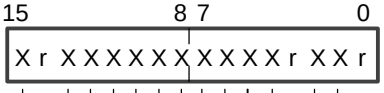
S-0-0011 Diagnostics class 1

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Drive interlock
Detection by the drive of an error of diagnostics class 1 has the following effect:

- optimum drive halting with subsequent torque removal
- setting of static error bit in diagnostics class 1 for the drive status. The error bit will be cleared when:
  - no error of diagnostics class 1 is present any more, **and**
  - the command "Reset diagnostics class 1" (S-0-0099) has been received through the service channel.

Parameter configuration



X is assigned:
0 = no error
1 = error detected
r = reserved

Bit 1: amplifier overtemperature shut-off (see S-0-0203, page 9-12)
Bit 2: motor overtemperature shut-off (see S-0-0204, page 9-14)
Bit 4: Control voltage fault
Bit 5: Feedback error (encoder, measuring system)
Bit 6: Error in electronic commutation system
Bit 7: Overcurrent
Bit 8: Overvoltage
Bit 9: Undervoltage fault
Bit 10: Phase fault in power supply
Bit 11: excessive controller deviation (see S-0-0159)
Bit 12: Communication error (see S-0-0014, page 9-9)
Bit 13: Position limit value exceeded, shut-down (see S-0-0049)
Bit 15: Manufacturer-specific error (see S-0-0129, page 9-4)

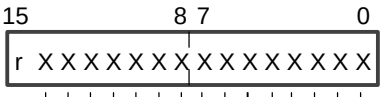
S-0-0129 Manufacturer's diagnostics class 1

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Drive interlock
An error in the manufacturer's diagnostics class 1 detected by the drive has the following effects:

- optimum drive halting with subsequent torque removal
- setting of "Manufacturer-specific error" in diagnostics class 1 (S-0-0011).
  The error bit will be cleared when:
  - no error of the manufacturer's diagnostics class 1 is present any more, **and**
  - the command "Reset diagnostics class 1" (S-0-0099) has been received through the service channel.

Parameter configuration



X is assigned:
0 = no error
1 = error detected
r = reserved

Bit 0: plausibility error of speed controller (P-0-0010, page 4-10)
Bit 1: overspeed
Bit 2: lag error (P-X-0502, page 9-24)
Bit 3: current controller synchronisation error
Bit 4: A/D converter error in current controller
Bit 5: VM error
Bit 6: VM switched off
Bit 7: Watchdog error
Bit 8: error in option module
Bit 9: error in Personality Module
Bit 10: Software switch-off
Bit 11: channel error, security
Bit 12: error in hardware speed monitoring
Bit 13: initialisation error
Bit 14: uncorrectable I^2C bus error

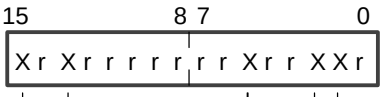
S-0-0012 Diagnostics class 2

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Switch-off prewarning
When a warning of diagnostics class 2 is present, the drive initially continues running and sets the ”alteration bit diagnostics class 2” in the drive status.
If there is no response to this warning, an error of diagnostics class 1 may occur, causing the drive to be switched off.

- If a warning should not be registered, the effect on the ”alteration bit diagnostics class 2” can interrupted by ”suppress diagnostics class 2”.
- By reading diagnostics class 2 through the service channel, the bit is reset.

Parameter configuration



X is assigned:
0 = no switch-off prewarning
1 = switch-off prewarning active
r = reserved

Bit 1: amplifier overtemperature warning (S-0-0311, page 9-13)

Bit 2: motor overtemperature warning (S-0-0312, page 9-15)

Bit 5: positioning speed > n_{limit} (S-0-0315, page 4-24)

Bit 13: target position outside position limit value (S-0-0323, page 4-24)

Bit 15: manufacturer-specific warning (see S-0-0181, page 9-6)

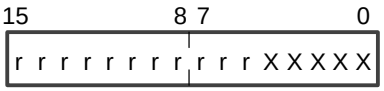
S-0-0181 Manufacturer's diagnostics class 2

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Switch-off prewarning
When a warning of the manufacturer's diagnostics class 2 is present, the drive initially continues running and sets the "manufacturer-specific warning" in diagnostics class 2 (S-0-0012).
If there is no response to this warning, an error of manufacturer's diagnostics class 1 may occur, causing the drive to be switched off.

- The "alteration bit diagnostics class 2" of the drive status is not affected.
- By reading diagnostics class 2 through the service channel, the bit is reset.

Parameter configuration



X is assigned:
0 = no error
1 = error has been detected
r = reserved

Bit 0: Warning: ASTS about to be switched off
Bit 1: Warning: Security channel error
Bit 2: Warning: VM error
Bit 3: Warning: ASTS error
Bit 4: Warning: VM mains failure

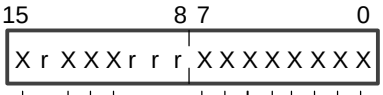
S-0-0013 Diagnostics class-3

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Operating status messages
When a message of diagnostics class 3 is present, the drive sets the ”alteration bit diagnostics class 3” in the drive status. This bit is reset by reading diagnostics class 3 through the service channel.
If a message should not be registered, its effect on the ”alteration bit diagnostics class 3” can be interrupted by ”suppress diagnostics class 3”.

The bits defined in diagnostics class 3 are additionally defined by ident. numbers.

Parameter configuration



X is assigned:
0 = no message
1 = message present.
r = reserved

Bit 0: $n_{act} = n_{set}$ (see S-0-0330, page 9-21)

Bit 1: $n_{act} = 0$ (see S-0-0331, page 9-23)

Bit 2: $|n_{act}| < |n_x|$ (see S-0-0332, page 9-22)

Bit 3: $|Md| \geq |Md_x| \times$ (see S-0-0333, page 9-18)

Bit 4: $|Md| \geq |Md_{limit}|$ (see S-0-0334, page 9-17)

Bit 5: $|n_{set}| > |n_{limit}| \times$ (see S-0-0335, page 9-20)

Bit 6: InPosition (see S-0-0336, page 9-27)

Bit 7: $|P| \geq |P_x|$ (see S-0-0337, page 9-25)

Bit 11: In position, rough (see S-0-0341, page 9-27)

Bit 12: Target position reached (see S-0-0342, page 9-28)

Bit 13: Interpolator stopped (see S-0-0343, page 9-28)

Bit 15: Manufacturer-specific operating conditions (see S-0-0182, page 9-8)

S-0-0182 Manufacturer's diagnostics class 3

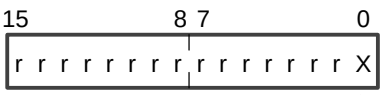
–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Operating status messages

When a message of diagnostics class 3 is present, the drive sets the "manufacturer-specific operating condition" in diagnostics class 3. This bit is reset by reading the manufacturer's diagnostics class 3 through the service channel.

The "alteration bit diagnostics class 3" in the drive status is not affected.

Parameter configuration



X is assigned:
0 = no message
1 = message is active
r = reserved

Bit 0: Message: Security channel error

Security channel error:

The two redundant security channels simultaneously register the normal operating mode and the special operating mode with the safety door open, i.e. an error in the safety zone.

S-0-0014 Interface status

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The interface status contains the current communication phase and all active interface errors, if any.

In the event of an interface error, the drive returns to communication phase 0. The error is stored in the interface status together with the communication phase and can be read out when run-up to phase 2 has been repeated.
In addition, the ”communication error” bit is set in diagnostics class 1.

The error bit in diagnostics class 1 will be cleared when:

- no interface error is active any more, **and**
- the command ”reset diagnostics class 1” (S-0-0099) was received through the service channel.

Even without an interface error, the current communication phase can be queried via the interface status.

Parameter configuration

15 8 7 0

r r r r r X X X X X X X X X X X

X is assigned:
0 = no error
1 = error active (bits 3–15)
r = reserved

Bits 0–2: communication phase

Bit 3: MST failure
(Master Synchronisation Telegram)

Bit 4: MDT failure (Master Data Telegram)

Bit 5: Invalid communication phase (phase > 4)

Bit 6: Error in next phase selection (sequence)

Bit 7: Error in previous phase selection
(not when returned to phase 0)

Bit 8: Phase shift without ready message

Bit 9: Change-over to non-initialised operating mode

Bit 10: Drive with identical address available in ring

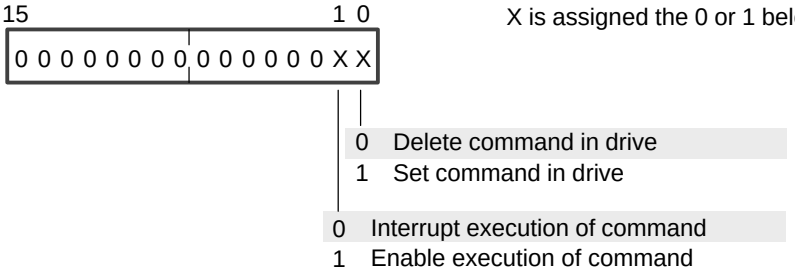
S-0-0099 Command ”Reset diagnostics class 1”

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

When the drive receives this command through the service channel and no errors are present any more, the following will be deleted:

- diagnostics class 1
- interface status
- manufacturer’s diagnostics class 1
- bit 13 in drive status (= ”error in diagnostics class 1”)

Parameter configuration:



X is assigned the 0 or 1 below it.

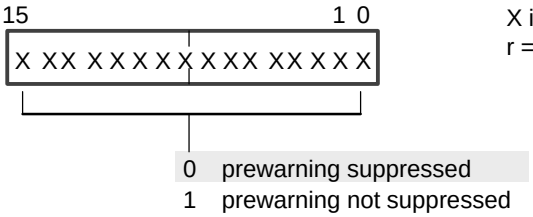
S-0-0097 Suppress diagnostics class 2

Phase 2, 3, 4	–	–	MDT	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The effect of prewarnings of diagnostics class 2 on the ”alteration bit diagnostics class 2” in the drive status can be suppressed:

- Suppressed prewarnings have no effect on the ”alteration bit diagnostics class 2” in the drive status
- Suppression has no effect on diagnostics class 2 itself.

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

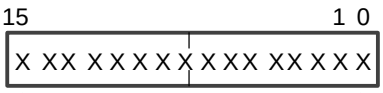
S-0-0098 Suppress diagnostics class 3

Phase 2, 3, 4	–	–	MDT	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The effect of messages of diagnostics class 3 on the ”alteration bit diagnostics class 3” in the drive status can be suppressed:

- Suppressed prewarnings have no effect on the ”alteration bit diagnostics class 3” in the drive status
- Suppression has no effect on diagnostics class 3 itself

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

0 0 message suppressed
1 1 message not suppressed

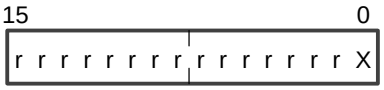
9.2.2 Temperature monitoring

S-0-0208 **Weighting type for temperature data** **(Master → Drive)**

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Using this parameter, ˚C or ˚F can be selected for all temperature data. The temperature weighting is 0.1 ˚C or 0.1˚F.

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

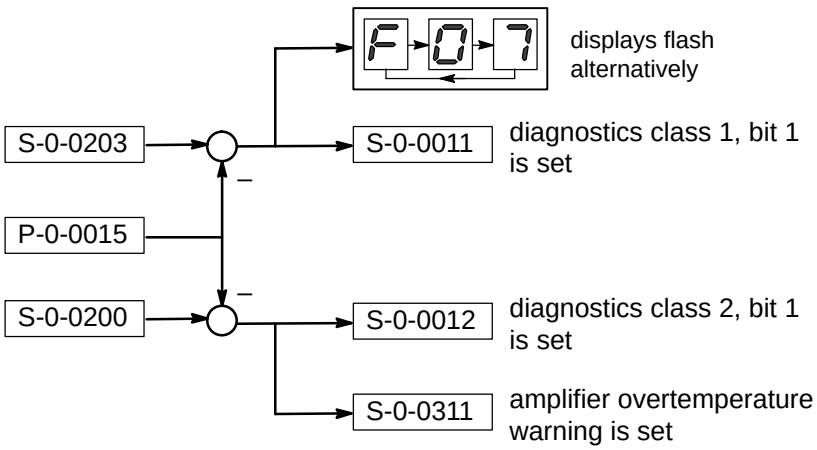
0 temperature in 0.1 ˚C
1 temperature in 0.1 ˚F

Amplifier temperature

P-0-0015 **Amplifier temperature** **(Drive → Master)**

–	–	–	DT	–	Temp.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Current inverter temperature, weighting in accordance with S-0-0208. The value is compared cyclically with the amplifier warning temperature S-0-0200 and the amplifier switch-off temperature S-0-0203:



S-0-0203 **Amplifier switch-off temperature**

Phase 3,4	–	–	–	FEPROM	Temp.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Switch-off temperature for inverter monitoring.

