AK-15

Operating Manual
Axis Cassette Art.-No. 454-00044

Please keep for further use!

Imprint

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Italics and **bold** type are used for the title of a document or to emphasize text passages.

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Revision History

i *Note*

The cover of this document shows the current revision status and the date of the last changes. Since each individual page has its own revision status and date in the footer, this means that there may be several different revision statuses in the same document.

Document created on: 21.06.1999

Modification	Date

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Foreword

The concept of axis plug-in units

Axis plug-in units are multi-purpose devices for use with industrial processes. They are compatible with various encoder systems. The software can be individually adapted to client-specific problems. To do this, you use a standardized set of parameters. To make keyboard and PC operation easier, all parameters that are irrelevant to the problem are masked-out.

Two PC programs are available for operation of the plug-in units. The PC-AK program is aimed at users who want preconfigured, unchangeable system settings for the job in hand. This program emphasises easy handling of the plug-in unit. In this connection, you only need to program a few encoder settings and cams. This keeps the application clear and easy. It is, however, no longer possible to take advantage of other solutions that the plug-in unit offers but are not supported by the PC program.

The second possible solution is available to users of the PCPK program: you can use it to deal with even the most complex applications. Specific accessing of all the parameters that are relevant to the client is possible. The modification options are controlled using three hierarchical coding levels. Users can decide for themselves which code is to be used to reach a specific parameter, i.e. you can enable the parameters that must be frequently adapted at your own machine.

Both programs are for archiving all the system settings and help you when printing the accessible parameters.

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1 Safety

1.1 General Danger Potential

The axis cassette is supplied with a *R*eady-*F*or-*O*peration Relay (potential-free **RFO**-Relay).
Operating errors which prevent the cassette from controlling correct functioning are reported with opening the *R*eady-*F*or-*O*peration Relay. Acknowledgement of the error is needed to reset. This means that it is crucial to **integrate this error output into your own safety concept**.

(See also the chapter "Safety Facilities" page 12)

All personnel that is involved in assembly, commissioning and operation of the device must

- be appropriately qualified
- follow these operating instructions.

Your safety and the safety of your property are at stake!

1.2 Safety Information

This operating manual contains instructions which you must closely follow to guarantee your own personal safety and to avoid material damage. The instructions are highlighted by a warning triangle and are represented as follows depending on the degree of exposure to danger:

⚠️ *Warning*
means that death, serious bodily injuries or considerable material damage may arise if the appropriate precautions are not taken.

⚠️ *Caution*
means that slight bodily injuries or material damage may arise if the appropriate precautions are not taken.

i *Note*
This shows important information or features and operating tips on the product used.

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1.2.1 Information about Installation

In most applications, the axis cassette is a component part of larger systems; this means that this information is a guideline for risk-free integration of the axis cassette in its environment.

⚠️ *Warning*

- Observe the safety and accident prevention regulations applicable to individual cases.

- In the case of systems with fixed connections (permanent systems) with no all-pole mains switch and/or fuses, you must install a mains disconnector or a fuse in the system installation; this facility must be connected to a protective earth.

- With devices running on mains power, check before commissioning whether the set rated voltage range matches the local mains voltage.

- With 24-V supply, ensure that there is safe electrical isolation of the extra-low voltage. Use only mains units manufactured in accordance with IEC 364 - 4 - 41 or HD 384.04.41 (VDE 0100 Part 410).

- Mains voltage fluctuations or variations from the rated value may not exceed the tolerances stated in the technical data; otherwise, functional failures and dangerous conditions cannot be ruled out.

- Take measures to ensure that after power dips or failures it is possible to continue operation correctly with an interrupted program. In this connection, danger conditions may not arise even for brief periods of time. If necessary, an **EMERGENCY STOP** must be forced.

- EMERGENCY STOP facilities in accordance with EN 60204/IEC 204 (VDE 0113) must continue to be effective in all the operating modes of the automation equipment. Unlocking the EMERGENCY STOP facilities must not lead to an uncontrolled or undefined restart.

- Install the connection and signal lines such that inductive and capacitive interference does not affect the automation functions.

- Install automation technology equipment and their operating elements such that they are adequately protected from being touched by accident.

- Ensure that cable or wire breaks on the signal side can not lead to undefined status conditions in the automation equipment by taking appropriate hardware and software measures with the I/O link.

1.2.1.1 Screening

The use of electronic sensor active systems in modern machines demands a consistently and correctly executed interference suppression and wiring concept.
Meeting this condition is the only guarantee for perfect functioning of a system containing electronic measuring subsystems and of the cassette.

Recommended Screened Cable Wiring

Ground cable 10 mm²
$(R_{\text{ground cable}} << R_{\text{screen}})$
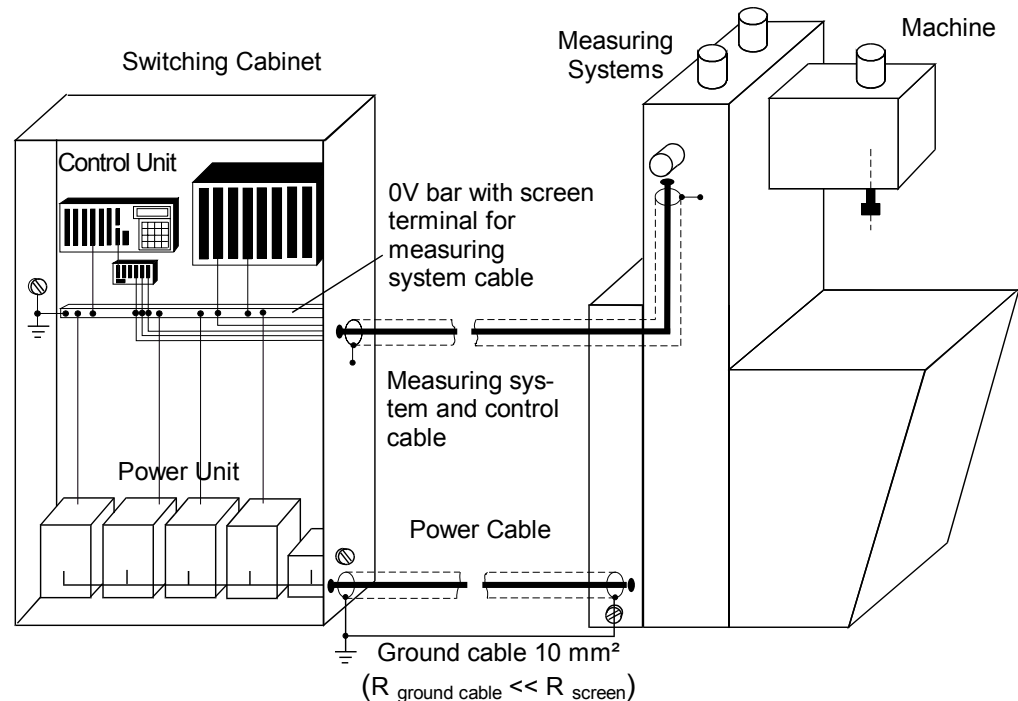
1.2.1.2 Interference Suppression Measures

- Lay the connection cable to the axis cassette a long way away from or physically separately from (screened) energy cables that carry interference.

