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# Instruction Manual HIPERDRIVE with EtherCAT

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halstrup-walcher GmbH  
Stegener Straße 10

D-79199 Kirchzarten, Germany

Tel.: +49 (0) 76 61/39 63-0  
Fax: +49 (0) 76 61/39 63-99

E-Mail: [info@halstrup-walcher.de](mailto:info@halstrup-walcher.de)  
Internet: [www.halstrup-walcher.de](http://www.halstrup-walcher.de)

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## Purpose of instruction manual

This instruction manual describes the features of the HIPERDRIVE positioning system and provides guidelines for its use.

Improper use of these devices or failure to follow these instructions may cause injury or damage equipment. Every person who uses the devices must therefore read the manual and understand the possible risks. The instruction manual, and in particular the safety precautions contained therein, must be followed carefully. **Contact the manufacturer if you do not understand any part of this instruction manual.**

Handle this manual with care:

- It must be readily available throughout the lifecycle of the devices.
- It must be provided to any individuals who assume responsibility for operating the device at a later date.
- It must include any supplementary materials provided by the manufacturer.

The manufacturer reserves the right to continue developing this device model without documenting such development in each individual case. The manufacturer will be happy to determine whether this manual is up-to-date.

## Conformity

This device is state of the art. It complies with the legal requirements of EC directives. This is shown by the CE mark.



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The manufacturer owns the copyright to this instruction manual. It contains technical data, instructions and drawings detailing the devices' features and how to use them. It must not be copied either wholly or in part or made available to third parties.

EtherCAT<sup>®</sup> 

EtherCAT<sup>®</sup> is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

# 1 Safety precautions

## 1.1 Appropriate use

Positioning systems are especially suitable for automatically setting tools, stops or spindles for wood-processing equipment, packing lines, printing equipment, filling units and other types of special machines.

**HIPERDRIVE positioning systems are not stand-alone devices and may only be used if coupled to another machine.**

Always observe the operating requirements – particularly the permissible supply voltage – indicated on the rating plate and in the “Technical data” section of this manual.

The device may only be handled as indicated in this manual. Modifications to the device are prohibited. The manufacturer is not liable for damages caused by improper use or failure to follow these instructions. Violations of this type render all warranty claims null and void.

## 1.2 Shipping, assembly, electrical connections and start-up

Assembly and the electrical connections should only be handled by professionals. They should be given proper training and be authorised by the operator of the facility.

The device may only be operated by appropriately trained individuals who have been authorized by the operator of the facility.

Specific safety precautions are given in individual sections of this manual.

## 1.3 Troubleshooting, maintenance, repairs, disposal

The individual responsible for the electrical connections must be notified immediately if the device is damaged or if errors occur.

This individual must take the device out of service until the error has been corrected and ensure that it cannot be used unintentionally.

This device requires no maintenance.

Only the manufacturer may perform repairs that require the housing to be opened.

The electronic components of the device contain environmentally hazardous materials and materials that can be reused. The device must therefore be sent to a recycling plant when you no longer wish to use it. The environment codes of your particular country must be complied with.

## 1.4 Symbols

The symbols given below are used throughout this manual to indicate instances when improper operation could result in the following hazards:



**WARNING!** This warns you of a potential hazard that could lead to bodily injury up to and including death if the corresponding instructions are not followed.



**CAUTION!** This warns you of a potential hazard that could lead to significant property damage if corresponding instructions are not followed.



**INFORMATION:** This indicates that the corresponding information is important for operating the device properly.

## 2 The HIPERDRIVE concept

The HIPERDRIVE positioning system, an intelligent, compact, complete solution for positioning auxiliary and positioning axes, consists of an EC motor, gear, power amplifier, control electronics, absolute measuring system and EtherCAT interface. The integrated absolute measuring system eliminates the need for time-consuming reference runs. Connecting to a bus system simplifies the wiring. The positioning system is especially suitable for automatically setting tools, stops or spindles for wood-processing equipment, packing lines, printing equipment, filling units and other types of special machines.

There are two options for the EtherCAT connection:

- 1) The HIPERDRIVE units are connected to a central connecting station. This connecting station is called the "HIPERDRIVE Hub". Up to eight drives can be connected to a hub, all drives are used via the same bus address. In addition, the HIPERDRIVE Hub distributes the operating voltage for the drives. This means that only one cable is required to connect a drive. Both data and power for the drives are transmitted via the same cable. For the HIPERDRIVE Hub itself, apart from the fieldbus and 24V motor supply voltage, only a 24V auxiliary voltage is required for the hub electronics.
- 2) The HIPERDRIVE drives are equipped with a bus adapter. The bus adapter has a fixed connection to the drive. Each drive unit therefore has its own bus address and its own fieldbus connection. In the same way, each adapter has an input for the 24V power supply to the bus adapter and the 24V power supply to the drive.

## 3 Device description: HIPERDRIVE Hub

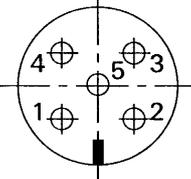
### 3.1 Pin assignment HIPERDRIVE Hub

A round, 5-pin plug, series 713/763 (A-coded) manufactured by Binder for the supply voltage is located on the housing cover of the HIPERDRIVE Hub.

Two round 4-pin sockets, series 825 (D-coded) are provided for connection to the bus.

#### Round plug for the power supply of the control unit:

(External top view)

	<p>1: +24V control unit                  2: NC                  3: Ground (control unit)                  4: NC                  5: NC</p>
---	--

#### Supply for the drives connected to the HIPERDRIVE Hub:

The motor power supply (24VDC and GND) is connected using two screw connections for cable lugs M6. These are concealed under a cover on the front side of the hub.

#### Screw terminal for each of the drives connected to the HIPERDRIVE Hub:

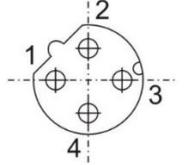
For each drive to be connected to the HIPERDRIVE Hub, there is a flange adapter containing a screw terminal with the following pin assignment:

Pin	Signal	Wire colour
1	RS485 data +	white
2	RS485 data -	green
3	+24V	orange
4	GND	black
5	+24V	red
6	GND	blue

Terminals 3 and 5 are connected internally in the hub, as are terminals 4 and 6.