Entry: 0 ... 6 553.5
Weighting type in accordance with S-0-0208

S-0-0311 Amplifier overtemperature warning

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

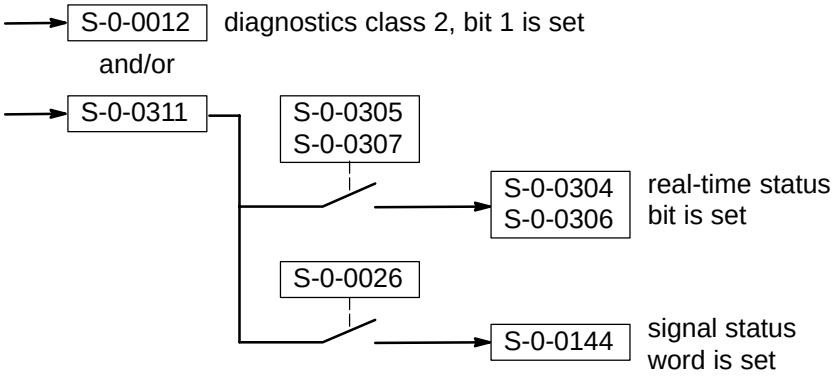
X is assigned the 0 or 1 below it.

0 no inverter overtemperature warning
1 inverter overtemperature warning present

The message is set when

Inverter warning temperature S-0-0200 – P-0-0015 < 0

Effect:



S-0-0200 Amplifier warning temperature

Phase 3,4	–	–	–	FEPROM	Temp.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Temperature warning for inverter monitoring

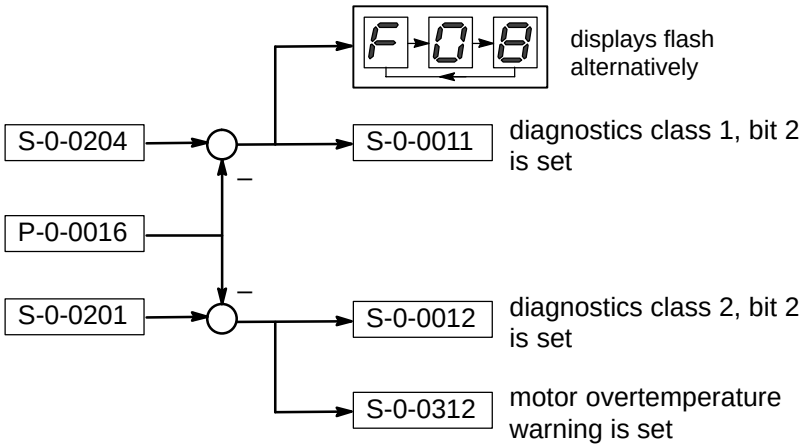
Entry: 0 ... 6 553.5
Weighting type in accordance with S-0-0208

Motor temperature

P-0-0016 Motor temperature (Drive → Master)

–	–	–	DT	–	Temp.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Current motor temperature, weighting in accordance with S-0-0208.
This value is cyclically compared with the motor warning temperature S-0-0201 and the motor switch-off temperature S-0-0204:



S-0-0204 Motor switch-off temperature

Phase 3,4	–	–	–	FEPROM	Temp.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Switch-off temperature for motor monitoring.

Entry: 0 ... 6 553.5
Weighting type in accordance with S-0-0208

S-0-0312 Motor overtemperature warning

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

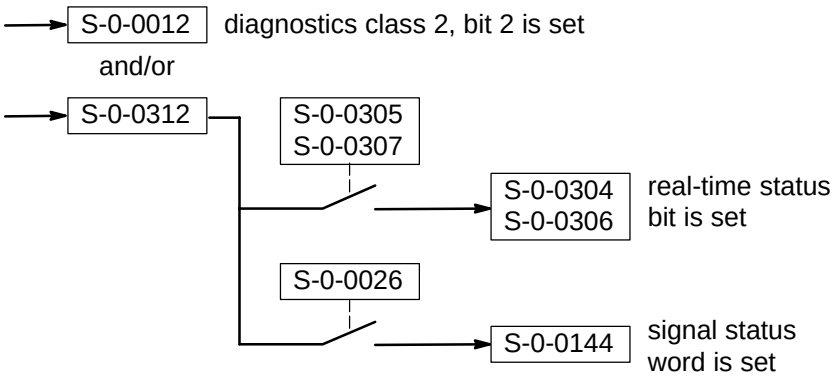
X is assigned the 0 or 1 below it.

0 no motor overtemperature warning
1 motor overtemperature warning present

The message is set when

Motor warning temperature S-0-0201 – P-0-0016 < 0

Effect:



S-0-0201 Motor warning temperature

Phase 3,4	–	–	–	FEPROM	Temp.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Temperature warning for motor monitoring

Entry: 0 ... 6 553.5
Weighting type in accordance with S-0-0208

9.2.3 Voltage/current monitoring

P-0-0034 D.C. link voltage

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Current d.c. link voltage of the drive combination in [V].

P-0-0037 Torque current setpoint

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Amount of the torque-forming component of the current setpoint in [A]. For the servo function, this value corresponds to the entire current setpoint.

P-0-0043 Torque current actual value

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Amount of the torque-forming component of the current actual value in [A]. For the servo function, this value corresponds to the entire current actual value.

P-0-0038 Field current setpoint

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Amount of the flow-forming component of the current setpoint for spindle function in [A].

P-0-0044 Field current actual value

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Amount of the flow-forming component of the current actual value for spindle function in [A].

P-0-0039 VM utilisation rate

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Present current utilisation rate of the connected supply module in [%] relative to the rated current.

9.2.4 Torque monitoring

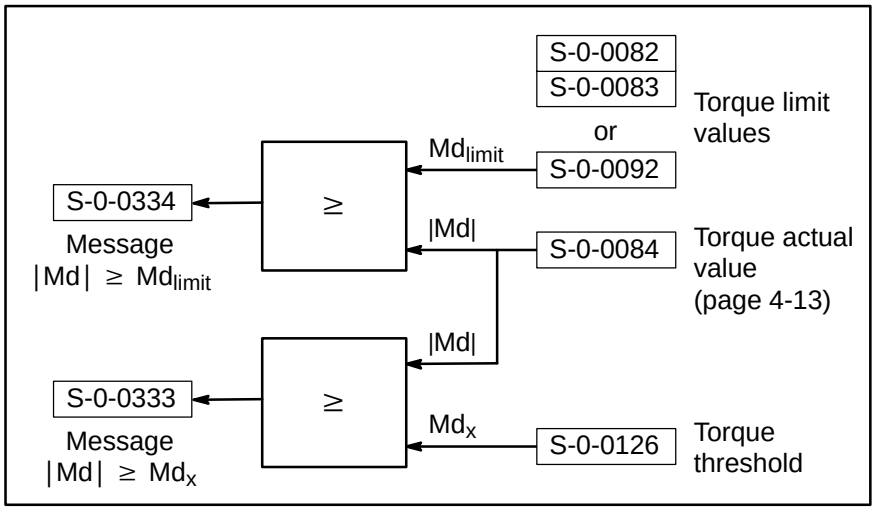


Fig. 9.1: Parameters for torque monitoring

S-0-0334 Message Md ≧ Md_{limit}

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This message is set when the amount of the torque actual value (S-0-0084) reaches or exceeds the lowest torque limit value from parameters S-0-0082, S-0-0083, or S-0-0092.

Example:
S-0-0082 positive limit value = 20 Nm
S-0-0083 negative limit value = 5 Nm
S-0-0092 bipolar limit value = 10 Nm

The message will be set with |Md| ≧ 10 Nm positive torque
|Md| ≦ 5 Nm negative torque

As a standard, only S-0-0092 is effective. S-0-0082 and S-0-0083 contain higher values, if necessary, they can be set in order to account for an asymmetrical load.

S-X-0082 Positive torque limit value

Phase 3,4	–	–	–	FEPROM	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Limit value for positive torque.
When the limit value is reached, the drive sets the message **|Md| ≥ Md_{limit}** in diagnostics class 3.

Weighting and preferred weighting in accordance with section 3.4.3 .

S-X-0083 Negative torque limit value

Phase 3,4	–	–	–	FEPROM	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Limit value for negative torque.
When the limit value is reached, the drive sets the message $|\mathbf{Md}| \geq \mathbf{Md_{limit}}$ in diagnostics class 3.

Weighting and preferred weighting in accordance with section 3.4.3 .

S-X-0092 Bipolar torque limit value

Phase 3,4	–	–	–	FEPROM	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Symmetrical torque limit in both directions.
When the limit value is reached, the drive sets the message $|\mathbf{Md}| \geq \mathbf{Md_{limit}}$ in diagnostics class 3.

Weighting and preferred weighting in accordance with section 3.4.3 .

S-0-0333 Message Md $\geqq$ $\mathbf{Md_X}$

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The message is set if the torque actual value (S-0-0084) reaches or exceeds the torque threshold (S-0-0126).

S-X-0126 Torque threshold $\mathbf{Md_X}$

Phase 3,4	–	–	–	FEPROM	Torque	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

When the amount of the torque actual value reaches the torque threshold Md_X, the drive sets the message $|\mathbf{Md}| \geq \mathbf{Md_X}$ in diagnostics class 3.

Weighting and preferred weighting in accordance with section 3.4.3.

9.2.5 Speed monitoring

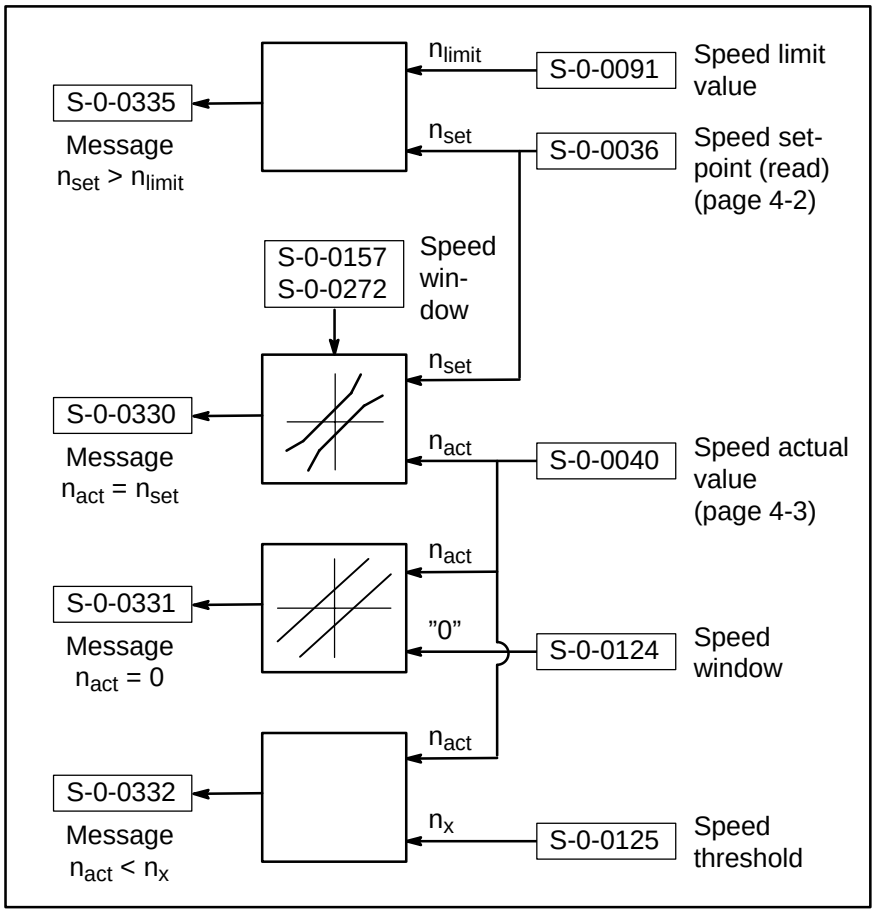


Fig. 9.2: Parameters for speed monitoring

S-X-0157 Speed window

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The message $n_{act} = n_{set}$ remains set for as long as the speed measured value is within the window set by this parameter.

Entry: Speed value in the range 0 ... 90% n_{max}
Weighting and preferred weighting in accordance with section 3.4.2 .

S-0-0272 Speed window in percent

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The message $n_{act} = n_{set}$ remains set for as long as the speed measured value is within the window set by this parameter.

Entry: Speed value in the range 0 ... 90% of the comparative value in [%]

S-0-0335 **Message $n_{set} > n_{limit}$**

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

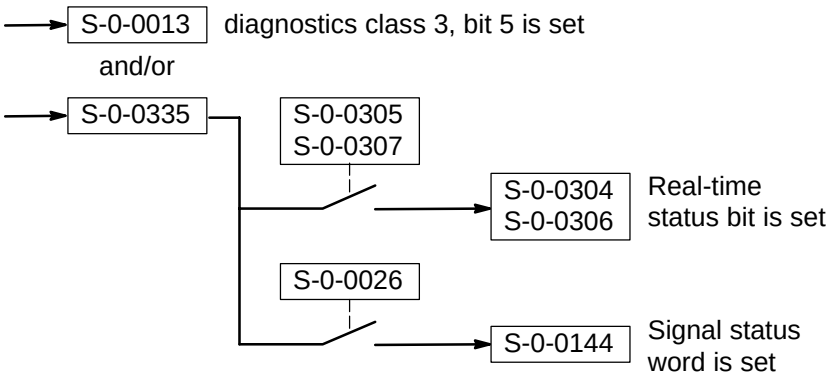
X is assigned the 0 or 1 below it.