- Use completely screened, well-earthed cables to ensure safe data transfer. In the case of differential data transfer (RS422, RS485, etc.) you must, additionally, use twisted-pair wires.

- Use cables with a minimum cross-section of 0.22 mm² for data transfer.

- Use a ground cables with a minimum cross-section of 10 mm² to avoid equipotential bonding currents across the screen. Note in this connection that the resistance of the ground cable is much lower than that of the screen.

- Wire the screen consistently laying wide areas on the special screen connection terminals.

- Avoid cables crossing. If this is unavoidable, they should cross at right angles only.

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1.3 Intended Use

The supplied axis cassette or encoder system is programmed using the **PC-AK** software.

The application files on the PC-AK installation disk determine the use of the axis cassette. When you load the files, the cassette is preconfigured for a specific application. At this stage, the encoder parameters are set to a basic setting. For this reason, you still have to program various encoder settings for your particular applications.

For every application three cassette specific files are required (see installation disk):

Applications 1-7 :   Configuration files: A15-1a.cfg to A15-7a.cfg
Parameter files: A15-1a.ak to A15-7a.ak
Files for keyboard key: A15-1a.def to A15-7a.def

The delivered axis cassette AK-15 is equipped as follows:

Encoder-Interface:	PNT
Inputs:	8 (parallel)
Outputs:	24 (parallel)
Number of axis:	1 up to max. 7
Application program:	Axis management
***R*eady-*F*or-*O*peration Relay **(RFO):**	Yes
Keyboard:	No
Memory expansion:	32 kRAM + EEPROM

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Warning
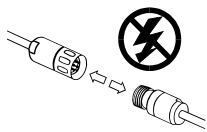
Only carry out wiring work and opening and closing electrical connections when the equipment is deenergized!
Short-circuits, voltage peaks, etc. can lead to malfunctions and uncontrolled status conditions in the system or to serious injury to human beings or damage to property.

Before switching on the system, check all the electrical connections!
Connections that have not been made correctly can lead to malfunctions; faulty connections can result in serious injury to human beings or damage to property.
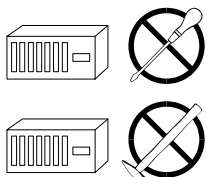
For safety reasons, it is forbidden to carry out mechanical or electrical changes to the axis cassette or the measuring systems!

i *Note*
It is crucial to comply with the commissioning, operating and programming instructions in this manual.

1.4 Danger Due to Specific Types of Use

Caution
A current flow that is too high will destroy the axis cassette!

- Maximum current Axis-Cassette: 800 mA. The encoder must be fed separately if the current is > 800 mA.
- Encoders with built-in heating must also be fed separately.

1.5 Danger Due to Accessories

Caution
Mating connectors that are not correctly plugged in can lead to a cassette malfunction!

- Screw the mating connector tight to the connector provided for it.

1.6 Permissible Operators

Commissioning and operation of this/a device may only be carried out by qualified personnel. In the sense of the safety information, qualified personnel is considered to be people who are authorized to commission, ground and mark devices, systems and circuits in accordance with safety standards.

1.7 Safety Measures at the Place of Assembly

⚠️ *Warning*

Do not carry out welding work if the axis cassette has already been wired or is switched on!
Voltage fluctuations can destroy the axis cassette or affect its function.

Do not touch connector contacts with your hands!
Static charges could destroy electronic components of the axis cassette.

Unused inputs must not be wired (refer to the plug assignments)!

Keep to the voltage supply range: 15-30 V DC (± 5 % residual ripple)

i *Note*
Ensure that the assembly environment is protected from aggressive media (acid, etc.).

1.8 Safety Facilities

*R*eady-*F*or-*O*peration Relay **RFO (potential-free output)**

The relay is activated if the axis cassette works error-free. The relay opens its contact in the following cases:

- No encoder is connected (determination at the start-up stage)
- All encoder data have to be identical with the cassette data (only for PNT encoder)
- All parallel outputs are read back and must have the output level indicated
- After 5 successively effectuated measuring system time-outs
- Encoder supplies faulty positioning values

8-pole MINI-COMBICON	14	Relay (RFO) **(normally-open contact)**
Male Connector	12	Relay (RFO) **(normally-closed contact)**
(Supply)	11	Relay (RFO) **(changeover contact)**

After elimination of the error by the input "Reset-Error" the relay can be closed.
During read-out of the error with the PC, the error is only deleted in the ring buffer. The RFO-Relay remains unaffected !
(see also chapter "Pin Assignments" page 16 or. chapter "Disturbances" page 25)

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2 Transportation/Commissioning

2.1 Transportation/Storage

Transportation Information

Do not drop the axis cassette or subject it to severe vibrations!
The device contains sensitive electronic components.

Use only original packaging materials!
Using incorrect packaging materials can lead to damage to the device in transit.

Storage

- Storage temperature: -20 to +50°C

- Store in a dry place.

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2.2 Cassette structure

2.2.1 Front view

LED (yellow): Special Error ("Sonderfehler")
 - axis-independent
 - see error list, type of error "S"

LED (red): Encoder Error ("Geberfehler")
 - axis-dependent
 - see error list, type of error "F"

LED (green): Supply ok ("Versorgung ok")
 - Supply Voltage connected

LED (green): RFO ("BBR")
 - Ready For Operation Relay
 - Functionality see RFO

Shielding (Setscrew)