#### Round sockets for the bus:

(External top view)

	<p>1: TD+ (WH/GN, white/green)                  2: RD+ (WH/OR, white/orange)                  3: TD- (GN, green)                  4: RD- (OR, orange)</p>
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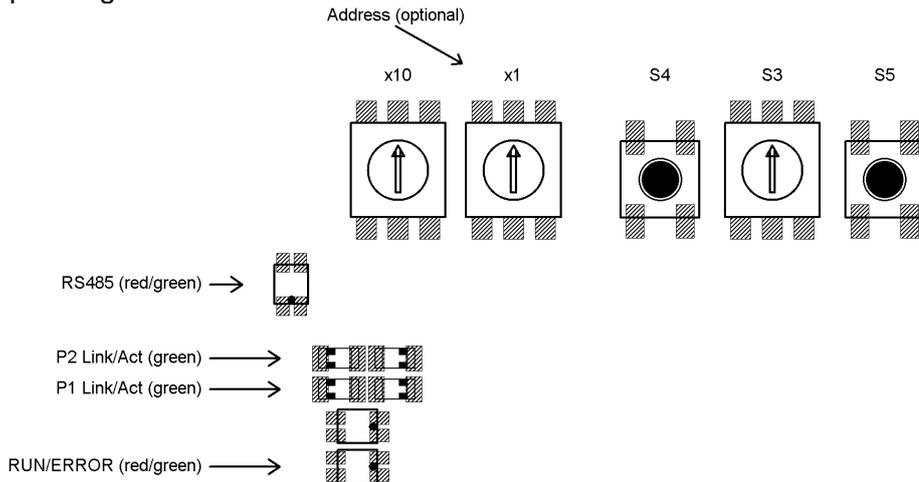
Due to the use of 4-pin sockets, only four-wire cables should be used.

### 3.2 Setting the device address

The device address is assigned via the bus of the EtherCAT master. Alternatively, the “configured station alias” can be defined using the two rotary switches (address switch value > 0).

### 3.3 LEDs and jog keys for the HIPERDRIVE Hub

Opening the housing cover on the top side of the hub provides access to the following operating and observation elements:



The LEDs are visible through two windows in the housing cover even when it is closed.

#### Meaning of the LEDs:

1) Each of the ports (P1/P2) has an associated green LED for the “Link” and “Activity” states.

#### For each port the following states are possible:

- off → no connection
- on → line connection is active, no data activity
- flickering at 10 Hz → line connection and data transmission active

2) Red/green EtherCAT status LED

EtherCAT STATUS LED (green/red; see EtherCAT specification)

3) Red/green LED “RS485”

The LED “RS485” signals the status of the RS485 connections to the connected motors

Switch S3 = 0 → displays a collective message,

Switch S3 > 0 → Status of the RS485 connection to the motor selected with S3

(see also following section)

Meaning of the rotary switches and keys:

- S1/S2: Definition of the “configured station alias” (address switch value 0 means that the last value saved in the device will be used)
- S3: Selection of the drive to be jogged or to identify a faulty drive
- S4: Jog the drive selected with S3. Starts a jog step with the parameters from SDO #2090 (jog 2; default 1/16 rotation backwards)
- S5: Jog the drive selected with S3. Starts a jog step with the parameters from SDO #208F (jog 1; default 1/16 rotation forwards)



**Important: Always close the housing cover after completing the operating and observation task. This will prevent dust and contaminants from entering the device.**



**The HIPERDRIVE drives can only be run via the bus if S3 is set to 0.**

### 3.4 Meaning of the LED statuses of LED “RS485”

The LED RS485 shows a collective message. When switch S3 is set to 0, the meanings are as follows:

Status	Meaning
off	No power supply to the HIPERDRIVE electronics.
flashes red+green alternately (5 Hz)	Presence test The hub is detecting the ports to which drive are connected
red on	Communication error for at least one of the drives marked as “required”
red+green on	Drive error for at least one of the drives marked as “required” (communication to these drives is functioning correctly)
flashes green (2 Hz)	All drives marked as “required” are functioning without communication or drive errors.  At least one further drive exists, which is not marked as “required”. No drive errors for any “non-required” drive.
flashes red+green simultaneously (2 Hz)	All drives marked as “required” are functioning without communication or drive errors.  At least one further drive exists, which is not marked as “required”. At least one of the “non-required” drives has a drive error.
green on	Only the drives marked as “required” are available and none of these have a drive error.

When S3 is set to a value > 0, the LED RS485 shows the status of the drive selected using the switch S3:

Status	Meaning
off	Not available and not required.
red on	Communication error
red+green on	Communication OK, but drive error
green on	Communication OK, no drive error

When the S3 switch is set to 0, it is therefore possible to view the communication status with the drives and, if a problem arises, identify the specific drive causing the problem by setting the S3 switch to the next corresponding position.

### 3.5 Start-up: HIPERDRIVE Hub

After connecting the supply voltage, the hub automatically performs a presence test.

During this test, the hub detects the ports to which drives are connected. For each drive, the baud rate is set to the last value saved in the hub for the specific drive. The "RS485 message complete time" (time after which the drive evaluates a received message) is set to a value corresponding to the desired baud rate. The RS485 address of the drive is set to 1 (steady-state).

In addition, the hub loads the most recently saved information about the ports at which drives were most recently required, i.e. were released for issuing run commands.

If at least one drive requested recently is not found, the LED RS485 is illuminated red.

If precisely the number of drives requested recently is found, the LED RS485 is illuminated green.

If more drives than last required are found, the LED RS485 flashes green (frequency 2 Hz).

In the delivery state, no drive is marked as "required".



**A drive must first be "required" at the hub in order to execute run commands. For the drive "n", this is done by setting SDO (0x20A4 + (n-1) \* 0x80) to 1.**

The presence test can also be repeated at any time after switching on the supply voltage by setting SDO #200D to -3.

## 4 Device description: HIPERDRIVE bus adapter

### 4.1 Assembly of the HIPERDRIVE drives with bus adapter

The drives are fixed in position using 4x M5 screws via the centring spigot flush on the mounting surface. Please ensure that the screw depth in the mounting surface is at least 10mm.

The mounting flange is symmetrical, i.e. the drives can be mounted in four different angle positions on the mounting surface depending on the cable outlet.

The shaft connection with the feather key shows a positive engagement. When installing mechanical coupling elements, please take note of the permitted axial and radial forces stated in the “Technical data” section. If necessary, use a suitable coupling element to balance the axial and radial tolerances.



**To prevent damage to electromechanical components, please avoid banging or knocking the output shaft.**

### 4.2 Pin assignment: HIPERDRIVE bus adapter

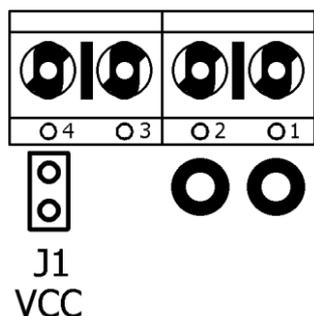
A 4-pin screw terminal for connecting the supply voltage is located in the housing cover of the HIPERDRIVE bus adapter. A PG threaded connection through which the screw terminal can be accessed is provided as standard. Optionally, these terminals are already factory-wired to the pins of a 7/8" plug (manufacturer: Lumberg; designation RSF 50/11-04). In this case, the PG threaded connection is omitted.

Two round 4-pin sockets, series 825 (D-coded) are provided for connection to the bus.