0 limit value not exceeded
1 limit value exceeded

The message is set when:

$$|n_{set}| - S\text{-}0\text{-}0091 > 0$$

Effect:



S-X-0091 **Bipolar speed limit value**

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Limit value for the maximum admissible speed in both directions.

Entry: 0 ... 90 % n_{max},
Weighting and preferred weighting in accordance with section 3.4.2 .

S-0-0330 **Message $n_{act} = n_{set}$**

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

X is assigned the 0 or 1 below it.

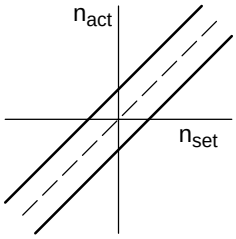
0 setpoint not reached
1 setpoint reached

This message is set when:

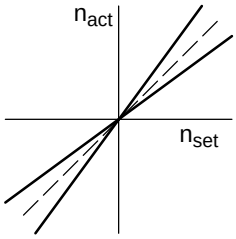
$$|n_{act} - n_{set}| \leqq |n_{set}| \times S\text{-}0\text{-}0272 + S\text{-}0\text{-}0157$$

S-0-0272 and S-0-0157 determine a speed window by which the precision of the message can be influenced

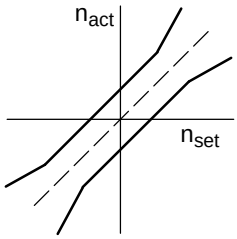
Constant
speed window
S-0-0272 = 0
S-0-0157 ≠ 0



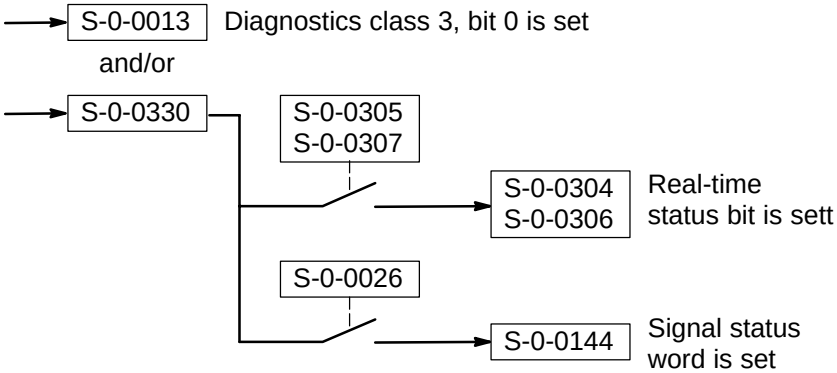
Percent
speed window
S-0-0272 ≠ 0
S-0-0157 = 0



Constant percent
speed window
S-0-0272 ≠ 0
S-0-0157 ≠ 0



Effect:



S-0-0332 **Message $|n_{act}| < |n_x|$**

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

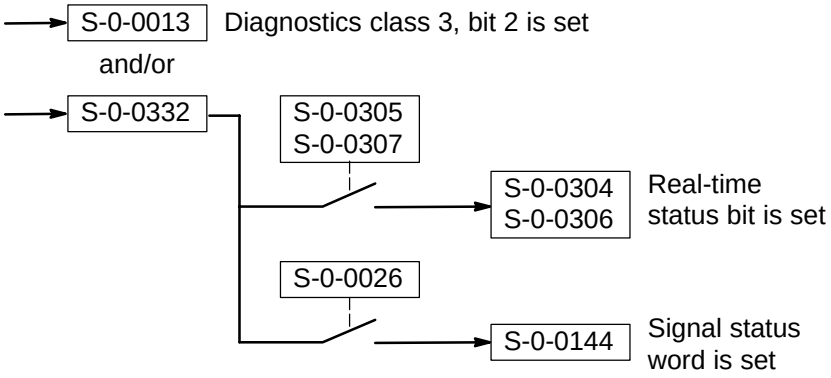
X is assigned the 0 or 1 below it.

0 threshold not exceeded
1 threshold exceeded

The message is set when:

$$|n_{act}| - \text{S-0-0125} < 0$$

Effect:



S-X-0125 **Speed threshold n_x**

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Threshold value for speed in both directions.

Entry: 0 ... 90% n_{max}
Weighting and preferred weighting in accordance with section 3.4.2 .

S-0-0331 Message $n_{act} = 0$

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Parameter configuration

15 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X

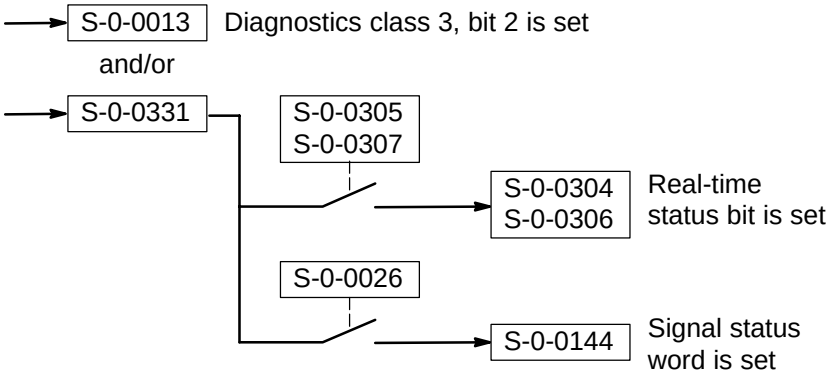
X is assigned the 0 or 1 below it.

0 no standstill
1 standstill window reached

The message is set when:

$$|n_{act}| - S\text{-}0\text{-}0124 < 0$$

Effect:



S-0-0124 Standstill window

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The standstill window describes the speed deviation from n = 0 in both directions of rotation.

Entry: Speed value in the range 0 ... 90% n_{max}
Weighting and preferred weighting in accordance with section 3.4.2 .

9.2.6 Standstill monitoring

The standstill monitoring monitors the lag (following error) of the drive at standstill and without setpoint input.
If the lag is greater than the lag limit value (P-0-0502), the error message “Lag error” is generated in the manufacturer’s diagnostics class 1 (S-0-0129, bit 2) after a waiting period (P-0-0503).

Standstill monitoring is activated by entering a waiting time > 0.

P-X-0502 Lag limit value

Phase 3,4	–	–	–	FEPROM	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Value for maximum lag that can be accepted as standstill.
The value should be greater than the positioning window rough (S-0-0261)

Weighting and preferred weighting in accordance with section 3.4.1.

P-0-0503 Waiting time, standstill monitoring

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Waiting time, after which a “lag error” is reported when the lag limit value has been exceeded.

Entry: 0 ... 6553.5 ms
Weighting and preferred weighting in accordance with section 3.4.1.
0 = no standstill monitoring

9.2.7 Power output monitoring

P-0-0020 Smoothing time constant for power output

Phase 3,4	–	–	MDT	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

All parameters containing power data will be output through a 1st order filter, whose smoothing time constant can be changed with this parameter.

Entry: 1 ... 1000 [ms]

S-0-0337 Message P ≧ P_x

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The message is set if the output yielded reaches or exceeds the preset output threshold (S-0-0158).

S-0-0158 Output threshold P_x

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Value for output threshold P_x.

Entry: 0 ... 2^{31} [W]

9.2.8 Motor monitoring

P-0-0002 Active power

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Active electrical power input to the motor in [W].

P-0-0003 rms current

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Total electrical current input (reactive and active current) to the motor in [A_{rms}].

P-0-0018 Mechanical power

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Mechanical power output of the motor in [W].

P-0-0019 Motor utilisation rate

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Current motor utilisation rate in [%] with the following reference:

- **synchronous motor:** M/M_N
- **asynchronous motor:**
  in basic speed range n ... n_N: M/M_N
  in the field weakening range N_N ... n_{max}: P/P_N

P-0-0025 Speed actual value

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Current motor speed in rpm.

9.2.9 Messages from operating statuses for position (servo axis and spindle)

P-0-0007 Position controller cycle time

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The position controller cycle time is calculated by the drive itself from the following input data:

- NC cycle time (S-0-0001) and
- SERCOS interface cycle time (S-0-0002)

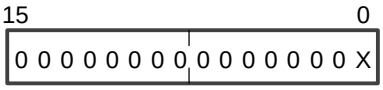
The value is between 500 ... 2000 µs. It can only be read.

S-0-0336 Message “In-Position”1.

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “In-Position” message can be assigned to a real-time status bit via this ident. no. (S-0-0305).
The message is defined in the diagnostics class 3 and is set if the position actual value (S-0-0051 or S-0-0053), relative to the position setpoint, lies within the positioning window S-0-0057.

Parameter configuration:



X is assigned the 0 or 1 below it.

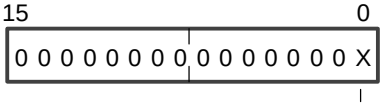
0 outside the positioning window
1 inside the positioning window

S-0-0341 Message “In-Position rough” 1.

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “In-Position rough” message can be assigned to a real-time status bit via this ident. no. (S-0-0305).
The message is defined in the diagnostics class 3 and is set if the position actual value (S-0-0051 or S-0-0053), relative to the position setpoint, lies within the “positioning window rough” (S-0-0261).

Parameter configuration:



X is assigned the 0 or 1 below it.

0 outside the positioning window
1 inside the positioning window

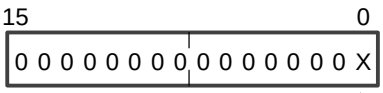
9.2.10 Messages from operating statuses for interpolation (servo axis)

S-0-0342 Target position reached

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “Target position reached” message can be assigned to a real-time status bit via this ident. no. (S-0-0305).
The message is defined in diagnostics class 3 and is set if the position setpoint of the drive interpolator (IPO position setpoint) is equal to the target position (S-0-0258).

Parameter configuration:



X is assigned the 0 or 1 below it.

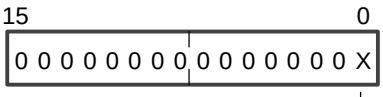
0 Target psition not reached
1 Target position reached

S-0-0343 Interpolator halt

–	–	D → M	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The “Interpolator halted” message can be assigned to a real-time status bit via this ident. no. (S-0-0305).
The message is defined in diagnostics class 3 and is set if the interpolator of the drive (IPO) has not yet reached the target position (S-0-0258) and the IPO position setpoint change is already zero.

Parameter configuration:



X is assigned the 0 or 1 below it.

0 Interpolator active
1 Interpolator halted

9.3 Control bits/status bits

In the control field of the MDT and in the status field of the DT, two real-time bits are provided for every drive for communicating selected statuses or events of binary operating data (bits, operating signals) in real time.
The assignments are transmitted through the service channel if necessary.

If a write access is made to a control bit assigned to the real-time control bits through the service channel, the drive generates the error message ”data currently write-protected”.

