Intelligent Drivesystems, Worldwide Services

GB

BU 0090

AS-Interface Bus modules

Supplementary manual for NORDAC frequency inverters

DRIVESYSTEMS

N O R D A C Frequency Inverters

Safety and operating instructions for drive power converters

(as per: Low Voltage Directive 2006/95/EEC)

1.General

During operation, drive power converters may, depending on their protection class, have live, bare, moving or rotating parts or hot surfaces.

Unauthorised removal of covers, improper use, incorrect installation or operation causes a risk of serious personal injury or material damage.

Further information can be found in this documentation.

All transportation, installation commissioning and maintenance work must be carried out by **qualified personnel** (compliant with IEC 364 or CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national accident prevention regulations).

For the purposes of these basic safety instructions, qualified personnel are persons who are familiar with the assembly, installation, commissioning and operation of this product and who have the relevant qualifications for their work.

2. Proper use in Europe

Drive power converters are components intended for installation in electrical systems or machines.

When installed in machines, the drive power converter must not be commissioned (i.e. commencement of the proper use) until it has been ensured that the machine meets the provisions of the EC Directive 2006/42/EEC (Machinery Directive); EN 60204 must also be complied with.

Commissioning (i.e. implementation of the proper use) is only permitted if the EMC directive (2004/108/EEC) is complied with.

Drive power converters with a CE label meet the requirements of the Low Voltage Directive 2006/95/EEC. The stated harmonized standards for drive current inverters are used in the declaration of conformity.

Technical data and information for connection conditions can be found on the rating plate and in the documentation, and must be complied with.

The drive power converters may only be used for safety functions which are described and explicitly approved.

3. Transport, storage

Information regarding transport, storage and correct handling must be complied with.

4. Installation

The installation and cooling of the equipment must be implemented according to the regulations in the corresponding documentation.

The drive power converter must be protected against impermissible loads. Especially during transport and handling, components must not be deformed and/or insulation distances must not be changed. Touching of electronic components and contacts must be avoided.

Drive power converters have electrostatically sensitive components, which can be easily damaged by incorrect handling. Electrical components must not be mechanically damaged or destroyed (this may cause a health hazard!).

5. Electrical connection

When working on live drive power converters, the applicable national accident prevention regulations must be complied with (e.g. BGV A3, formerly VBG 4).

The electrical installation must be implemented as per the applicable regulations (e.g. cable cross-section, fuses, earth lead connections). Further instructions can be found in the documentation.

Information regarding EMC-compliant installation – such as shielding, earthing, location of filters and installation of cables – can be found in the drive power converter documentation. These instructions must be complied with even with CE marked drive power converters. Compliance with the limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

6. Operation

Systems in which drive power converters are installed must be equipped, where necessary, with additional monitoring and protective equipment as per the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc.

The parameterisation and configuration of the drive power converter must be selected so that no hazards can occur.

All covers must be kept closed during operation.

7. Maintenance and repairs

After the drive power converter is disconnected from the power supply, live equipment components and power connections should not be touched immediately, because of possible charged capacitors. Observe the applicable information signs located on the drive power converter.

Further information can be found in this documentation.

These safety instructions must be kept in a safe place!

Documentation

Designation: BU 0090 GB
Part No.: 607 09 02
Device series: **AS Interface** for SK 300E, SK 500E (entire series), SK 700E, SK 750E

Version list

Designation of previous issues	Software Version	Comments
BU 0090 DE, February 2005	V 1.0 R0	First version, prototype
BU 0090 DE, March 2006	V 1.1 R0	Inclusion of inverter series SK 5xxE and SK 750E
BU 0090 DE, August 2007	V 1.1 R0	Address corrections, SK 5xxE, example 6.1.4
BU 0090 DE, May 2008 Part No. 607 0901 / 1908	V 1.1 R0	Application example, notes and recommendations for additional components supplemented, Sections 3 and 4 revised
BU 0090 DE, September 2010 Part No. 607 0901 / 3910	V 1.2 R1	Module SK TU2-AS3 supplemented (A/B - Slave ("Extended Address Range")) Slave profile 7.A, Combination of Sections 5 - 7

Publisher

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NOTE

This supplementary operating manual is only valid in conjunction with the operating manual supplied for the respective frequency inverter.

Intended use of the frequency inverter

Compliance with the operating instructions is **necessary for fault-free operation** and the acceptance of any warranty claims. **These operating instructions must be read** before working with the device!

These operating instructions contain **important information about servicing.** They must therefore be kept **close to the device**.

The AS interface module can only be used with the particular defined frequency inverter series. Use with different series is only possible with the SK TU2-... module with SK 300E and SK 750E. The use of these modules with other devices is not permitted and can lead to their destruction.

The AS interface module and the associated frequency inverters are devices for fixed installation in switching cabinets or decentralised units. All details regarding technical data and permissible conditions at the installation site must be complied with.

Commissioning (implementation of the correct use) is not permitted until it has been ensured that the machine complies with the EMC directive 204/108/EEC and that the conformity of the end product meets the machine directive 2006/42/EEC (note EN 60204).

1 Introduction

1.1 General information

This AS Interface documentation is valid for the NORDAC SK 300E, SK 500E, SK 700E series and for SK 750E.

NORDAC frequency inverters can be equipped with various modules for parameterisation or control. A slot is provided for this in the basic device. As delivered, there is a blank cover at this location, which must be replaced by the DeviceNet technology unit.

1.2 The bus system

The **A**ctuator**S**ensor **Interface** (AS-Interface) is a bus system for the lower field bus level. The transmission principle is a single master system with cyclical polling. A maximum of 31 slaves (or 62 A/B slaves in the extended address region) can be operated on an up to 100m long unshielded two-wire cable in any network structure (tree/line/star). For the AS interface, since the *Complete Specification* V2.1, a differentiation has been made between Standard Slaves and A/B Slaves. This version includes the doubling of the number of slaves to 62. This is done by the double-assignment of addresses 1-31 and their designation as "A Slave" and "B Slave". A/B Slaves are designated by the ID code A, and therefore can be uniquely identified by the Master.

NORD AS Interface Modules type SK TUx-**AS1** are standard slaves which correspond to the slave profile **S-7.4**. They can be administered by masters whose profile at least corresponds to class **M4** (in some cases **M3** is sufficient).

NORD AS Interface Modules type SK TUx-**AS3** are standard slaves which correspond to the slave profile **S-7.A**. They can be administered by masters whose profile at least corresponds to class **M4**.

The S-7.4 profile describes the function for the transfer of bit strings and the bi-directional data communication. Modules with profile S-7.A (SK TUx-AS3) use the extended address range, however transfer of strings is not possible.

Type SK TUx-AS1 and -AS3 modules can be jointly operated within an ASi network as of version 2.1 (Master profile M4) with observance of the allocation of addresses (see example).

Permissible
Standard slave 1 (Address 6)
A/B-Slave 1: (Address 7A)
A/B-Slave 2: (Address 7B)
Standard slave 2 (Address 8)

Not permissible
Standard slave 1 (Address 6)
Standard slave 2: (Address 7)
A/B-Slave 1: (Address 7B)
Standard slave 3 (Address 8)

The AS interface cable (yellow) transmits data and energy while a second two-wire cable (black) can be used for a low auxiliary voltage (24V). Addressing is implemented via the master, which can also provide other management functions, or via a separate addressing device. The transfer of the 4 Bit reference data (in each direction) is performed with effective error protection for standard slaves with a maximum cycle time of 5ms. Due to the the correspondingly high number of participants, for A/B slaves the cycle time (max. 10ms) is doubled for data which is sent from the slave to the master. Extended addressing procedures for the transmission of data to the slave also cause an additional doubling of the cycle time to max. 21ms.

The bus system is completely defined in the *AS-Interface Complete Specification* and is standardised as per EN 50295, IEC62026t.

1.3 AS interface for NORDAC frequency inverters

Features:

- Electrically isolated bus interface
- Status display with 2 LEDs (SK TU1-AS1 and SK TU3-AS1: 14 additional LEDs for I/O display)
- **SK TUx-AS1**: Slave profile 7.4.0 with cyclic 4 Bit I/O data and the facility for string transfer
- **SK TUx-AS3**: Slave profile 7.A.7 (A/B Slave) with cyclic 4 Bit I/O data, no string transfer
- External 24V power supply for the unit
- All parameters of the frequency inverter can be programmed via the AS interface
- Connection via M12 (SK TU2-ASx) or open-style plugs with screw terminals (SK TU1-AS1, SK TU3-AS1)
- Additional 4 digital inputs and 2 digital outputs (connected to 24V)
- Up to a maximum of 31 frequency inverters on one bus conductor (standard slave technology) with SK TUx-AS1 bus modules
- Up to a maximum of 62 frequency inverters on one bus conductor (A/B slave technology) with SK TU2-AS3 bus modules
- Cycle time ≤ 5ms (AS Interface network with standard slaves),
- Cycle time ≤ 21ms (AS Interface network with A/B slaves),

1.4 Delivery

Check the equipment **immediately** after delivery/unpacking for transport damage such as deformation or loose parts.

If there is any damage, contact the carrier immediately and carry out a thorough assessment.

Important! This also applies even if the packaging is undamaged.

1.5 Scope of supply

SK TU1-AS1	for frequency inverter SK 700E	IP20 or
SK TU2-AS1(-C)	for frequency inverter SK 300E or SK 750E	IP55 **(optionally IP66)** or
SK TU2-AS3(-C)	for frequency inverter SK 300E or SK 750E	IP55 **(optionally IP66)** or
SK TU3-AS1*	for frequency inverter SK 500E *incl. screw for optional fixing to the FI	IP20

1.6 Certifications

1.6.1 European EMC Directive

If NORDAC frequency inverters or their options are installed according to the recommendations in this instruction manual, it meets all EMC directive requirements, as per the EMC product standard for motor-operated systems EN 61800-3.

1.6.2 RoHS compliance

The AS Interface bus options described here are designed to be RoHS compliant according to Directive 2002/95/EEC

1.7 Identification System

SK TU3-AS1(-C)

IP protection class:	Standard = IP55, C = "coated" (IP66)
Bus system:	**AS1 = AS Interface** (S-7.4.0 - Slave), CAO = CANopen, AS3 = AS Interface (S-7.A.7 - Slave), ECT = EtherCAT®, etc.
Device series:	SK TU1 / SK TU2 / **SK TU3**

2 Modules

2.1 NORDAC SK 500E

By the use of various modules for display, control and parameterisation, the NORDAC SK 5xxE can be easily adapted to various requirements.

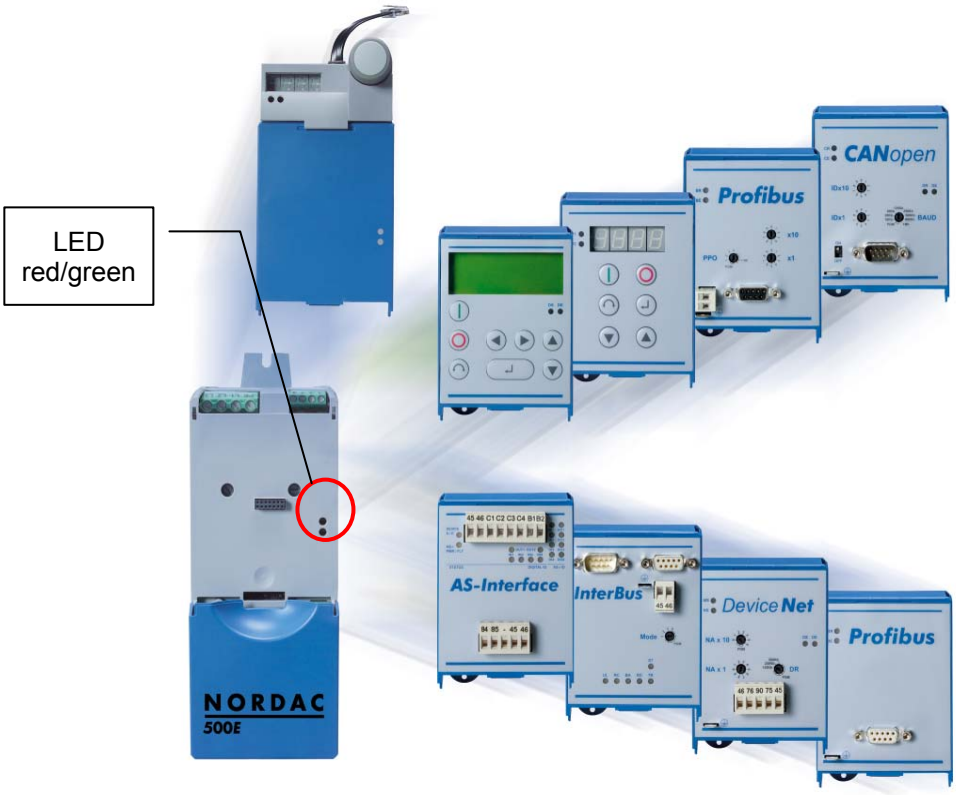
Alphanumerical display and operating modules can be used for simple commissioning. For more complex tasks, various connections to a PC or an automation system can be selected.

The technology unit (Technology Unit, SK TU3-…) is connected externally to the front of the frequency inverter and is therefore easy to access and replace at any time.

In the delivery condition, without the technology unit, 2 LEDs (green/red) are visible externally. These signal the actual device status.

The green LED indicates that the mains voltage is present and operational, while a flashing code that increases in speed shows the degree of overload at the frequency inverter output.

The red LED signals actual error by flashing with a frequency which corresponds to the number code of the error (Manual BU 0500 Section 6).



WARNING

Modules should not be inserted or removed unless the device is free of voltage. The slots may only be used for the intended modules.

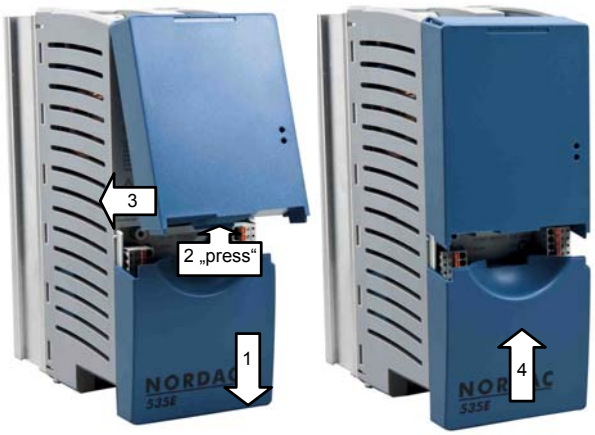
Installation of a technology unit separate from the frequency inverter is not possible. It must be connected directly to the frequency inverter.

NOTE

2.1.1 Installation of the SK TU3 technology unit

The technology units must be installed as follows:

1. Switch off the mains voltage, observe the waiting period.
2. Push the control terminals cover down slightly or remove.
3. Remove the blank cover by pressing the release on the lower edge and pulling off with an upward turning movement. If necessary, the fixing screw next to the release must be removed.
4. Hook the technology unit onto the upper edge slots and press in lightly until engaged. Ensure full contact with the connector strip and fasten with the screws if necessary (separate packet).
5. Close the control terminal cover again.



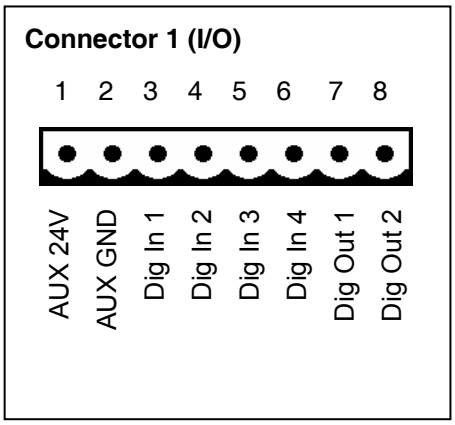
Similar to illustration

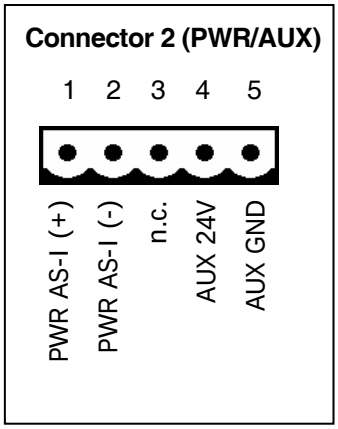
Further detailed information can be found in the device manual BU 0500.

- www.nord.com –

2.1.2 AS Interface module SK TU3-AS1

The SK 5xxE supports the AS interface technology unit as of software version 1.3 Rev.1 (P707/P742).





Status LEDs	**Device S/E** (red/green)	Module status/error. (see Section 4.3)
	AS-Int. PWR/FLT (red/green)	Standard status display for AS interface slaves. (see Section 4.3)
Digital I/O LEDs	**OUT 1 … 2** (yellow)	Status of the AS interface bits received/transmitted from the Master. (see Section 4.4)
	IN 1 ... 4 (yellow)	
AS-i I/O LEDs	**DI 1 ... 4** (yellow)	Status at digital input/output. (see Section 4.4)
	DO 1 ... 4 (yellow)	

2.2 NORDAC SK 700E

By the use of different modules for display, control and parameterisation, the NORDAC SK 700E can be easily adapted to various requirements.

Alphanumerical display and operating modules can be used for simple commissioning. For more complex tasks, various connections to a PC or an automation system can be selected.

The **technology unit (Technology Unit, SK TU1-...)** is connected externally to the front of the frequency inverter and is therefore easy to access and replace at any time.

In addition, further modules (customer interfaces and special extensions) can be used in the frequency inverter for the processing of digital and analogue signals and for speed control or positioning.

WARNING

Modules should not be inserted or removed unless the device is free of voltage. The slots may only be used for the intended modules.

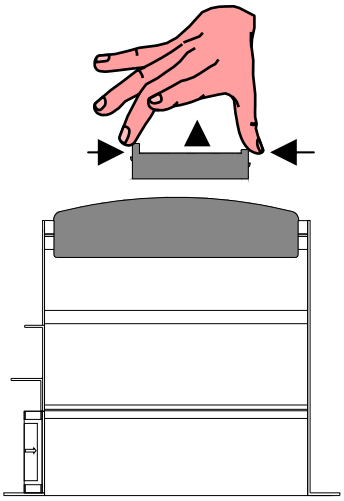
Installation of a technology unit separate from the frequency inverter is not possible. It must be connected directly to the frequency inverter.

NOTE

2.2.1 Installation of the SK TU1 technology unit

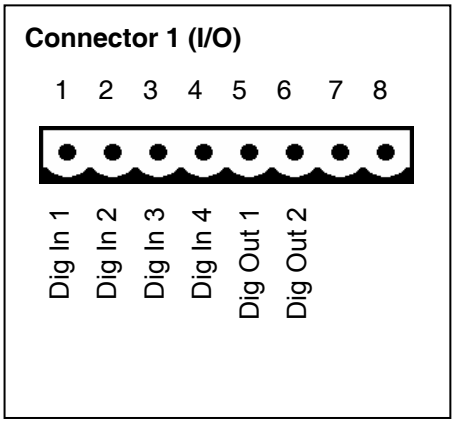
The **installation** of the technology units must be carried out as follows:

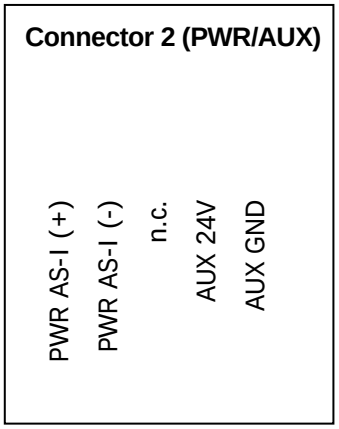
1. Switch off the mains voltage, observe the waiting period.
2. Remove the dummy cover by actuating the unlocking device on the top and bottom edge.
3. Allow the technology unit to engage audibly by pressing lightly on the installation surface.



2.2.2 AS interface module SK TU1-AS1

The SK 700 E supports the AS interface technology unit from software version 3.1 Rev. 1 (P707 / P742).





Status LEDs	**Device S/E** (red/green)	Module status/error. (see Section 4.3)
	AS-Int. PWR/FLT (red/green)	Standard status display for AS interface slaves. (see Section 4.3)
Digital I/O LEDs	**OUT 1 … 2** (yellow)	Status of the AS interface bits received/transmitted from the Master. (see Section 4.4)
	IN 1 ... 4 (yellow)	
AS-I I/O LEDs	**DI 1 ... 4** (yellow)	Status at digital input/output. (see Section 4.4)
	DO 1 ... 4 (yellow)	

2.3 NORDAC SK 750E and *trio* SK 300E

By the use different modules for display, control and parameterisation, the NORDAC SK 750E and trio SK 300E can be easily adapted to various requirements.