#### **Screw terminal for the power supply of the HIPERDRIVE drive unit with bus adapter:**

- |   |                  |
|---|------------------|
| 1 | GND drive        |
| 2 | +24V drive       |
| 3 | GND bus adapter  |
| 4 | +24V bus adapter |

The bus adapter electronics can either be powered via separate connection points (terminals 3/4) or be interconnected with the motor power supply via the jumpers J1 in the adapter:

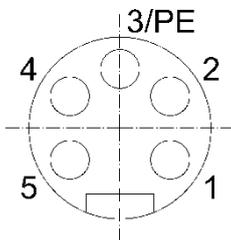


The former is generally selected if the motor power supply is run in a safety circuit with the EMERGENCY STOP and the databus has to remain active during an EMERGENCY STOP, or if the motor power supply does not permit correct operation of the bus adapter due to inadequate voltage stability or high interference voltages.



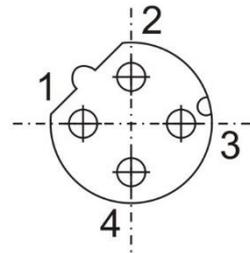
In addition, the two GND potentials should be connected outside the device (e.g. directly at the power supplies which provide the two supply voltages) so that potential compensating currents will not flow through the device.

**Round plug for power supply  
(optional):**  
(External top view)



- 1 +24V Motor
- 2 Ground (motor)
- 3 Housing
- 4 Ground (control unit)
- 5 +24V control unit

**Round socket for the bus:**  
(External top view)



- 1 TD+ (WH/GR, white/green)
- 2 RD+ (WH/OG, white/orange)
- 3 TD- (GR, green)
- 4 RD- (OR, orange)



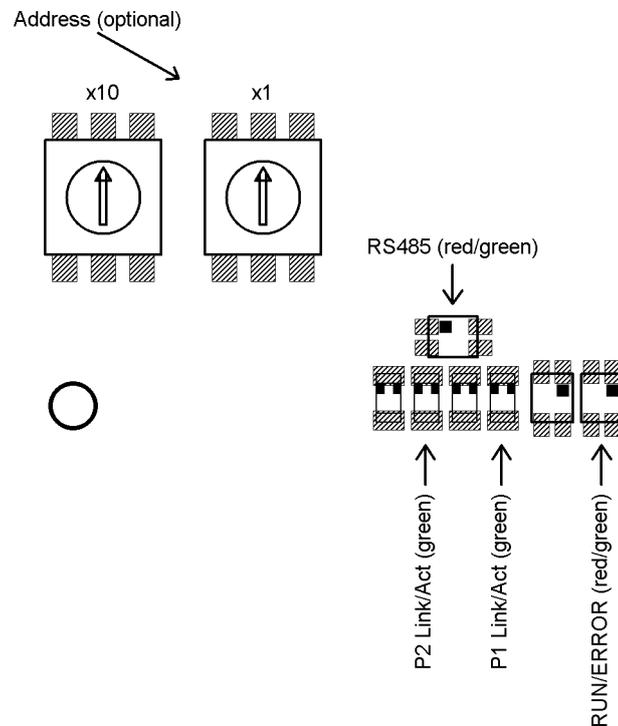
Due to the use of 4-pin sockets, only four-wire cables should be used.

### 4.3 Setting the device address

The device address is assigned via the bus of the EtherCAT master. Alternatively, the “configured station alias” can be defined using the two rotary switches (address switch value > 0).

## 4.4 LEDs for the HIPERDRIVE bus adapter

Opening the cover of the bus adapter provides access to the following operating and observation elements:



The LEDs are visible through two windows even when the bus adapter cover is closed.

### Meaning of the LEDs:

1) Each of the ports (P1/P2) has an associated green LED for the “Link” and “Activity” states.

### For each port the following states are possible:

- off → no connection
- on → line connection is active, no data activity
- flickering at 10 Hz → line connection and data transmission active

2) Red/green EtherCAT status LED

EtherCAT STATUS LED (green/red; see EtherCAT specification)

3) Red/green LED “RS485”

The LED “RS485” signals the status of the RS485 connection to the connected motor (collective message, see also following section).

**Meaning of the rotary switches:**

The two rotary switches are used to define the “configured station alias” (address switch value 0 means that the last value saved in the device will be used). These can be accessed by opening the cover of the bus adapter.



**Important: Always close the cover of the bus adapter after completing the operating and observation task. This will prevent dust and contaminants from entering the device.**

### 4.5 Meaning of the LED statuses of LED “RS485”

LED-RS485 shows a collective message.

Status	Meaning
off	No power supply to the HIPERDRIVE electronics.
flashes red+green alternately (5 Hz)	Presence test The bus adapter determines whether communication with the basic unit has been established.
red on	Communication error to the drive, if this is marked as “required”
red+green on	Drive error (communication to the drive is functioning correctly)
flashes green (2 Hz)	The drive is not marked as “required”, no drive error.
flashes red+green simultaneously (2 Hz)	The drive is not marked as “required”, the drive has a drive error.
green on	Communication to the drive is functioning correctly, the drive has no drive error.

### 4.6 Start-up: HIPERDRIVE bus adapter

After connecting the supply voltage, the bus adapter automatically performs a presence test:

During this test, the adapter determines whether a drive is connected to the adapter. If so, the transfer rate is set to the last value saved in the adapter. The “RS485 message complete time” (time after which the drive evaluates a received message) is set to the value corresponding to the desired baud rate. The RS485 address of the drive is set to 1 (steady-state).

If no drive is found, the LED RS485 is illuminated red.

If the drive is found, the LED RS485 is illuminated green.

## 5 The EtherCAT interface

### 5.1 EtherCAT interface with CoE protocol (CANopen over EtherCAT)

The EtherCAT interface uses the CANopen over EtherCAT protocol in accordance with ETG1000.6 Section 5.6:

- one send and one receive SDO per device
- one asynchronous send and receive PDO, active by default
- Meaning of the LEDs:

1) Each of the ports (P1/P2) has an associated green LED for the “Link” and “Activity” states.

For each port the following states are possible:

- off → no line connection
- flickering at 10 Hz → line connection; data transmission active
- on → line connection; data transmission inactive

2) The green “Run” LED signals the ESM status:

- off → INIT
- flashes at 2.5Hz → PRE-OPERATIONAL
- single flashes at 1Hz → SAFE-OPERATIONAL
- on → OPERATIONAL

3) The red “Error” LED signals an error:

- off → no error
- single flashes at 1Hz → local fault, application is changing ESM status
- double flashes at 1Hz → watchdog timeout
- flashes at 2.5Hz → configuration fault



Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W	
Transmit PDO 1 mapping	1A00	Sub index 0: No. of indices (Adapter → 3; Hub-4 → 12; Hub-8 → 24)	8 bit			R	
		Sub 1: 0x20840010	32 bit			R	
		Sub 2: 0x20850010	32 bit			R	
		Sub 3: 0x20860020	32 bit			R	
		<u>In addition, for Hub-4 and Hub-8:</u>					
		Sub 4: 0x21040010	32 bit			R	
		Sub 5: 0x21050010	32 bit			R	
		Sub 6: 0x21060020	32 bit			R	
		Sub 7: 0x21840010	32 bit			R	
		Sub 8: 0x21850010	32 bit			R	
		Sub 9: 0x21860020	32 bit			R	
		Sub 10: 0x22040010	32 bit			R	
		Sub 11: 0x22050010	32 bit			R	
		Sub 12: 0x22060020	32 bit			R	
<u>In addition, for Hub-8:</u>							
Sub 13: 0x22840010	32 bit			R			
...	...			...			
Sub 24: 0x24060032	32 bit			R			
SM Comm Types	1C00	Sub index 0: No. of indices (= 4) Sub 1: SM0 (= 1) Sub 2: SM1 (= 2) Sub 3: SM2 (= 3) Sub 4: SM3 (= 4)	8 bit 8 bit 8 bit 8 bit 8 bit		4	R R R R R	
SM0 PDO Assignment	1C10	Sub index 0: No. of indices (= 0)	8 bit		0	R	
SM1 PDO Assignment	1C11	Sub index 0: No. of indices (= 0)	8 bit		0	R	
SM2 PDO Assignment	1C12	Sub index 0: No. of indices (= 1) Sub 1: 0x1600 (1. RxPDO)	8 bit 16 bit		1	R	
SM3 PDO Assignment	1C13	Sub index 0: No. of indices (= 1) Sub 1: 0x1A00 (1. TxPDO)	8 bit 16 bit		1	R	

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W
general purpose register	2000	10 general purpose registers Sub index 0: No. of indices (= 10) Sub 1..10: Free register	8 bit 32 bit	yes	10 0	R R/W
Address	2001	Configured Station Alias <u>Write:</u> When writing the address via SDO, the new address will only be taken over into the ESC and the SII after saving the parameters in the EEPROM (see SDO #200D) and restart.  If the value is written directly to the SII by the master (i.e. not via SDO), it will be saved automatically by the HIPERDRIVE Hub or adapter.	16 bit	yes	0	R/W
HIPERDRIVE category	2002	Adapter → "HIPERDRIVE SINGLE" 4-port hub → "HIPERDRIVE HUB-4" 8-port hub → "HIPERDRIVE HUB-8"				R
HIPERDRIVE name	2004	Type designation as string				R
Item number	2005	halstrup-walcher article number as string (format xxxx.xxxx)				R
Serial number	2006	Serial device number of the hub or adapter	0... 65535 16 bit			R
Production date	2007	Year and week of manufacture as string (format WW/YYYY)				R
Version	2008	Software version number as string (format x.xx)				R
U control	2009	Current supply voltage to control unit, in 0.1 V	16 bit			R
Device temperature	200B	Internal device temperature in °C	16 bit			R

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W
Delivery state	200D	<p><u>Writing a "-3":</u> resets all the connected drives and sets the desired baud rate</p> <p>The execution of this command may take up to 2 sec for the HIPERDRIVE bus adapter and up to 8 sec for the HIPERDRIVE Hub → Watch acknowledgement of drive (receiving of SDO response).</p> <p><u>Writing a "-2":</u> sets the values of all the parameters that can be saved in the hub or adapter to the last values saved by the user, without saving the parameters in EEPROM</p> <p><u>Writing a "-1":</u> sets the values of all the parameters that can be saved in the hub or adapter to the delivery state, without saving the parameters in EEPROM</p> <p><u>Writing a "1":</u> saves the parameters in EEPROM</p> <p><u>Reading after booting:</u> 0 → Memory content correct ≠ 0 → Memory content incorrect</p> <p><u>Reading after saving:</u> 0 → Saving successfully completed ≠ 0 → Saving not yet completed or completed incorrectly (saving can take up to 200ms)</p>	-3, -2, -1 or 1 (during writing) 0..3 (during reading) ±15 bit	no		R/W

For HIPERDRIVE Hubs, the following section is repeated for each additional drive:

The area above 0x2080 of the object dictionary contains those objects that exist once for each connectable drive.

The following table describes the SDOs for the first drive connected, i.e. drive 1 on the hub or the drive connected to the HIPERDRIVE bus adapter.

For each additional drive, an index number is created for a specific SDO by adding  $n * 0x80$  to the stated number. i.e.

$$\text{Index number}_{\text{Drive } n} = \text{Index number}_{\text{Drive } 1} + (n - 1) * 0x80$$

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W
Control word	2080	Start and finish positioning runs (see diagram)	16 bit	no	0	R/W
Percentaged target speed	2081	Sets the speed (r.p.m.) as a % of the max. value (SDO #208C)	1...100 8 bit	no	100	R/W
Percentaged maximum torque	2082	Sets the torque as % of the maximum value. Internally, the value is rounded up to multiples of 25%.	1...100 8 bit	no	100	R/W
Target position	2083	Target position The upper 16 bits represent the number of rotations, the lower 16 bits represent the desired angle within a rotation (applicable for default values of the scale setting SDO #2095)	±31 bit	no	0	R/W
Status word	2084	Status of the drive (see diagram)	16 bit			R
Actual r.p.m.	2085	Current speed in [0.1 r.p.m.] (applicable for default values of the scale setting SDO #2096)	±15 bit			R
Actual position	2086	Actual position of the output shaft The upper 16 bits represent the number of rotations, the lower 16 bits represent the desired angle within a rotation (applicable for default values of the scale setting SDO #2095).	±31 bit			R

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W
Fault buffer *)	2088	The most recent causes of faults or errors Sub index 0: No. of indices (= 8) Sub 1: latest cause of error ... Sub 8: oldest cause of error (still filed)  <u>Error codes:</u> 0x8200 Overcurrent 0x8201 Undervoltage 0x8202 Temperature too high 0x8203 Drag error 0x8300 block detection in backward direction 0x8301 block detection in forward direction 0x8304 Lower limit reached 0x8305 Upper limit reached 0x8401 Internal error (control loop) 0x8410 Internal error (EEPROM) 0x8500 Attempted start of a positioning run not possible (e.g. due to an RS485 communication error) 0x8501 Value transferred in SDO or PDO is not valid 0x8502 Internal error (SINCOS evaluation) 0x8503 Target position invalid 0x8601 Communication timeout (drive received no message from the RS485 master) 0x8603 RS485 communication error (no valid response from the drive)	8 bit 16 bit ... 16 bit			R R ... R
Number of faults	2089	Number of faults that have occurred since the last clearing of the fault buffer (or since the last activation of the axle). Setting to 0 clears the error list, other values are not permitted.	8 bit	no		R/W

\*) In case the EtherCAT interface is switched on continuously, the fault buffer might be filled with one or more values after switching off and on again the motor power supply. This neither influences the processing of the flow chart (see section “Flow chart”) nor the actual values of the status bits.

However, after switching on the motor power supply again, the fault buffer might be flushed in the following way as needed:

If the only error code which is contained is error code 0x8603, a simple flushing of the fault buffer is sufficient (setting SDO #2089 to 0). However, if additional error codes are listed, rather a reset of all connected drives has to be carried out. This takes place by setting SDO #200D to -3. Alternatively, the reset might also be executed by a positioning run, e.g. to the actual position. After this run has been finished, the fault buffer also might be flushed by setting SDO #2089 to 0.