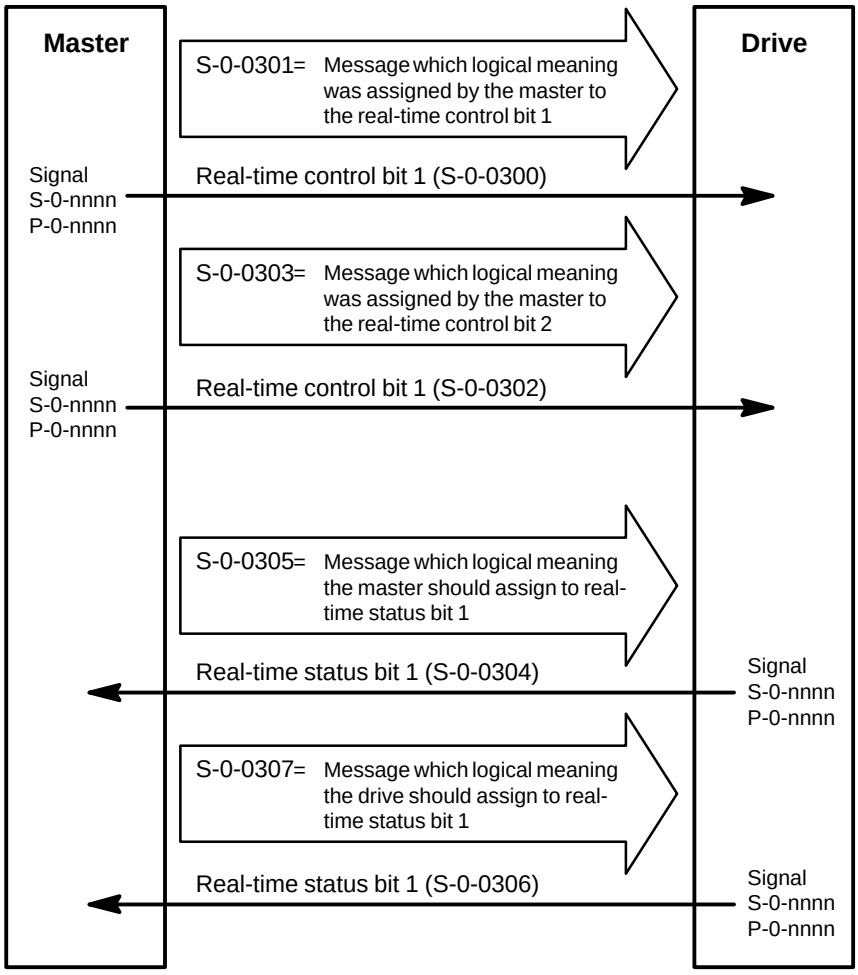


Fig. 9.3: Function of real-time bits

Real-time control bits

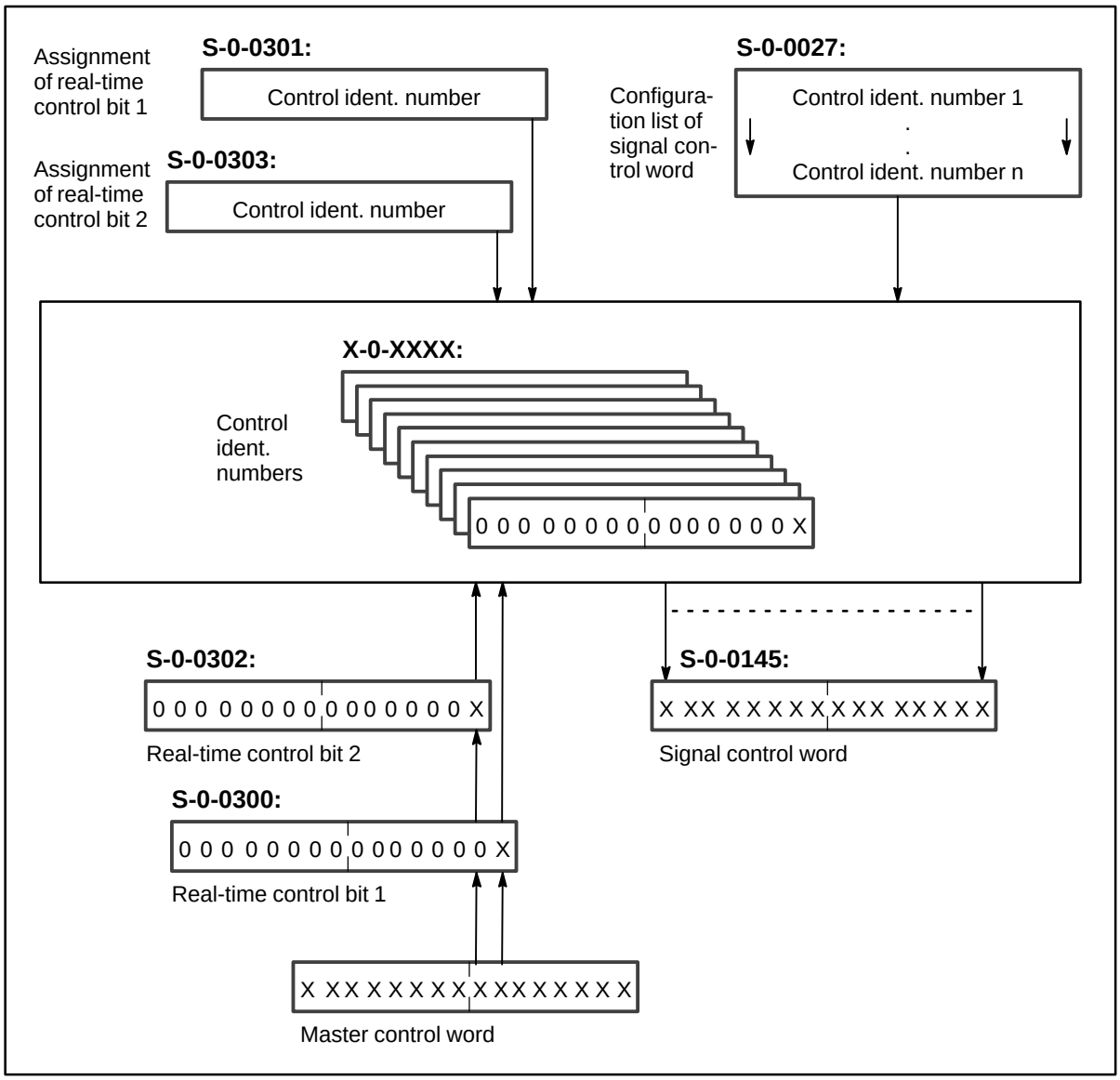


Abb. 9.4: Ident. numbers of real-time control bits

S-0-0301 Assignment of real-time control bit 1

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In order to assign a signal to real-time control bit 1, the ident. number of the signal is written into the operating data of this parameter. Afterwards, the signal appears in real-time control bit 1.

S-0-0303 Assignment of real-time control bit 2

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

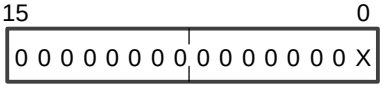
In order to assign a signal to real-time control bit 2, the ident. number of the signal is written into the operating data of this parameter. Afterwards, the signal appears in real-time control bit 2.

S-0-0300 Real-time control bit 1

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to assign an ident. number to be specified in S-0-0301 and thus a certain function to the real-time control bit 1 of the control word.

Parameter configuration



X is assigned the 0 or 1 below it.

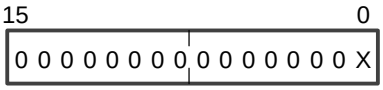
0 no assignment
1 ident. no. has been assigned

S-0-0302 Real-time control bit 2

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to assign an ident. number to be specified in S-0-0303 and thus a certain function to the real-time control bit 2 of the control word.

Parameter configuration



X is assigned the 0 or 1 below it.

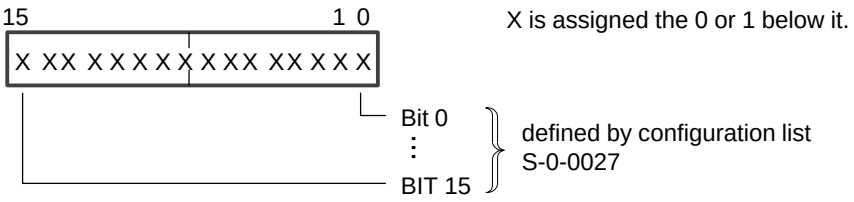
0 no assignment
1 ident. no. has been assigned

S-0-0145 Signal control word (Master → Drive)

Phase 2, 3, 4	–	–	MDT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The signal control word can be used to transmit signals in real time from the master to the drive. For this purpose, the signal control word must be integrated into the master data telegram (MDT) as cyclic data.
The bits of the signal control word can be freely defined via the ”signal control word configuration list”.

Parameter configuration



S-0-0027 Signal control word configuration list

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The data of the configuration list contain the ident. numbers of the signals to be transmitted by the signal control word.
The first ident. no. of the configuration list defines bit 0, the last one bit 15 of the signal control word.

For an example, see S-0-0026, page 9-36.

Status bits

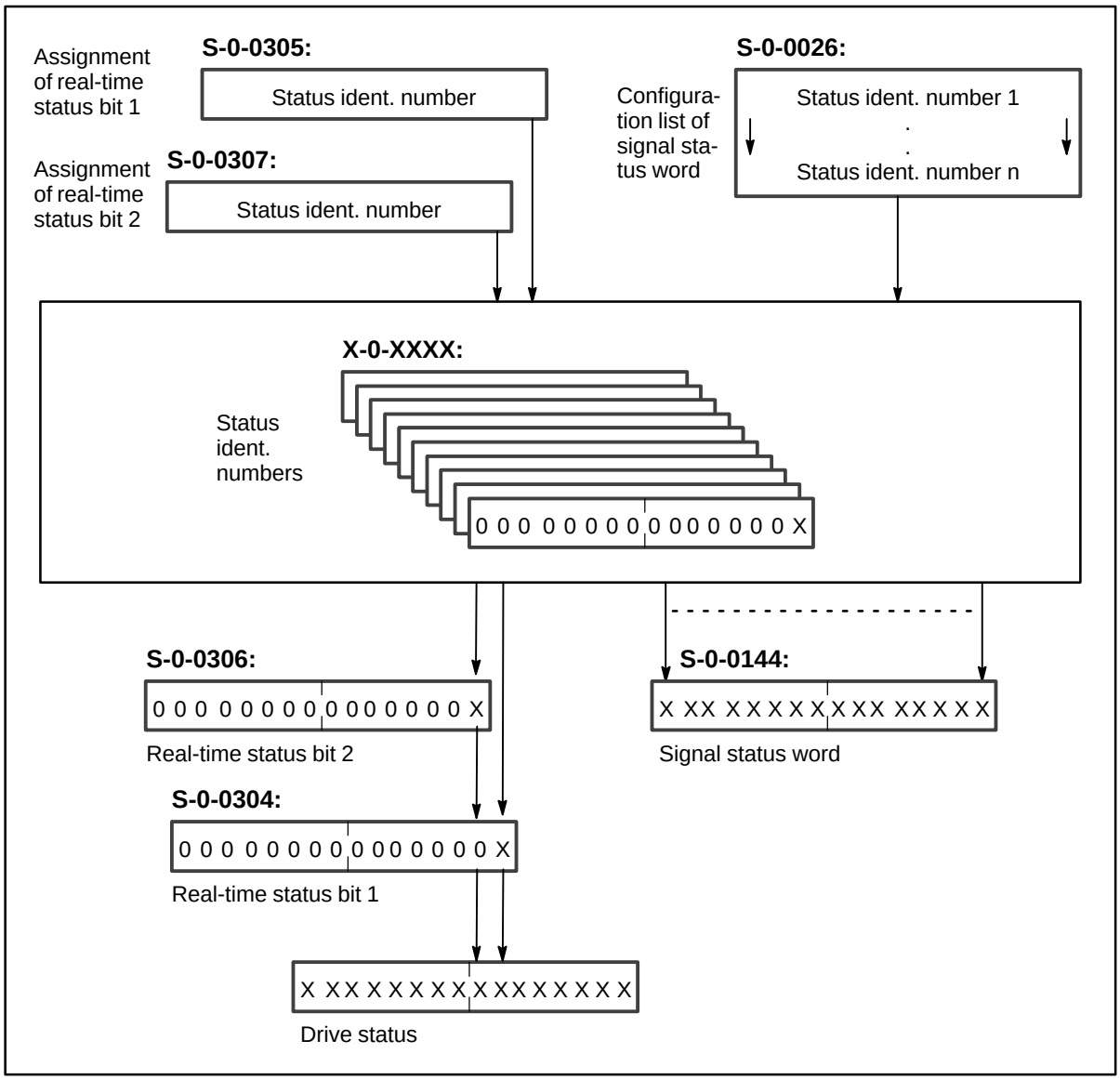


Abb. 9.5: Ident. numbers of real-time status bits

S-0-0305 Assignment of real-time status bit 1

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

In order to assign a signal to real-time status bit 1, the ident. number of the signal is written into the operating data of this parameter. Afterwards, the signal appears in real-time status bit 1.

S-0-0307 Assignment of real-time status bit 2

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

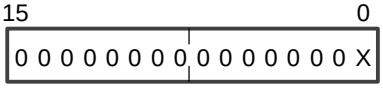
In order to assign a signal to real-time status bit 2, the ident. number of the signal is written into the operating data of this parameter. Afterwards, the signal appears in real-time status bit 2.

S-0-0304 Real-time status bit 1

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to assign an ident. number to be specified in S-0-0305 and thus a certain function to the real-time status bit 1 of the drive status.

Parameter configuration



X is assigned the 0 or 1 below it.

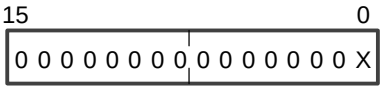
0 no assignment
1 ident. no. has been assigned

S-0-0306 Real-time status bit 2

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to assign an ident. number to be specified in S-0-0307 and thus a certain function to the real-time status bit 2 of the drive status.

Parameter configuration



X is assigned the 0 or 1 below it.

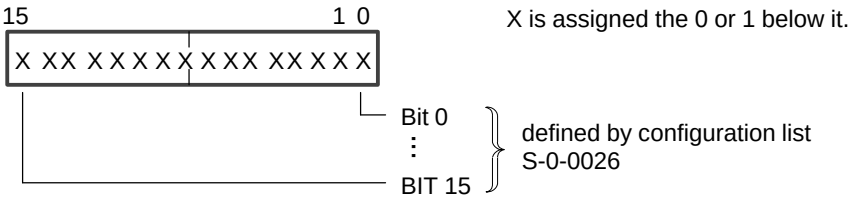
0 no assignment
1 ident. no. has been assigned

S-0-0144 Signal status word (Drive → Master)

–	–	–	DT	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The signal status word can be used to transmit signals in real time from the drive to the master. For this purpose, the signal status word must be integrated into the drive telegram (DT) as cyclic data.
The bits of the signal status word can be freely defined via the ”signal status word configuration list”.