Alphanumerical display and operating modules can be used for simple commissioning. For more complex tasks, various connections to a PC or an automation system can be selected.

The **technology unit (Technology Unit, SK TU2-...)** is connected externally to the front of the frequency inverter and is therefore easy to access and replace at any time.

In addition, further modules (customer interfaces and special extensions) can be used in the frequency inverter for the processing of digital and analogue signals, and with the SK 750E, for speed control or positioning.

WARNING

NOTE

Modules should not be inserted or removed unless the device is free of voltage. The slots may only be used for the intended modules.

Installation of a technology unit separate from the frequency inverter is not possible. It must be connected directly to the frequency inverter.

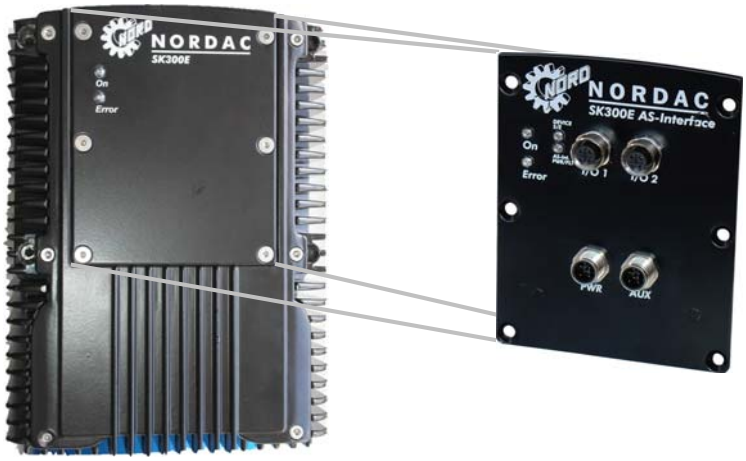
Operation is not permitted if there is no secure PE connection to the frequency inverter and to the technology unit!

2.3.1 Installation of the SK TU2 technology unit

To install a technology unit, remove the 6 screws from the cover plate. Note the grounding (earthing) lead, which is connected to the plate with a plug.

When installing the technology unit this lead must be connected in order to ensure complete grounding (earthing).

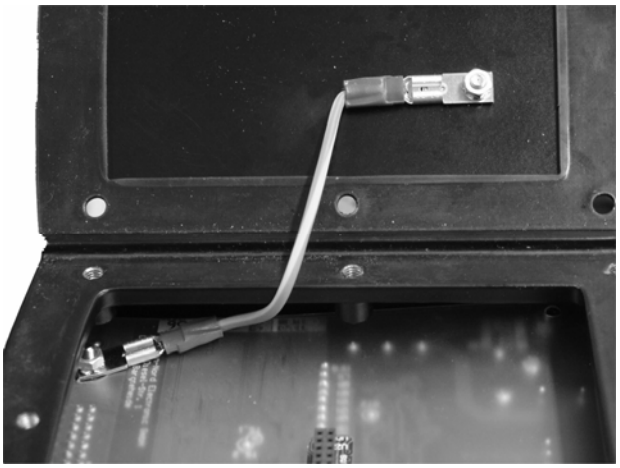
Sealing for the maximum protection level IP55/66 is only ensured by installing the seal and correctly tightening the 6 screws.



The procedure for installation is identical for the device series trio SK 300E and SK 750E. For SK 750E the bus module must always be installed in the right-hand technology slot.

Earthing line

Make sure the earthing line is plugged into the plate of the standard device and each technology unit. This line must be connected when installing the technology unit to ensure it is fully earthed.



2.3.2 AS interface module SK TU2-ASx

The trio SK 300E supports the AS interface technology unit as of software version 1.6 Rev.3, the SK 750E as of the software version 3.1 Rev. 1.

Device S/E LED (red/green):

Status/error of module (see Section 4.3)

AS- Int. PWR/FLT LED (red/green):

Standard status display for AS interface slaves (see Section 4.3)

On LED (green):

AC line input (mains) voltage applied to frequency inverter

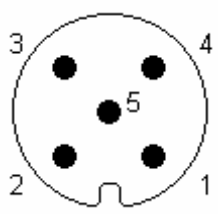
Error LED (red):

Frequency inverter error

Connector assignment:

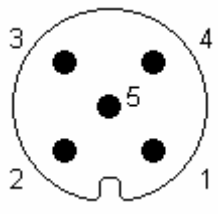
Socket I/O 1

1 AUX 24V
2 Dig In 1
3 AUX GND
4 Dig Out 1
5 Dig In 3



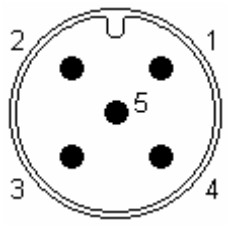
Socket I/O 2

1 AUX 24V
2 Dig In 2
3 AUX GND
4 Dig Out 2
5 Dig In 4



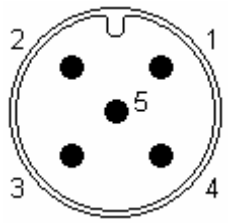
Connector PWR

1 AS-i (+)
2 AUX GND
3 AS-i (-)
4 AUX 24V
5 n.c.



Connector AUX

1 AUX 24V
2 n.c.
3 AUX GND
4 n.c.
5 n.c.



SK TU2-AS1

The AS-Interface module SK TU2-AS1 is designed as a standard slave module. It is capable of string communication as described in section 5.

SK TU2-AS3

The AS-Interface module SK TU2-AS3 is designed as an A/B slave module. It can be operated in the extended address range (A/B). String communication is not possible.

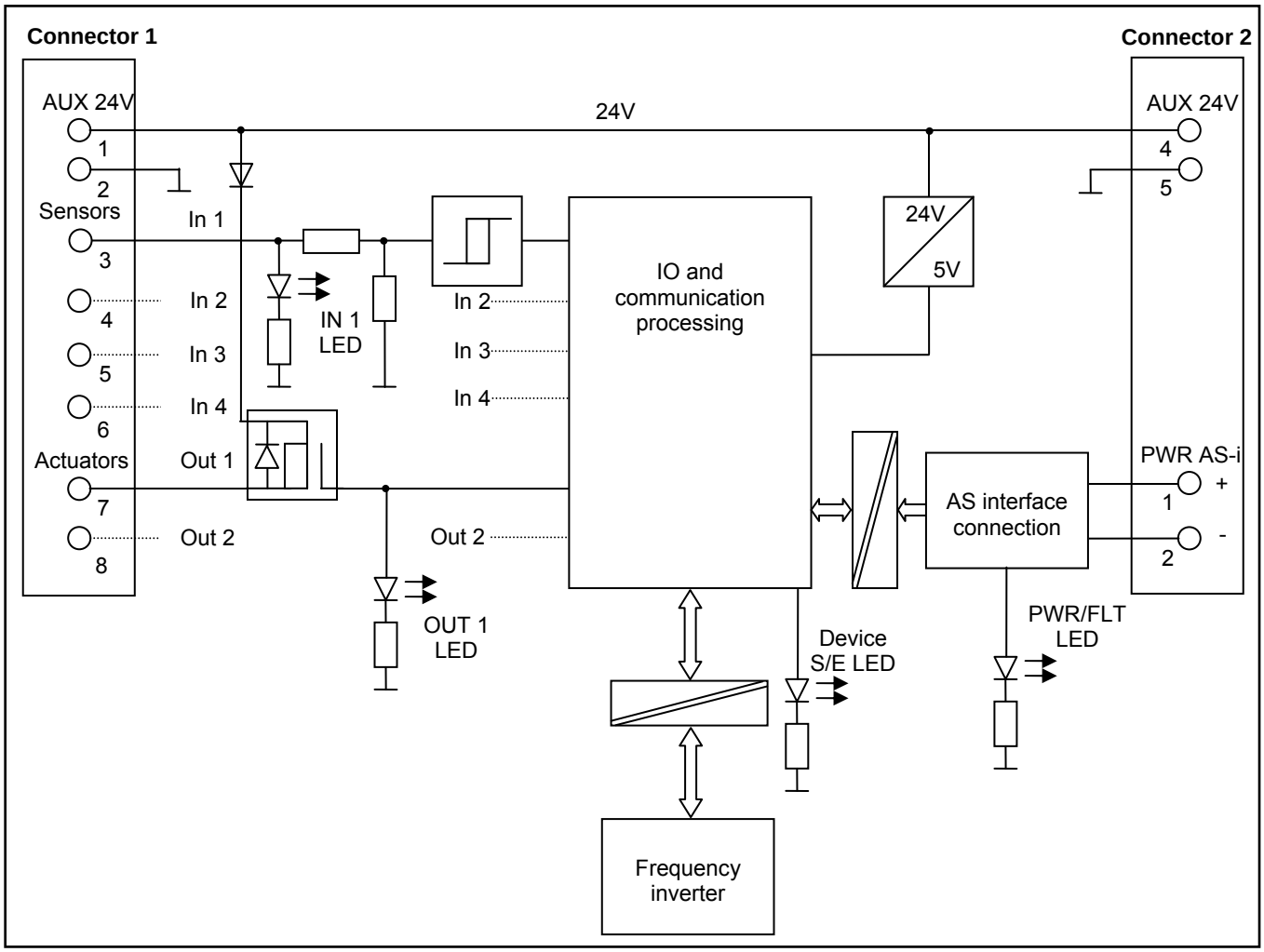
NOTE

Differentiation between the modules SK TU2-AS1 and SK TU2-AS3 can be made via the type plate (rear of the module) or via the bus master in the network.

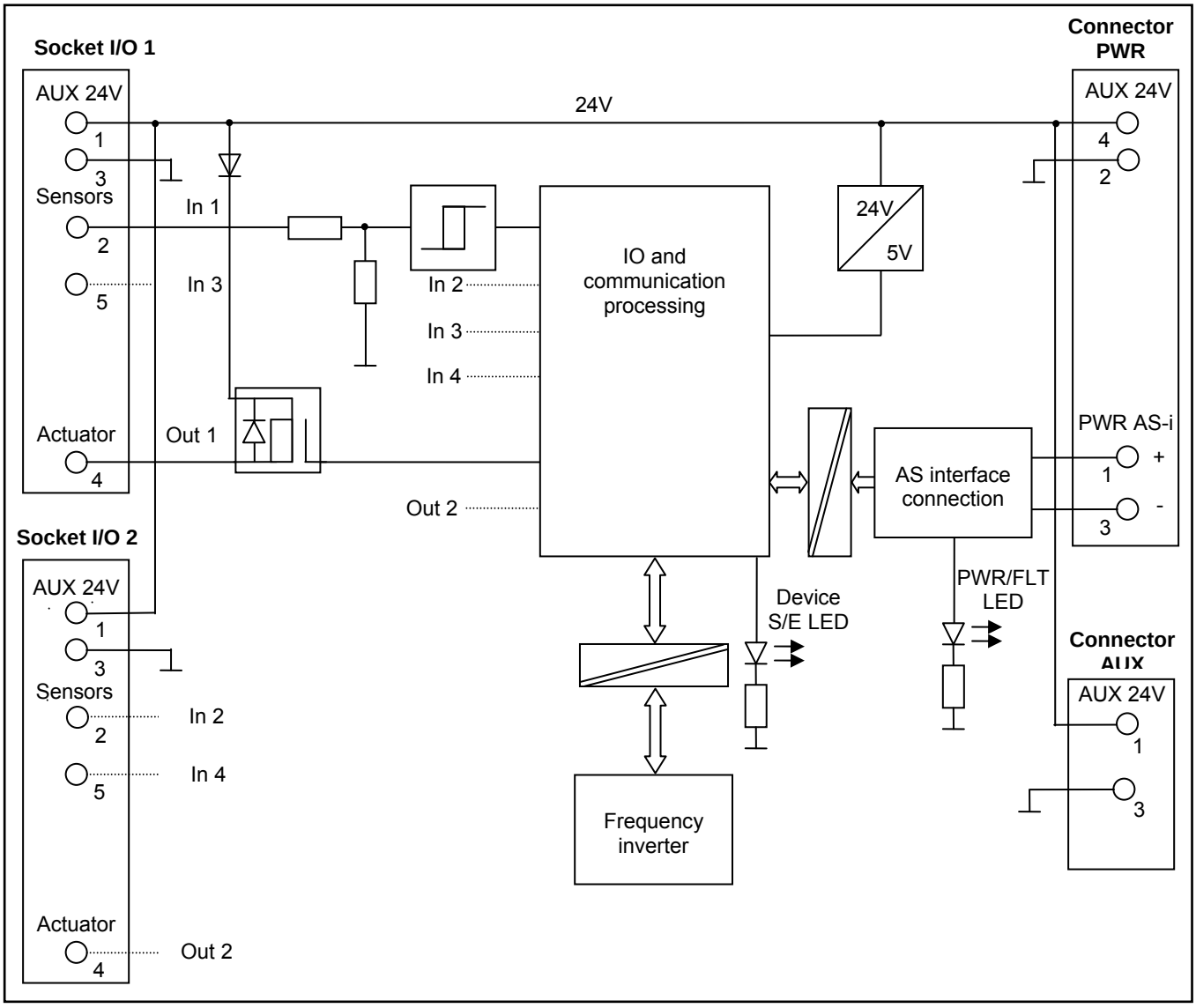
2.4 Schematic circuit diagram of the AS interface technology unit

The following schematic circuit diagrams illustrate the internal structure or wiring of the AS interface modules.

2.4.1 Technology unit SK TU1 / TU3-AS1



2.4.2 Technology Unit SK TU2-ASx



2.5 Description of connections to the AS interface module

SK TU1- / TU3-AS1

By means of the AS interface cable and the AS interface master the sensors and actuators are connected to the automation device via the AS interface module. To connect an SK TU1 / TU3-AS1 module to an AS interface network, special connecting accessories must be used. An AS interface cable with an M12 connector and open cable ends is required in order to connect to the Phoenix terminals of the SK TU1 / TU3-AS1.

SK TU2-ASx

To connect the SK TU2-ASx module, M12 components (socket - plug) are used on both sides. Two individual cables with a cable branch for the PWR connection and a second cable branch for the AUX connection can be used, or by the use of a combined cable branch module both connections (AUX and PWR) can be made by means of a cable to the PWR connector.

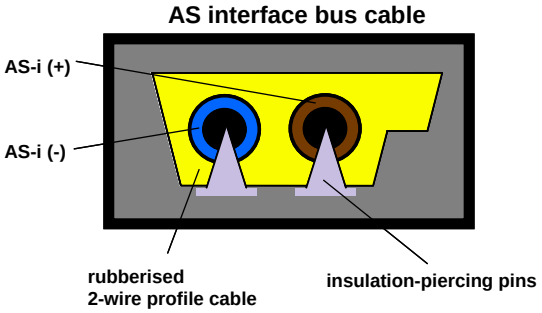
The wire colours and the assignment of pins for the M12 components is as follows:

Designation	Connection	Connector PWR		Connector AUX	
		Pin	Colour	Pin	Colour
AS interface PWR	AS-i (+)	1	brown	-	-
	AS-i (-)	3	blue	-	-
AS interface AUX	AUX 24V	4	black	1	brown
	AUX GND	2	white	3	blue

In both connectors pin 5 is not used. Pins 2 and 4 of the AUX connector are also not used.

2.5.1 Connection of the AS interface bus cable

The yellow unshielded AS interface cable (profile cable) is a rubberised 2-core cable, which connects the AS interface module to the AS interface network. This cable provides both the power supply to the sensors and actuators as well as the transfer of data between the AS interface master and the connected slaves. When connecting to the terminals, care must be taken that the wires are connected to the correct colours in order to prevent incorrect polarity. A separate AS interface cable should be used for each AS interface conductor.



AS Interface connection PWR:

- AS-i (+) If the standard cable is used, this is the brown wire.
- AS-i (-) If the standard cable is used, this is the blue wire.

The AS interface bus cable is connected to the PWR AS-i (+) and PWR AS-i (-) terminals. For the AS interface module SK TU1 / TU3-AS1, terminals 1 and 2 are on connector 2 (see Section 2.1.2 / 2.2.2).

On the AS interface module SK TU2-ASx, the wire to AS-i (+) must be wired to pin 1 of the PWR connector and AS-i (-) to pin 3 (see Section 2.3.2).

2.5.2 Connection of the AS interface AUX power supply

The black cable is used for the power supply to the sensors. The AS interface supply cable is connected to the AUX 24V and AUX GND terminals. The corresponding connection terminals on the particular AS interface module are illustrated in Sections 2.1.2 / 2.2.2 / 2.3.2.

The AS interface modules have multiple supply terminals. These terminals are interconnected internally.

24V power supply AUX:

- AUX 24V : If the standard black cable is used, this is the brown wire.
- AUX GND : If the standard black cable is used, this is the blue wire.

2.5.3 Connection of the AS interface sensors and actuators

For the SK TU1/TU3-AS1 module the sensors and actuators are connected to connector 1 via terminals 3 to 8 (see Section 2.1.2 / 2.2.2). On the SK TU2-ASx module the connection is made via the I/O sockets 1 and 2. The corresponding pin assignment is illustrated in Section 2.3.2 . The connecting cables should be laid separately from the energy cables and kept as short as possible.

I/Os for sensors and actuators:

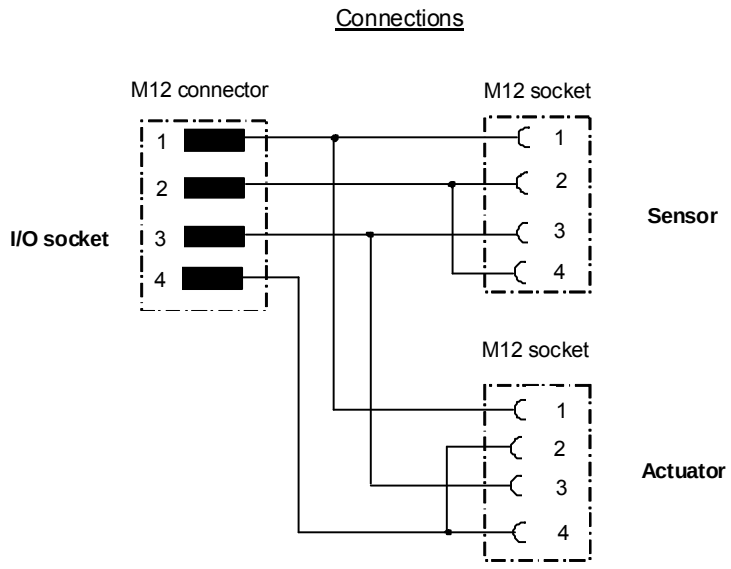
- Dig In 1-4 : digital inputs 1-4 for connection to the sensors
- Dig Out 1-2 : digital outputs 1-2 for connection to the actuators

2.5.4 Connection examples to SK TU2-ASx for sensors and actuators

In the following, 4 connection combinations to the SK TU2-ASx module for sensors and actuators by means of standard connector systems (M12 components) are illustrated. The illustrations in a) and b) refer to the connection of several sensors / actuators to a single I/O socket. Of course, two sensors can be each connected to a separate I/O socket. Suitable connector systems are e.g. those from the firm Murr Elektronik:

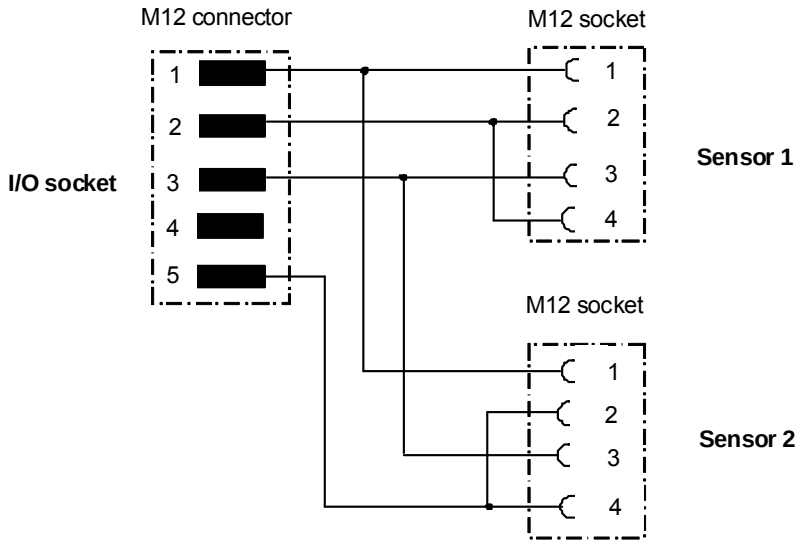
a) **1 sensor:** The sensor can be connected directly to the I/O sockets by means of 4-pin M12 plugs.

b) **1 Sensor + 1 Actuator:** Use of a 4-pin M12 – M12 / Y-connection or T connector.