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W	
Position lower limit	208A	Minimum permitted target position	The upper limit must be min. 1 higher than the lower limit. Values will only be accepted if the current actual position is within the newly defined positioning range.	see table ±31 bit	yes	see table	R/W
Position upper limit	208B	Maximum permitted target position		see table ±31 bit	yes	see table	R/W
Max. target speed (r.p.m.)	208C	100% value of the target speed [0.1 r.p.m.]	5...350 16 bit	yes	350	R/W	
New target position	208E	Actual position to be displayed at the current position The new actual position must be located within the position range defined by the limits.  The value is used for referencing the internal measuring system to the physical conditions. Resetting has no effect.  Setting to the delivery state sets the value to 0, the new actual position then corresponds to the position of the output shaft and is located between 0 and 1 revolution.  The value entered is rounded up or down to a multiple of 64.	±31 bit	yes	0	R/W	
Jog 1	208F	Inching run with switch "S5" ("Jog +") Sub index 0: No. of indices (= 3) Sub 1: step width: Number of increments a drive is moved by pressing the switch "S5" Sub 2: Sets the speed (r.p.m.) as a % of the max. value (SDO #208C) Sub 3: Sets the torque as % of the maximum value	8 bit ±31 bit	no	3 4096	R R/W	
Jog 2	2090	Inching run with switch "S4" ("Jog -") Sub index 0: No. of indices (= 3) Sub 1: step width: Number of increments a drive is moved by pressing the switch "S4" Sub 2: Sets the speed (r.p.m.) as a % of the max. value (SDO #208C) Sub 3: Sets the torque as % of the maximum value	8 bit ±31 bit	no	3 -4096	R R/W	
			1...100 8 bit	no	100	R/W	
			1...100 8 bit	no	100	R/W	

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W
Idle period for manual run	2091	Length of time a manual run key must be held pressed in order to begin a manual run [ms]	100... 10000 16 bit	no	1000	R/W
Error status 'HD_Err'	2092	Status 'HD_Err' from the last transfer	16 bit			R
Error status 'Motion_Status'	2093	Status 'Motion_Status' from the last transfer	16 bit			R
Error status 'SCI_Err'	2094	Status 'SCI_Err' from the last transfer (independent of the state of the drive) 0x0000 → no error or no communication is requested 0xFFFF → no communication is possible (eventually the power supply of the connected drive is missing) other values → communication is present, but with errors	16 bit			R
Position scaling	2095	Scaling of the position Sub index 0: No. of indices (= 2) Sub 1: Numerator value Sub 2: Denominator value	8 bit 16 bit 16 bit	yes yes	2 256 1	R R/W R/W
Speed scaling	2096	Scaling of speed (r.p.m.) Sub index 0: No. of indices (= 2) Sub 1: Numerator value Sub 2: Denominator value	8 bit 16 bit 16 bit	yes yes	2 10 1	R R/W R/W
Delivery state (for the drive)	2098	0 → The drive performs a reset (corresponds to switching off and back on again) 1 → The drive parameters are reset to the delivery state. The changes come into effect immediately. (The RS485 parameters "message complete time", "address" and "baud rate" are not affected.)	0...1 8 bit	no		W
Drive variant number	2099	0 → No drive connected 1 → HRA25A 2 → HRA25B 3 → HRA25E 4 → HRA35A 5 → HRA35B 6 → HRA35E 7 → HDA30A 8 → HDA30B 9 → HDA30E 10 → HDA45A 11 → HDA45B 12 → HDA45E 13 → HDA70 0xFFFF → other	16 bit			R
Drive variant name	209A	Name of the drive variant as string				R
Item number of the drive	209B	halstrup-walcher article number of the drive as string				R

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W
Serial number of the drive	209C	Serial number of the drive as string				R
Production date of the drive	209D	Year and week of manufacture of the drive as string (format WW/YYYY)				R
Version of the drive	209E	Software version number of the drive as string (format x.xx)				R
Nominal data of the drive	209F	Sub index 0: No. of indices (= 4) Sub 1: Nominal voltage [V] Sub 2: Nominal current [A] Sub 3: Nominal torque [Nm] Sub 4: Nominal rated speed [r.p.m.]  The data are displayed as a string. An "A" preceding any value signifies that this value must be divided by 10.	8 bit		4	R R R R R
Timeout	20A0	Time for RS485 communication timeout If the status of the drive is at least "Ready for operation" and no telegram is received from the RS485 bus master within the stated time, the drive enters the error state. If the drive is running at that moment, it will stop. Specification is made in [0.1s]. Value 255 means that the monitoring is deactivated.	1... 100 or 255 16 bit	yes	20	R/W
Complete time	20A1	RS485 message complete time [ms] The drive considers the transmission of a message to have been completed if no further byte is received within the stated period of time. The parameter is reset automatically during every power-up and every time the drive is activated (SDO #20A4 from 0 to 1) with the value corresponding to the desired baud rate (SDO #20A3).  The change to the message complete time will only come into effect after a reset.	16 bit	yes		R/W
Address (drive)	20A2	RS485 address of the drive  The change of address will only come into effect after a reset. The address is not important for the EtherCAT connection of the drive. Every activation of the drive via EtherCAT sets the address to 1.	0...253 8 bit	yes	1	R/W

Name, designation	Index number	Function	Range of values	Back up?	Delivery state	R/W
Baud rate	20A3	<p>RS485 baud rate of the drive</p> <p>The values 9600, 19200 and 38400 are permitted. The appropriate value for the “message complete time” is also transmitted at the same time as the baud rate is being written.</p> <p>The change to the baud rate will only come into effect after a reset as well as after every activation of the operated drive (SDO #20A4 from 0 to 1)</p> <p>A change to the baud rate will also be noticed in the hub or adapter and, if necessary, saved in its EEPROM (by setting SDO #200D to 1), so that the desired baud rate is also valid for a new drive if the old drive has to be replaced.</p>	32 bit	yes	38400	R/W
Drive required	20A4	<p>0 → The drive is not accepting run commands issued via EtherCAT, the actual values (status word, actual r.p.m. and actual position) are not being updated.</p> <p>1 → The drive can be run via EtherCAT, the actual values are updated cyclically.</p> <p>A transition from 0 to 1 sets the drive to the last baud rate saved in the hub or adapter and performs a reset.</p>	0...1 8 bit	yes	0 (at the hub) 1 (at the adapter)	R/W
Drive temperature	20A5	Internal drive temperature in °C	8 bit			R

**Table of rated speed and torque values for various models of gears**

	Device type	HDA 30 HDA 45	HDA 70	PSE441
Name, designation	Index number	Range of values delivery state	Range of values delivery state	Range of values delivery state
Position lower limit	208A	-512 rot...+512 rot -511 rot	-16000 rot...+16000 rot -16000 rot	-127 rot...+127 rot -127 rot
Position upper limit	208B	-512 rot...+512 rot +511 rot	-16000 rot...+16000 rot +16000 rot	-127 rot...+127 rot +127 rot
New target position	208E	-512 rot...+512 rot 0	-16000 rot...+16000 rot 0	-127 rot...+127rot 0

### 5.3 PDO format

The following table describes the PDOs for the first drive connected, i.e. drive 1 on the hub or the drive connected to the HIPERDRIVE bus adapter.