Choose wire ∅ sufficiently largely
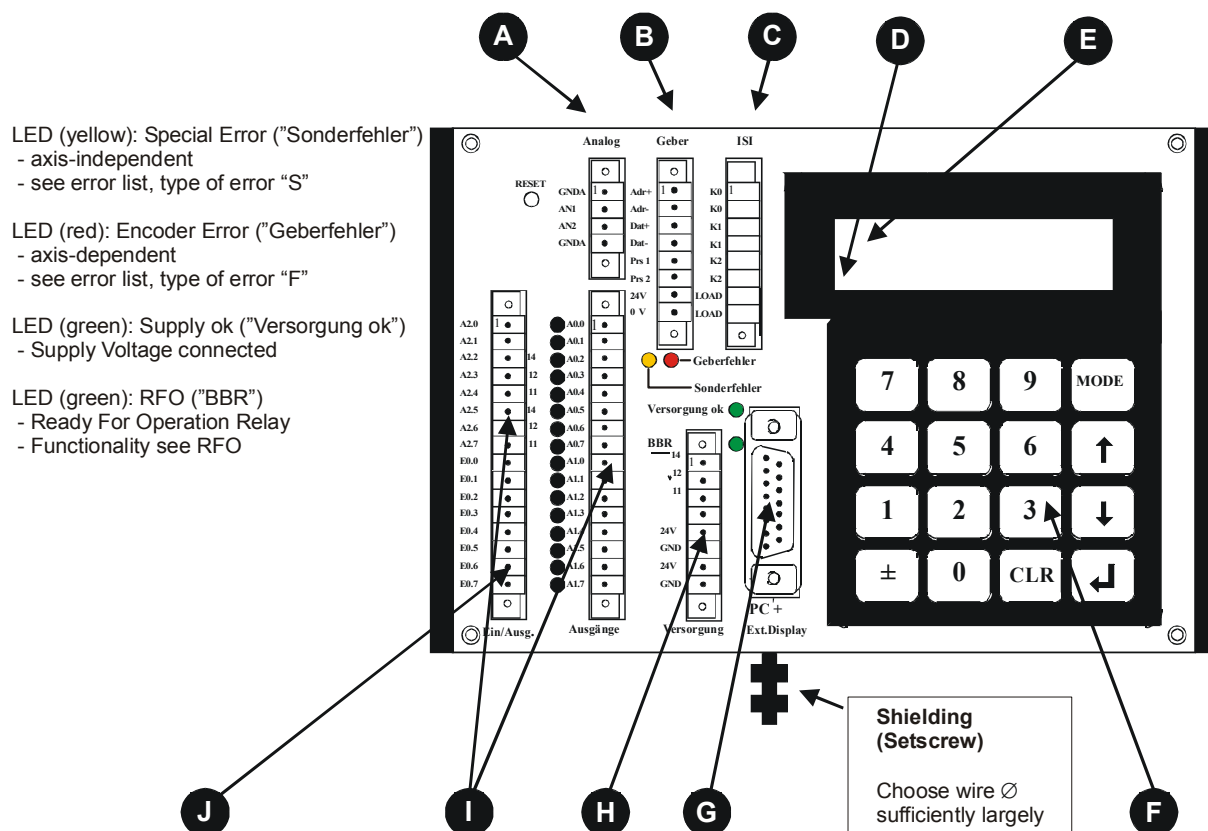
Ⓐ
1 - 2 analog outputs (option)
± 10 V, max 10 mA
GND A1 and GND A2 may be jumpered

Ⓑ
Encoder interface RS 422
External Preset-Inputs

Ⓒ
Incremental outputs (option)
100 mA, push-pull

Ⓓ
Status field (if display is available)
Axis number

Ⓔ
Error field (if display is available)
Display of main error in three categories:
Fxx: Error in the chosen axis
Sxx: Special error, axis-independent (priority)
Wxx: Warning, limits may have been exceeded, no other effect

Ⓕ
Keypad (option)
Use see chapter „Keyboard".
Option: Keypad on the backside of the cassette

Ⓖ
Connector for PC- and TA-Mini
PC:standard baudrate 9600
Interface RS232 and RS422

TA-Mini: standard baudrate 4800
Interface RS422 (2-wire)

Ⓗ
Supply
(15-30V, 10% residual ripple)
Ready-For-Operation Relay (RFO)
(24V, 1 A permanent current)

Ⓘ
Output connector
24 outputs 50mA push-pull

Ⓙ
Input connector
8 inputs/ Input impedance 5kOhm

2.2.2 Dimensions

Width:	173 mm
Depth:	115 mm
Height:	49 mm

2.2.3 Technical Data

Operating Voltage: .... 15-30 V DC (+/- 5 % residual ripple)

Power Consumption (No Load): .... approximate 3,6 watt

Programming Unit: .... PC; RS232 or RS422

Inputs: .... Input impedance 5kOhm
    Preset, Reset Error: .... Switching point: 1/3 of the supply voltage
    Bus, Latch, Select, Strobe: .... Switching point: 2/3 of the supply voltage

Outputs:
    Driver: .... Push-Pull / 50mA / short-circuit-proof
    Output level: .... Supply voltage - 0,7 V

PNT – Encoder interface
    Data and addresses separated: RS422 (4-wire)
    Baud rate: .... 307.2 kBaud, with CRC

Cycle-time: .... 0,6 - 1 ms / axis

External Display (TA-MINI): .... RS 485 (2-wire)
Standard baud rate 4800
Format: 7 Bit, Even Parity, 1 Stopbit

Ready-For-Operation Relay (RFO): .... 24 V, 1 A permanent current, opener and
make-contact usable

Applications software: .... Axis management for max. 7 axes

Memory capacity: .... 32 kRAM + EEPROM

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2.3 Pin Assignments

In-/Output	Short name.	
1	**A2.0**	Output 2^{16}
2	**A2.1**	Output 2^{17}
3	**A2.2**	Output 2^{18}
4	**A2.3**	Output 2^{19}
5	**A2.4**	Output error bit
6	**A2.5**	Output No. of axis 2^0
7	**A2.6**	Output No. of axis 2^1
8	**A2.7**	Output No. of axis 2^2
9	**E0.0**	Select 2^0
10	**E0.1**	Select 2^1
11	**E0.2**	Select 2^2
12	**E0.3**	Strobe axis number
13	**E0.4**	Reset all errors
14	**E0.5**	-
15	**E0.6**	Latch
16	**E0.7**	Bus

Outputs	Short name	
1	**A0.0**	Output 2^0
2	**A0.1**	Output 2^1
3	**A0.2**	Output 2^2
4	**A0.3**	Output 2^3
5	**A0.4**	Output 2^4
6	**A0.5**	Output 2^5
7	**A0.6**	Output 2^6
8	**A0.7**	Output 2^7
9	**A1.0**	Output 2^8
10	**A1.1**	Output 2^9
11	**A1.2**	Output 2^{10}
12	**A1.3**	Output 2^{11}
13	**A1.4**	Output 2^{12}
14	**A1.5**	Output 2^{13}
15	**A1.6**	Output 2^{14}
16	**A1.7**	Output 2^{15}