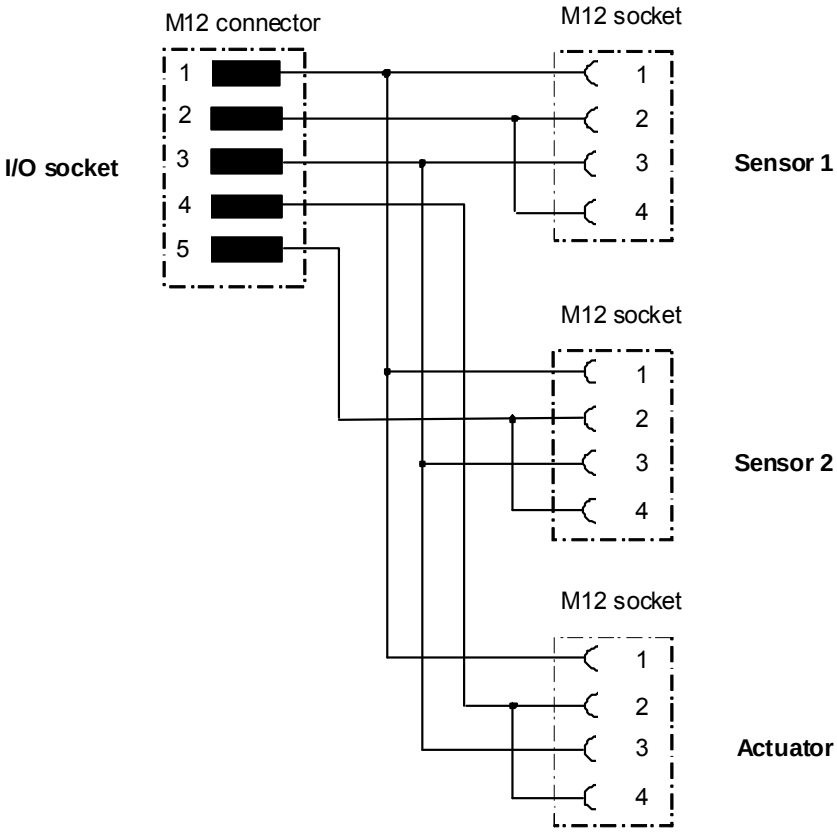
c) **2 Sensors:** Use of a 5-wire M12 cable with open cable ends and wiring of the sensors according to the assignment of connections. As there is no standard system connection technology, the wiring must be carried out accordingly.

Connections



d) **2 Sensors + 1 Actuator:** Use of a 5-wire M12 cable with open cable ends and wiring of the sensors and actuator according to the assignment of connections. As there is no standard system connection technology, the wiring must be carried out accordingly.

Connections



2.6 Recommended AS interface accessory and connection components

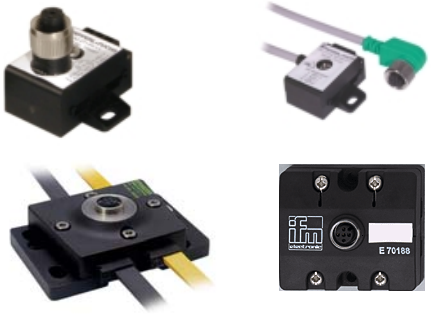
NOTE

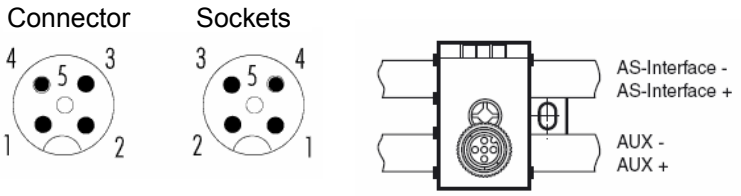
The components listed below or in this section should only be regarded as recommendations.

For further information please refer to the particular manufacturer's information and data sheets.

Please observe the manufacturer's information regarding installation and the corresponding installation guidelines.

AS-i / AUX double (combi) flat cable connector to M12

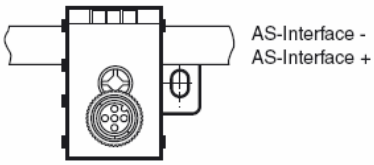




Supplier	Designation	Part no.
Pepperl+Fuchs	Passive connector to AS interface and auxiliary voltage to 1 x M12 round plug connector with cable	VAZ-2T1-FK-1M-PUR-V1-W
	Passive connector to AS interface and auxiliary voltage to 1 x M12 round plug connector without cable	VAZ-2T1-FK-V1
ifm	PAAS M12, plug sockets M12 x 1 AS-i and external voltage available via an M12 plug socket	E70188
MURR Elektronik	MASI67 converter 2 x profile cable to M12 (socket)	55037

AS-i single flat cable connector to M12 to connect the AS interface or AUX cable

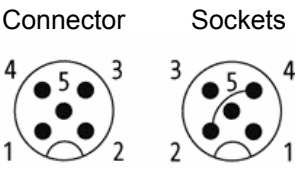


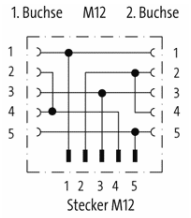



Connections
for connection to the yellow AS-i flat cable:
Pin 1: AS interface +
Pin 3: AS interface -
for connection to the black / AUX flat cable:
Pin 1: +24V DC
Pin 3: 0V

Supplier	Designation	Part no.
Pepperl+Fuchs	Passive connector to AS interface or auxiliary voltage to 1 x M12 round plug connector	VAZ-T1-FK-V1
ifm	Flat cable branch, M12 socket - AS-i flat cable Flat cable branch, M12 socket - AS-i flat cable	AC5005 E70096
MURR Elektronik	AS interface branch from profile cable to M12	55741

AS-i Y connector (T connector) for connecting sensors/actuators





2:1 connector, pin 2+4 bridged, to connect 2 sensors
5-pin M12 connector, 2 x 5-pin M12 sockets

Supplier	Designation	Part no.
Pepperl+Fuchs	Y-connector, M12 connector to M12 socket/socket	V15S-T-V15
ifm	Double central connector	E10803
MURR Elektronik	T connector, straight 5-wire connecting cable to straight sockets Y connector M12 to socket, M12 straight connector to straight or angled sockets, Y connector M12 - M12, 4 pin	7000-41181-0000000 7000-407XX-XXXXXX

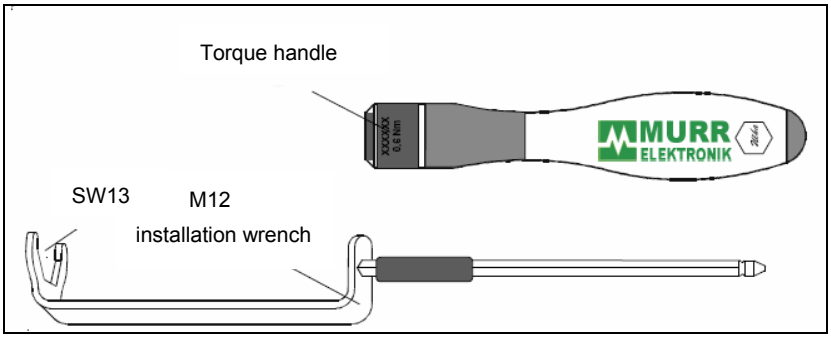
M12 round connector for connecting sensors/actuators and options/slaves to the AS interface cable

M12 x 1 round plug connectors are supplied and distributed by many manufacturers of industrial applications. When selecting the components, special attention should be paid to application-specific requirements, e.g.

- Type of connection, number of pins (4 or 5-pin)
- Plug and socket coding, straight or angled design etc.
- Tightening torque and special tools from the manufacturer
- Cable length, cable quality and material
- Protection class (IPxx)
- Quick-fit connection and/or securing against vibration

M12 - torque wrench for connecting M12 round connectors

The M12 torque wrench set is used to check the optimum tightening torque of M12 round connectors. The torque wrench is calibrated to the optimum tightening torque is 0.6Nm.




Anwenderhinweise

MURR ELEKTRONIK

Mit Sicherheit dicht!

Der Montageschlüssel hilft ihnen bei der Überprüfung des optimalen Anzugsmomentes (0,6 Nm) bei ihren M12 - Rundsteckverbindern.

Bitte beachten Sie:
Durch das Setzverhalten der Dichtung im Verteiler bzw. in der M12-Buchse kann der Rundsteckverbinder bereits nach kurzer Zeit nachgezogen werden.
Dies ist bereits in dem definierten Anzugsdrehmoment (0,6Nm) berücksichtigt!
Bei ordnungsgemäßem Einsatz ist der Schutzgrad IP 67 ohne Nachziehen gewährleistet.

Ein einmaliges Nachziehen ist möglich. Von einem regelmäßigen Nachziehen der Steckverbinder wird allerdings abgeraten, da dies Einfluss auf die elastischen Eigenschaften und die Funktionstüchtigkeit der Dichtung hat.

Supplier	Designation	Part no.
MURR Elektronik	M12 wrench set for M12 round connectors with calibrated torque of 0.6Nm	7000-99102-0000000

NOTE

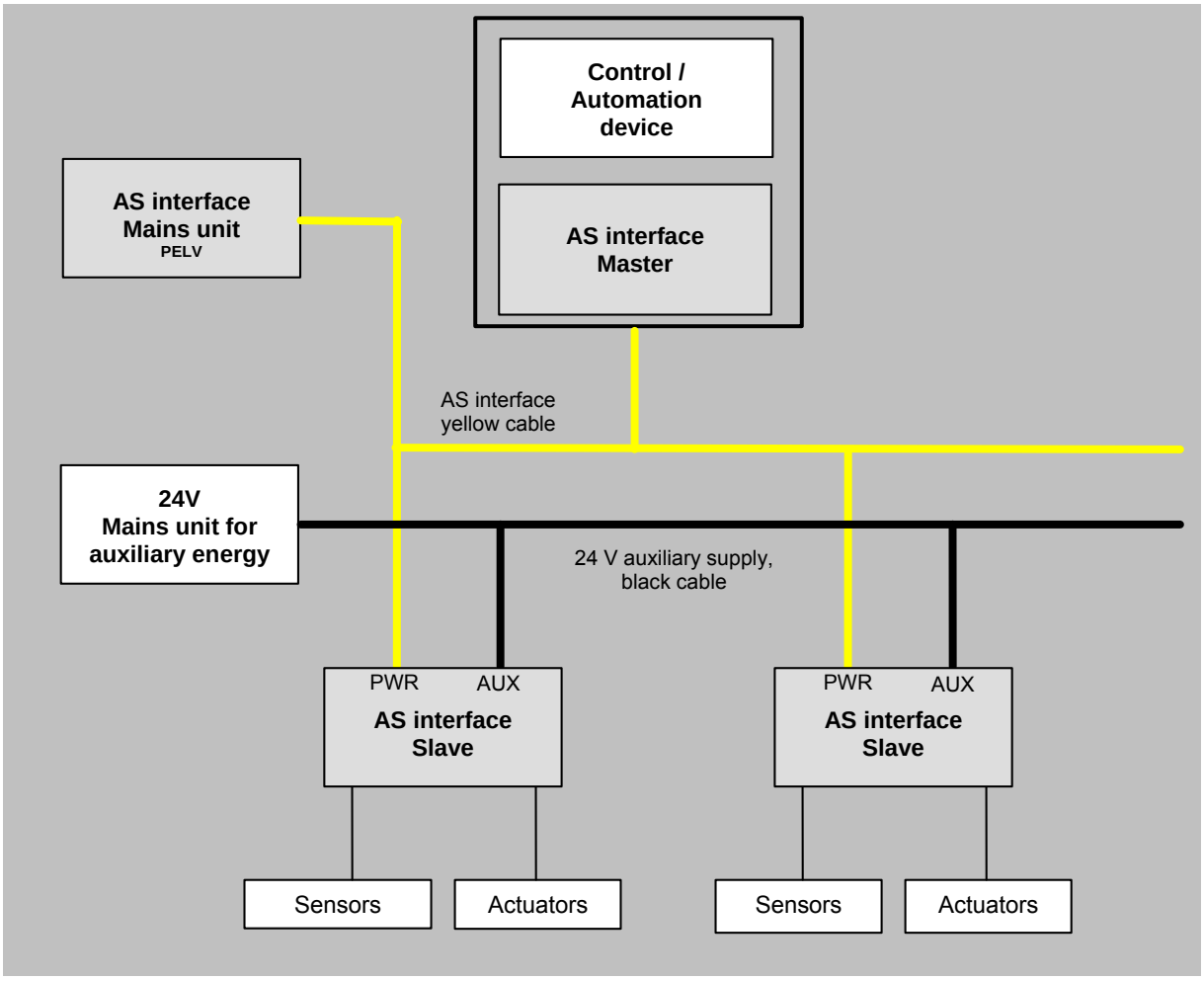
In order to ensure a secure, sealed and vibration-proof connection, connecting components with hexagonal fittings should be used.

After the completion of installation work, all M12 round connectors must be tightened to a torque of 0.6Mn using an M12 installation wrench.

3 Bus structure and topology

The AS interface network can be set up in any desired form. Linear, star, ring and tree structures are possible. An existing network can be expanded by further slaves at any time. For the sake of simplicity the standard slave application will mainly be described in this manual. Up to 31 standard slaves (i.e. a maximum of 124 binary sensors and 124 binary actuators) or 62 A/B slaves (i.e. a maximum of 248 binary sensors and 248 binary actuators) can be connected to an AS interface network or an AS interface master. Each AS interface slave has its own address (1 to 31 (or 1A … 31A, 1B … 31B)), which is assigned to the slave with the aid of an addressing device, or is transferred to the slave by means of a command from the AS interface master (see the manual of the AS interface master used). Each slave address may only be assigned once.

Normally the AS interface master is a component or module of the control unit and forms the interface between the control unit and the connected slave. An AS-i master communicates independently and exchanges data with the connected AS-i slave options. Normal power units must not be used in the AS interface network. For each AS interface connector, only a special AS interface power units (PELV) may be used for the power supply. This special power supply device for the AS interface must be used in order to decouple the data in the yellow cable. This AS interface power supply is directly connected to the yellow standard cable (ASI+ and ASI- cable) and should be positioned as close as possible to the AS-i master in order to keep the voltage drop small. In order to provide an adequate power supply to the NORD-AS interface modules or sensors and actuators, an additional 24V auxiliary voltage (black cable) must be fed to each slave.



NOTE

Only separate AS interface PELV standard power units (Protection Extra Low Voltage) with secure separation of the low functional voltage may be used!

The PE connection of the AS interface power unit (if fitted) must always be grounded (earthed).

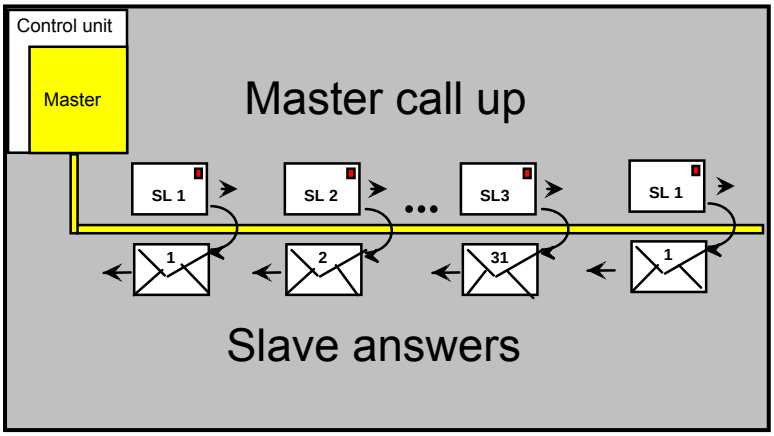
The brown ASI+ and the blue ASI- wire of the yellow AS interface cable must not be grounded (earthed).

The AS interface system replaces the expensive parallel wiring of decentralised sensors (inputs) and actuators (outputs) with a few bits (1-4 bits).

The AS interface options from Getriebebau NORD, which need to be supplied with an additional +24V DC supply (AUX, black cable connection) for the electrical components, can also be used as I/O expansions for customer-specific applications. An AS interface option can be used wherever more I/Os are required than are available on the frequency inverters (i.e. onboard) or on the additional customer's interfaces. The black and yellow AS-i standard cables are completely independent of each other, i.e. if the +24V DC voltage (AUX / black cable) is switched off, the AS interface network (yellow cable) remains in operation and therefore supplies the slave. Due to their special geometrically asymmetrical dimensions, both the yellow standard cable and the optional black AS interface cable are mechanically protected against incorrect polarity.

The AS interface is a "single master / multiple slave system", i.e. there is only one master and several slaves in an AS interface network. In the normal address mode, a maximum of 31 slaves can be integrated and operated in an AS interface network with one master. With AS-i masters which support the extended address mode, up to 62 slaves can be administered by a single master. Both the master and the slaves are connected via the yellow standard AS interface cable. Both the master and the slaves are connected via the yellow standard AS interface cable.

The AS interface master sends the same number of telegrams as the number of connected and active AS interface slaves in the network. Each slave in sequence is cyclically addressed by these telegrams, starting from the active slave with the lowest address.



For the master there are as many slave (addresses), as there are AS interface modules connected to the network and activated. The response time of all active slaves is the data cycle time (approx. 5 ms for max. 31 slaves in standard mode). The response time is fixed or specified (real-time capability) and is proportional to the number of activated slaves. Hence, e.g. the response time is halved for about half the number of slaves to:

5 ms * 15/31 = approx. 2.4 ms.

An AS interface master communicates independently with the AS interface slave modules which are connected and addressed to the AS-i bus. It exchanges data with the individual slave modules. A master coordinates all activities on the AS-i bus. An AS-i slave only communicates with the AS-i master on request by the master. The AS-i slave passes on the requested information and signal statuses of the connected peripherals (inputs, outputs...) to the master. A repeated telegram takes 150 µs and is included in the cycle time of max. 5 ms (AS Interface network with S-7.4 slaves) or max. 21 ms (AS Interface network with S-7.A slaves).

It is the task of the control unit (SPS, PC) and not that of the AS-i master to control the plant. However, at the latest after 5ms or 21 ms (the maximum cycle time) the master detects whether a slave is no longer responding (slave failure). The AS interface telegram is the message between the master and the slave in both directions. First the initial data are sent (written) to the connected slave from the master, then the initial data from the slave for each slave access and within a telegram are returned to the master (read).

Data exchange process:

The ASi data protocol provides 4 bits for the exchange of reference data.

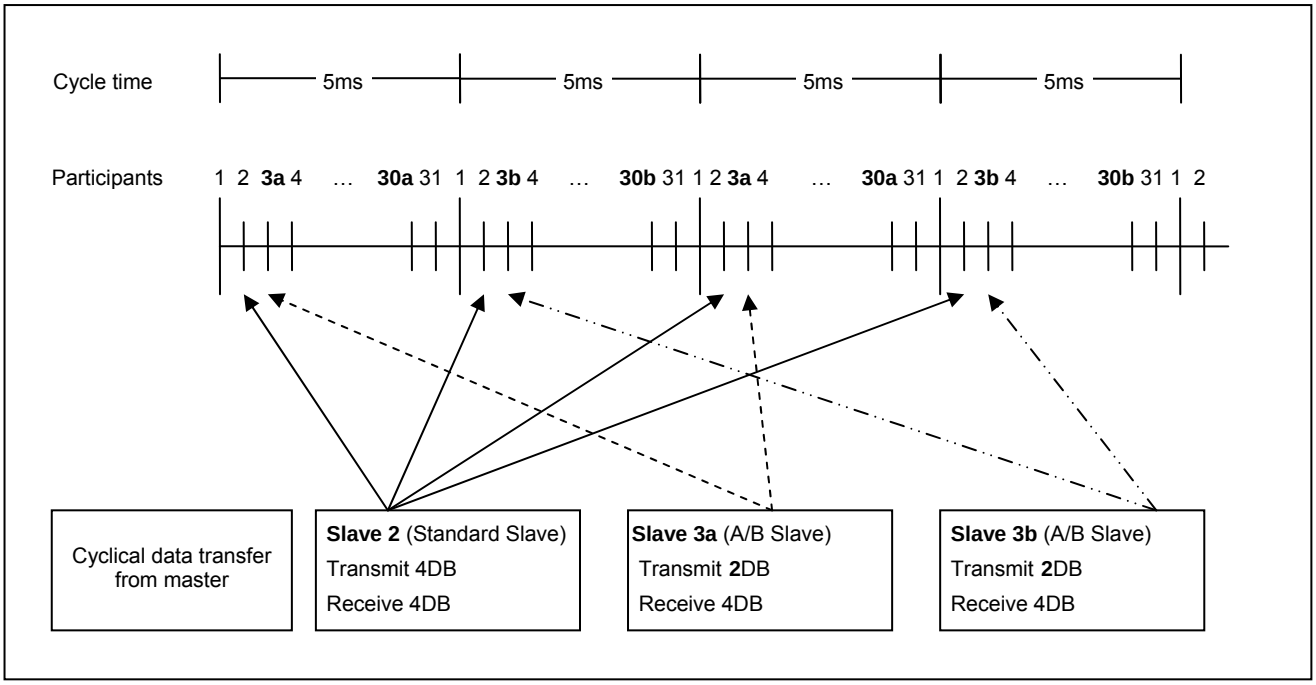
During a cycle, each address (1 ... 31) is accessed once by the master. The master sends an order telegram (with 4 Bit reference data) to the slave and immediately receives a corresponding response telegram (also with 4 Bit reference data).