The PDO information for each additional drive (on the hub) is attached in each case, i.e. the following applies:

$$\text{Byte number}_{\text{Drive } n} = \text{Byte number}_{\text{Drive } 1} + (n - 1) * 8$$

1) Receive PDO (from the perspective of the HIPERDRIVE)

Assignment (cannot be modified):

Bit	Byte	Meaning	Corresponding SDO index number
0-15	0,1	Control word	2080h
16-23	2	Percentaged target speed	2081h
24-31	3	Percentaged maximum torque	2082h
32-63	4-7	Target position	2083h

2) Transmit PDO (from the perspective of the HIPERDRIVE)

Assignment (cannot be modified):

Bit	Byte	Meaning	Corresponding SDO index number
0-15	0,1	Status	2084h
16-31	2,3	Current r.p.m.	2085h
32-63	4-7	Actual position	2086h

### 5.4 Detailed description of status bits

The functions of the status and control bits are based on the PROFIDRIVE protocol:

*Bit 0:* Ready to switch on

This bit is set:

- when bit 10 of the control word is set (set control word to 0x0400)

This bit is reset:

- when bit 10 is reset (set control word to 0x0000)

*Bit 1:* Ready for operation

This bit is set:

- when bit 0 of the control word is set in the state "Ready to Switch on" (set control word to 0x0401)

This bit is reset:

- when bit 0 is reset

- Bit 2:* Operation enabled  
This bit is set:  
- when bit 3 of the control word is set in the state “Ready for operation” (set control word to 0x0409)  
This bit is reset:  
- when bit 3 is reset
- Bit 3:* Fault  
This bit is set:  
- when an error arises if the state is at least “Ready for operation”  
This bit is reset:  
- in the case of a negative edge of bit 7 of the control word
- Bit 4:* No OFF2  
This bit is set:  
- when a drive is being detected during the presence test  
- when a drive is marked as “required” by the PLC  
This bit is reset:  
- at the beginning of a presence test
- Bit 5:* No OFF3  
This bit is set:  
- when a drive is being detected during the presence test  
- when a drive is marked as “required” by the PLC  
This bit is reset:  
- at the beginning of a presence test
- Bit 6:* Switch on inhibit  
This bit is set:  
- in the case of a negative edge of bit 7 of the control word in the state “Fault”  
This bit is reset:  
- in the case of a negative edge of bit 0 of the control word
- Bit 7:* Warning  
This bit is set:  
- when an error arises (independent of the operating status)  
This bit is reset:  
- when all the errors present have been eliminated  
When the bit “Fault” is active, the bit will only be reset together with the bit “Fault” once the state “Fault” has been acknowledged.
- Bit 8:* No drag error  
This bit is set:  
- when no drag error occurred during a movement (i.e. the difference between the target and actual position is within in the drag error window)  
This bit is reset:  
- at the beginning of a presence test  
- when a drag error occurred during a movement (i.e. the difference between the target and actual position is not within in the drag error window)
- Bit 9:* Control requested  
This bit is set:  
- when a drive is being detected during the presence test  
- when a drive is marked as “required” by the PLC  
This bit is reset:  
- at the beginning of a presence test

- Bit 10:** Target position reached  
This bit is set:  
 - when a drive has arrived at its target position  
This bit is reset:  
 - at the beginning of a positioning run  
 - when the state is less than “Ready for operation” (in the states “Fault” and “Switch on inhibit”, the bit initially retains its old value)
- Bit 11:** Reference point set  
This bit is set:  
 - when a drive is being detected during the presence test  
 - when a drive is marked as “required” by the PLC  
This bit is reset:  
 - at the beginning of a presence test
- Bit 12:** Acknowledgement of target value  
This bit is set:  
 - at the start of a movement when bit 6 of the control word is set  
This bit is reset:  
 - at the start of a movement when bit 6 of the control word is reset  
 - when the state is less than “Ready for operation”  
 (In the state “Ready for operation” a new movement will only be started if bit 6 of the control word complements the bit “acknowledgement of target value” in the status word → toggle function.)
- Bit 13:** Drive at standstill  
This bit is set:  
 - when the drive has completed a run  
This bit is reset:  
 - at the beginning of a run
- Bit 14:** Motor overcurrent  
This bit is set:  
 - when the maximum current for the drive is exceeded (in this case the drive enters the state “Fault”)  
This bit is reset:  
 - when the state “Fault” is acknowledged (negative edge of bit 7 of the control word)
- Bit 15:** Position limit reached  
This bit is set:  
 - when the actual position of the drive is located outside the range defined by the positioning range limits  
This bit is reset:  
 - when the actual position of the drive is again located within the range defined by the positioning range limits

## 5.5 Detailed description of control bits

- Bit 0:** ON  
 The drive goes from the state “Ready to Switch on” into the state “Ready for operation” (bit 10 must still be set).

- Bit 1:* No OFF2  
reserved, must be set to 0
- Bit 2:* No OFF3  
reserved, must be set to 0
- Bit 3:* Operation enabled  
The drive goes from the state “Ready for operation” to the state “Operation enabled” (bits 0 and 10 must still be set).
- Bit 4:* Function in positioning mode:  
No stop  
The bit must be continuously active to execute a run command. When the bit is reset, the drive stops immediately, the current run command is dismissed. The run command is activated by an edge to bit 6.
- Function in speed control mode:  
CLOCKWISE  
If the bit is set, the movement will start in a CLOCKWISE direction, otherwise it will be COUNTERCLOCKWISE.
- Bit 5:* Function in positioning mode:  
No intermediate stop  
The bit must be continuously active to execute a run command. When the bit is reset, the drive stops immediately but the current run command is not dismissed. The run command is continued when bit 5 is set once again.
- Function in speed control mode:  
Endless  
When this bit is set, the movement in speed control mode is endless, otherwise until it reaches the respective end of the positioning range.
- Bit 6:* Function in positioning mode:  
Activate run command  
Every edge releases a run command or new target value (toggle bit). A rising or falling edge may only be carried out if bit 12 of the status word acknowledges that the previous run command has been accepted. In other words, the run command is activated if this bit complements the current state of bit 12 of the status word.
- Function in speed control mode:  
Start speed control mode  
A rising edge triggers a run in speed control mode, a falling edge completes it.
- Bit 7:* Acknowledge fault  
A negative edge acknowledges a current fault condition.
- Bit 8:* Inching 1 ON  
The drive runs with jog target value 1 with the step width and in the direction indicated in the parameters.
- Bit 9:* Inching 2 ON  
The drive runs with jog target value 2 with the step width and in the direction indicated in the parameters.