Encoder	Short name	
1	**Adr+**	Adressen+
2	**Adr-**	Adressen-
3	**Dat+**	Daten+
4	**Dat-**	Daten-
5	**Prs1**	Preset1, selected axis
6	**Prs2**	Preset2, selected axis
7	**24V**	24V DC (to encoder)
8	**0 V**	0 V DC (to encoder)

Supply	Short name		
1	**BBR (14)**	Work	Ready-
2	**BBR (12)**	Reposal	For-Operation
3	**BBR (11)**	Change	Relay
4			
5	**24V**	24V DC	Supply for
6	**0 V**	0 V DC	following AK´s
7	**24V**	24V DC	Supply
8	**0 V**	0 V DC	axis cassette

Connector of the serial interfaces (15-pin SUB-D)

Pin	Short name	Interface name	Inter-face	Meaning		PC-lacing 9-pole SUBD	PC-lacing 25-pol-SUBD	TA-MINI 15-pole SUBD-socket
1	Disp -	RS485	S2	Ext. display (TA-MINI)				1
2	Disp +		S2	Ext. display (TA-MINI)				2
3	RS232 RC	RS232	S1	Receive	<-	3	2	
4	RS232 TM		S1	Send	->	2	3	
5	Send PC -	RS422	S1	Send, channel B				
6	Send PC +		S1	Send, channel A				
7	Receive PC +		S1	Receive channel A				
8	Receive PC -		S1	Receive channel B				
9-13	-							
14	US			24V DC for TA-MINI	->			14
15	GND			ground	->	5	7	15
						Bridge! 1 DCD + 4 DTR + 6 DSR	Bridge! 8 DCD + 20 DTR + 6 DSR	5, 7, 9 and 11 are jumpered against 24 V in accordance
						Bridge! 7 RTS + 8 CTS	Bridge! 4 RTS + 5 CTS	with the axis number

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i   *General Information on Pin Assignments*

Data Acceptance

The requested axis number must be connected on the select inputs E0.0-E0.2. The filter time for the inputs is set as a default to 10 msec. That means that the input signal must be connected up stable a minimum of 10 msec long so that the axis number is recognized. As soon as the axis number is recognized as stable, the read axis number with the relevant error bit is set on the output (A2.4-A2.7). The transfer of the axis number on the select inputs E0.0-E0.2 occurs with a strobe pulse (input E0.3). The reaction time conducts <12 msec in total (default setting). After this reaction time the positon value of 20 bits is available on the outputs. On request, by modification of the CFG file, the reaction time can be set to 5 msec.

Preset Input 1 / 2

With connection of this input on the cassette, the parallel-outputs of the chosen axis (select inputs E0.0-E0.2) are set to the programmed value.
The preset value can be entered into the PCAK-Program in the menu *ENCODER DATA* and activation of the button *EDIT* .

Reset all Errors

If this input is connected, the Ready-For-Operation relay after 10 msec is switched to readiness. Exists an error which is tested periodically by the cassette , the Ready-For-Operation relay opens his contact again in the next cycle. All errors which were stored in the ring buffer of the cassette are deleted. Therefore an error read-out via PC is not possible more.

Strobe Input

With the positive edge on the strobe input, the connected axis number at the select-inputs E0.0-E0.2 is taken over. With the axis number "0" all outputs are set to low. The transfer of an invalid axis number generates an error report. The last valid axis number is retained.

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Select Inputs

Selection of the axis number 1 to 7. The axis number on the inputs E0.0-E0.2. must be connected as a binary code.

Latch Input

If this input is connected with at least 2/3 of the supply voltage, the data outputs of the chosen axis (A0.0 - A2.7) are latched. This allows a faultless transfer of the data since an information change while reading in is prevented.

Bus Input

If this input is connected with at least 2/3 of the supply voltage, the data outputs of the chosen axis (A0.0 - A2.7) are in tristate.

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2.4 Assembly instructions

The axis cassettes are designed to be mounted on rails in the switch cabinet. No extra assembly accessories are required for mounting the cassette on the rail.

Cassette

Mounting Rail NS 35 / 7.5

Spring for fastening
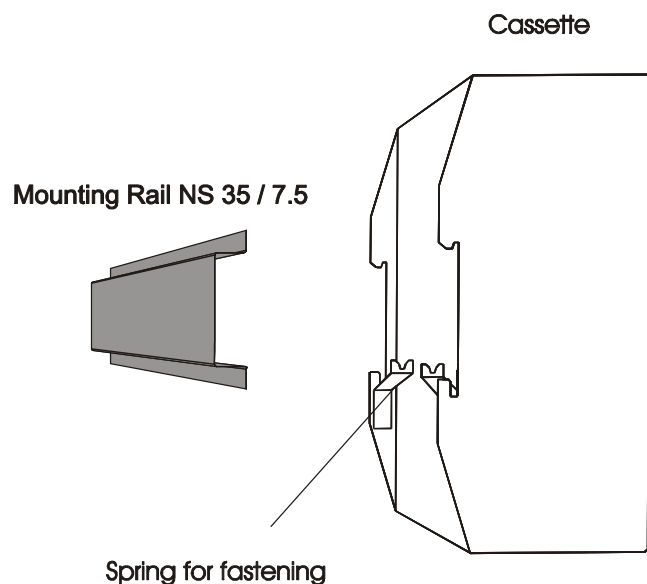
The cassette housing is placed on the mounting rail from below and pushed upwards with the tension springs (Fig. 1). Simply push the cassette housing against the mounting rail until it snaps into place (Fig. 2).
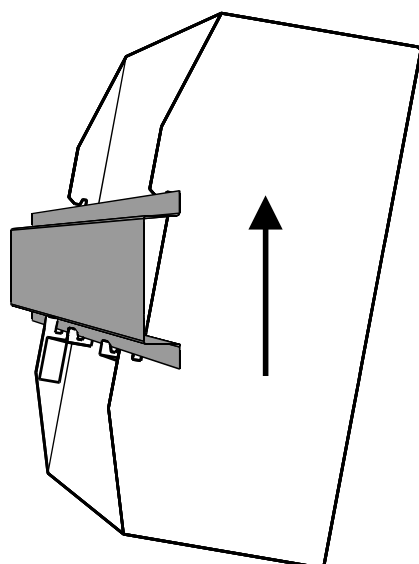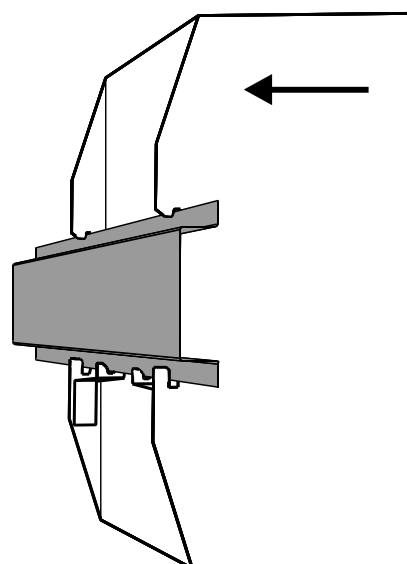

Fig. 1

Fig. 2

2.5 Commissioning (Encoder)

2.5.1 Encoder Interface

⚠️ *Caution*

Revocation of operationality!
The input "Preset" on the encoder **must not be used** in connection with axis cassettes.