Parameter configuration



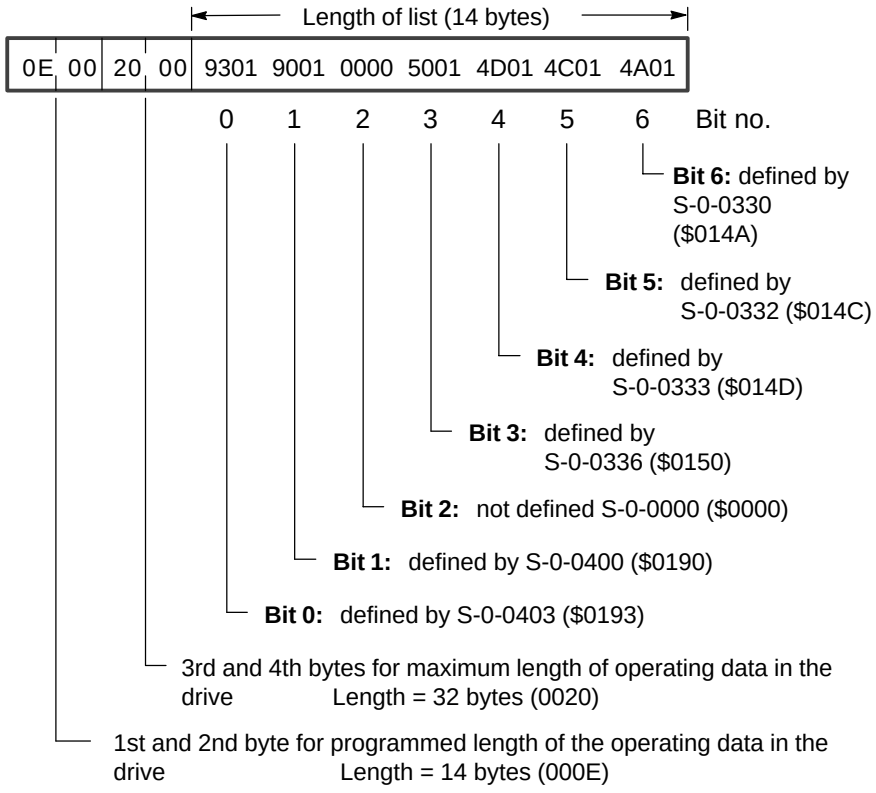
S-0-0026 Signal status word configuration list

Phase 2	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The data of the configuration list contain the ident. numbers of the signals to be transmitted by the signal status word.
The first ident. no. of the configuration list defines bit 0, the last one bit 15 of the signal status word.

Example:

Parameter configuration (variable length)



9.4 Data protection

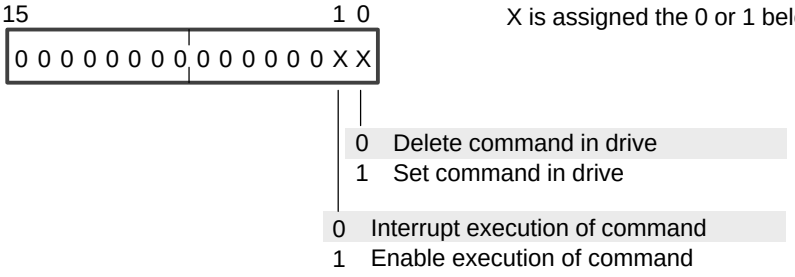
S-0-0264 Command "Save working memory"

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This command saves all data necessary for operation (= list S-0-0192, see page 9-41) contained in the working memory to the FEPROM of the Personality Module (PM).

☞ **Note** **With this command, all data in the FEPROM will be overwritten. If necessary, this data should be previously saved with the help of the master or the commissioning and diagnostics system DSS-D.**

Parameter configuration:



P-0-0489 Password

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Serves for the protection of some functions and data. The parameter can only be written. For an attempted read access the drive will always return the result "0".

☞ **Note** **The user interface of the DSS-D offers a dialog for password entry with the menus "Options – User".**

9.5 Error memory

S-0-0028 MST error counter (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The MST error counter counts all invalid master synchronisation telegrams (MST) during communication phases 3 and 4:

- Upon failure of an MST, synchronisation is maintained. However, a drive telegram (DT) will only be transmitted when another MST has been received.
- If two successive MST's fail, the drive automatically returns to communication phase 0 and expects an MST of phase 0. Rotating motors are halted within the best time possible.
- If more than two successive MST's fail, additional failures will not be counted.

In the event of a heavily disturbed transmission, the error counter may contain the maximum value of 65 535 after a long time.

S-0-0029 MDT error counter (Drive → Master)

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The MDT error counter counts all invalid master data telegrams (MDT) in communication phase 4:

- Upon failure of an MDT, operation is maintained. The drive calculates the missing telegram on the basis of the last setpoints received.
- If two successive MDT's fail, the drive concerned will be halted within the best time possible. The drive automatically returns to communication phase 0 and expects an MST of phase 0.

In the event of a heavily disturbed transmission, the error counter may contain the maximum value of 65 535 after a long time..

P-0-0480 Error memory: HW initialisation error

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains all initialisation statuses of the drive in encoded format.

P-0-0481 Error memory: SERCOS service channel errors

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter stores up to 16 errors that have occured in the SERCOS interface communication between the master and the drive.
The error information includes the number of the parameter where the error occurred and a related error number. For this purpose, a ring-type memory was used for the memory range of the parameter.
The last occurring error is always in the first place. For more information on the error numbers, please refer to the ”Diagnostics” manual.

P-0-0482 Error memory: DSS service channel error

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter stores up to 16 errors that have occured in the communication between the DSS and the drive.
The error information includes the number of the parameter where the error occurred and a related error number. For this purpose, a ring-type memory was used for the memory range of the parameter.
The last occurring error is always in the first place. For more information on the error numbers, please refer to the ”Diagnostics” manual.

☞ **Note** **The DSS-D user interface offers a listbox for read access to the contents of this parameter in the menu items ”Diagnostics – Module configuration” (”Logbook, DSS error” group).**

P-0-0483 Error memory: Diagnostics class 1

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter stores up to 16 errors that have occured in diagnostics class 1.
The error information includes the relevant error numbers for parameter S-0-0129 and parameter S-0-0011 (error message in S-0-0129 sets bit 15 in S-0-0011). For this purpose, a ring-type memory was used for the memory range of the parameter.
The last occurring error is always in the first place. For more information on the error numbers, please refer to the ”Diagnostics” manual.

☞ **Note** **The DSS-D user interface offers a listbox for read access to the contents of this parameter in the menu items ”Diagnostics – Module configuration” (”Logbook, ZSK-1 error” group)**

P-0-0488 Error memory: command runtime errors

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter stores up to 16 command runtime errors.
The error information includes the error numbers which also refer to certain commands.
A ring-type memory was used for the memory range of the parameter, so that the last occurring error is always in the first place.
For more information on the error numbers, please refer to the ”Diagnostics” manual.

9.6 Information lists

(Drive → Master)

S-0-0192 List of operating data to be saved

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This list contains all ident. numbers required for operating the drive. The master can create a backup copy of this list of drive parameters.

S-0-0017 List of all operating data

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Lists the ident. numbers of all operating data available in the drive.

S-0-0018 List of operating data of communication phase 2

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Ident. numbers of all communication parameters to be transmitted in phase 2. Change-over to phase 3 is not possible unless this list has been processed.

S-0-0019 List of operating data of communication phase 3

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Ident. numbers of all communication parameters to be transmitted in phase 3. Change-over to phase 4 is not possible unless this list has been processed.

S-0-0020 List of operating data of communication phase 4

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Ident. numbers of all operating parameters that can be changed online in phase 4.

S-0-0023 List of invalid operating data of communication phase 4

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Ident. number list of the operating data which are recognised as invalid data by the drive in normal operation after change-over to phase 4.

S-0-0025 List of all commands

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Contains the ident. numbers of all commands available in the drive.

P-0-0491 Ident. no. table with search identification of ident. no. P–0–0490

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Using this parameter, a preselectable parameter list can be read from the drive.
After selecting one of the possible identifications in P-0-0490, the drive stores all ident. numbers that meet the respective criteria in parameter P-0-0491.

P-0-0490 Search identification for ident. no. P-0-0491

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

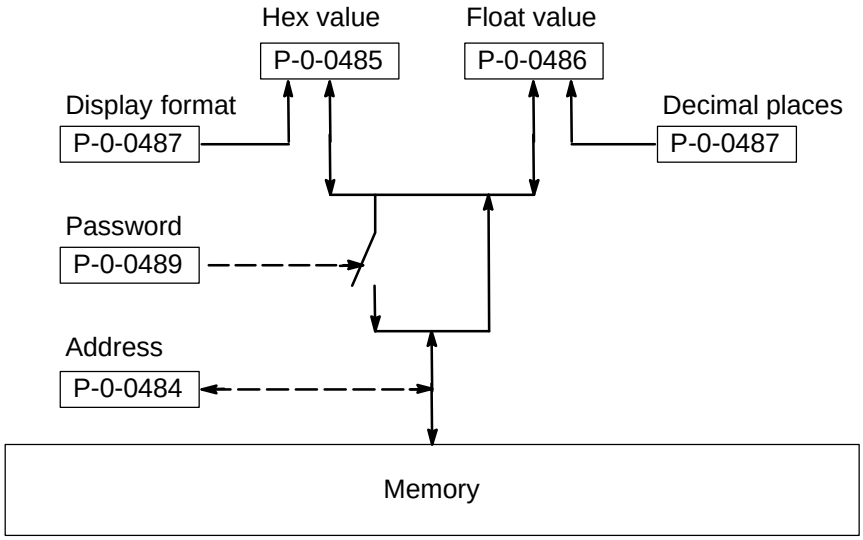
The following identifications are available for the parameter list preselectable in P-0-0491:

0 Ident. numbers currently in the cyclic MDT/DT telegram
1 Ident. numbers write-protected in phase 2
2 Ident. numbers write-protected in phase 3
3 Ident. numbers write-protected in phase 4
4 Ident. numbers with parameter sets
5 Ident. numbers with individual min./max. values for every parameter set
6 Ident. numbers suitable for cyclic MDT telegram
7 Ident. numbers suitable for cyclic DT telegram
8 Automatic initialisation during change between phases 2 and 3
9 Automatic initialisation during change between phases 3 and 4
10 Ident. numbers suitable for real-time control bits
11 Ident. numbers suitable for real-time status bits
12 Ident. numbers must be initialised in phase 2
13 Ident. numbers must be initialised in phase 3
14 Ident. numbers belonging to ”SERCOS” group
15 Ident. numbers belonging to ”position controller” group

16 Ident. numbers belonging to ”speed controller” group
17 Ident. numbers belonging to ”current controller” group
18 Ident. numbers belonging to ”diagnostics” group
19 Ident. numbers belonging to ”oscilloscope” group
20 Ident. numbers belonging to ”setpoint generator” group
21 Ident. numbers belonging to ”controller optimisation” group
22 Ident. numbers belonging to ”motor” group
23 Ident. numbers belonging to ”encoder” group
24 Ident. numbers belonging to ”amplifier” group
25 Ident. numbers belonging to ”weightings” group
26 Ident. numbers belonging to ”general control” group
27 Ident. numbers whose data are saved in the FEPROM (= S-0-0192)
28 All ident. numbers (= S-0-0017)
29 Ident. numbers belonging to ”unknown” group
30 Ident. numbers belonging to ”double for winding change-over” group
31 Ident. numbers belonging to ”motion control” group

9.7 Targetet memory access

Targetet access to a memory location and reading of data can be performed according to the following method. Write access is only possible when enabled by a password.
The data format and decimal places can be set with control word P-0-0487.



P-0-0484 Address for target/source ident. nos. P-0-0485 and P-0-0486

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Address of memory location to be read or overwritten.

P-0-0485 Value in target/source address of ident. no. P-0-0484 (hex)

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Hexadecimal or **binary** format of the value read from the addressed memory location or to be written to this address.

P-0-0486 Value in target/source address of ident. no. P-0-0484 (float)

Phase 2, 3, 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Decimal format of the value read from the addressed memory location or to be written to this address.

P-0-0487 Control word for memory access

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to define the display format and decimal places:

Parameter configuration

X is assigned the 0 or 1 below it.

Number of decimal places in P-0-0486

0 0 0	max. 8 decimal places selectable
1 1 1	

Display format of P-0-0485

0 0 0	hexadecimal
0 0 1	decimal without sign
0 1 0	decimal with sign
0 1 1	binary

9.8 Drive identification (Drive → Master)

Version data

The following parameters contain information on the type of inverter, motor, and software:

S-0-0030 Manufacturer version

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Example:

SM–D V X.XXX

Software type:
SM = servo module for synchronous motors
FO = spindle module for asynchronous motors
UF = frequency inverter for U/f control

Software version of the inverter

S-0-0140 Controller device type

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Example:

Bosch – DM 8 K

Manufacturer

VM = Supply module
DM = Three-phase module

Maximum current with f_s = 2 kHz

Module width: A = 50 mm
B = 100 mm
C = 150 mm
D = 200 mm
K = compact mechanics

S-0-0142 Type of application

Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter may be used to enter data on the application of the drive, such as main spindle drive, rotary axis, etc.