For standard slaves (SK TUx-AS1) the maximum cycle time is therefore 5ms.

An additional bit is required in order to address an A/B slave. This bit is inserted into the reference data area, so that the content of the 4 data bits must be divided over 2 protocols, i.e. 2 transmission cycles.

On the other hand, the response telegrams contain all 4 data bits, so that the telegrams from the slave to the master are completely updated after each order.

Also, due to the extended address range, A/B slaves can only be accessed every 2nd cycle. This also additionally doubles the cycle time for these participants.



For the operation and parameterisation of the master please refer to the particular manual of the AS-i master manufacturer. There you can find more detailed information regarding the individual AS interface masters used.

The main component of the AS interface is a special slave module, which can control the following functions:

I. only 4 inputs,
II. only 4 outputs
III. 4 inputs and 4 outputs simultaneously (within a single telegram)

Therefore, according to III, there are a maximum of 248 binary inputs and outputs for an AS interface system with 31 slaves (496 in extended address mode with A/B slaves). This AS interface chip (ASIC) has 4 parameter bits for the non-cyclic setting of special slaves. If the parameter bits are used, the master transmits asynchronous parameter telegrams between the normal data cycles.

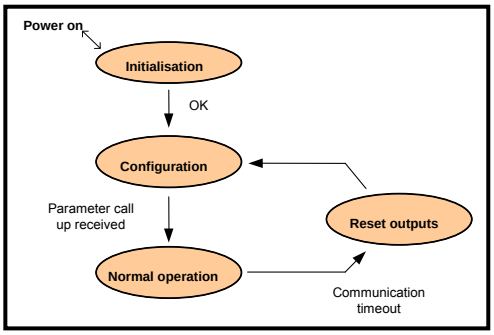
NOTE

The address range available is from 0 - 31 (62 for A/B slaves):

For normal addressing of slaves do not use the address 0. Address 0 is an exception and is reserved for automatic addressing via the master.

In general, there are two categories of AS interface slaves:

- Integrated slaves
- Slave modules for the connection of conventional (no field bus capability) sensors, actuators or field devices



In the "configuration" status the slave waits to be identified by the master and ultimately to be activated. This is performed by means of a command "Exchange parameters" After this the slave reverts to normal operation and responds to calls for data. A timeout function "watchdog" monitors the current data communication. If this fails for a certain time ("timeout"), then the outputs are reset and the slave reverts to the "configuration" status.

The following tasks are performed by the slave chip (ASIC) in the processing of the interfaces below:

- Operating interface for the user: Status display, addressing interface and diagnosis,
- Process interface to the sensor/actuator/field device (only modules)
- Interface to the AS interface network.

Device profile:

The device profiles are uniquely labelled by the combination of the I/O configuration, ID code, ID1 code and ID2 code and therefore identify each slave.

I/O configuration	EA3	EA2	EA1	EA0
ID Code	ID3	ID2	ID1	ID0
ID1 Code				
ID2 Code	ID3	ID2	ID1	ID0

The device profiles establish the following and specify between products from different manufacturers:

- the meaning of the information which is transferred with the data bits
- whether parameters are used, and if yes, what meaning they have
- which addressing mode is used
- whether the peripheral error bit in the status register can be evaluated
- whether a combined exchange of information has been implemented.

AS interface properties	
Topology	free structure, i.e. linear, tree, star, spur branches etc.
Medium for data + energy AUX connection (black cable)	unshielded 2-wire AS interface cable (= yellow standard AS interface cable) Insulation piercing technology as per IEC 60352-6 AUX voltage according to PELV (IEC 60364-4-41)
Length of bus cable	max. 100 m (without repeater), can be extended to 300 m with a maximum of 2 repeaters
Number of slaves	max. 31 (62 for A/B slaves)
Number of participants	up to 4 sensors and 2 actuators per slave
Addresses	Each slave is given a unique address
Messages	Messages from the master to each individual slave address with immediate response from the slave (bidirectional)
Bit rate	4 bits (pure data) per slave and message
Cycle time	max. 5 ms for max. 31 connected S-7.4 slaves, max. 21 ms for max. 62 connected S-7.A slaves
Error identification	Incorrect messages are reliably identified and repeated
Process data in the master	Cyclical call-up of all participants; cyclical transfer of the data to the host or to the slaves
Master functions	Initialisation of the network, identification of the participants, acyclic adjustment of the parameter values of the slaves, diagnosis of the network and the AS interface slaves, Error messages to the host, setting of the addresses for replaced slaves

NOTE

For the identification of the slave by the master, in addition to the slave address, each certified slave has a fixed, non-volatile ID and I/O code (identification, input/output code) according to the AS interface specification. After switching off, the ID, I/O code and the address are stored "non-volatile" in an internal slave EEPROM. Only the slave address can be changed by the user (via the master or a manual programming device).

3.1 Laying the bus cables

The length of the AS interface cable must not exceed 100m. For greater distances a repeater should be used. The maximum length can be extended to 300m with two repeaters. Caution: An additional AS-i power unit must be used after each repeater.

By the use of several repeaters in different conductors and a star configuration of the network, a total bus length of 500m may be achieved. For this, the AS-i master must be located in the central segment of the AS-i bus system.

In an industrial environment the correct installation of the Bus system is particularly important in order to reduce potential interference. The following points are designed to help prevent interference and problems right from the start. These installation instructions can not be complete and do not constitute a release from the applicable safety and accident prevention regulations.

Although the use of shielded cable for AS interface applications is possible, it can however, have a negative effect on the length of the conductors which can be achieved. The AS interface is a potential-free and ground (earth)-symmetrical system, which provides a high resistance to interference in industrial environments, even without additional measures such as shielding.

Non ground (earth)-symmetrical cable configurations over long distances are unfavourable and must be avoided. In addition, care must be taken that the AS interface cable is laid separately from power cables.

3.2 Cable type

A simple 2-wire cable with a cross section of 2 x 1.5mm² should be used for networking. It is recommended that the yellow profile cable is used. Due to the mechanical profile of the cable, each slave can be simply connected without danger of incorrect polarity. As the geometrically coded position of the wires is fixed and there is no obstruction from shielding, the slaves can be connected to the AS interface bus using simple insulation piercing components. The twin-wire profile coded flat cable must not be twisted, screened and terminated with a terminal bus resistor. For further information, or which cable type was specified for the AS interface application, please refer to the AS interface specification.

There are different coloured flat cables for different applications:

Yellow for the AS interface Black for the 24V auxiliary power supply

The warranted transfer speeds or transfer distances without disturbances can only be achieved if the specified cable parameters are complied with.

The maximum length of the yellow cable without a repeater is 100m including the spur cables and branches of the free AS interface topology. The maximum length of the black cable depends on the power consumption of the actuators and is normally shorter than the length of the yellow cable. The permissible voltage range direct to the actuators must be checked.

3.3 Cable layout and shielding (EMC measures)

Without EMC measures, high frequency interference, which is mainly caused by switching processes or lightning often has the effect of interfering with electronic components in the bus participants and error-free operation is no longer ensured. Correct laying of the bus cable dampens the electrical influences which may occur in an industrial environment. Bus lines should be laid with a minimum spacing of 20cm to other lines which carry a voltage higher than 60V. This applies to lines laid inside and outside of control cabinets.

A separate cable should be used for each AS interface conductor, i.e. AS interface cables should not be laid with other AS interface conductors or other power circuits in a common cable.

If however, e.g. single wires are used in a switching cabinet, both wires for AS+ and AS- should always be installed in pairs and twisted wherever possible.

NOTE

For applications with frequency inverters AC line input (mains) filters, or if necessary output chokes and shielded motor cables should be used.

When laying the cables, as great a distance as possible should be maintained between potential sources of interference such as frequency inverters and their cables.

3.4 Recommendations of the AS International Association

Please take special note of the information from the "Technical Guidelines" of the AS International Association:

- Installation recommendations, hints and tips for AS interfaces
- Installation hints
- Complete Specification 3.0 Rev. 0

This information can be found on the Internet page www.as-interface.net, under the heading Software/Publications.

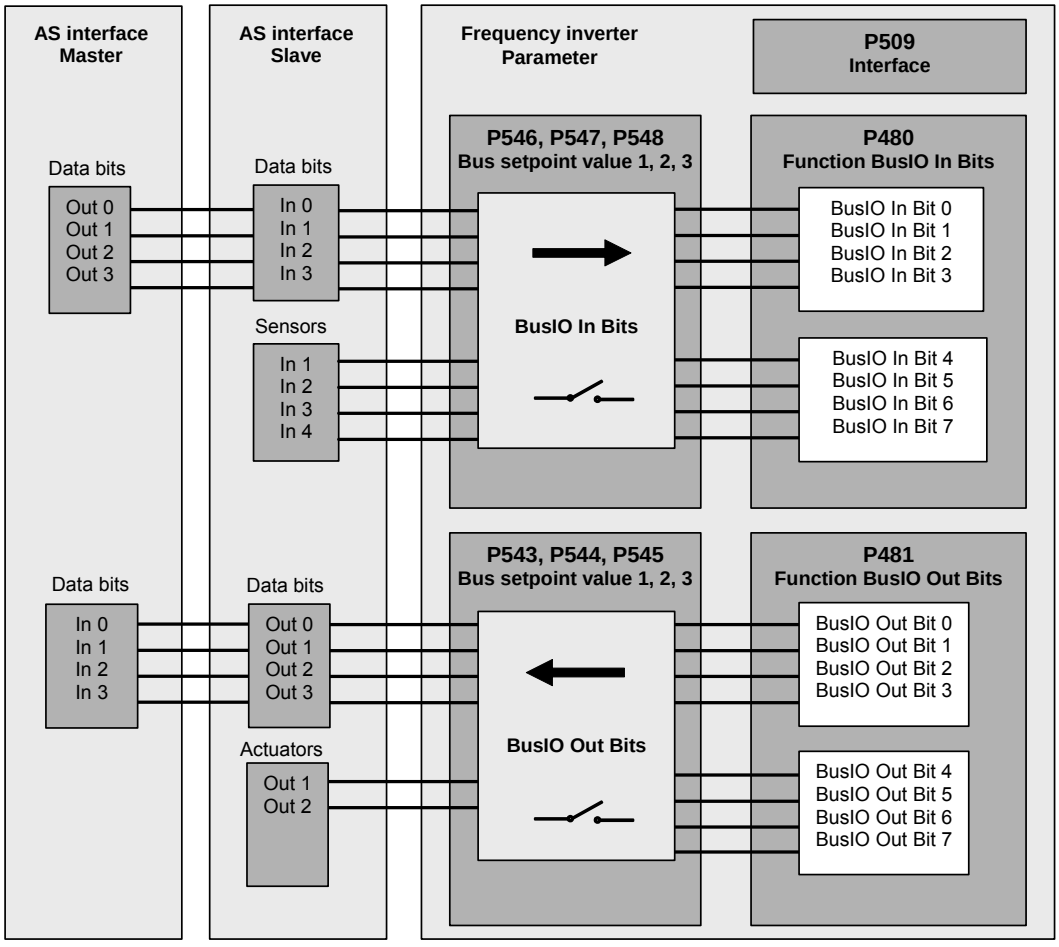
4 Frequency inverters - settings and control elements

Parameters and settings specific to the AS interface can be made via a ParameterBox or also via the NORD CON software. For more detailed information, please refer to the corresponding operating instructions. To ensure bus monitoring of the AS interface, the telegram downtime **P513** should be parameterised by the user. This prevents an uncontrolled start-up (with enabling via the bus) of the drive unit after restoration of the bus connection.

4.1 Frequency inverter BUS parameters

In order to operate the frequency inverter with the AS interface, in addition to the bus connection to the master, several parameter settings must be made on the frequency inverter.

Control of the frequency inverter via the AS interface can be activated by setting parameter **P509** to a value for *control via control terminals* (e.g. 0, 1, 2, 5, for further details please see below), as the data from the AS interface is treated as input and output terminals. These BusIO In or BusIO Out bits should be regarded as extensions to the control terminals. The same functions can be realised as can be parameterised via the digital inputs or the multifunctional output relay. The functions are specified in **P480** or **P481**. In order to process the AS interface data as control terminals, one of the setpoint values (**P546**, **P547** or **P548**) must be applied to *BusIO In bits*. The digital Bus I/O In functions for the inputs (sensors) DI1 to DI4 are allocated in parameter P480 in the arrays [05] to [08]. For the digital Bus I/O Out functions the allocation of the outputs (actuators) DO1 and DO2 is carried out in parameter P481 in the arrays [05] or [06]. In order to process the AS interface data as output terminals, one of the setpoint values (**P543**, **P544** or **P545**) must be parameterised to *BusIO Out bits*. Enabling of the bus transfer can be checked by means of the information parameter **P740** *Control word Bus* and **P741** *Status word Bus*. With this, e.g. the process input and output data is displayed during operation. In addition, module information and status information can be displayed via the parameters **P745** and **P746**. Parameterisation of the frequency inverter via the parameter string transfer (see Section 5.3) can be carried out without a particular setting.



NOTE

For array parameters the sub-index (the value transferred via the bus) starts at 0, the designation of the element corresponds to 1 (index). A detailed description of the signal processing (e.g. High or Low signal) of the individual functions is documented in the relevant manuals of the device series.

4.1.1 Control terminal parameters

Parameter	Setting value / Description / Note	Comments
P480 .. - 01 ... .. - 12	**Function Bus I/O In Bits**	
0 ... 72 [0]	The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions as the digital inputs (See P420…of the relevant FI manual). **[01]=** Bus I/O In Bit 0 **[02]=** Bus I/O In Bit 1 **[03]=** Bus I/O In Bit 2 **[04]=** Bus I/O In Bit 3 **[05]=** Bus I/O In Bit 4 **[06]=** Bus I/O In Bit 5 **[07]=** Bus I/O In Bit 6 **[08]=** Bus I/O In Bit 7 **[09]=** Flag 1 (only SK 500E) **[10]=** Flag 2 (only SK 500E) **[11]=** Bit 8 BUS control word (only for SK 500E) **[12]=** Bit 9 BUS control word (only for SK 500E)	
P481 .. - 01 ... .. - 10	**Function Bus I/O Out Bits**	
0 ... 39 [0]	The bus I/O Out bits are perceived as multi-function relay outputs. They can be set to the same functions as the digital inputs (See P434…of the respective FI manual). **[01]=** Bus I/O Out Bit 0 **[02]=** Bus I/O Out Bit 1 **[03]=** Bus I/O Out Bit 2 **[04]=** Bus I/O Out Bit 3 **[05]=** Bus I/O Out Bit 4 **[06]=** Bus I/O Out Bit 5 **[07]=** Bus I/O Out Bit 6 / Flag 1 **[08]=** Bus I/O Out Bit 7 / Flag 2 **[09]=** Bit 10 BUS status word (only for SK 500E) **[10]=** Bit 13 BUS status word (only for SK 500E)	
P482 .. - 01 ... .. - 10	**Standardisation of bus I/O Out bits**	
-400 … 400 % [100]	Adjustment of the limit values of the relay functions/Bus Out Bits. For a negative value, the output function will be output negative. When the limit value is reached and the setting values are positive, the relay contact closes, with negative setting values the relay contact opens.	
P483 .. - 01 ... .. - 10	**Hysteresis of bus I/O Out bits**	
1 … 100 % [10]	Difference between switch-on and switch-off point to prevent oscillation of the output signal.	

NOTE

For flank-controlled input functions via BusI/O or AS interface In Bits and simultaneous connection of a ParameterBox, the signal flank may be incorrectly identified, i.e. the drive unit may be unintentionally enabled! This behaviour occurs with the combination of different types of protocols.

4.1.2 Additional parameters

Parameter	Setting value / Description / Note	Comments
P509	**Interface**	**SK 300E, SK 700E, SK 750E**
0 ... 21 [0]	Selection of the interface from which the inverter is controlled. **0 = Control terminal or keyboard control** with the **Control Box** (option), the **ParameterBox** (option) or **the Potentiometer option** **1 = Control terminals only,** the inverter can only be controlled via the 4 digital inputs and the analog input. **Note:** For control via the AS interface this parameter must be set for a value for control via control terminals. Otherwise only the safety function is active via the AS interface (see note at the end of this section). **… other setting possibilities (bus control),** see the manual for the frequency inverter	
P509	**Control word source**	**SK 500E**
0 ... 10 [0]	Selection of the interface via which the FI is controlled. **0 = Control terminal or keyboard control** with the Control Box (if P510=0), the ParameterBox (not extension parameter box) or via BUS I/O Bits. **1 = Only control terminals** , the FI can only be controlled via the digital and analog inputs or via the bus I/O Bits. **2 = USS** , the control signals (enable, rotation direction, etc.) are transferred via the RS485 interface, the setpoint via the analog input or the fixed frequencies. **3 = CAN** control word **4 = Profibus** control word **5 = InterBus** control word **6 = CANopen** control word **7 = DeviceNet** control word **8 =** Reserved **9 = CAN Broadcast** **10 = CANopen Broadcast** **Note:** For control via the AS interface this parameter must be set for a value for control via control terminals. Otherwise only the safety function is active via the AS interface (see note at the end of this section).	
P510	**Auxiliary setpoint interface**	**SK 300E, SK 700E, SK 750E**
0 ... 8 [0]	Selection of the interface from which the inverter is controlled. **0 = Auto:** The auxiliary setpoint value is automatically taken from the interface of the main setpoint value P509 >interface< **1 = USS** **2 = CANbus** **3 = Profibus** **4 = InterBus** **5 = CANopen** **6 = DeviceNet** **7 =** Reserved **8 = CAN Broadcast**	

Parameter	Setting value / Description / Note	Comments
P510 **... - 01** **... - 02**	**Setpoint source**	**SK 500E**
0 ... 10	Selection of the setpoint source to be parameterised.	
[0]	**[01] =** Main **setpoint source** **[02] =** Auxiliary **setpoint source**	
	Selection of the interface via which the FI receives the setpoint.	
	0 = **Auto:** the source of the auxiliary setpoint is automatically derived from the setting in the parameter P509 >Interface< **1 =** **Control terminals**, digital and analog inputs control the frequency, including fixed frequencies **2 =** **USS** **3 =** **CAN** **4 =** **Profibus** **5 =** **InterBus** **6 =** **CANopen** **7 =** **DeviceNet** **8 =** Reserved **9 =** **CAN Broadcast** **10 =** **CANopen Broadcast**	
P513	**Telegram downtime**	
-0.1 / 0.0 / 0.1 ... 100.0 s	Monitoring function of the active bus interface. Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the inverter reports an error and switches off with the error message E010 (10.0) >Bus Time Out<.	
[0.0]	**Note:** For AS interface applications, the telegram downtime should be parameterised, in order to prevent uncontrolled starting (with enabling via the bus)of the drive unit after restoration of the bus connection. In addition, the error display is activated by the parameterisation of the telegram down time.	
	With the setting value 0 or <0.1, an internal timeout time of 40 ms is used, which does not result in an inverter error. With a setting value ≥ 0.1 after the elapse of an internal timeout time of 40 ms an error is generated and displayed on the inverter. The internal timeout time of 40 ms is used to indicate errors in the AS interface communication (see Section 4.3)	
P541	**Set Output**	
00000000000000 ... 11111111111111 (binary)	This function provides the opportunity to control the relay and the digital outputs independently of the frequency inverter status. To do this, the relevant output must be set to the function "External control".	
0000 ... 3F1F (hex)	This function can either be used manually or in combination with a bus control.	
[0000]	**Bit 0 =** Output 1 (K1) **Bit 4 =** Dig. AOut 1*** **Bit 10 =** Bus Out Bit 2 **Bit 1 =** Output 2 (K2)* **Bits 5 ... 7 =** reserved **Bit 11 =** Bus Out Bit 3 **Bit 2 =** Output 3 (DOUT1)** **Bit 8 =** Bus Out Bit 0 **Bit 12 =** Bus Out Bit 4 **Bit 3 =** Output 4 (DOUT2)** **Bit 9 =** Bus Out Bit 1 **Bit 13 =** Bus Out Bit 5	

* SK 300E: Analog output (digital function)

** except SK300E

*** Analog output (digital function), except SK 300E

	Bits 13-12	Bits 11-8	Bits 7-4	Bits 3-0	
Min. value	00	0000	0000	0000	Binary
	0	**0**	**0**	**0**	**hex**
Max. value	11	1111	0001	1111	Binary
	3	**F**	**1**	**F**	**hex**

BUS: The corresponding hex value is written into the parameter, thereby setting the relay and the digital outputs.