The PNT interface is busable for up to 31 encoders and uses data and address lines corresponding to EIA standard RS422. Data is transferred asynchronously with parity checking. Depending on cable lengths, you can select transfer rates ranging from 9.6 kbps to 307.2 kbps. In combination with cassettes, it will always used a baudrate of 307.2 kbps. It is possible to define node numbers on the bus in software with a PC or in hardware with appropriate jumpers (binary coded) in the encoder`s mating connector.
Connecting the encoder via the RS422 interface is virtually standard practice today, due to the high level of transfer security provided if EMC problems arise. A physical plausibility check is also carried out in the cassette. These checks provide a high degree of security at further processing of the actual data.
In principle, PNT encoders can be programmed in the axis number, the number of steps, the direction of rotation and a few options. The data is stored power failure-protected in the encoder.

Bus features

Bus structure:	4-wire acc. to EIA RS-422, differential signal transmission, separated data and addresses.
* Line type:	Line twisted in pairs and well screened with 100 Ω up to 130 Ω wave impedance. Min. cross section 0.22 mm² with a capacity of approx. 60 pF/m.
Screen:	Connect shielding **on large surface**
* Length of cable for:	
307.2 kbps ($\varnothing$ 0.22mm²)	400 m per encoder connection
307.2 kbps ($\varnothing$ 0.50mm²)	600 m per encoder connection
* Length of stub cables:	max. 10 m per encoder-connection on the baud rate 307.2 kbit/s
	Comment:
	Please note that the sum of stub line lengths is added to the total line length per encoder-connection.

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Transmission format:	1 start bit, 8 data bit, 1 parity bit, 1 stop bit
Transmission rate:	307200 bps
Transmission mode:	two-way alternate, asynchronous
Addresses:	0 to 31, 0 = global address
Security:	1 CRC Byte, Parity
Max. wire cross-sections on screw terminals VT6:	2.5 mm^2
Bus load resistance of each encoder:	1.6 kOhm

* Specification and lengths stated according to DIN 19245-1 PROFIBUS
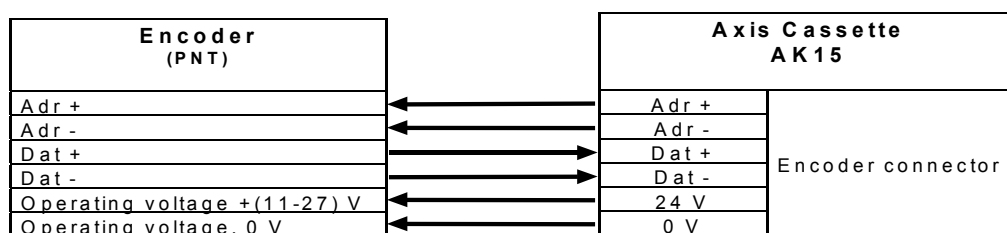
Bus terminating resistor

If all encoders are installed, the whole resistance of the address-busline should be have 100–200Ω. Internal in the AK the data-lines are also (encoder-answer) terminated. For this reason the line-driver will be loaded with the nominal current and so the external liability to interferences will be reduce.

A adaptation of resistance must be do in the encoder`s mating connector between the address-lines.

It is recommended for use the star hub in the case of critical line lengths (> 500- 800 m in total) and / or with severe EMC problems.

2.5.2 Wiring

You must make the power connections below for each PNT encoder:

Encoder (PNT)		Axis Cassette AK15	
Adr +	←	Adr +	
Adr -	←	Adr -	
Dat +	→	Dat +	Encoder connector
Dat -	→	Dat -	
Operating voltage +(11-27) V	←	24 V	
Operating voltage. 0 V	←	0 V	

i Notice the reference in chapter "Danger Due to Specific Types of Use " on page 11!

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3 Programming

3.1 Preparations for programming / operation

Encoder (PNT)		Axis cassette	
Adr. +		Adr +	
Adr -		Adr -	Encoder connector
Dat +		Dat +	
Dat -		Dat -	
Supply +(11-27) V		24 V	
Supply. 0 V		0 V	

PC-connection 9-pin-SUB-D (female)			RS232 RC / RS232 TM	
DCD	1			
RxD	2	3	RS232 RC	15 pin SUB-D
TxD	3	4	RS232 TM	15 pin SUB-D
DTR	4			
GND	5	15	0 V	15 pin SUB-D
DSR	6			
RTS	7			
CTS	8			
RI	9			
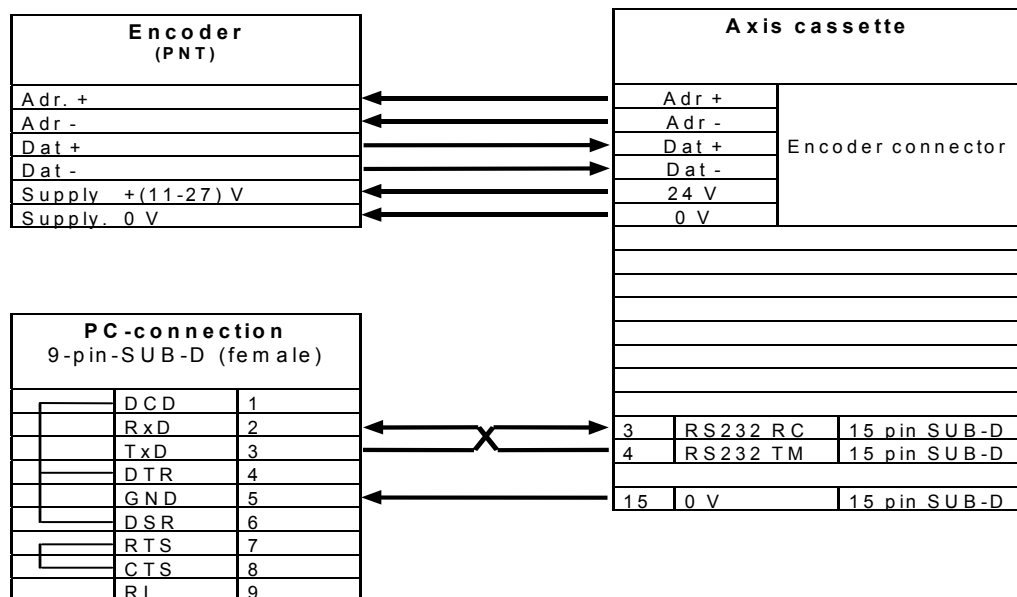
3.2 Encoder Parameter

3.2.1 Software Addressing

Each Encoder which is connected to the cassette must at first be addressed. Via this number, the Encoder will be addressed on the data bus. In order to preserve the clarity, the axis number and the encoder number should be identical (not in the case of monitoring function).