S-0-0141 Motor type

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Contains the type designation of the connected motor.

S-0-0143 SERCOS interface version

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The version of the implemented SERCOS interface specification is stored here.

Inverter data

The following parameters contain technical data of the drive module:

S-0-0110 Amplifier peak current

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The peak current of the drive module stored in this parameter is limited by the module itself. Hence, the maximum torque limit value is also defined.

S-0-0112 Amplifier rated current

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The rated current of the drive module is its permitted continuous current. This value is automatically downloaded from the module during start-up.

Motor data

The following parameters contain technical data of the motor:

S-0-0109 Motor peak current

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The motor peak current stored in this parameter is downloaded from the electronic nameplate of the connected motor during start-up.
The peak current of the drive module is automatically limited to the motor peak current.

S-0-0111 Motor zero-speed current

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the motor zero-speed current.
For synchronous motors, the zero-speed current is used as a reference quantity for all motor-related current values. The resulting zero-speed torque is taken as reference quantity for all torque data.

S-0-0196 Rated motor current

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the rated motor current specified in the motor data sheet.
For asynchronous motors, the rated current is used as a reference magnitude for all motor-related current values. The resulting rated torque is taken as reference quantity for all torque data.

S-0-0113 Maximum motor speed (n_{max})

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains the maximum motor speed specified in the motor data sheet. This value is automatically downloaded from the electronic nameplate of the motor during start-up.

9.9 Language selection

S-0-0265 Language selection

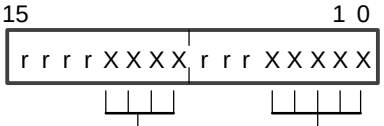
Phase 2, 3, 4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to select the languages available in the drive (see S-0-0266).
By changing the language, all texts such as

- names
- units of measure
- diagnostics (S-0-0095)

will be displayed in the newly selected language.

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

0	German
1	English
2	French
3	Spanish
4	Italian
5	Portuguese
6	Polish
7	Hungarian
8	Russian (special character set)
9	Swedish
10	Danish
11	Norwegian

0 SERCOS interface character set

S-0-0266 List of available languages

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

List of all language codes presently available which can be selected with S-0-0265.
(Variable length operating data)

Your notes :

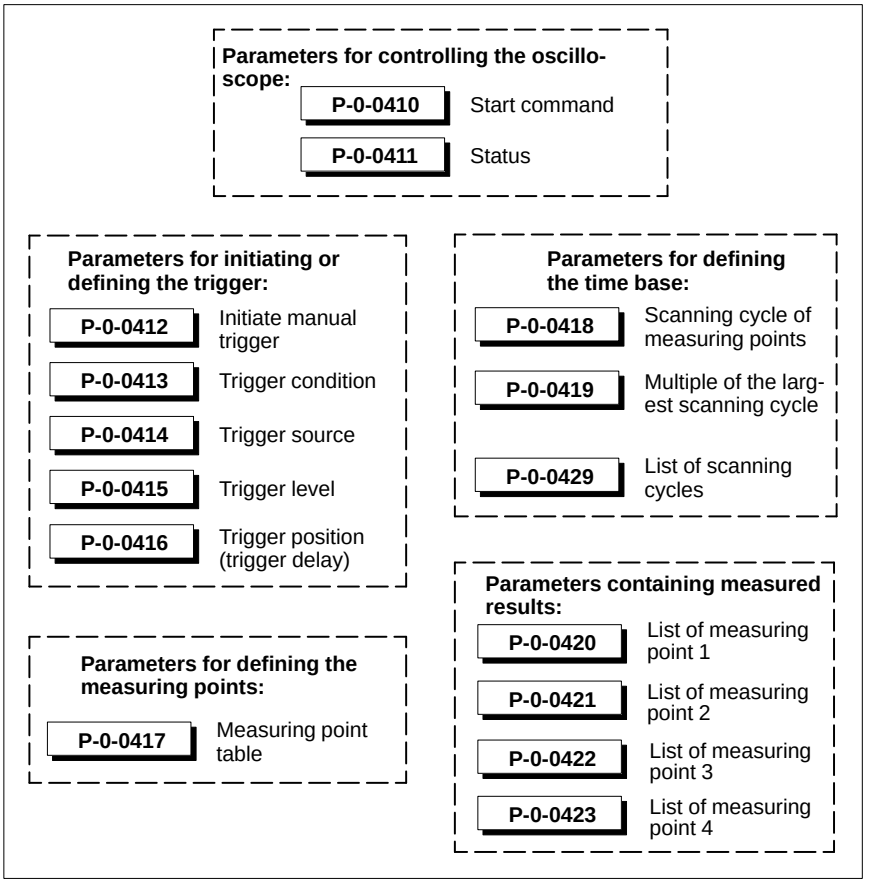
10 Oscilloscope

10.1 Procedure

With the help of the ”oscilloscope” function, internal **drive data** can be scanned **as a function of time** for the purpose of testing or optimisation. Additional external measuring instruments or wiring are not necessary. Starting up a machine or axis thus becomes much easier.

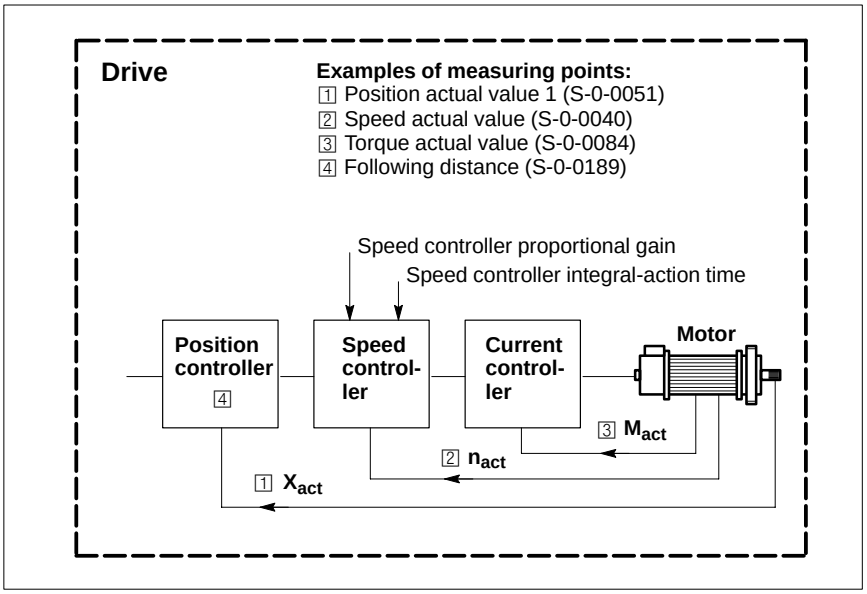
The oscilloscope is controlled by a number of parameters.
In analogy to a ”normal” oscilloscope, you can set the trigger, time base and up to 4 measureing channels (measuring points).
The only difference lies in the type of measurement output: instead of a monitor, we use measurement lists for intermediate storage of the measured values. When measurement has been completed, the contents of these lists can be downloaded from the drive for further external processing.

The parameters relevant for the oscilloscope and their functional assignment is shown in the following figure.



As a rule, the values of most drive parameters can be scanned and used as trigger sources.
However, only scanning of values that change over time makes sense. These include, e.g., position, speed, torque, but also messages concerning certain events (in-position, $n_{act}=0$, $n_{act}=n_{set}$, etc.).

The following block diagram shows an example of some ”measuring points” where data can be ”picked up ”:



During measurement, values relating to a maximum of 4 parameters (measuring points) can be scanned simultaneously. An internal ring memory with a capacity of 4096 32-bit words is available for this purpose, which is automatically subdivided by the drive depending on the required number of measuring points and the scanning cycle setting (scanning frequency).

The trigger conditions are set by yourself to determine from which event onward the internal ring memory shall be filled again with measured values maximally once before scanning is finished.

When measurement has been completed, all measured values can be output from the drive and further processed externally after adequate data preparation.

☞1 1 **Note**

Within the oscilloscope function, several parameters have a combined effect. The DSS-D user interface provides support for measurement settings, data handling and the graphics display of measured values by the integrated ”oscilloscope” diagnostics progrm. Thus, you need not know the structure of the parameters used.
However, if you do not use DSS-D for communicating with the drive, it is absolutely necessary to have detailed knowledge of the structure of all parameters used.

Measurement procedure

1. Assign appropriate values to parameters P-0-0413 to P-0-0419 one by one.
   All parameters must be given valid values. For detailed information, please refer to the description of the individual parameters.
2. Start the oscilloscope (set bit 0 and bit 1 of P-0-0410 to ”1”).
   The drive checks the previously assigned parameters for their validity. In the event of invalid data in parameters P-0-0412 to P-0-0417, the command error bit (bit 3 of command acknowledgement) will be set. The oscilloscope then waits for the trigger event. In this course, the current values at the measuring points are permanently written to the internal ring memory with the selected scanning frequency.
   When the trigger event has occurred, the oscilloscope will fill the internal ring memory maximally 1 time with measured values (depending on the trigger position defined). The scanned data is standardised, min. and max. values will be determined, and the command alteration bit is set (bit 2 of command acknowledgement changes to ”0”).
   Then P-0-0420 to P-0-0423 will be output.
3. Stop the oscilloscope (set bit 0 and bit 1 of P-0-0410 to ”0”). The drive switches the oscilloscope off and resets the command alteration bit.

10.2 Parameters

P-0-0410 Oscilloscope: Start command

Phase 3,4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The oscilloscope can be started and stopped with **P-0-0410**

Parameter configuration

15 … 1 0

r r r r r r r r r r r r r r X X

X is assigned the 0 or 1 below it.
r = reserved

0 0 stop oscilloscope
1 1 start oscilloscope

0 valid data
1 set command in drive

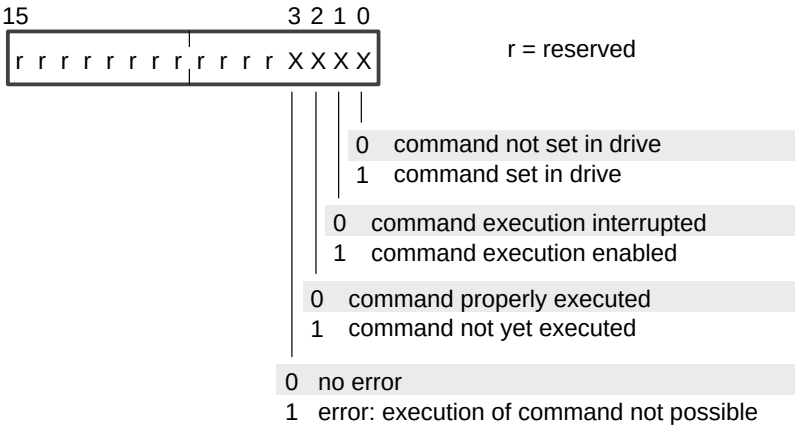
0 interrupt execution of command
1 enable execution of command

The **command acknowledgement** can be used to check whether:

- the oscilloscope was properly started (oscilloscope is active), and

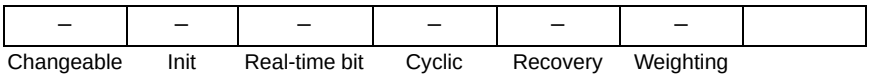
○ the measurements have been completed (oscilloscope not active, but not yet stopped).

Parameter configuration



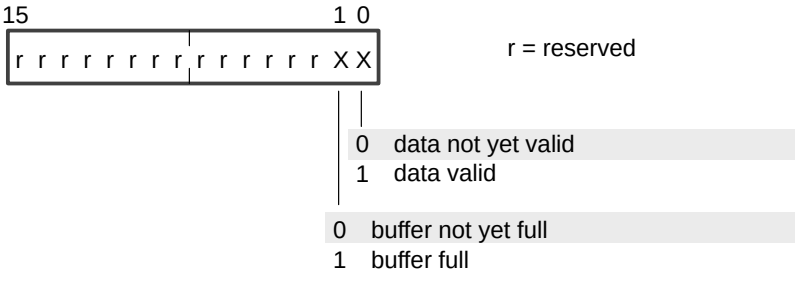
☞ **Note** **Other conditions within an active oscilloscope can be queried with P-0-0411.**

P-0-0411 **Oscilloscope: status**



You determine the current status of an active oscilloscope (active: bit 0 and bit 1 of P-0-0410 have the value ”1”).

Parameter configuration



Bit 0 indicates whether standardisation of the measured data has been completed (”data valid”). Afterwards, the drive sets the command alteration bit.

Bit 1 indicates whether the ring memory is full (”buffer full”).
Bit 1 carries the value ”0” when

○ the trigger event has not yet been initiated

○ the ring memory is not completely filled because of a suitable specification in the trigger position parameter (P-0-0416).