ControlBox: The hexadecimal code is entered directly when the ControlBox is used.

ParameterBox: Each individual output can be separately called up in plain text and activated.

Parameter	Setting value / Description / Note	Comments
P543 (P)	**Actual bus value 1**	
0 ... 12 (22) [1]	The return value 1 (IW1) can be set for bus control in this parameter. **SK 300E, SK 700E SK 750E** **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Current **4 =** Torque current **5 =** Status of digital inputs and relay **6 =** Actual position (only *posicon, SK700/750E*) **7 =** Setpoint position (only *posicon, SK700/750E*) **8 =** Setpoint frequency **9 =** Error number **10 =** Actual position increment [1] (only *posicon, SK700/750E*) **11 =** Setpoint position increment [1] (only *posicon, SK700/750E*) **12 =** BUS I/O Out Bits 0-7 **SK 500E** **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Current **4 =** Torque current (100% = P112) **5 =** State of digital inputs and outputs[2] **6 =** Actual position Low word **7 =** Setpoint position Low word **8 =** Setpoint frequency **9 =** Error number **10 =** Actual position increment Low word **11 =** Setpoint position increment Low word **12 =** Bus I/O Out Bits 0...7 **13 =** Actual position High word **14 =** Setpoint position High word **15 =** Actual position increment High word **16 =** Setpoint position increment High word **17 =** Value analog input 1 (P400) **18 =** Value analog input 2 (P405) **19 =** Setpoint frequency master value (P503) **20 =** Setpoint frequency after master value ramp **21 =** Actual frequency without master value slip **22 =** Speed from encoder (only possible with SK 52x/53xE and encoder feedback)	
P544 (P)	**Actual bus value 2**	
0 ... 12 (22) [0]	In this parameter, the return value 2 (IW2) can be set for bus control. For setting values, see parameter (P543)	
P545 (P)	**Actual bus value 3**	
0 ... 12 (22) [0]	In this parameter, the return value 3 (IW3) can be set for bus control. This is only available if P546 ≠ 3 (only applies for SK 700E / SK 750E). For setting values, see parameter (P543)	

[1] An indicated revolution of the motor results from 8192 encoder increments.

[2] The assignment of the digital inputs in P543/ 544/ 545 = 5

Bit 0 = DigIn 1	Bit 1 = DigIn 2	Bit 2 = DigIn 3	Bit 3 = DigIn 4
Bit 4 = DigIn 5	Bit 5 = DigIn 6	Bit 6 = DigIn 7	Bit 7 = Reserved
Bit 8 = Reserved	Bit 9 = Reserved	Bit 10 = Reserved	Bit 11 = Reserved
Bit 12 = Out 1	Bit 13 = Out 2	Bit 14 = Out 3	Bit 15 = Out 4

Parameter	Setting value / Description / Note	Comments
P546 (P)	**Bus setpoint 1**	
0 ... 7 (47) [1]	In this parameter, a function is assigned to the delivered setpoint 1 (SW1) for bus control. **NOTE:** Further details can be found in the respective FI manual or in the description of P400. **SK 300E, SK 700E SK 750E** **0 =** Off **1 =** Setpoint frequency (16 bit) **2 =** 16 Bit setpoint position (only *posicon, SK700/750E*) **3 =** 32 Bit setpoint position (only *posicon, SK700/750E* and if PPO- type 2 or 4 are selected) **4 =** Control terminals *posicon (*only *posicon, SK700/750E*, 16Bit) **5 =** Setpoint position (16 Bit) increment [1] (only*posicon, SK700/750E*) **6 =** Setpoint position (32 Bit) increment [1] (only*posicon, SK700/750E*) **7 =** Bus IO In Bits 0-7 **SK 500E** **0 =** Off **1 =** Setpoint frequency (16 bit) **2 =** Torque current limit (P112) **3 =** Actual frequency PID **4 =** Frequency addition **5 =** Frequency subtraction **6 =** Current limit (P536) **7 =** Maximum frequency (P105) **8 =** Actual PID frequency limited **9 =** Actual PID frequency monitored **10 =** Torque servo mode (P300) **11 =** Lead torque (P214) **12 =** Reserved **13 =** Multiplication **14 =** PI process controller actual value **15 =** PI process controller setpoint **16 =** PI process controller lead **17 =** Digital In bits 0...7 **18 =** Reserved **19 =** Set relay (P434/441/450/455=38) **20 =** Set analog output (P418=31) **21 =** ... 45 reserved **46 =** Setpoint torque process controller **47 =** Gearing transfer factor	
P547 (P)	**Bus setpoint 2**	
0 ... 46 (47) [0]	In this parameter, a function is assigned to the delivered setpoint 2 (SW2) for bus control. **0 =** Off **1 =** Setpoint frequency **2 =** Torque current limit (P112) **3 =** Actual frequency PID **4 =** Frequency addition **5 =** Frequency subtraction **6 =** Current limit (not SK 300E) **7 =** Maximum frequency (not SK 300E) **8 =** Actual PID frequency limited **9 =** Actual PID frequency monitored **10 =** Torque (not SK 300E) **11 =** Torque lead (not SK 300E) **12 =** Control terminals *posicon* (not SK 300E) **13 =** Multiplication (not SK 300E) **14 =** PI process controller actual value **15 =** PI process controller setpoint **16 =** PI process controller lead **17 =** Digital In bits 0...7 **18 =** Curve travel calculator (not SK 300E) **19 =** Set relay **20 =** Set analog output **21 =** ... 45 Reserved **46 =** Setpoint, torque process controller (not SK 300E) **47 =** Gearing transfer factor (only SK 500E)	
P548 (P)	**Bus setpoint 3**	
0 ... 46 (47) [0]	In this parameter, a function is assigned to the delivered setpoint 3 (SW3) for bus control. This is only available if P546 ≠ 3 (only applies for SK 700E / SK 750E). For setting values, see parameter (P547)	

4.1.3 Information parameters

Parameter	Setting value / Description / Note		Comments
P740 **... - 01** **...** **... - 06**	**Process data bus In**		**SK 300E, SK 700E, SK 750E**
0000 ... FFFF (hex)	Displays the actual control word and the setpoints.		**... - 01** = Control word **... - 02** = Setpoint 1 (P546) **... - 03** = Setpoint 1 High byte **... - 04** = Setpoint 2 (P547) **... - 05** = Setpoint 3 (P548) **... - 06** = Bus I/O In Bits (P480)
P740 **... - 01** **...** **... - 13**	**Process data bus In**		**SK 500E**
0000 ... FFFF (hex)	This parameter informs about the actual control word and the setpoints that are transferred via the bus systems.	**... - 01** = Control word...	Control word, source from P509.
		... - 02 = Setpoint 1 **... - 03** = Setpoint 2 **... - 04** = Setpoint 3	Setpoint data from main setpoint P510 - 01.
		... - 05 = Bus I/O Out Bits (P480)	The displayed value depicts all Bus In bit sources linked with *OR*.
		... - 06 = Parameter data In 1 **... - 07** = Parameter data In 2 **... - 08** = Parameter data In 3 **... - 09** = Parameter data In 4 **... - 10** = Parameter data In 5	Data during parameter transfer.
		... - 11 = Setpoint 1 **... - 12** = Setpoint 2 **... - 13** = Setpoint 3	Setpoint data from auxiliary setpoint P510 -02.
P741 **... - 01** **...** **... - 06**	**Process data bus Out**		**SK 300E, SK 700E, SK 750E**
0000 ... FFFF (hex)	Displays the actual status word and actual values.		**... - 01** = Status word **... - 02** = Actual value 1 (P543) **... - 03** = Actual value 1 High byte **... - 04** = Actual value 2 (P544) **... - 05** = Actual value 3 (P545) **... - 06** = Bus I/O In Bits (P481)
P741 **... - 01** **...** **... - 13**	**Process data bus Out**		**SK 500E**
0000 ... FFFF (hex)	This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.	**... - 01** = Status word	Status word, source from P509.
		... - 02 = Actual value 1 (P543) **... - 03** = Actual value 2 (P544) **... - 04** = Actual value 3 (P545)	
		... - 05 = Bus I/O Out Bits (P481)	The displayed value depicts all Bus In bit sources linked with *OR*.
		... - 06 = Parameter data Out 1 **... - 07** = Parameter data Out 2 **... - 08** = Parameter data Out 3 **... - 09** = Parameter data Out 4 **... - 10** = Parameter data Out 5	Data during parameter transfer.
		... - 11 = Master function actual value 1 **... - 12** = Master function actual value 2 **... - 13** = Master function actual value 3	Actual value of master function P502/P503.

Parameter	Setting value / Description / Note	Comments
P742	**Database version**	
0 ... 9999	Displays the internal database version of the FI.	

P744	**Configuration**	**SK 300E, SK 700E, SK 750E**
0 ... 9999	This parameter displays the option modules detected by the FI. The display with the ParameterBox is in plain text. The possible combinations are displayed in code in the ControlBox. Both right digits indicate the customer unit used and the two left digits indicate the special extension unit. The options vary depending on the FI type.	

Customer Unit **SK CU1-...**		Special extension unit **SK XU1-...**	
No IO	**XX00**	Encoder	**01XX**
Basic IO	**XX01**	PosiCon	**02XX**
Standard IO	**XX02**		
Multi IO	**XX03**		
USS IO	**XX04**		
CAN IO	**XX05**		
Profibus IO	**XX06**		

P744	**Configuration**	**SK 500E**
0000 ... FFFF (hex)	This parameter displays the design status integrated in the FI. Display is in hexadecimal code (SimpleBox, ControlBox, Bus system). The display is in plain text when the ParameterBox is used. **SK 500E = 0000** **SK 520E = 0101** **SK 530E/535E = 0201** **SK 510E/511E/515E = 0000**	

P745	**Module version**	**SK 300E, SK 500E**
0.0 ... 3276.7	Design status (software version) of the technology unit (SK TU2/3-xxx), but only when a separate processor is present, therefore not for SK TU2/3-CTR. Have this data available if you have a technical query.	

P745 **... - 01** **...** **... - 03**	**Module version**	**SK 700E, SK 750E**
0.0 ... 3276.7	Software version of the installed module [01] Technology unit (E.g.: AS interface Technology Unit) [02] Customer Unit [03] Special Extension Unit	

Parameter	Setting value / Description / Note	Comments
P746	**Module status**	**SK 300E, SK 500E**
0000 ... FFFF (hex)	Indicates the actual status (readiness, error, communication) of the technology unit (SK TU2/3-xxx), but only when own processor is present, therefore not for the SK TU2/3-CTR. Code details can be found in the respective BUS module manual. Different contents are shown depending on the modules. (AS interface: See Section 4.2)	
P746 ... - 01 ... ... - 03	**Module status**	**SK 700E, SK 750E**
0000 ... FFFF (hex)	Status of integrated modules [01] Technology unit (E.g.: AS interface Technology Unit) [02] Customer Unit [03] Special Extension Unit	

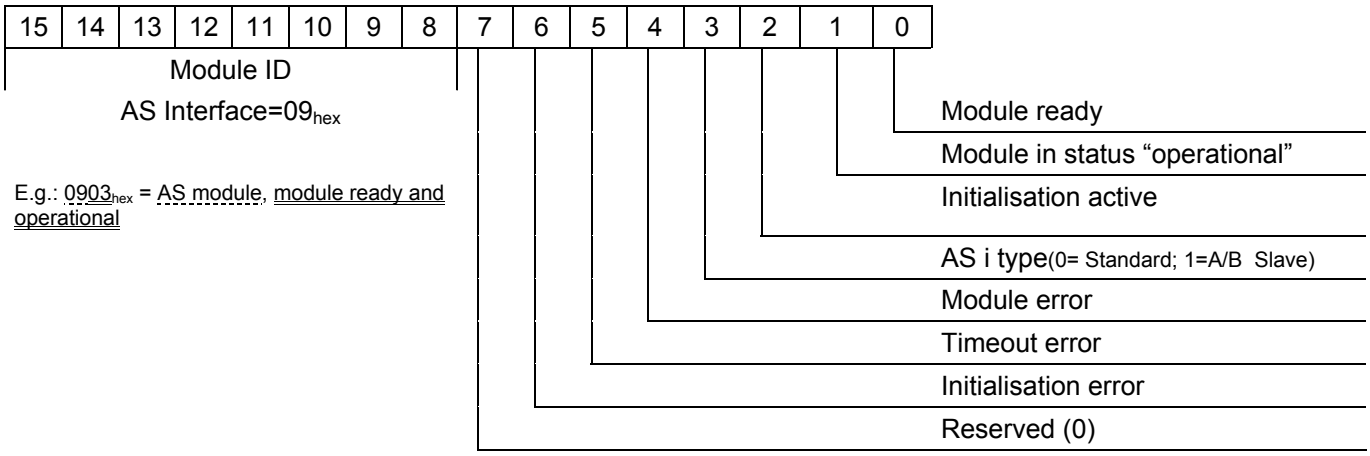
NOTE

When activated, the functions **block current**, **quick stop**, **remote control** and **cancel error** are available at the (local) control terminals. To operate the drive, a high signal must be present on the digital inputs being used before the drive can be enabled.

4.2 Module status

The status of the AS interface module can be read out in parameter **P746**.

Parameter P746 is a subindex parameter: Subindex 0 contains the status of the AS interface technology unit. The parameter contains binary coded information which is displayed in hexadecimal:



4.3 LED display

The status of the AS interface technology unit is displayed with 2 LEDs:

- Device S/E: Module status/error (dual LEDs)
- AS-Int. PWR/FLT: Standard status display for AS interface slaves (dual LEDs)

DEVICE S/E (red/green): Module status/error (dual LEDs)

Display	Meaning: AS-i / Inverter	
Off	No 24V (AUX) supply voltage to the module	
Yellow on	Initialisation phase of the module	
Green on	AS-I communication ok	Inverter ok
Green flashing (1s)	AS-I communication not yet active	
Green, rapid flashing (0.2s)	AS-i communication timeout [3]	
Red flashing (1s)	AS-I communication ok	Inverter is in an error condition (see frequency inverter operating instructions)
Red/green, alternating (1s)	AS-I communication not yet active	
Red/green, alternating (0.2s)	AS-i communication timeout [3]	
Red, rapid flashing (0.2s)	AS-I communication ok	System error, e.g. plug connector not correct or inverter off
Red	AS-I communication timeout / not yet active	

AS-Int. PWR/FLT (red/green): Standard status display for AS interface slaves (dual LEDs)

Display	Meaning
Off	No (PWR) AS interface voltage to the module
Green on	Normal operation
Red on	No data exchange possible (possible causes: Slave address = 0, master in STOP mode, slave not in LPS, slave with incorrect IO/ID, Reset active)
Red/green, alternating	Peripheral error (see LED: Device S/E)

In operational condition both the DEVICE S/E LED and the PWR/FLT LED illuminate green.

4.4 LED IO Display (only SK TU1-AS1 and SK TU3-AS1)

The status of the inputs and outputs of the technology unit is indicated be a total of 14 yellow LEDs (LED on corresponds to switched on status):

- DI1-DI4 : Status of the AS interface bits, which are received by the Master.
- DO1-DO4 : Status of the AS interface bits, which are transmitted from the Master.
- IN1-IN4 : Status of digital input 1-4
- OUT1-OUT2 : Status of digital output 1-2

[3] If P513 is set < 0.1, an internal timeout of 40 ms is used, which does not cause an inverter error. If P513 is set ≥ 0.1, an inverter error is reported after the elapse of the internal timeout of 40ms.

4.5 Peripheral error on AS interface module

A peripheral error of an AS interface slave occurs if:

- No AC line input (mains) voltage is applied to the inverter
- The 24V supply (AUX 24V) to the AS interface module is not present

A peripheral error is not reported if an error specific to the inverter is present. If a peripheral error is active, the signal statuses of the 4 Out data bits from the AS interface module to the AS interface master are set to LOW. This must be taken into account in programming or processing (pos. logic) the input signals in the control unit.

NOTE

In order to prevent uncontrolled starting of the drive unit after a communication error, the user should monitor **peripheral errors** in the control program. As soon as a peripheral error is reported, the enable signal - which is parameterised via the **BusIO Bits** - should be reset by the application program.

A second or better error monitoring facility would be to parameterise the **error** [7] (see P481) via one of the four available AS interface **BusIO Out Bits**, and to evaluate or link this accordingly. The error bit is set to "1" in case of no error, and is set to "0" if one of the following error conditions occurs:

- Error specific to the frequency inverter
- Frequency inverter has no AC line input (mains) voltage
- AS interface module not ok (see error status LED indicators Section 4.3).
- Either the PWR AS interface power supply or the 24V power supply is missing!

Acknowledgement of the error [12] (see P480) should then be carried out via one of the four available **BusIO In Bits**.

5 Data transfer / Parameter-string transfer

NOTE

The information in Section 5 does not apply to the AS interface Technology Unit SK TU2-**AS3** (A/B slave).

(only necessary for extended functionality)

The **Parameter string transfer** is available for the modules SK TUx-**AS1** (Standard slaves, slave profile S-7.4). This extended functionality is implemented in the AS interface master according to the *Complete Specification* 2.1. With this, direct communication and transfer of parameter data to the AS interface slave can be simply realised. In contrast to the data transfer from the sensors (cyclical processing), the string transfer is carried out acyclically. Therefore the transfer of parameter strings takes considerably longer than the cyclical exchange of 4I/4O data.

By means of the functions "*write parameter*" and "*read parameter*", parameters in the frequency inverter can be changed or read out by the application control program. Three string reading commands and a string writing command are available:

- **Read ID string** -Inverter and AS interface version information and identification
- **Read diagnosis string** -Signal statuses of the I/Os, process data and if necessary, inverter error no.
- **Read parameter string** -Read out the parameter values of the frequency inverter
- **Write parameter string** -Write the parameter values of the frequency inverter

The following sections provide information on the available commands.

NOTE

It should be noted that with continuous parameter string transfer and certain interface-bus configurations, the cyclical data exchange (every 5ms) to and from the sensors is suppressed! Due to the specified AS system behaviour, this condition cannot be avoided by NORD as manufacturers of the device. This system behaviour must therefore be taken into consideration when programming the control unit and the use of the parameter string transfer functionality.

5.1 Read ID string

(***read from slave)***

Via the AS interface module, specific data from the frequency inverter can be read out by means of the *Read ID string* command. The information and values in the ID string will first be shown when the AS interface has recognised the frequency inverter.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
03_{hex}	$2D_{hex}$	07_{hex}	12_{hex}	12_{hex}	03_{hex}	FF_{hex}		03_{hex}			03_{hex}			03_{hex}			

18	19	20	21	22	23
		03_{hex}			01_{hex}

Byte *Contents*

0-6, 8/11/14/20/23: determined according to the AS interface specification (4I/4O-operation; supports diagnosis; protocol)

7 : version of AS interface module (with 1 decimal place)

9/10 : frequency inverter version (P707[0])

12/13 : frequency inverter revision (P707[1])

15/16 : frequency inverter power (P743)

17 : frequency inverter voltage range (P747); 03_{hex} = 100 V to 120 V 13_{hex} = 200 V to 240 V
23_{hex} = 380 V to 480 V
93_{hex} = P747 not available

18/19 : frequency inverter configuration (P743)

21/22 : frequency inverter ID (for servicing)

In word variables, the high-byte is transferred before the low-byte. For details and information regarding the particular parameters, please refer to the operating instructions of the frequency inverter used.

5.2 Read diagnosis string

(***read from slave)***

By means of the *Read diagnosis string* command, the process and status data of the frequency inverter can be read out and analysed via the AS interface. The information and values in the diagnosis string will first be shown when the AS interface has recognised the frequency inverter.