- Bit 10:* Control by the automation equipment  
The drive goes from the state “Not ready to Switch on” to the state “Ready to Switch on”.
- Bit 11:* Start referencing  
Reserved, must be set to 0.
- Bit 12:* Speed control mode  
If this bit is set and the drive is in the state “Operation enabled”, an edge of bit 6 triggers a run in speed control mode rather than a positioning run to the desired position.
- Bit 13:* Reserved, must be set to 0.
- Bit 14:* Reserved, must be set to 0.
- Bit 15:* Reserved, must be set to 0.

## 5.6 Flow chart

The following flow chart shows the possible states of a drive as well as the transitions between the states.

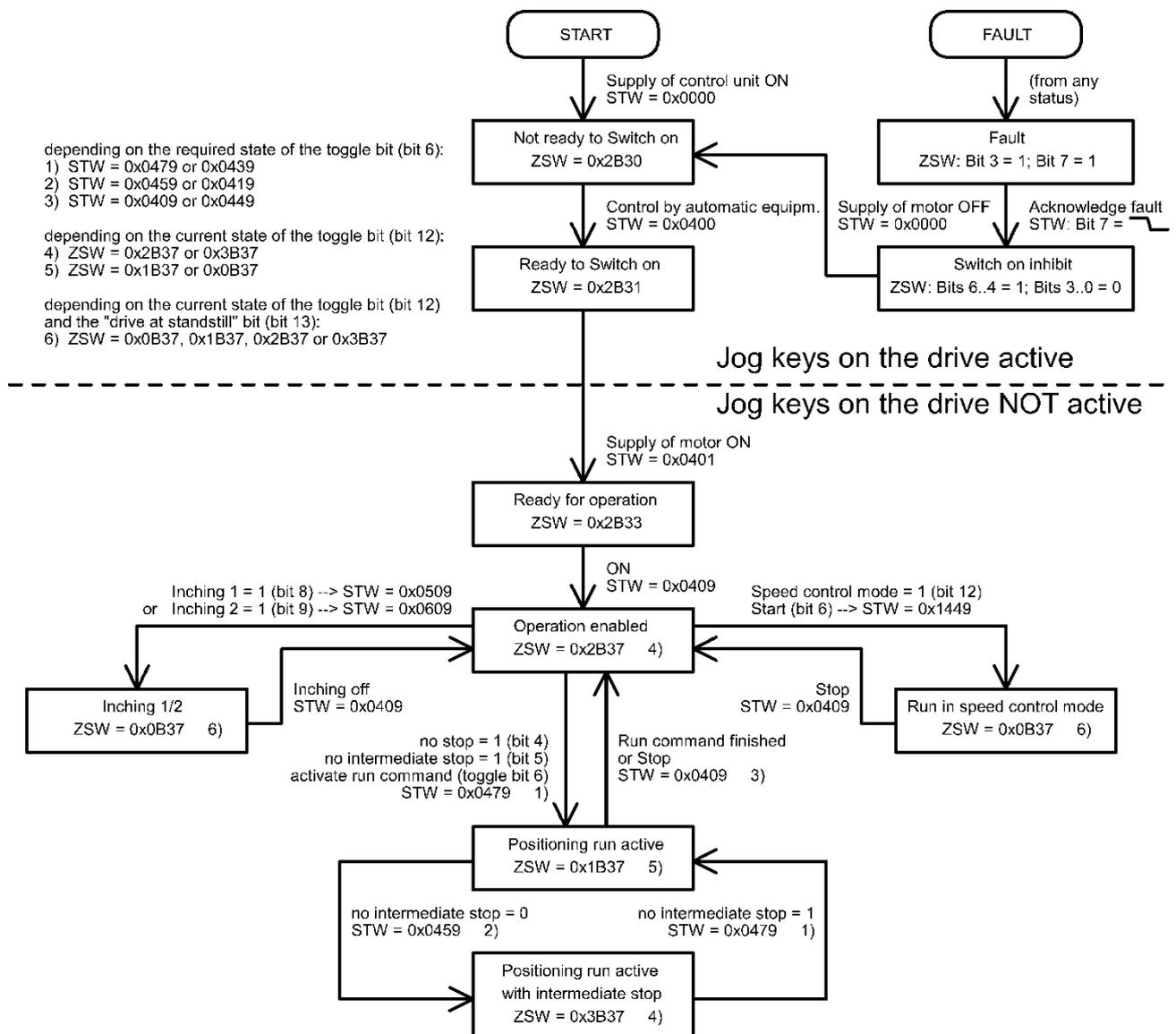
### Abbreviations used:

STW = Control word

ZSW = Status ("status word")

The requirement for each run is that the "percentaged target speed" and "percentaged maximum torque" have a value > 0. In addition, for a run command, the target position must be set to a permitted value.

Any jog keys which are eventually present at the drive are only active in the states "Not ready to Switch on", "Ready to Switch on", "Fault" and "Switch on inhibit". In all other cases, the PLC has sole access to the drive.



## 6 Jog function

### 6.1 Jog function with jog keys on the drive

Some versions of the drive have two integrated jog keys for running left and right.

These keys are always active when the drive is not connected to a control module. When connected to a control module, they are active in the following states:

- Not ready to Switch on
- Ready to Switch on
- Fault
- Switch on inhibit

### 6.2 Jog function with jog keys in the HIPERDRIVE Hub

The two jog keys in the HIPERDRIVE Hub can always be used to run the drive selected using the switch S3 (located in the middle between the two jog keys) and independently of the PLC.

S4 ("Jog -") starts a jog step with the parameters from SDO #2090 (Jog 2), S5 (Jog "+") starts a jog step with the parameters from SDO #208F (Jog 1).

The parameters for the jog steps are set using values from the individual subindices:

- SI 1 = increment and direction (default 1/16 rotation)  
 Jog key S4 ("Jog -") → counter-clockwise  
 Jog key S5 ("Jog +") → clockwise
- SI 2 = Sets the speed (r.p.m.) as a % of the max. value from SDO #208C
- SI 3 = Sets the torque as a % of the nominal torque

If the key is released during the movement, the jog step still runs until it has been completed. This makes it possible to run to a precisely defined angle. The run can be aborted before it has been completed at any time by pressing both keys simultaneously. A new jog step can then only be triggered when both keys have been completely released.

If the key remains pressed after the jog step has been completed, it will be followed by a manual run, which continues until the key is released or the end of the positioning range has been reached. The parameter "idle period for manual run" (SDO #2091 on drive 1) is available in order to provide better control of the transition to a manual run. The manual run begins once the set time, measured from the start of the jog step, has expired.

A manual run can also be aborted by pressing both keys simultaneously.

## 7 Special features

### 7.1 Target speed (r.p.m.) and torque

These values are stated as a percentage of a reference value. The 100% value for the target speed (r.p.m.) is stated in SDO #208C (for drive 1), the 100% value for the target torque is fixed and is the same as the nominal torque for the drive.

The maximum values valid for each movement are indicated at the beginning of each movement. In the ESM status “operational”, these must be provided in the RxPDO, in the status “pre-operational” or “safe-operational” they must be provided in the SDOs #2081 and #2082 (for drive 1).