In the main menu of PC-AK, choose *COMMUNICATION* and then the option *PROGRAM ENCODER ADDRESS ON PNT*. The system opens the ***Initialize bus*** window:

- switch off
- disconnect all encoders from bus
- connect encoder to program
- switch on AK
- select encoder address from list
- to program press button < **P** >
- switch off AK
- disconnect successfully programed encoder
- repeat step 3 to 8 for every further encoder

If ready, connect all encoders and switch on AK, read error

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3.2.2 Programming Encoder Data

In the main menu of PC-AK, choose *Encoder data.* The system opens the ***Encoder data*** window. You can program the following parameters:

3.2.2.1 Encoder Type

Using this parameter, you must specify the encoder system that is to be run on the axis cassette. You can choose between rotary encoders and linear scales; in the case of an axis cassette with several axes, you can in addition choose *no own encoder.*

If you choose a rotary type encoder, you must enter the values of the encoder resolution in the program. In the input lines, keep paging using the arrow keys until you find the values stated on the encoder's rating plate.
If you choose linear scale type, you must enter on the input line the rod length stated on the rating plate.
If you choose *no own encoder,* you must, in the case of an axis cassette with several axes, enter on the input line the axis number that this particular axis is to monitor.

i *Note*

If you do not correctly enter the encoder's original data, transfer of the data to the axis cassette is not possible or operation is not permissible.

3.2.2.2 Edit

Here you edit the parameters necessary for scaling the actual value.

Rotary Encoder:

The following formula applies to the scaling parameters:

$$\text{Number of steps/rev} = \frac{\text{Steps per measuring length}}{\dfrac{\text{Revs per measuring length numerator}}{\text{Revs per measuring length denominator}}}$$

i *Note*

In the case of linear paths, the revs per measuring length numerator should always be 1, and the revs per measuring length denominator should always be a power of two.

Linear Scale:

The following formula applies to the scaling parameters:

$$\text{Number of steps/mm} = \frac{\text{Steps per measuring length}}{\text{Length of rod in mm}}$$

Depending on the individual application, you should change these formulae appropriately to calculate unknown parameters.

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Explanation of Terms

Measuring Length

In the case of rotary encoders, the measuring length indicates the total number of resolved steps. Since counting starts at zero, the final value of the number of encoder steps is one step less than the measuring length. After this, the system starts counting from zero again. With linear scales, the actual value indicator shows End of Measurement when the lowest point is reached. This is not the case until after the value of the measuring length.

Number of Revs per Measuring Length

The number of revs per measuring length indicates the number of revolutions the encoder is to go through until the number of steps per measuring length is reached. Since this can be either an integer (with a denominator of 1), or an odd-numbered transmission ratio can arise, you must enter the ratio as a fraction.

3.2.2.3 Adjust

This opens a dialog window in which the system displays the actual value of the currently selected axis. If you enter a value and then click on the *Adjust* pushbutton the encoder value is set to the one you entered.

3.3 Adjust external display (TA-Mini)

In the main menu of PC-AK, choose *EXTERNAL DISPLAY*. The system opens the **ADJUST EXTERNAL DISPLAY** window. Choose the axis on which adjustments must be carried out. Then click on the *EDIT* pushbutton. You can program the following parameters:

Decimal places
Entering of the number of the places which are displayed after the decimal point (max. 4 places possible). Confirmation of entering with the <RETURN> key.

Indication factor
With the indication factor „1:X" the places before or after the decimal point can be set. Confirmation of entering with the <RETURN> key.

Zero offset
Setting of the neutral point for the external display. It can be entered only positive values. The max. end value of the external display results from the encoder end value minus the zero offset. If it is driven under the neutral point, the display value is negative (e.g. -1, -2 and so on). The entered zero offset corresponds to the most negative value which the display represents. That the displayed value of the external display corresponds to the PNT master value, a correction must be carried out in the PNT master. For this purpose, the calculated value must be subtracted from the display value of the master by "shift for PNT master".

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3.4 Send programmed parameters to the axis cassette

In the PC-AK main menu, pull down the *Communication* menu and select item *SEND DATA TO AK.*

4 Disturbances

4.1 Fault Analyses

Fault analysis plays a significant role in the global concept. The comprehensive error messages are to be enable you to specify the causes of faults as precisely as possible as well as to determine the necessary remedies.

The PC-AK program completely supports the fault analysis system. You read out faults by pulling down the *TRANSFER* menu and choosing the first menu item, *READ DEVICE FAULTS.*

i   *Note*
The RFO-Relay remains unaffected !

4.2 Structure of the Error Message

Main errors are structured in accordance with the different sources. Single errors indicate the exact source of the fault. The example below shows how you should read errors:

> *Error format: 03 / 43*

where F03 is the main error and 43 is the associated single error. This means that you can look in the decimal column of the main error list to find the message:

> *Transmission of encoder disturbed, more measuring errors occurred in succession than programmed*

With single errors, the main error is of type 0x/... This means that the encoder error list applies. In the list you will find for number 43 in the decimal column the following text:

> *Filter constant reached: Check sum error in the correctly received character string*

This makes it clear that the encoder has reported correctly but more errors occurred in succession in the transfer path than were specified by the Maximum Number of Encoder Errors in Succession filter. In the list of single errors, a remedy number 3 is also shown. You can look up this additional information in the chapter entitled Remedies which contains a description of possible causes, information about observation options and recommended remedies.

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4.3 Representation of errors on the cassette display

In the axis error field, the system displays additional information about the source of the error:

F   Error messages occoured on the selected axis
S   Special error, affects the cassette and is not axis-specific
W   Warnings, these do not have individual errors, but are axis-specific

In the example above, the cassette signals axis error F03 in the error display. This is main error number 03. The"F" identifier indicates an axis-specific error. It is only written to the error display when the corresponding axis is marked in the keypad dialog.