0	1	2	3	4	5	6	7	8	9	10	11	12	13
Status	00_{hex}	BusIO In	BusIO Out	Error No.		ZSW		IW1		IW2		IW3	

Byte *Contents*

0 : Module status or status of the AS interface module (see Section 4.2)

1 : Reserved

2 : Status of AS interface inputs (BusIO In Bits)

3 : Status of AS interface outputs (BusIO Out Bits)

4/5 : Inverter error (P700)

6/7 : PZD-ZSW (Status word, see Section 5.4.1)

8/9 : PZD-IW1 (actual value 1, see Section 5.4.2)

10/11 : PZD-IW2 (actual value 2, see Section 5.4.3)

12/13 : PZD-IW3 (actual value 3, see Section 5.4.3)

In word variables, the high-byte is transferred before the low-byte. For details and information regarding the particular parameters, please refer to the operating instructions of the frequency inverter used.

5.3 Read / Write parameter string

(***read from slave / write to slave)***

The parameterisation of the frequency inverter can be carried out and checked with the commands *Read parameter string* and *Write parameter string*. Information parameters can also be read out in the same way.

For both reading and writing, the first two bytes in the parameter string are used as an index. Then the data content is transferred. The number of data words is restricted to 8 words (16 Byte). The total string transfer length is therefore limited to a maximum of 9 words (18 Bytes). Transfer is always in the form of complete words, i.e. odd numbers of bytes may not be transferred. There is a facility for simply accessing several parameters (direct parameters), and a more complex access to all parameters via the USS protocol. Both parameterisation facilities are described in the following sections.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Index		Data		Data		Data		Data		Data		Data		Data		Data	

Byte : *Contents*

0+1 : Index

2 – 17 : data (length varies according to content, but always in the form of words (2 bytes) and with the high-byte first)

Index (2 Byte)	Data content	Data length
0000_{hex} – 0001_{hex}	Reserved	-
0002_{hex}	PKW-Parameter-String (USS protocol) (see Section 5.3.2)	6 Byte or 8 Byte
0003_{hex} – $003F_{hex}$	Reserved	-
0040_{hex} – $00A5_{hex}$	Direct parameter (see Section 5.3.1)	2 bytes each. A maximum of 16 bytes can be transferred
$00A6_{hex}$ – $FFFF_{hex}$	Reserved	-

Reserved indices may not be set, as this can alter the behaviour of the system.

5.3.1 Direct parameters

The list of direct parameters contains selected parameters from the entire parameter range of the frequency inverter. With direct parameters, individual or several parameter sets or array elements can be written simultaneously (from 1 to 8 words or values). In order to read a direct parameter, the index of the relevant direct parameter must be sent with a Write order of length 1 word prior to the read command. After this, the index and the associated value (total 2 words) are transferred with a Read command.

Even after a Write order in which one or more values are written, with the next Read command the first value is read back. Here a certain time (≈ 200ms) must elapse before the value can be checked with a Read command (very important for the transfer of several parameters). After each Read command the index is automatically increased by 1 and the next value can be read without starting a further Write order. After reading the last direct parameter the index is again set to the first direct parameter.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Index		Array-element 1		Array-element 2		Array-element 3		Array-element 4		Array-element 5		Array-element 6		Array-element 7		Array-element 8	
Index		Parameter set 1		Parameter set 2		Parameter set 3		Parameter set 4									

As up to 8 data words (16 Byte) can be transmitted, it is also possible to transfer up to 4 parameter sets from two consecutive parameters by means of a single direct parameter Write command. If e.g. for SK 700E the index 0054_{hex} and 8 data words are written, the 4 parameters of the start-up time P102 and the braking time P103 are each changed. If only two parameter sets are available (SK 300E) the data words for the parameter sets 3 and 4 are not processed, i.e. the two data words are simply placeholders.

Index	Parameter	No. of parameter sets / array elements[4]	Parameter No.	Resolution	Value range[5]
0040_{hex} - 0043_{hex}	Fixed frequency 1	1 – 4	P429	0.1 Hz	-400 – 400 Hz
0044_{hex} - 0047_{hex}	Fixed frequency 2	1 – 4	P430	0.1 Hz	-400 – 400 Hz
0048_{hex} - $004B_{hex}$	Fixed frequency 3	1 – 4	P431	0.1 Hz	-400 – 400 Hz
$004C_{hex}$ - $004F_{hex}$	Fixed frequency 4	1 – 4	P432	0.1 Hz	-400 – 400 Hz
0050_{hex} - 0053_{hex}	Fixed frequency 5	1 – 4	P433	0.1 Hz	-400 – 400 Hz
0054_{hex} - 0057_{hex}	Start-up time	1 – 4	P102	0,01 s	0 – 99,99 s
0058_{hex} - $005B_{hex}$	Braking time	1 – 4	P103	0,01 s	0 – 99,99 s
$005C_{hex}$ - $005F_{hex}$	Emergency stop time	1 – 4	P426	0,01 s	0 – 99,99 s
0060_{hex} - 0063_{hex}	Minimum frequency	1 – 4	P104	0.1 Hz	0,1 – 400 Hz
0064_{hex} - 0067_{hex}	Maximum frequency	1 – 4	P105	0.1 Hz	0 – 400 Hz
0068_{hex} - $006B_{hex}$	Torque current limit	1 – 4	P112	1 %	25 – 401 %
$006C_{hex}$ - 0073_{hex}	Function BusIO In Bits	Array 1 – 8	P480	1	0 – 62
0074_{hex} - $007B_{hex}$	Function BusIO Out Bits	Array 1 – 8	P481	1	0 – 33
$007C_{hex}$ - 0083_{hex}	Standard BusIO Out Bits	Array 1 – 8	P482	1 %	-400 – 400 %
0084_{hex} - $008B_{hex}$	Hyst. BusIO Out Bits	Array 1 – 8	P483	1 %	1 – 100 %
$008C_{hex}$	Interface	1	P509	1	0 – 21
$008D_{hex}$	Telegram downtime	1	P513	0.1 s	-0,1 – 100 s
$008E_{hex}$ - 0091_{hex}	Actual bus value 1	1 – 4	P543	1	0 – 11
0092_{hex} - 0095_{hex}	Actual bus value 2	1 – 4	P544	1	0 – 11
0096_{hex} - 0099_{hex}	Actual bus value 3	1 – 4	P545	1	0 – 11
$009A_{hex}$ - $009D_{hex}$	Function Bus setpoint 1	1 – 4	P546	1	0 – 7
$009E_{hex}$ - $00A1_{hex}$	Function Bus setpoint 2	1 – 4	P547	1	0 – 18
$00A2_{hex}$ - $00A5_{hex}$	Function Bus setpoint 3	1 – 4	P548	1	0 – 18

Further information regarding the particular parameters can be found in the operating instructions of the relevant frequency inverter.

[4] If supported by the device (SK 300E only 2 parameter sets)

[5] Minimum and maximum values depend on the inverter used

Examples of direct parameters:

Writing the parameter P102 start-up time with value 1s (with 0.01 resolution $100_{dec} = 64_{hex}$)

-00 54 00 64 (2 words) transferred as a Write order

Writing the functions in parameter P480 for BusIO In Bits 0 and 1
(Bit 0: enable right = 1; Bit 1: Error acknowledgement = 12)

-00 6C 00 01 00 0C (3 words) transferred as a Write order

Reading of parameter P509 interface and P513 telegram down time

-00 8C (1 word) transferred as a Write order

-transfer Read command and evaluate the value for P509, interface

-transfer Read command and evaluate the value for P513, telegram down time

5.3.2 PKW Parameter-String

The data after the index 00 02_{hex} correspond to the PKW component of the USS protocol. Further information regarding the structure and meaning of the individual data words of the parameter range (PKW) is described in Section 5.5. In principle, all parameters of the frequency inverter can be read and written with this (insofar as they can be changed).

0	1	2	3	4	5	6	7	8	9
Index		PKW data, 3 or 4 words							
0002_{hex}		PKE		IND		PWE1		PWE2	

There are permissible lengths of a total of 4 and 5 words, corresponding to integer (16 Bit) and long (32 Bit) parameters. Write orders with other lengths are ignored by Index 00 02_{hex}. This causes the index to be reset to 00 00_{hex}. If a Write order is transferred in order to read a parameter, this must also have the corresponding length (integer/long). The parameter value for the Read command is only updated once by the frequency inverter, i.e. if at a later time only the Read command is carried out (without a previous Write order), the parameter value read is not the current one. If e.g. an information parameter (P7xx) is to be regularly read, this must always be started with a new Write order and a subsequent Read command.

Examples of PKW parameter strings:

Writing (command of parameter P102 start-up time ($P102 = 66_{hex}$; Subindex = 0; Integer) with the value 1s (with 0.01 resolution $100_{dec} = 64_{hex}$)

-00 02 20 66 00 00 00 64 (4 words) transferred as a Write order

-perform the Read command repeatedly until the parameter number and the subindex in the order agree. If these are identical, the response label and the parameter value must be checked.

Reading (order label =1) of the module status parameter ($P746 = 2EA_{hex}$; Subindex = 0; Integer)

-00 02 12 EA 00 00 00 00 (4 words) transferred as a Write order

-perform the Read command repeatedly until the parameter number and the subindex in the order agree. If these are identical, the response label must be checked. Reading of a current value must be once again started with a Write order.

Reading (order label = 1) of actual position parameter ($P601 = 259_{hex}$; Subindex = 0; long)

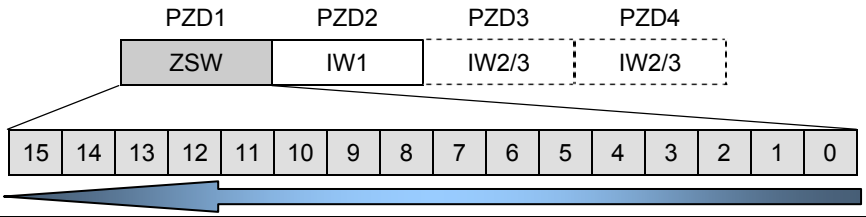
-00 02 12 59 00 00 00 00 00 00 (5 words) transferred as a Write order

-perform the Read command repeatedly until the parameter number and the subindex in the order agree. If these are identical, the response label must be checked.

5.4 Process data (PZD)

5.4.1 Status word (ZSW)

In the inverter response telegram, in the area of the process data the status word (ZSW) is transferred as the first word. For example, the status word "Ready for switch-on" corresponds to $0B31_{(hex)}$.



Bit	Value	Meaning	Comments
0	0	Not ready to start	
	1	Ready to start	Initialisation completed, charging relay ON, output voltage disabled
1	0	Not ready for operation	Causes: No command has been activated, fault is signaled, OFF2 or OFF3 activated, starting disabled state activated
	1	Ready for operation	ON command activated, no faults present. The inverter can be started with the command ENABLE OPERATION
2	0	Operation disabled	
	1	Operation enabled	The output voltage is enabled; ramp to the existing setpoint
3	0	No fault	
	1	Fault	Drive fault resulting in stoppage; this state is changed to starting disabled after the fault has been successfully acknowledged
4	0	OFF 2	OFF2 command applied
	1	No OFF 2	
5	0	OFF 3	OFF3 command applied
	1	No OFF 3	
6	0	Starting not disabled	
	1	Starting disabled	Switches first to OFF1, then to ready-to-start status
7	0	No warning	
	1	Warning	Drive operation continues, no acknowledgement necessary
8	0	Actual value not O.K.	Actual value does not match the setpoint (with *posicon:* failure to reach setpoint position)
	1	Actual value O.K.	Actual value matches required setpoint (setpoint has been reached) (with *posicon:* setpoint has been reached)
9	0	Local guidance	Guidance on local device has been activated
	1	Guidance requested	The master has been requested to assume guidance.
10	0		
	1	Bit 10 active	Bus bit 10 from the status word is set. For further details of function, please refer to parameter P481.
11	0		
	1	Rotational direction: right	Inverter output voltage is turning right
12	0		
	1	Rotational direction: left	Inverter output voltage is turning left
13	0		
	1	Bit 13 active	Bus bit 13 from the status word is set. For further details of function, please refer to parameter P481.
14	0/1	Currently active parameter set 0	00 = Parameter set 1 01 = Parameter set 2 10 = Parameter set 3 11 = Parameter set 4
15	0/1	Currently active parameter set 1	

Deviations in the status word (ZSW) for SK 300E and SK 700/750E series devices

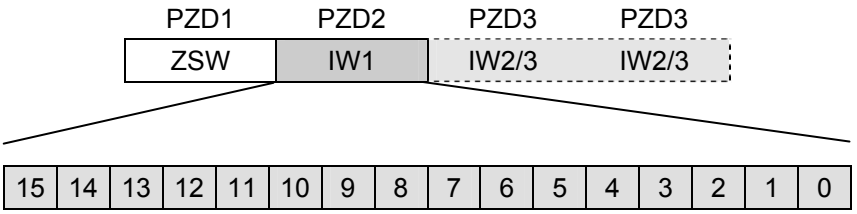
With the above device types, the meanings of the two bits 10 and 13 in the status word deviate from the status word of the SK 500 E.

Meaning of the two individual bits:

Bit	Value	Meaning	Comments
10	0	MFR 1 reference value undershot	Programmed function of the MFR 1 met or □actual value < programmed reference value
	1	MFR 1 reference value reached	Programmed function of the MFR 1 is fulfilled, or Actual value > programmed reference value
13	0	MFR 4 reference value undershot	Only for SK 700E/750E with posicon upgrade: Status MFR 4 = 0
	1	MFR 4 reference value reached	Only for SK 700E/750E with posicon upgrade: Status MFR 4 = 1

5.4.2 The actual value 1 (IW1)

The actual value 1, i.e. the actual output frequency of the inverter, is transferred as a 16 Bit value as standard in the actual value 1. The actual value 1 is transferred to the master in the inverter response telegram as the second word in the process data area.



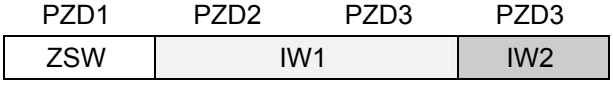
The actual value 1 is transferred as a whole number in the range (-32768 to 32767). In addition to the actual frequency, other actual inverter values can be transferred. The setting is made in P543 *'Actual value 1 function*'.

The settings ‘Actual frequency’, ‘Actual speed’, ‘Current’ and ‘Torque current’ are transferred as percentages of the respective nominal values. The value 16384 (4000 HEX) corresponds to 100%. The value C000 HEX corresponds to -100%. Actual values in the range –200% to +200% can be transferred.

With the setting ‘Digital I/O status’, the states of the control terminals and the relay (MFR) can be transferred:

Bit	Status
Bits 0-5	Digital input 1-6
Bit 6-11 for *posicon* special extension unit	Digital input 7-12
Bit 6 for encoder special extension unit	Digital input 7
Bits 12-15	Multifunctional relay 1-4

With the setting 'Actual position' and 'Setpoint position' the actual absolute position is transferred. The resolution is 1 = 0.001 revolutions. If the value 'Setpoint position 32 Bit' is set in parameter P546 (*Function setpoint 1*), then the actual value (Setpoint or actual position) is also transferred to IW2 and IW3 as a 32 Bit value.



5.4.3 Actual value 2 and actual value 3 (IW2/3)

It is possible to forward two more actual values to the controller if PPO type 2 or 4 is used for transfer.

The actual value 2 (IW2) is transmitted in PZD4. The value to be transferred can be selected in P544 (actual bus value 2). Actual value 3 (IW3) can be transmitted in PDZ3 if actual value 1 is **not** a 32 Bit value. The value to be transferred can be selected in P545 (actual bus value 3). The standardisation corresponds to actual value 1 (see above)

5.4.4 The status machine

The frequency inverter passes through a status machine. The changes between various states are triggered by the respective control commands in the process data control word. The actual status is returned in the process data status word.

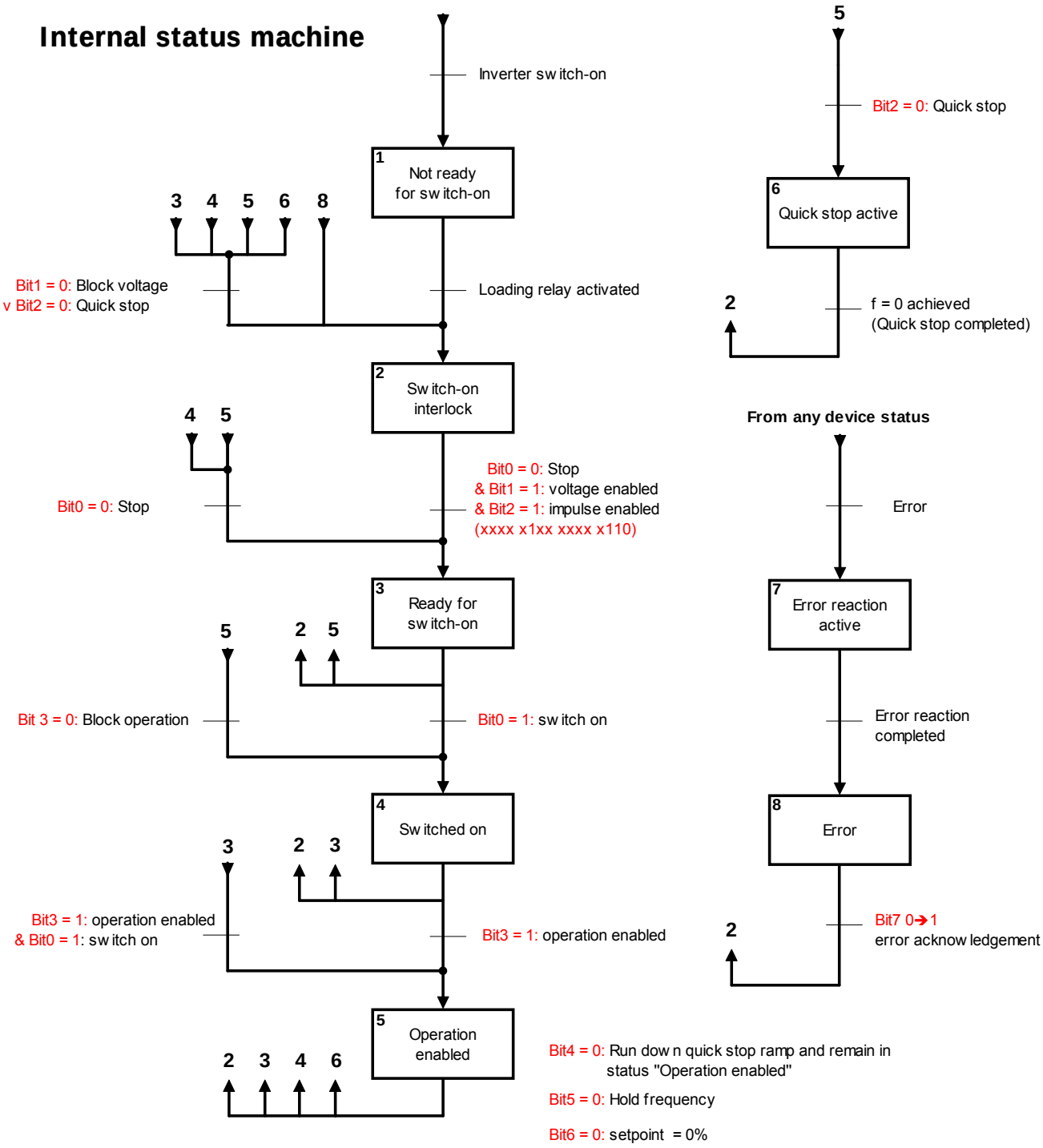
After switching on, the inverter is in **switch-on disabled** status. This status can only be ended by transmitting the “Shut down (Off 1)” command.

The answer to a Master telegram normally does not yet contain a reaction to the control command. The controller has to check the answers from the slaves as to whether the control command has been carried out.

The following Bits indicate the status of the frequency inverter:

Status	**Bit 6** Switch-on disable	**Bit 5** Emergency stop	**Bit 4** Disable voltage	**Bit 3** Fault	**Bit 2** Operation enabled	**Bit 1** Standby	**Bit 0** Ready for switch-on
Not ready to start	0	X	X	0	0	0	0
Starting disabled	1	X	X	0	0	0	0
Ready to start	0	1	1	0	0	0	1
Activated	0	1	1	0	0	1	1
Operation enabled	0	1	1	0	1	1	1
Fault	0	X	X	1	0	0	0
Error active	0	X	X	1	1	1	1
Emergency stop active	0	0	1	0	1	1	1

Internal status machine



Control Bits
0. Operational / Stop
1. Voltage enable / disable
2. Impulse enabled / Quick stop
3. Operation enable / disable
4. Operating condition / disable HLG
5. Enable / stop HLG
6. Setpoint enable / disable
7. Error acknowledgement (0➔1)
10. Control data valid / invalid
11. Direction of rotation right
12. Direction of rotation left
14. Parameter set Bit 0
15. Parameter set Bit 1

Priority of control commands:
1. Block voltage
2. Quick stop
3. Stop
4. Operation enable
5. Switch on
6. Operation disable
7. Reset error

Identification of statuses:
1: Bit 0 = 0
2: Bit 6 = 1
3: Bit 0 = 1
4: Bit 1 = 1
5: Bit 2 = 1
6: Bit 5 = 0
7: Bit 2 & Bit 3 = 1
8: Bit 3 = 1

5.5 Data transfer with USS reference data / Parameter range (PKW)

(only necessary for extended functionality)

The reference data (without telegram framework) correspond to the USS protocol.