**In the status “operational”, the values of the parameters control word, percentaged target speed, percentaged maximum torque and target position are overwritten by the values from the PDOs.**

### 7.2 Response of the drive in case of block

If the drive detects a block, the drive aborts the run and enters the state “Fault”.

An entry is then made in the fault buffer (SDO #2088 on drive 1). The fault must be acknowledged by a negative edge to bit 7 of the control word. The drive then enters the state “Switch on inhibit”, which can be exited by a falling edge to bit 0.

### 7.3 Response of the drive if it is turned manually (readjustment function)

After switching on the voltage, the drive readjusts its position if the divergence between the current actual value and the target value saved before it was last powered down is  $< 5^\circ$ .

After reaching a target position or stopping, the drive always readjusts its position as soon as it is turned beyond the tolerance range by external forces.

### 7.4 Using actual value assessment factors to set the spindle pitch

Index numbers SDO #2095:01 (numerator factor) and #2095:02 (denominator factor) can be used to modify the device’s spindle resolutions as required.

$$\text{number of steps per revolution} = 256 * \frac{\text{numerator factor}}{\text{denom. factor}}$$

The default setting for the numerator factor is 256, the denominator factor is set to 1, giving a resolution of 65,536 increments per revolution.

The numerator factor makes it simple to set the spindle pitch and resolution. The denominator factor is primarily used for setting “unlevel” resolutions.

Examples:

Spindle pitch	Resolution	Numerator factor	Denominator factor
4 mm	1/100 mm	400	256
1 mm	1/100 mm	100	256
2 mm	1/10 mm	20	256

## 7.5 Aborted run when the master fails

If the connection to the master is interrupted during a positioning run, the master cannot abort a run that is already underway. In order to generate an automatic run abort in this case, there is the option of timeout monitoring by the Sync Manager Watchdog which is implemented in the EtherCAT master: If the HIPERDRIVE Hub or adapter does not receive a SYNC event within a specified time, it will command an abort of any positioning to all connected drives.

## 8 Technical data

### 8.1 HIPERDRIVE Hub

#### Ambient conditions

Ambient temperature	0 °C to +70 °C
Storage temperature	-25 °C to +75 °C
Shock resistance as stipulated in DIN IEC 68-2-27	8 g / 50 ms
Resistance to vibration as stipulated in DIN IEC 68-2-6	10 ... 500 Hz: 10 g
EMC standards	CE
Conformity	CE declaration of conformity available upon request
Protection class	IP 65
Duty cycle	100 %

#### Electrical data

Supply voltage	24 VDC $\pm$ 15 % Recommendation: Use a regulated power adapter
Nominal current, control unit	0.15 A
Motor connections	One 6-pin screw terminal per motor Max. cross section of conductor 1.5mm <sup>2</sup>
Supply voltage connection for the motors	2 x cable lug M6 Recommendation: Use a regulated power supply
Bus connection	M12, 4-pin Type D (2 x)
Protocol	EtherCAT (IEC 61158-6-12), CoE protocol
Status information	2 x Link/Act (green) 1 x ECAT status (red/green) 1 x RS485 status (red/green)

#### Physical data

Dimensions (l x w x h)	see drawings
Weight (approx.)	1.5 kg

## 8.2 Drives with HIPERDRIVE bus adapter

### Ambient conditions

Ambient temperature	0 °C to +60 °C
Storage temperature	-25 °C to +75 °C
Shock resistance as stipulated in DIN IEC 68-2-27	11 g / 30 ms
Resistance to vibration as stipulated in DIN IEC 68-2-6	10 ... 150 Hz: 10 g
EMC standards	CE
Conformity	CE declaration of conformity available upon request
Protection class	IP 65

### Electrical data

Nominal power output	HDA 30	30 W
	HDA 45	45 W
	HDA 70	42 W
Supply voltage	24 VDC $\pm$ 15 % Recommendation: Use a regulated power supply	
Nominal current	HDA 30	3.5 A
	HDA 45	4.8 A
	HDA 70	4.8 A
Connection for supply voltage	4-pin screw terminal (either with separate or shared power supply with the HIPERDRIVE electronics and the motor) Max. cross section of conductor 1.5mm <sup>2</sup> Optional: 7/8" plug	
Bus connection	M12, 4-pin Type D (2 x)	
Protocol	EtherCAT (IEC 61158-6-12), CoE protocol	
Status information	2 x Link/Act (green) 1 x ECAT status (red/green) 1 x RS485 status (red/green)	
Absolute value acquisition	Magnetic and with EEPROM	

## Physical data

Positioning range	HDA 30, HDA 45: 1024 rotations HDA 70: 32000 rotations (no mechanical limits)
Positioning accuracy	max. $\pm 2.5^\circ$
Repeat accuracy	max. $\pm 1.0^\circ$
Output shaft	type "S": 10 mm solid circular shaft with feather key type "H": 12 mm hollow shaft
Maximum radial force	linear type: 200 N radial type: 440 N
Maximum axial force	linear type: 150 N radial type: 165 N
Dimensions (l x w x h)	see drawings
Weight (approx.)	HDA 30, HDA 45 linear: 2.8 kg HDA 30, HDA 45 radial: 3.2 kg HDA 70 linear: 2.5 kg HDA 70 radial: 3.7 kg

For additional specifications and dimension drawings, please visit our website at

[www.halstrup-walcher.de/en/produkte/positioniertechnik/positioniersysteme/index.php](http://www.halstrup-walcher.de/en/produkte/positioniertechnik/positioniersysteme/index.php)

## 9 Certificate of Conformity



Die Lösung liegt im Detail

**EG-Konformitätserklärung** im Sinne der  
EG- Richtlinie 2014/30/EU, EMV

**Certificate of Conformity** based on the  
European Standard 2014/30/EU

Der Hersteller  
The manufacturer

**halstrup-walcher GmbH  
Stegener Straße 10  
79199 Kirchzarten  
Deutschland**

erklärt, dass die Bauart des Produktes  
declares, that the construction of instrument type

**Positioniersystem Typ Hiperdrive HDA70  
Positioning System Type Hiperdrive HDA70**

entwickelt, konstruiert und gefertigt ist in Übereinstimmung mit den EG – Richtlinien  
is developed, designed and manufactured in accordance with the EC Directives.

Störaussendung / Emmission  
EN61000-6-4: 2001  
EN55011:1998 + A1:1995  
EN55022:1998 + A1:1995

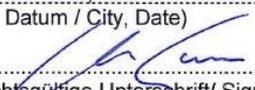
Störfestigkeit / Immunity  
EN61000-6-2:2001  
EN61000-4-3:1996 + A1:1998 + A2:2001  
EN61000-4-4:1995 + A1:2001 + A2:2001  
EN61000-4-5:1995 + A1:2001  
EN61000-4-6:1996 + A1:2001

abgegeben durch / stated by:

Sura, Christian  
(Nachname, Vorname / Surname, first name)

Geschäftsführer, Managing Director  
(Stellung im Betrieb des Herstellers / Position )

Kirchzarten, 19. 10. 2016  
(Ort, Datum / City, Date)

  
(Rechtsgültige Unterschrift/ Signature)