P-0-0412 Oscilloscope: Initiate manual trigger

Phase 3,4	–	M → D	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

When ”manual trigger” has been set as trigger condition in parameter P-0-0413, the change of bit 0 to value ”1” will initiate the trigger event.

Parameter configuration

15 0

r r r r r r r r r r r r r r r X

r = reserved

0 manual trigger not initiated
1 initiate manual trigger

☞ **Note** **Since this parameter belongs to the group of real-time control bits, you may also enter it in P-0- 2000, thus assigning one of the 10 digital inputs to the manual trigger. In this case, bit 0 is a logical image of the corresponding hardware input.**
A high level at this input will then initiate the manual trigger. Concerning the initialisation and scanning frequency of the hardware inputs, please refer to the description of parameter P-0-2000.

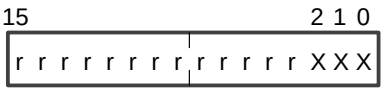
P-0-0413 Oscilloscope: trigger condition

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

You specify whether the ”manual trigger” (see also P-0-0412) or the ”comparative trigger” shall be activated.
If you do **not** select the ”manual trigger” in P-0-0413, the comparative trigger will automatically be active.

Parameter configuration

X is assigned the 0 or 1 below it.
r = reserved



0 0 manual trigger
0 1 comparative trigger: greater than/equal
1 0 comparative trigger: less than/equal
1 1 comparative trigger: identical

0 condition-triggered
1 edge-triggered

”Manual trigger”:
The trigger is exclusively initiated by P-0-0412. Bit 2 has no significance in this case. The trigger source (P-0- 0414) and trigger level (P-0-0415) parameters will not be considered, however, they must be assigned valid values.

”Comparative trigger: greater than/equal” and ”condition-triggered”:
The trigger is initiated when the value of the trigger source (P-0-0414) was greater than or equal to the trigger level (P-0-0415) in at least 2 consecutive scanning cycles.
The condition of P-0-0412 will not be considered.

”Comparative trigger: greater than/equal” and ”edge-triggered”:
The trigger is initiated when the value of the trigger source (P-0-0414) is initially less, but then greater than or equal to the trigger level (P-0-0415) in 2 consecutive scanning cycles.
The condition of P-0-0412 will not be considered.

”Comparative trigger: less than/equal” and ”condition-triggered”:
The trigger is initiated when the value of the trigger source (P-0-0414) is less than or equal to the trigger level (P-0-0415) in at least 2 consecutive scanning cycles.
The condition of P-0-0412 will not be considered.

”Comparative trigger: less than/equal” and ”edge-triggered”:
The trigger is initiated when the value of the trigger source (P-0-0414) is initially greater, but then less than or equal to the trigger level (P-0-0415) in 2 consecutive scanning cycles.
The condition of P-0-0412 will not be considered.

”Comparative trigger: identical”:
The trigger is initiated when the value of the trigger source (P-0-0414) is exactly identical to the trigger level (P- 0-0415) in 2 consecutive scanning cycles.
Bit 2 is of no significance in this case.
The condition of P-0-0412 will not be considered.

P-0-0414 Oscilloscope: trigger source

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Specifies the parameter to be triggered.
For this purpose, you only need to enter the desired parameter number in the data of P-0-0414.
As a rule, most drive parameters can be used as trigger sources.

☞ **Note** **Parameter P-0-0414 must be defined before parameter P-0-0415.**

P-0-0415 Oscilloscope: trigger level

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The drive compares the values measured at the trigger source (P-0-0414) according to the selected trigger condition (P-0-0413) permanently with the value entered in this parameter.

☞ **Note** **This parameter is automatically given attributes, the unit of measure and the limit values of the parameter defined in P-0-0414 for monitoring the validity of the value entered here.**
Therefore, parameter P-0-0414 must be defined before parameter P-0-0415.

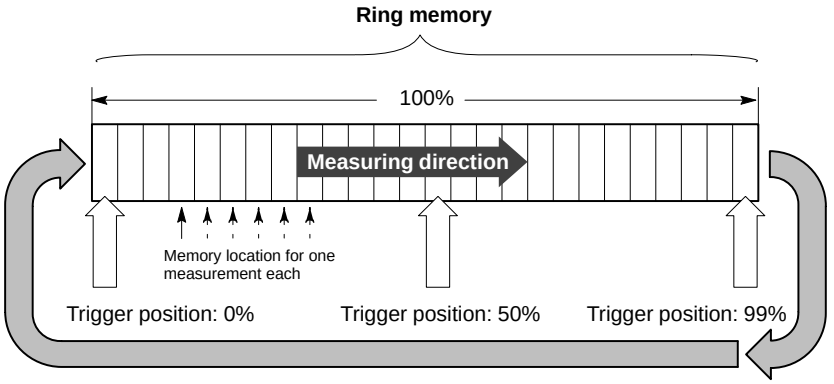
P-0-0416 Oscilloscope: Trigger position

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

You specify which percentage of the measured values already stored in the ring memory shall be retained when the valid trigger arrives. Thus, you may also check the data measured before occurrence of the trigger event.

Range: 0 ... 99 %, only **integer** values

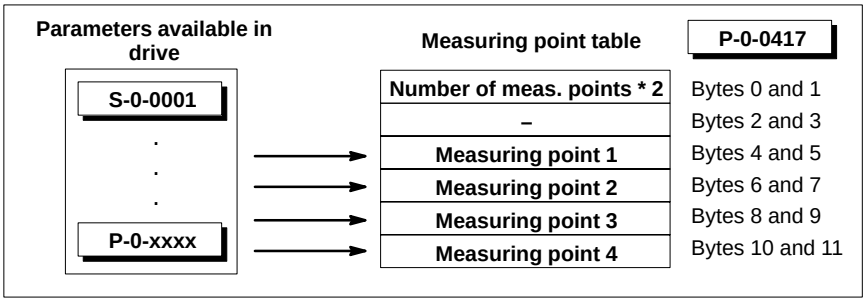
Default: 0 %



P-0-0417 Oscilloscope: Measuring point table

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Defines the measuring points where the oscilloscope is to scan data. For this purpose, enter a maximum of 4 parameters according to the following schematic:



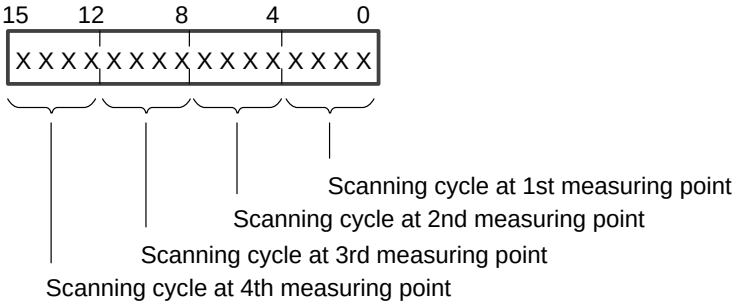
In case any parameters specified here are not suitable as measuring points, or if the measuring point table is incorrect, the drive sets the command error bit to ”1” when the oscilloscope has been started (bit 3 of the command acknowledgement). The exact cause of the error can be determined through parameter P-0-0482.

P-0-0418 Oscilloscope: scanning cycles of measuring points

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Specifies a separate scanning cycle for every measuring point. The possible values are stored in parameter P-0-0429.

Parameter configuration



P-0-0418 must be assigned valid values in ascending order, starting with the scanning cycle at the first measuring point (bits 0–3, bits 4–7, bits 8–11, and bits 12–15).

Parameter P-0-0418 will not be considered if a value "> 1" is entered in P-0-0419. In this case, the same cycle will be used for scanning data at all defined measuring points (see P-0-0419).

☞ **Note** **Even if less than 4 measuring points have been defined in P-0-0417, or if P-0-0418 is not considered because of identical scanning cycles, you must enter valid values in this parameter.**

P-0-0419 Oscilloscope: Multiples of the greatest scanning cycle

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

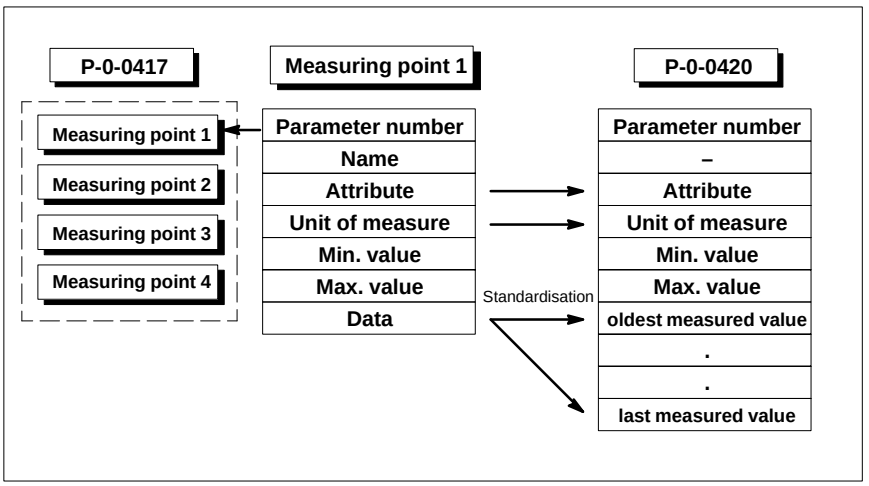
If measurements must be performed for prolonged periods of time for a predetermined number of measuring points, the scanning frequency (measurements/sec) must be reduced because the complete measured data memory available has a constant size of 4096 32-bit words.
For this purpose, you must enter an integer factor (> 1) in P-0-0419. The drive multiplies the greatest scanning cycle – contained in P-0-0429 – with this factor and interprets the result as the desired scanning cycle of **all** defined measuring points.

☞ **Note** **If the value "1" is entered in parameter P-0-0419, the scanning cycles specified in parameter P-0-0418 will be used.**

P-0-0420 Oscilloscope: List of measuring point 1

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains – in addition to information on the actual measuring point – the list of data measured at measuring point 1 (for definition of the measuring points, see P-0-0417).
The unit of measure, standardisation and parts of the attribute of the selected measuring point will be taken over. The limit values ”min. value” and ”max. value” are automatically determined by the drive on the basis of the measured values.
Thus, parameter P-0-0420 contains all information required for subsequent display or scaling of the display.
The data of P-0-0420 contain all individual measured values.



☞ **Note** **The DSS-D user interface provides support for measurement settings, data handling and the graphics display of measured values by the integrated ”oscilloscope” diagnostics program. Thus, you need not know the structure of the parameters used.**

P-0-0421 Oscilloscope: List of measuring point 2

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Contains the list of data measured at measuring point 2.
For structure, see P-0-0420.

P-0-0422 Oscilloscope: List of measuring point 3

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Contains the list of data measured at measuring point 3.
For structure, see P-0-0420.

P-0-0423 Oscilloscope: List of measuring point 4

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Contains the list of data measured at measuring point 4.
For structure, see P-0-0420.

P-0-0429 Oscilloscope: List of scanning cycles

–	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter contains a list of maximally 4 possible scanning cycles (in µs).
Enter the desired cycle in parameter P-0-0418 separately for each measuring point.

Your notes :

11 Setpoint generator

11.1 Procedure

An integrated setpoint generator can be activated for optimising and testing the drive in terms of:

- current setpoints,
- speed setpoints, and
- position setpoints

For this purpose, different freely selectable signal conditions can be specified, cyclic setpoint input is deactivated during this time.

P-0-0401 Setpoint generator: control parameter

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The control parameter serves to specify the mode of functioning of the setpoint generator.

Parameter configuration

15							7	6			2	1	0
r	r	r	r	r	r	r	r	X	X	r	r	X	X	X

X is assigned the 0 or 1 below it.
r = reserved

Bits 0–2: Setpoint generator

0 0 1	position generator
0 1 0	speed generator
1 0 0	current generator

Bit 6: Autorepeat for speed/current setpoints

1	one-time execution
0	automatic repetition

Bit 7: Signal condition for speed/current setpoints

1	with standard generator (P-0-0403 ... P-0-0408)
0	from table (P-0-0402, P-0-0407)

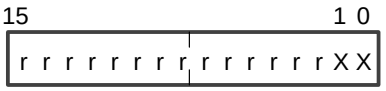
☞ **Note** **Autorepeat and signal condition cannot be selected for position setpoints. All necessary information is specified by the standard parameters.**

P-0-0400 Setpoint generator: command ”Start setpoint generator”

Phase 4	–	–	–	–	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter starts the setpoint generator and switches off cyclic setpoint input. When the setpoint generator is stopped, cyclic setpoint input becomes active again.

Parameter configuration



X is assigned the 0 or 1 below it.
r = reserved

0 Delete command in drive
1 Set command in drive

0 Interrupt execution of command
1 Enable execution of command

CAUTION !