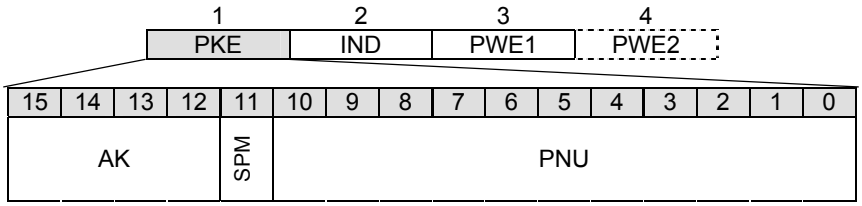
Using the PKW mechanism, parameter processing can be carried out in the cyclical data traffic. For this the master formulates an order and the inverter formulates the response to this.

In principle, the parameter range consists of a **parameter identification**, in which the type of order (Write, Read etc.) and the relevant parameters are specified. Individual parameter sets or array elements can be addressed with the aid of the **Index**. The **parameter value** contains the value to be written or read.

Note: A parameter order must be repeated until the inverter responds with the corresponding response telegram.

5.5.1 Parameter label (PKE)

The order or response and the associated parameters are encrypted in the parameter label (**PKE**).



The parameter label (**PKE**) is always a 16 bit value.

PNU: The bits 0 to 10 contain the number of the required parameter (**PNU**), or the number of the current parameter in the response parameter of the inverter.

Note: For the inverter parameter numbers (**PNU**) please refer to the relevant operating instructions for the inverter.

SPM: Bit 11 is the toggle-bit for spontaneous messages. This function is **not** supported!

AK: Bits 12 to 15 contain the order or response label.

The following table lists all the orders which can be transferred from the master to the inverter. The right-hand column contains the response, which is normally sent (response label positive). Only certain response labels are possible, depending on the order label. In case of error (response label negative) the inverter will always supply the value 7 in the response label (AK) to the master.

AK	Function	Response label positive
0	No order	0
1	Order parameter value	1 / 2
2	Change parameter value (word)	1
3	Change parameter value (double word)	2
4	Reserved	-
5	Reserved	-
6	Order parameter value (array)	4 / 5
7	Change parameter value (array word)	4
8	Change parameter value (array double word)	5
9	Order the number of array elements	6
10	Reserved	-
11	Change parameter value (array double word) without writing into EEPROM	5
12	Change parameter value (array word) without writing into EEPROM	4
13	Change parameter value (double word) without writing into EEPROM	2
14	Change parameter value (word) without writing into EEPROM	1

Meaning of the values sent in the response label:

AK	Function
0	No response
1	Transfer parameter value (word)
2	Transfer parameter value (double word)*
4	Transfer parameter value (array word)
5	Transfer parameter value (array double word)*
7	Order cannot be executed (with error number in PWE2)

*Only possible with 4 words

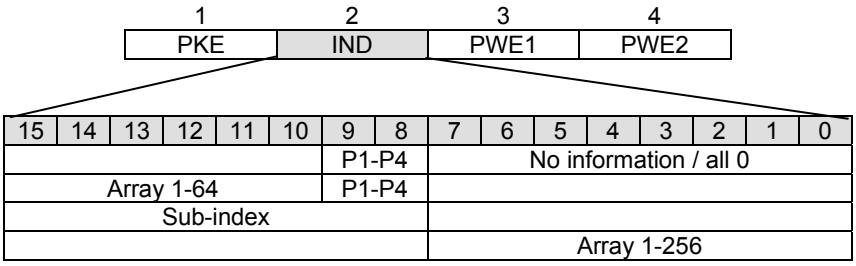
As long as an order has not yet been executed, the inverter provides the response to the last order. Therefore the master must always check whether the received response matches the order sent. For the plausibility check, the value in the response label (AK), the received parameter number (PNU) with the corresponding Index (IND) as well as the current parameter value (PWE) can be used for the description of parameters.

Error messages if the order cannot be executed

In the response label "Order cannot be executed" (AK = 7), then an error message is added to the parameter value (**PWE2**) of the inverter response. For the meanings of the values transferred, please refer to the following table.

No.	Meaning
0	Invalid parameter number
1	Parameter value cannot be changed
2	Lower or upper value limit exceeded
3	Incorrect sub-index
4	No array
5	Invalid data type
6	Only resettable (only 0 may be written)
7	Description element cannot be changed
9	Description data not present
201	Invalid order element in the last order received
202	Internal response label cannot be depicted

5.5.2 Sub-index (IND)



The structure and function of the parameter index (IND) depends on the type of parameter to be transferred.

For values which depend on the parameter set, the parameter set can be selected via Bits 8 and 9 of the Index (IND) (0 = parameter set 1, 1 = parameter set 2,...).

If the parameter to be processed is also an array parameter (e.g. position array for the PosiCon option), then the sub-index of the required parameter can additionally be accessed via Bit 10 to Bit 15 of the sub-index (0 = array element 1, 1 = array element 2,…):

Array element	Parameter set	Index
5 (000101_{BIN})	2 (01_{BIN})	15_{HEX} = $0001\ 0101_{BIN}$
21 (010101_{BIN})	4 (11_{BIN})	57_{HEX} = $0101\ 0111_{BIN}$

If a parameter is not dependent on the parameter set, then Bit 8 -15 are used for the sub-index.

Please refer to the operating instructions for details of the structure of the individual parameters and which values may be called up.

If the sub-index is used, nos. 6, 7, 8 or 11, 12 must be used as the order label (see Section 5.5.1), in order for the sub-index to be effective.

5.5.3 Parameter value (PWE)

For each parameter, the transfer of the parameter value (PWE) is always as a word (16 Bit) or double word (32 Bit). Only one parameter value can be transferred in a telegram.

A 32 bit parameter value comprises PWE1 (high value word) and PWE2 (low value word, 4th word).

A 16 Bit parameter value is transferred in PWE2. For negative values the high word must be set to $FFFF_{hex}$.

Note: 32- Bit parameter values are only used with the *posicon* option. All the relevant parameters are described in the supplementary *posicon* manual.

The parameter value is transferred as an integer value. For parameters with resolutions 0.1 or 0.01 the parameter value must be multiplied by the inverse of the resolution.

Example: A start-up time of 99.99 seconds is to be set:

99.99s $\rightarrow$ 99.99 * 1/0,01 = 99,99 * 100 = 9999. Therefore the value $9999_{dec} = 270F_{hex}$ must be transferred.

6 Examples

For information about AS interface data, e.g. identification code (ID Code), extended ID Codes 1 and 2 and the I/O configuration (I/O Code), please refer to Section 8.

NORD AS-Interface modules are Standard-Slaves (exception: SK TU2-AS3 = A/B Slave) and are set with the slave address 0 at the factory.

6.1 Example based on a Siemens Master CP343-2P

This example supports the user in the design and implementation of the AS interface application. Information is presented for various application examples, which illustrate which steps are necessary in order to control the frequency inverter with the SPS via the AS interface. This example is illustrated for a SIMATIC S7-300 automation device. Prerequisites for the understanding of this document are:

- Basic knowledge of the SIEMENS SIMATIC S7, STEP 7
- Knowledge of the operation of frequency inverters – BU 0300, BU 0500, BU 0700, BU 0750
- Knowledge of the manual CP 343-2 / CP 343-2 P for the AS interface master

For the procedure regarding the design of the AS interface master in STEP 7 please refer to the Siemens manual. All examples described here refer to an AS interface slave with address 1 for the SK 700E series.

6.1.1 Slave design

In order to connect the AS interface slave to the AS interface bus, or to activate it on the AS interface master, the CP343-2 P must be switched to *design mode*. By means of key "Design" (see Siemens AS interface master manual) the device can be switched over from *protected mode* to *design mode*.

In addition to key "Design" (to record the actual current configuration) a setpoint configuration can be designed and loaded into the CP via the hardware configuration in Step 7.

6.1.2 AS interface control Bits (control signals)

The relevant digital inputs and outputs (4I/4O) are accessed via Step 7 peripheral loading and transfer commands (see program example FC1). For each standard slave 4 input Bits are read in or 4 output Bits are available.

As an example, the following illustrates the allocation of the input and output Bits for Slave 1:

Input Byte 1	Reserved				Slave 1			
Bit No.	7	6	5	4	3	2	1	0
Bus module connection					In 3	In 2	In 1	In 0

Output Byte 1	Reserved				Slave 1			
Bit No.	7	6	5	4	3	2	1	0
Bus module connection					Out 3	Out 2	Out 1	Out 0

For more precise I/O Byte allocation for all standard slaves, please refer to the AS interface master manual. The numbering of the In and Out Bits in the AS interface master manual may differ by "1".

By means of the digital 4I/4O data Bits, the control of the frequency inverter can be operated or the control unit can receive status information from the frequency inverter.

For example, a frequency inverter is to be enabled for the directions of rotation right and left via the digital AS interface In Bits. In addition, a parameter set switchover and an error acknowledgement are to be parameterised via the In Bits. The operation and the error indication of the frequency inverter are to be transferred to the control unit via the first two of the four digital AS interface Out Bits.

For this, the following FI parameters must be set as follows:

P480 [01] Bus IO In Bit 0	1 = Enable right
P480 [02] Bus IO In Bit 1	2 = Enable left
P480 [03] Bus IO In Bit 2	8 = Parameter switch-over
P480 [04] Bus IO In Bit 3	12 = Error acknowledgement
P481 [01] Bus IO Out Bit 0	2 = Inverter operating
P481 [02] Bus IO Out Bit 1	7 = Error
P509 interface	0 = Control terminals or keyboard control
P543 Bus actual value 1	12 = Bus IO Out Bits 0-7
P546 Bus setpoint 1	17 = Bus IO In Bits 0-7

For the switch-over of the parameter set it should be noted that the parameters dependent on the parameter set, e.g. P543 and P546 are also accordingly parameterised onto Bus IO Bits.

6.1.3 AS interface binary values (Digital inputs and outputs)

The following example purely serves for the I/O expansion of the control signals and can also be operated without the AS interface master.

For example, a frequency inverter is to be enabled for the directions of rotation right and left via the digital AS interface In Bits (Sensor Dig), and the direction of rotation changed via the second sensor input. In addition, a setpoint increase is to be made via fixed frequency 1. An error acknowledgement is to be performed with the fourth and last In Bit (Sensor Dig). The operation and the error indication of the frequency inverter are to be output via the first two of the four digital AS interface Out Bits (Actuator Dig).

For this, the following FI parameters must be set as follows:

P429 Fixed frequency 1	e.g. 10 Hz
P480 [05] Bus IO In Bit 4 (Sensor Dig In 1)	1 = Enable right
P480 [06] Bus IO In Bit 5 (Sensor Dig In 2)	3 = Reverse direction of rotation
P480 [07] Bus IO In Bit 6 (Sensor Dig In 3)	4 = Fixed frequency 1
P480 [08] Bus IO In Bit 7 (Sensor Dig In 4)	12 = Error acknowledgement
P481 [05] Bus IO Out Bit 4 (Actuator Dig Out 1)	2 = Inverter operating
P481 [06] Bus IO Out Bit 5 (Actuator Dig Out 2)	7 = Error
P509 interface	0 = Control terminals or keyboard control
P543 Bus actual value 1	12 = Bus IO Out Bits 0-7
P546 Bus setpoint 1	17 = Bus IO In Bits 0-7

6.1.4 Data transfer of the sensor signal statuses to the AS-I master alone

It is often the case that the signal statuses from photoelectric beam detectors, buttons or other field components have to be communicated to the AS i master via the two-conductor AS interface network. In the parameterisation of the available BUS IO bits, there is the possibility of transferring the signal statuses of sensors connected to the AS interface module or the IO sockets 1/2 to the ASi master. In this case the sensor inputs (Bus IO In Bits) are not assigned with any inverter-specific functions and are assigned to the ASi master or control unit for processing. The parameters described in Section 4.1 are available for the pure processing of the sensor signal statuses.

The following example serves purely for the recording of the signal statuses of the sensors/initiators via the AS interface. Transfer is only possible if the frequency inverter is switched on **(AUX and PWR connection and supply to the AS interface module is not sufficient)**.

For example, the four digital AS interface n Bits (Sensor Dig) are to be recorded via the frequency inverter or the AS interface module. For this, the following FI parameters must be set as follows:

P480 [05] Bus IO In Bit 4 (Sensor Dig In 1)	0 = No function
P480 [06] Bus IO In Bit 5 (Sensor Dig In 2)	0 = No function
P480 [07] Bus IO In Bit 6 (Sensor Dig In 3)	0 = No function
P480 [08] Bus IO In Bit 7 (Sensor Dig In 4)	0 = No function
P481 [01] Bus IO Out Bit 4 (AS-Interface Out Bit 1)	34 = Bus IO In Bit 4
P481 [02] Bus IO Out Bit 5 (AS-Interface Out Bit 2)	35 = Bus IO In Bit 5
P481 [03] Bus IO Out Bit 6 (AS-Interface Out Bit 3)	36 = Bus IO In Bit 6
P481 [04] Bus IO Out Bit 7 (AS-Interface Out Bit 4)	37 = Bus IO In Bit 7
P509 interface	0 = Control terminals or keyboard
P543 Bus actual value 1[6]	12 = Bus IO Out Bits 0-7
P546 Bus setpoint 1[7]	17 = Bus IO Bits 0-7

6.2 Example of data transfer / Parameter-string transfer

(extended functionality / does not apply to A/B slaves)

For extended functionality the commands described in Section 5 are available. If the commands or orders are not completed with DONE = 1 - order completed without error, but rather ERROR = 1, order completed with error, a corresponding error code is indicated in the AS interface status word. The precise description of errors is documented in the Siemens AS interface master manual. In addition to the 4 commands described (see Section 5) further commands (see Siemens AS interface master manual) can be used.

For the extended operation of the CP 343-2 P the STEP 7 module FC "ASI-3422" (Version 2.0) should be used. In the program example, DB13 is declared as the command interface.

[6] One of the three actual Bus values in parameters P543 to P545 must be parameterised on Bus IO Out Bits 0…7.

[7] One of the three Bus setpoint values in parameters P546 to P548 must be parameterised on Bus IO Out Bits 0…7.

6.2.1 Read ID string

The command number 42_{hex} is to be entered into DB13.DBB4 and the slave address 1 into DB13.DBB5 in the transmission buffer of the command interface. After the command or the order from the AS interface has been completed without error (DONE = 1), the response date is displayed in the reception buffer.

For the allocation of the individual status Bits, please refer to the information in Section 5.1.

For example, the power of the FI is displayed in reception buffer Byte DB13.DBB244 and 245 (corresponding to Byte 15/16 of the ID string). If e.g. 00 96_{hex} is displayed in the Bytes, this corresponds to the display in parameter P743, i.e. 150_{dec}, which in turn corresponds to a power of 1.5kW for two decimal places (SK 700E).

6.2.2 Read diagnosis string

The command number 43_{hex} is to be entered into DB13.DBB4 and into the slave address 1 in DB13.DBB5 in the transmission buffer of the command interface. After the command or the order from the AS interface has been completed without error (DONE = 1), the response date is displayed in the reception buffer.

For the allocation of the individual status Bits, please refer to the information in Section 5.2.

E.g. in the reception buffer Bytes DB13.DBB233 and 234 (corresponding to Byte 4/5 of the diagnosis string) a current error of the frequency inverter is displayed. If, e.g. 00 46_{hex} is displayed in the Bytes, this corresponds to the display in parameter P700, i.e. 70_{dec}, which in turn in the table of possible error messages corresponds to error 7.0, AC line input (mains) phase failure.

The status word of the frequency inverter can be read out via Bytes DB13.DBB235 and 236 (corresponding to Byte 6/7 in the diagnosis string) in the reception buffer. For the allocation of the individual status Bits, please refer to the information in Section 5.4.1.

6.2.3 Read / Write parameter string

The command number 40_{hex} are to be entered into the transmission buffer of the command interface in DB13.DBB4, the slave address 1 is at be entered in DB13.DBB5, the number of parameter bytes into DB13.DBB6 and the string bytes to be transferred are to be entered into DB13.DBB7 and above. The index (see Section 5.3) must always be entered as words in the first two bytes DB13.DBB7 and DB13.DBB8. After the command or the order from the AS interface has been completed without error (DONE = 1), the transferred functions or parameters are communicated to the frequency inverter. For the available functions, please refer to the information in Section 5.3.

Note: The byte numbers in the following tables refer to the byte designations in Section 5.1. Here, the High byte is always located in front of the Low byte in the data word.

Example of writing of direct parameters:

Direct parameterisation is available in order to quickly re-parameterise selected parameters on the frequency inverter (See Section 5.3.1). E.g. in order to change the start-up time P102 in parameter set 1 to 10.00s, proceed as follows:

Data Byte in DB13	Value in hex	Meaning / Note
DBB4	40	Write the command number for the parameter string
DBB5	01	Slave address
DBB6	04	Number of parameter Bytes, 04_{hex}
DBB7	00	Byte 0: Index
DBB8	54	Byte 1: Index, start-up time P102, parameter set 1
DBB9	03	Byte 2: parameter value, taking the resolution 0.01 into account
DBB10	E8	Byte 3: parameter value, taking the resolution 0.01 into account

With this, the start-up time in P102 for parameter set 1 is changed to 10.00s.

If the start-up time for all 4 parameter sets is to be changed at the same time, this can also be carried out with only one Write Parameter String command. For this, the number of parameter Bytes must be increased to 10 and the corresponding parameter values entered in DBB11 to DBB16.

Data Byte in DB13	Value in hex	Meaning / Note
DBB4	40	Write the command number for the parameter string
DBB5	01	Slave address
DBB6	0A	Number of parameter bytes, $0A_{hex}$ corresponds to 10_{dec}
DBB7	00	Byte 0: Index
DBB8	54	Byte 1: Index, start-up time P102, parameter set 1
DBB9	03	Byte 2: parameter value of parameter set 1, taking the resolution of 0.01 into account
DBB10	E8	Byte 3: parameter value of parameter set 1, taking the resolution of 0.01 into account
DBB11	07	Byte 4: parameter value of parameter set 2, taking the resolution of 0.01 into account
DBB12	D0	Byte 5: parameter value of parameter set 2, taking the resolution of 0.01 into account
DBB13	0B	Byte 6: parameter value of parameter set 3, taking the resolution of 0.01 into account
DBB14	B8	Byte 7: parameter value of parameter set 3, taking the resolution of 0.01 into account
DBB15	0F	Byte 8: parameter value of parameter set 4, taking the resolution of 0.01 into account
DBB16	A0	Byte 9: parameter value of parameter set 4, taking the resolution of 0.01 into account

With this the different start-up times P102 for the 4 parameter sets are parameterised with the following values:

Parameter set 1	03E8 => 10.00s
Parameter set 2	07D0 => 20.00s
Parameter set 3	0BB8 => 30.00s
Parameter set 4	0FA0 => 40.00s

For array parameters (e.g. P480 to P483) all 8 arrays can be changed or executed with only a single Write Parameter String command. For this, the number of parameter Bytes must be increased to 18 and the corresponding parameter values entered in DBB17 to DBB24.

Example of reading direct parameters:

In order to check whether the direct parameter has been correctly transferred, a plausibility check should be performed. For this, the corresponding index must be sent with the function Write Parameter. For the start-up time P102 in parameter set 1, this would be the Index 0054_{hex}. Only the Index needs to be transferred, i.e. the number of parameter Bytes is 2.

In order to read out the parameter value P102, proceed as follows:

- Transfer the Index with Write Parameter
- Then read out the parameter value with Read Parameter

Data Byte in DB13	Value in hex	Meaning / Note
DBB4	40	Write the command number for the parameter string
DBB5	01	Slave address
DBB6	02	Number of parameter Bytes, 02_{hex}
DBB7	00	Byte 0: Index
DBB8	54	Byte 1: Index, start-up time P102, parameter set 1

After the successful completion of the Write order, start the Read order with command number 41.