In display [4] *single error info* mode, the complete error information about the cause of the error for axis-specific errors is located. The procedure for using the lists of errors was described above. If, however, there is a special error, the additional information is in *special error info* display [4] mode.

4.4 Error acknowledgement

The saved errors (max. eight per axis) can be read out or deleted by several possibilities.

PC: Error reading
Control input: With the positive edge on input "Reset-Error"

After elimination of all errors by the input "Reset-Error" the relay is in operation again.

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4.5 Error Lists

4.5.1 Main Error List

Main error			Meaning of the error:	Remedy see single error list type
	dec.	hex.		
			Encoder error	
F	01	01	Encoder measurement disturbed (velocity, acceleration, out of measuring range, ...)	0x / ..
F	02	02	Encoder not connected	0x / ..
F	03	03	Transmission of encoder disturbed, more measuring errors occurred *in succession* than programmed	0x / ..
F	05	05	Encoder data differs from programmed data in the cassette	0x / ..
F	07	07	Preset not executed correctly	0x / ..
			Programming error	
F	41	29	Programming data out of tolerance	4x / ..
F	44	2C	Pointer to programming data out of tolerance	4x / ..
F	45	2D	Parameter does not exist in this axis	4x / ..
F	46	2E	Axis does not exist	4x / ..
F	49	31	No authorization for programming	4x / ..
			PC- and fieldbus error	
S	60	3C	Transmission error from PC (wrong CRC, parity, ...)	6x / ..
S	61	3D	Command not correct (CRC ok)	6x / ..
F	62	3E	Pointer to programming tables invalid (list no., ...)	6x / ..
F	63	3F	Programmed data value out of tolerance	6x / ..
F	64	40	SINEC L2-DP error	6x / ..
			Hardware and check error	
F	90	5A	System limit reached or system conflicts (e.g. analogue 1 already assigned)	9x / ..
F	91	5B	Memory capacity exhausted	9x / ..
S	92	5C	External RAM-memory missing	9x / ..
S	93	5D	Hardware error	9x / ..
S	94	5E	Encoder error (encoder not readable, timeout overdue, Pos. -measurement jammed, ...)	9x / ..
S	95	5F	Unexpected arithmetic calculation (e.g. division by 0)	9x / ..
S	96	60	Unexpected interrupt	9x / ..
F	97	61	Unexpected value of parameter delivered	9x / ..
F	99	63	Readiness for operation missing	9x / ..

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4.5.2 Single error lists

Error 0x / ..			Encoder error	Remedies
	dec	hex	Meaning of the single error:	
F	01	01	Timeout during transmission, sending register never empty	1
F	03	03	Timeout during transmission, sending register never empty	1
F	04	04	Buffer overflow after the 12. character received (PNT)	2
F	05	05	CRC error in the character string received	3
F	06	06	Not 11 characters in the receiving buffer for data request as expected (PNT)	2
F	07	07	Not CR as 11. character for data request as expected (PNT)	2
F	08	08	Received encoder number not identical with requested encoder (PNT)	4, 3
F	09	09	Buffer overflow during receiving, more characters received than expected (without parity error) (PNT)	5
F	10	0A	Encoder sets error bit	6
F	11	0B	Timeout in RECEIVE, at least 1 character was read (PNT)	7
F	12	0C	Encoder (LA rod) out of measuring range	8
F	13	0D	Encoder (LA rod) below zero	8
F	14	0E	Position value > resolution for rotary encoder, value rejected	
F	15	0F	Position value after calculation of the measuring length still greater than resolution, value rejected	
F	16	10	SSI encoder not connected or data lines twisted	
F	30	1E	Own encoder of this axis not connected	
F	31	1F	The encoder for which a listener is defined does not exist	
F	32	20	Scan mode 3 used, but axis 1 not connected (axis 1 has no actual values without pos. inquiry)	
F	40	28	Filter constant reached: buffer overflow, more correct characters received than expected (PNT)	
F	41	29	Filter constant reached: Parity error in the received character string	
F	42	2A	Filter constant reached: 1.char. correctly transferred does not correspond to the correct encoder or the encoder indicates an error (PNT)	
F	43	2B	Filter constant reached: Check sum error in the correctly received character string	3
F	44	2C	Filter constant reached: Velocity exceeds limit	10
F	45	2D	Filter constant reached: Acceleration too high	10
F	46	2E	Filter constant reached: Change of rotational direction exceeds the minimum speed	10
F	47	2F	Filter constant reached: Position bounces	10
F	48	30	Filter constant reached: Ttimeout lasted too long	7
F	50	32	Encoder preset not executed correctly (encoder not identical or set error bit)	4
F	51	33	Encoder preset not executed correctly (Timeout during preset delivery to PNT-3encoder)	11
F	52	34	Requirements for preset function missing(system ready=1, no encoder, listener, encoder in timeout, preset running)	11
F	54	36	Preset value exceeds the range (larger than scaling number)	
F	60	3C	Received break / Framing-error on encoder interface	
F	61	3D	Overrun-error on encoder interface	
F	62	3E	Parity-error on encoder interface	

Error 4x / ..			Programming error	Remedies
	dec	hex	Meaning of the single error:	
F	04	04	Functions for PC dialogue not active	401
F	05	05	a programming in this range of the axis via another programming unit takes place at the moment	402
F	11	0B	Data value above limit value	408
F	12	0C	Data value below limit value	408
F	13	0D	Data value out of sequence	409
F	14	0E	Preset value too great as value $\geq$ measuring length	410
F	16	10	Encoder number invalid, as listening to own axis is not possible	
F	17	11	User program type not supported by this cassette	413
F	18	12	local memory of this axis too small for this program type	414
F	19	13	Axis number not supported by this cassette	415
F	50	32	Axis does not exist	425
F	51	33	Axis does not exist, therefore programming of this axis via PC dialogue not possible	426
F	52	34	The axis from which a listener wants to fetch values, does not exist	
F	53	35	Non-existing TA-MINI is activated	
F	54	36	The axis for which the difference should be calculated, does not exist	
F	72	48	Searched axis no. not included in list of connected encoders	
F	80	50	An encoder parameter is inadmissible set to zero	
F	81	51	Invalid encoder type, rotary encoder, LA and multi-magnet LA permitted only	
F	82	52	Overflow in division	
F	83	53	Overflow in multiplication	
F	84	54	Invalid parameter for gear programming (denominator of number of turns<> 1)	
F	85	55	An LA parameter is inadmissible set to zero	
F	86	56	Division by zero, that means a calculated parameter is zero contrary to expectations	