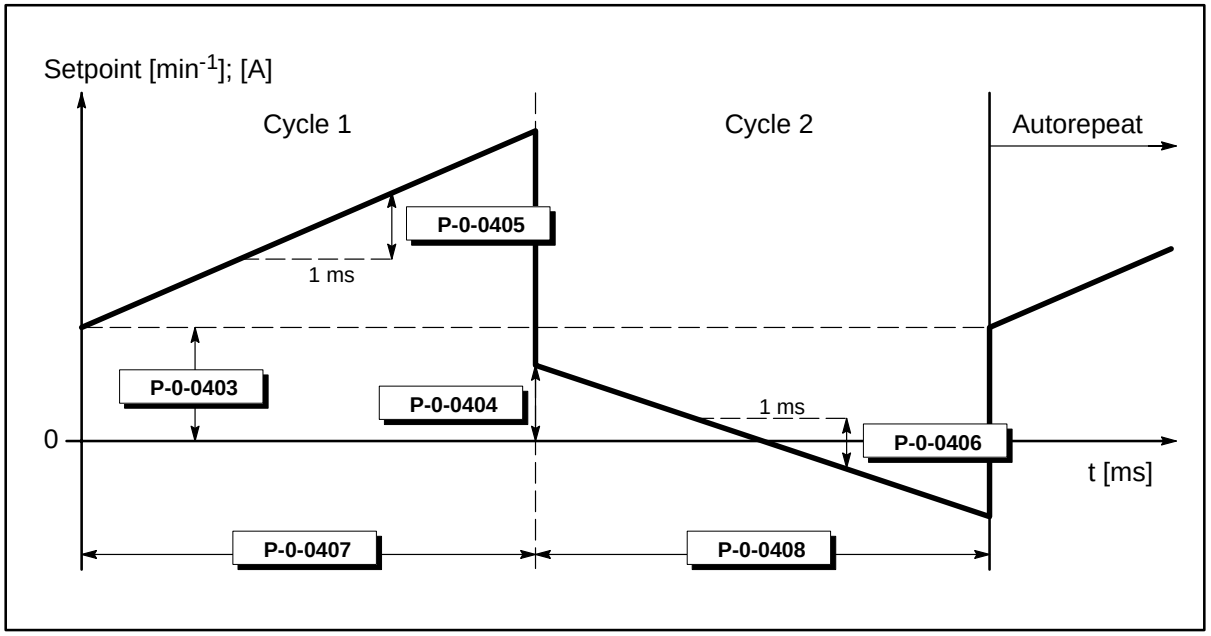
The setpoint generator starts the drive.

Please ensure by appropriate precautions that no damages can occur.

Procedure

1. Assign the required values to parameters P-0-0401 to P-0-0408, depending on the signal condition.
2. Start setpoint generator (set bit 0 and bit 1 of P-0-0400 to ”1”). The drive checks the previously assigned parameters for their validity. If they contain invalid data, the command error bit (bit 3 of the command acknowledgement) is set.
3. Stop setpoint generator (set bit 0 and bit 1 of P-0-0400 to ”0”).

11.2 Current and speed setpoints with standard generator



P-0-0403 Setpoint generator: initial amplitude, cycle 1

Phase 3,4	–	–	–	FEPROM	Setpoint generator	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entries: Current signal: $-I_{max}$ ... $+I_{max}$ [0.01 A]
Speed signal: $-n_N$ ... $+n_N$ [0.01 min^{-1}]

P-0-0404 Setpoint generator: initial amplitude, cycle 2

Phase 3,4	–	–	–	FEPROM	Setpoint generator	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entries: Current signal: $-I_{max}$ ... $+I_{max}$ [0.01 A]
Speed signal: $-n_N$ ... $+n_N$ [0.01 min^{-1}]

P-0-0405 Setpoint generator: acceleration, cycle 1

Phase 3,4	–	–	–	FEPROM	Setpoint generator	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entries: Current signal: –100 ... +100 [0.0001 A/ms]
Speed signal: –500 ... +500 [0.0001 min^{-1}/ms]

P-0-0406 Setpoint generator: acceleration, cycle 2

Phase 3,4	–	–	–	FEPROM	Setpoint generator	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entries: Current signal: –100 ... +100 [0.0001 A/ms]
Speed signal: –500 ... +500 [0.0001 min^{-1}/ms]

P-0-0407 Setpoint generator: duration of cycle 1

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

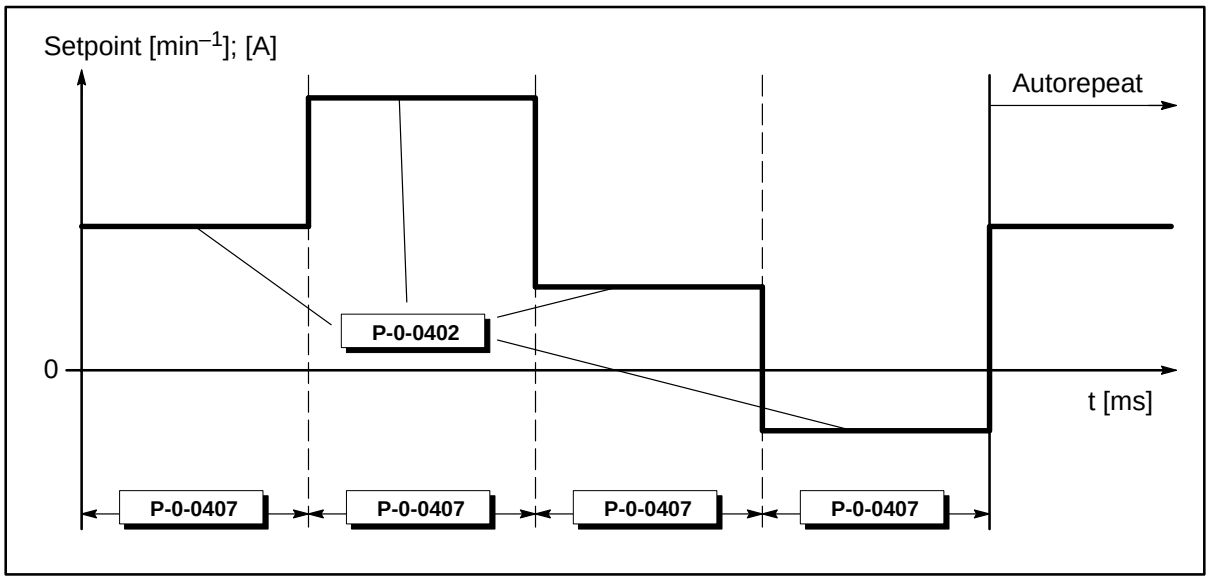
Entries: 1 ... 65535 [ms], integers only

P-0-0408 Setpoint generator: duration of cycle 2

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entries: 1 ... 65535 [ms], integers only

11.3 Current and speed setpoints from a table



P-0-0402 Setpoint generator: Setpoint table

Phase 3,4	–	–	–	FEPROM	Setpoint generator	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

This parameter serves to generate a stepped signal format. It may contain up to 32 amplitude values that can be repeated with Autorepeat.

P-0-0402

Bytes 0 and 1	**Number of ampl. values *4**
Bytes 2 and 3	**–**
Bytes 4 and 5	**1st amplitude value**
Bytes 6 and 7	**2nd amplitude value**
Bytes 8 and 9	**3rd amplitude value**
.	**.**
.	**.**
up to bytes 66 and 67	**max. 32 amplitude values**

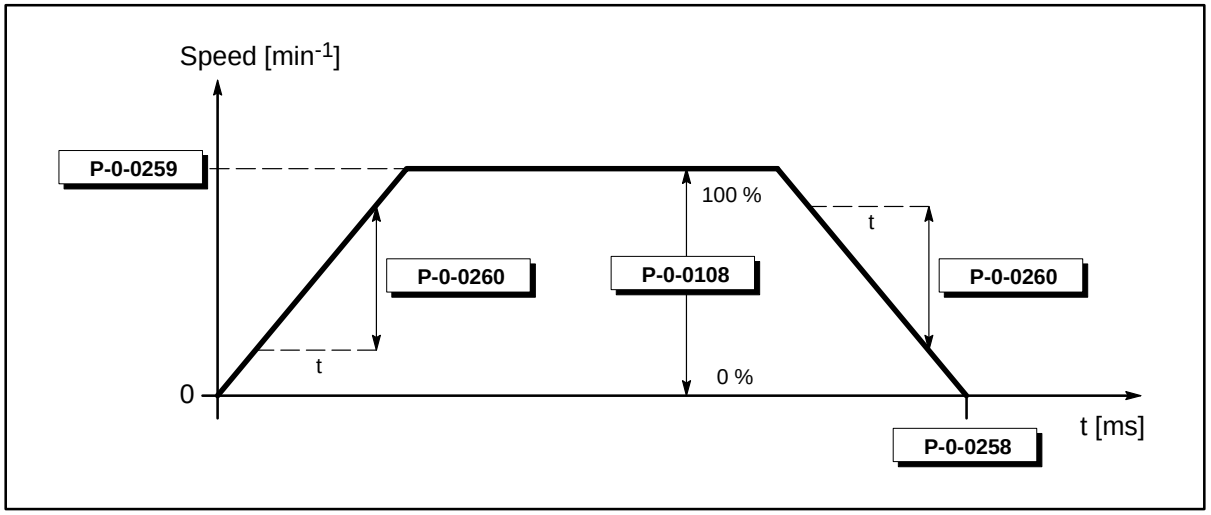
Entries: Current signal: $-I_{max}$ ... $+I_{max}$ [0.01 A]
Speed signal: $-n_N$ ... $+n_N$ [0.01 min^{-1}]

P-0-0407 Setpoint generator: duration of cycle 1

Phase 3,4	–	–	–	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entries: 1 ... 65535 [ms], integers only

11.4 Position setpoints



S-0-0258 Target position

Phase 3,4	–	–	MDT	–	Position	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

The target position is the position setpoint for the drive.
The drive approaches the target position, taking into account the positioning speed S-0-0259 and the positioning acceleration S-0-0260.

Entries: -2^{31} ... $+2^{31}$
Weighting and preferred weighting in accordance with section 3.4.1.

S-X-0259 Positioning speed

Phase 3,4	–	–	–	FEPROM	Speed	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Entries: 0 ... 90% n_{max}
Weighting and preferred weighting in accordance with section 3.4.2.

S-X-0260 Positioning acceleration

Phase 3,4	–	–	–	FEPROM	Accel.	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Weighting and preferred weighting in accordance with section 3.4.4.

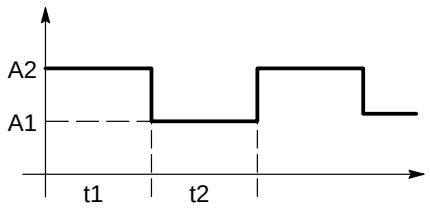
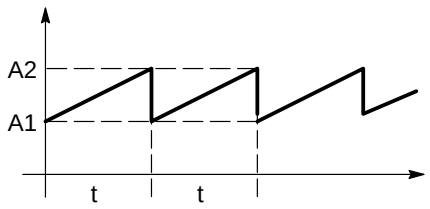
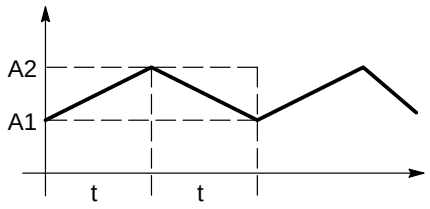
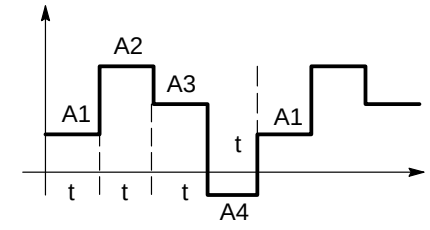
S-0-0108 Feedrate Override

Phase 3,4	–	–	MDT	FEPROM	–	
Changeable	Init	Real-time bit	Cyclic	Recovery	Weighting	

Effective only for drive-controlled traverse commands.
The feedrate override has a multiplying effect on the speed setpoints calculated by the drive.

Entries: 0.01 ... 635.35 %

11.5 Examples

Signal	P-0-0401	P-0-0402 ... P-0-0408
	15 0 r r r r r r r r 0 X r r r X X 0 Speed/current setpoints with standard generator with/without Autorepeat	P-0-0403 **A2** P-0-0404 **A1** P-0-0405 **0** P-0-0406 **0** P-0-0407 **t1** P-0-0408 **t2**
	15 0 r r r r r r r r 0 X r r r X X 0 Speed/current setpoints with standard generator with/without Autorepeat	P-0-0403 **A1** P-0-0404 **A1** P-0-0405 **(A2–A1) / t** P-0-0406 **(A2–A1) / t** P-0-0407 **t** P-0-0408 **t**
	15 0 r r r r r r r r 0 X r r r X X 0 Speed/current setpoints with standard generator with/without Autorepeat	P-0-0403 **A1** P-0-0404 **A2** P-0-0405 **(A2–A1) / t** P-0-0406 **(A2–A1) / t** P-0-0407 **t** P-0-0408 **t**
	15 0 r r r r r r r r 1 X r r r X X 0 Speed/current setpoints from table with/without Autorepeat	P-0-0402 **16, –, A1, A2, A3, A4** P-0-0407 **t**

A Appendix

A.1 List of ident. numbers described

A.1.1 Standard parameters

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