Data Byte in DB13	Value in hex	Meaning / Note
DBB4	41	Read the command number for the parameter string
DBB5	01	Slave address

The Index and the parameter value are then output to the reception buffer.

Data Byte in DB13	Value in hex	Meaning / Note
DBB228	04	Number of parameter bytes, $0A4_{hex}$ corresponds to 04_{dec}
DBB229	00	Index:
DBB230	54	Index: start-up time P102, parameter set 1
DBB231	03	Parameter value: takes the resolution 0.01 into account
DBB232	E8	Parameter value: takes the resolution 0.01 into account

If subsequently, i.e. without a further Write order being started in the meantime, one or more Read orders are started consecutively, the AS interface reads the corresponding parameter values consecutively according to the Index sequence of the direct parameter table. The AS interface automatically counts up the index.

Note: This automatic Index increase only applies to the direct parameter function.

As a result, after the next Read Parameter String order, the parameter value P102, start-up time, is read out from parameter set 2 in the reception buffer.

Data Byte in DB13	Value in hex	Meaning / Note
DBB228	04	Number of parameter bytes, $0A4_{hex}$ corresponds to 04_{dec}
DBB229	00	Index:
DBB230	55	Index: start-up time P102, parameter set 2
DBB231	07	parameter value, taking the resolution 0.01 into account
DBB232	D0	parameter value, taking the resolution 0.01 into account

Example for the writing of a parameter (PKW data via USS protocol / Parameter string):

For example, in order to set the release time of the brake P114 (parameter number PNU = 114 / 72_{hex}) of the FI to 1 sec for parameter set 1, proceed as follows:

- Select parameter label PKE (AK =1 for change parameter value (word) and parameter number PNU = 72_{hex})
- Taking the internal resolution of the frequency inverter into account (0.01sec) => for 1 sec there must be a parameter value PWE of 1 / 0.01 = 100_{dec} (64_{hex})
- Select parameter set 1 (IND = 0)
- Select order label 2 = change parameter value (word)
- Check response telegram (Read Parameter String)

The command Write Parameter String must be transferred with the following parameter Bytes DBB04 to DBB16 and the corresponding parameter values:

Data Byte in DB13	Value in hex	Meaning / Note
DBB4	40	Write the command number for the parameter string
DBB5	01	Slave address
DBB6	0A	Number of parameter bytes, $0A_{hex}$ corresponds to 10_{dec}
DBB7	00	Byte 0: Index
DBB8	02	Byte 1: Index PKW data
DBB9	20	Byte 2: parameter label PKE, order label 2 for change parameter value
DBB10	72	Byte 3: parameter label PKE, parameter number PNU
DBB11	00	Byte 4: Sub-index IND
DBB12	00	Byte 5: Sub-index IND, taking into account parameter set 1 = IND 0
DBB13	00	Byte 6: parameter value PWE1
DBB14	00	Byte 7: parameter value PWE1
DBB15	00	Byte 8: parameter value PWE2
DBB16	64	Byte 9: parameter value PWE2, 1sec corresponds to 64_{hex}

With this, the brake release time in P114 for parameter set 1 is changed to 1.00s.

Example for the reading of a parameter (PKW data via USS protocol / Parameter string):

In order to check whether the order has been correctly carried out and the new value of 1sec has been entered in parameter P114 for parameter set 1 in the inverter, the corresponding response label must be read out using the command Read Parameter String

Data Byte in DB13	Value in hex	Meaning / Note
DBB4	41	Read the command number for the parameter string
DBB5	01	Slave address

The following data is output to the reception buffer:

Data Byte in DB13	Value in hex	Meaning / Note
DBB228	0A	Number of parameter bytes, $0A_{hex}$ corresponds to 10_{dec}
DBB229	00	Index:
DBB230	02	Index: PKW data
DBB231	10	Parameter label PKE: transfer response label 1 for parameter value
DBB232	72	Parameter label PKE: parameter number PNU
DBB233	00	Sub-index IND:
DBB234	00	Sub-index IND: taking into account parameter set 1 = IND 0
DBB235	00	Parameter value PWE1:
DBB236	00	Parameter value PWE1:
DBB237	00	parameter value PWE2:
DBB238	64	parameter value PWE2: 1sec corresponds to 64_{hex}

The corresponding response label is in DBB231 of the reception buffer. According to the order / response code table (see Section 5.5.1), the response code is read by means of Bit 12 to 15 of the parameter coding (PKE). In the above example the response code is 1 and therefore the plausibility check is positive. If the response code is "Order cannot be executed" (AK = 7), an error number (see error table Section 5.5.1) is transferred to the parameter value PWE2 instead of the value.

6.3 Read peripheral error list

In order to determine whether or which AS interface slave is reporting an error, the peripheral errors indicated can be read out from the list of connected AS interface slaves by means of command number $3E_{hex}$.

Only the command number $3E_{hex}$ needs to be entered into DB13.DBB4 of the command interface transmission buffer. After the command or the order from the AS interface has been completed without error (DONE = 1), the response date is displayed in the reception buffer.

Bytes DB13.DBB228 to Byte DBB232 in the reception buffer display the peripheral error bits of all 31 standard slaves. The peripheral error of a slave is indicated by the appropriately set Bit (status High). For the allocation of the individual peripheral error Bits and further information please refer to the Siemens AS interface master manual.

6.4 AS interface as I/O expansion of the frequency inverter control terminals

By means of the AS interface module the number of digital inputs and outputs on the frequency inverters or made available by the use of a customer interface can be expanded by 4 further inputs and two outputs.

Via the 4 sensor inputs (Sensor Dig In / Bus IO In Bits 4 to 7) all functionalities specific to the frequency inverter can be assigned or parameterised via the parameter arrays in parameter P480. The possible settings are described in Section 4.1.

The following example serves purely for the expansion of the input and output range of the frequency inverter without field bus connection. The connection of the yellow AS interface cable (PWR) is not necessary for this application, however, a 24V power supply (AUX) to the module is essential. In addition to the possibility of connection via the digital inputs on the control connections, via the 4 AS interface module sensor inputs, additional functionalities for a Posicon application and the use of an SK 530E are illustrated. For this, the following FI parameters must be set as follows:

Function requirement for SK 530E with SK TU3-AS1 option:

- Manual, semi-automatic and automatic operation, i.e. parameter switch-over
- PS 1 manual operation. PS2 semi-automatic, PS3 automatic ("PS" = Parameter set)
- 15 absolute positions
- Direction of rotation right and left
- PTC connection
- Reference point run
- Reference point
- External brake
- Error indication
- Current limit
- Torque current limit
- Reference point
- Position reached

Parameterisation of functions:

Only the parameters relevant for the function of the I/Os are listed here. For further information, please refer to the manuals BU0500 and BU0510.

Parameter / Array	Input and Output	Setting / Function
P420 digital input 1	DIN1 / digital input 1	01 = Enable right
P421 digital input 2	DIN2 / digital input 2	02 = Enable left
P422 digital input 3	DIN3 / digital input 3	08 = parameter set switch-over Bit 0
P423 digital input 4	DIN4 / digital input 4	17 = parameter set switch-over Bit 1
P424 digital input 5	DIN5 / digital input 5	13 = PTC input
P425 digital input 6	DIN6 / digital input 6	22 = Error acknowledgement
P470 digital input 7	DIN7 / digital input 7	23 = Reference point
P480 [05] Bus IO In Bit 4	Sensor input Dig In 1	55 = Bit 0 position (increment) array
P480 [06] Bus IO In Bit 5	Sensor input Dig In 2	56 = Bit 1 position (increment) array
P480 [07] Bus IO In Bit 6	Sensor input Dig In 3	57 = Bit 2 position (increment) array
P480 [08] Bus IO In Bit 7	Sensor input Dig In 4	58 = Bit 3 position (increment) array
P434 function output 1	Relay contact K1	1 = External brake
P441 function output 2	Relay contact K2	7 = Error
P450 function output 3	DOUT 1	3 = Current limit
P455 function output 4	DOUT 2	4 = Torque current limit
P481 [05] Bus IO Out Bit 5	Actuator output Dig Out 1	20 = Reference point
P481 [06] Bus IO Out Bit 6	Actuator output Dig Out 2	21 = Position reached
P509 interface		0 = Control terminals or keyboard
P543 Bus actual value 1[8]		12 = Bus IO Out Bits 0…7
P546 Bus setpoint 1[9]		17 = Bus IO Bits 0…7

The signal statuses of the I/O are only virtually displayed via the digital I/O LEDs with the SK TU1-AS1 and SK TU3-AS1 AS interface modules. No I/O LEDs are available for the SK TU2-ASx modules.

In order to check the signal statuses of the IOs, the status can be checked via the information parameters P7xx. The relevant array must be selected in the corresponding information parameter. The sensor inputs or Bus IO In Bits are displayed in parameter P740 / process data Bus In.

The sensor inputs or Bus IO Out Bits are displayed in parameter P741 / process data Bus Out.

[8] One of the three actual Bus values in parameters P543 to P545 must be parameterised on Bus IO Out Bits 0…7.

[9] One of the three Bus setpoint values in parameters P546 to P548 must be parameterised on Bus IO Out Bits 0…7.

7 Faults

7.1 Troubleshooting

The majority of frequency inverter functions and operating data are continuously monitored and simultaneously compared with limiting values. If a deviation is detected, the inverter reacts with a warning or an error message.

Basic information on this topic is contained in the manual for the basic equipment.

Errors cause the frequency inverters to switch off, in order to prevent a device fault.

The following options are available to reset a fault (acknowledge):

1. switching the mains off and on again,
2. By an appropriately programmed digital input (P420 ... P425 = Function 12),
3. By switching of the “enable” on the frequency inverter (if no digital input is programmed for acknowledgement),
4. by bus acknowledgement or
5. by P506, the automatic error acknowledgement.

Device LEDs:	As delivered, with SK 300E series devices (except ATEX versions) and SK 500E (without technology unit), 2 LEDs (green/red) are externally visible. These signal the actual device status. The **green LED** indicates that the mains voltage is present and operational, while a flashing code that increases in speed shows the degree of overload at the frequency inverter output. The**red LED** signals actual error by flashing with a frequency which corresponds to the number code of the fault.

The following table shows all the faults which are attributable to bus operation. In the operating display of the optional "ControlBox" only error E010 is displayed. A finer categorisation of errors can be obtained from the information parameters P700 "Actual Faults" or P701 "Last Fault 1...5".

7.1.1 Error display

ControlBox / SimpleBox: The 4-digit, 7 segment display of these boxes indicates a fault with its number and the prefix "E". If the cause of the error is no longer present, the error display flashes and the error can be acknowledged with the OK key.

ParameterBox: The error messages are shown in plain text.

7.1.2 Error memory

The current error is saved in parameter P700 and the last five error messages are saved in parameter P701 [-01]…[-05]. Further information on inverter status at the time the error occurred are stored in parameters P702 to P706 / P799. More detailed information can be found in the main manual for the frequency inverter.

7.2 Error messages

Table of possible bus-specific error messages

Display in the ControlBox		Fault	Cause
Group	Details in P700 / P701	Text in the ParameterBox	• Remedy
E010	**10.0**	**Telegram downtime**	Data transfer is faulty. Check P513. • Check external Bus connection. • Check bus protocol program process. • Check Bus Master.
	10.2	**External bus module telegram timeout**	Telegram transfer is faulty. • Check external connection. • Check bus protocol program process. • Check Bus Master.
	10.4	**External bus module initialisation failure**	• Check P746. • Bus module not correctly plugged in. • Check Bus module current supply.
	10.1	**External Bus module system failure**	Further details can be found in Section 4.2.
	10.3		
	10.5		
	10.6		
	10.7		
	10.8	**External module communication failure**	Connection fault / error in the external component

7.3 Causes of errors

The following table lists possible causes of errors / error statuses and the procedure for rectifying them:

Error / Status	Possible cause	Course of action
Parameters specific to the AS interface are not displayed on the display of the FI or in NORDCON	The necessary software version of the FI is not installed. SK 700E ≥ Version 3.1 Rev.1 SK 750E ≥ Version 3.1 Rev.1 SK 300E ≥ Version 1.6 Rev.3 SK 5xxE ≥ Version 1.3 Rev.1	➢ Check which software version is installed using parameter P707 ➢ An update of the FI software version may be necessary ➢ For older devices or software versions the FI must be replaced
Communication to AS interface module interrupted	Timeout error Bus cable faulty Slave address incorrect No power supply	➢ Check LED status display (See Section 4.3) ➢ Check slave address ➢ Check bus connection and cable ➢ Check parameter P509, interface ➢ Check parameter P746, module status
PWR/FLT LED and/or DEVICE S/E LED are off	No 24V supply As interface power unit faulty or off Cable connection interrupted	➢ Check LED status display (See Section 4.3) ➢ Check AS interface power unit ➢ Check cable connection
Signal statuses of sensors and actuators are not recognised	Cable connection interrupted Incorrect connection Faulty sensor/actuator	➢ Check sensor or actuator connection ➢ Check whether signal status is indicated in IO LED display (only SK TU1-AS1 and SK TU3-AS1) (see Section 2.1.2 or 2.2.2) ➢ Check parameter P740 process data Bus In Bus ➢ Check parameter setting (Bus Out Bits 0…7) of the actual Bus values (P543 to 545) ➢ Check parameter setting (Bus In Bits 0…7) of the Bus setpoint values (P546 to 548) ➢ Check 24V (AUX) power supply
AS interface slave not recognised by AS interface master	Slave address incorrect or address 0 (default setting) Double addressing of slaves Bus cable / connection interrupted	➢ Check slave address, address ≥1 and ≤ 31 ➢ Slave addressing ➢ Re-address ➢ Check bus connection and cable
PWR/FLT LED alternate red/green	Peripheral error	➢ Check power supply to FI ➢ Check 24V (AUX) power supply

8 Technical data

AS interface options are only supported as of a particular software version

Software version requirements:

SK 700E from Version 3.1 Rev.1
SK 750E from Version 3.1 Rev.1
SK 300E from Version 1.6 Rev.3
SK 5xxE from Version 1.3 Rev. 0

Electrical data	
Supply of AS interface connection PWR connection (yellow cable)	18.5V – 31.6V, max. 35mA
Supply of communications electronics and sensors/actuators AUX connection (black cable)	18V -30V DC, electronics (max. 200mA) + sensors + actuators, max. total 1A AUX voltage according to PELV (IEC 60364-4-41)
Potential isolation	AS interface connection / IOs / inverter electrically isolated
Bus connection	M12 (SK 300E, SK 750E) / 5-pin connector (SK 5xxE, SK 700E)
Digital inputs (sensors)	Signal level "0" < 5V Signal level "1" ≥11...30V, max. ≈ 14mA
Sensor supply	max. 500 mA
Digital outputs (actuators)	max. 0.5A, Signal "0" → Output open, residual current 10µA Signal "1" → 24V AUX auxiliary voltage switched, internal voltage drop of 1V (Ri = 200mΩ)
Ambient temperature	According to the particular frequency inverter
Protection class	According to the particular frequency inverter

AS interface data	SK TUx-AS1 (Standard Slave)
Slave profile	S-7.4.0 "Extended Slave Profile for Combined Transaction type 1 with 4 Bit mode (4I / 4O)"
Required master profile	M4 (in some cases M3 also possible)
I/O-Code	7
ID Code	4
External ID Code 1	F
External ID Code 2	0
Address	1 – 31 (Condition as delivered: 0)
Toggle bit timeout	1s
String transfer length	max. 9 words (2 Byte for Index, and max. 16 Byte for data length)
Cycle time	≤ 5ms

AS interface data	SK TUx-AS3 (A/B Slave)
Slave profile	S-7.A.7 "Slave Profile for Combined Transaction type 3 with 4I / 4O in extended addressing mode"
Required master profile	M4
I/O-Code	7
ID Code	A
External ID Code 1	7
External ID Code 2	7
Address	1A – 31A and 1B - 31B (Condition as delivered: 0A)
Timeout	For parameter Bit P0 = 1 = 327ms For parameter P513 = 0 = 100ms For parameter P513 > 0 = P513
String transfer length	No string transfer
Cycle time	≤ 10ms (Data from slave) ≤ 21ms (Data from slave)

9 Additional information

9.1 Maintenance and servicing information

In normal use, NORDAC frequency inverters and their accessories are maintenance-free.

If air intake filters have been built into the control cabinet, then these should also be regularly cleaned or replaced.

If you contact our technical support, please have the precise device type (rating plate/display), accessories and/or options, the software version used (P707) and the series number (rating plate) at hand.

Repairs

The device must be sent to the following address if it needs repairing:

NORD Electronic DRIVESYSTEMS GmbH
Tjüchkampstr. 37
26605 Aurich, Germany

For queries about repairs, please contact:

Getriebebau NORD GmbH & Co. KG
Tel.: 04532 / 401-515
Fax: 04532 / 401-555

If a frequency inverter or accessories are sent in for repair, no liability can be accepted for any added components, e.g. such as line cables, potentiometer, external displays, etc.!

Please remove all non-original parts from the frequency inverter.

NOTE

If possible, the reason for returning the component/device should be stated. If necessary, at least one contact for queries should be stated.

This is important in order to keep repair times as short and efficient as possible.

On request you can obtain a suitable goods return voucher from Getriebebau NORD GmbH.

Internet information

You can find the comprehensive manuals in German and in English on our Internet site.

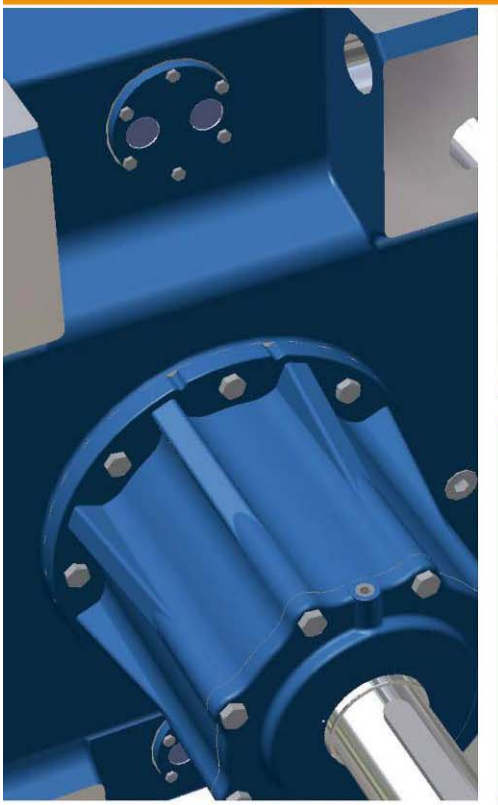
www.nord.com

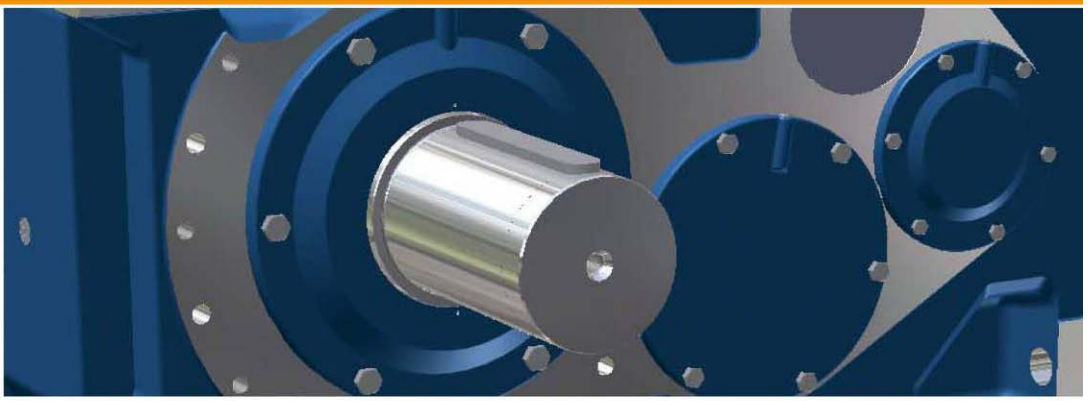
9.2 Abbreviations in this manual

AS-i .....Actuator Sensor Interface
ASIC .....Application Specific Integrated Circuit
AUX.....Auxiliary (auxiliary power supply)
IND.....Index
IP .....International Protection
IW.....Actual value
LAS.....List of Active Slaves
LES.....List of detected slaves
LPS.....List of designed slaves
n.c......not connected / free
PELV.....Protective Extra Low Voltage
PKE.....Parameter label
PKW.....Parameter range
PNU .....Parameter number
PWE.....Parameter value
PWR.....Power
PZD.....Process data
ZSW.....Status word

10 Keyword index

Intelligent Drivesystems, Worldwide Services





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