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Error 6x / ..			PC and fieldbus error	Remedies
	dec	hex	Meaning of the single error:	
F	01	01	Interface error (parity error, overrun error, framing error) command unusable	
F	02	02	Check sum error in PC dialogue	
F	06	06	Only two characters received, that means no complete command	602
F	07	07	Part of the command invalid, that means not within the range of 0 to z (H'30 to H'74)	603
F	10	0A	Too much characters for one command of the command chain	605
F	11	0B	Input buffer overflow, command unusable	606
F	12	0C	Address out of address range of this cassette, but setting to "send driver always on "	
F	21	15	Data value above limit value	
F	22	16	Data value below limit value	
F	23	17	Data value out of sequence	611
F	24	18	Preset value too large	612
F	26	1A	Encoder number invalid, as listening to own axis not possible	
F	27	1B	Program type not supported by this cassette	614
F	28	1C	Local memory of this axis too small for this program type	615
F	29	1D	Axis number not supported by this cassette	614
F	30	1E	Cam type invalid, not enabled for this device	
F	40	28	Configuration comparison not correct	
F	41	29	Address of the cassette not between 3 and 124 or number of bytes set wrong	
F	42	2A	Profibus DP, deviation in configuration length	
F	44	2C	Service controller error	
F	48	30	Hardware error in field bus driver	
F	50	32	Command from the fieldbus invalid	
F	51	33	Axis activated by the fieldbus does not exist	
F	52	34	Fieldbus error, programming values can only be values up to 24 bit, but the called value is larger	

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Error 9x / ..			Hardware and check error	Remedies
	dec	hex	Meaning of the single error:	
F	05	05	An attempt was made to reprogram an encoder into an existing encoder no. (PRGBNR)	900, 905
F	06	06	No entry in list of existing encoders, no listeners or "axis without encoder"	900, 906
F	09	09	Send register interface A (encoder) not empty for 5ms --> Position measurement jams	900, 907
F	10	0A	Send register interface D (TA-Mini) does not become empty	900, 908
F	11	0B	Value for memory length too large; the largest possible value is taken	900, 911
F	12	0C	Current memory selection not possible; first initialization takes place	
F	13	0D	Memory capacity too small for program type set --> "Axis not used " is set	900, 913
F	14	0E	No position free in table	900, 914
S	18	12	FPGA; wrong type or defective	
S	20	14	No 32K-RAM inserted	
F	28	1C	Division by 0 during initialization (boot)	
F	29	1D	Division by 0 in position processing	
F	30	1E	Ostensible no time difference between two scannings (PNT)	
F	31	1F	Time difference smaller than physically possible --> overflow of the time base counter	
F	32	20	Division by 0 for limit value calculation	923
F	33	21	Division by 0 or overflow	923
F	34	22	No encoder connected	900, 934
F	39	27	Encoder position invalid or data difference PNT encoder <->cassette	
F	40	28	Interrupt (IRQ0) not identifiable	938
F	42	2A	NMI of watchdog in micro controller. No post-triggering	
F	44	2C	Character string from encoder out of step	
F	59	3B	Decimal point for TA-Mini out of valid range	
F	65	41	Function number for cam functions out of valid limits	900, 960
F	75	4B	Interbus module accepts only 1, 2 or 4 axes. Wrong value is overwritten with 4	962

4.6 List of Warnings

No. of Warnings			Warnings	
(W+Exx)	dec	hex	Meanings of the warnings:	
W	01	01	Change of rotational direction above minimum velocity, filter constant without importance	
W	05	05	Overflow in calculation of resolution of linear stroke, position cannot be shown in 1/10mm / s	
W	06	06	For encoder type = LA linear is absolutely necessary (denominator of number of turns must be 1)	
W	10	0A	Encoder moved while the cassette was switched off, but the positions seems to be in the pull-in range	
W	11	0B	Accumulator defective? Data copied from EEPROM --> preset must be executed!	
W	12	0C	Accumulator defective? Even data from the EEPROM unusable--> Basic initialization was executed!	
W	15	0F	Axis is listener --> Programming of encoder parameter must be identical to master axis	
W	16	10	No. of the active cam program exceeds the number of cam programs --> no program activated	

i *Note for messages on the serial interface*

To differentiation from error messages and warnings the bit 27 in the main error part is set.
The single error is always „00".

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4.7 Remedies

4.7.1 Encoder errors

No		
1	**Cause:**	-Probably a hardware or software error in the cassette
	Remedy:	-Replace the cassette
2	**Cause:**	-On programming the encoder, 11-byte long frames are exchanged. If more than 11 bytes are received, this is an error. This also applies if the encoder doesn't read the expected CR as the 11th character.
	Observation:	-At switch-on of the AK/PK, all the edited axes try to read their encoders and to compare their programming to the cassette data. If three attempts fail to do this, error messages are generated.
	Remedy:	-Switch off and on again; -Replace the encoder if the error doesn't occur with all the encoders; -Replace the cassette;
3	**Cause:**	-At transfer of encoder frames, experience has shown that disturbances occur. *The Encoder settings/time constant for F3* structure parameter specifies the number of faulty transmissions in succession after which an error must be reported. The system counts all faulty transmissions (checksums or parity) and evaluations (timeout, speed, acceleration).
	Observation:	-In *encoder error* display mode, eight criteria for the cause of the fault are shown. Deletion is carried out once you have deleted the last error in the display from the keyboard.
	Remedy:	-If the error occurs very frequently, you should check the wiring: -Cable screened? -Connection to screen node? Can you pull on the connecting cables without them coming out of the terminals? -Have you used a screened cable of adequate cross-section? -No hum loops laid (star-shaped distribution)? -Does the interferer produce too many high-frequency portions (e.g. frequency converter), in this case, it may be sensible to ground the start and end points of the screen. -Possibly try another screen node.
4	**Cause:**	-The encoder must acknowledge the control word identically. If this is not the case, the wrong encoder responded or the transfer was disturbed.
	Remedy:	-If the error occurs very frequently, change the encoder; possible disturbance to frame see remedy 3.
5		
6	**Cause:**	-The encoder detects the error itself and reports it.
	Remedy:	-Change the encoder;
7	**Cause:**	-If the encoder hasn't responded 1.6 ms after position polling, the encoder is in a timeout. If this status continues more often than the structure parameter *encoder settings/time constant for F3* allows, an error is shown in the display. After this, the system polls the encoder 3-4 times per second. Positioning procedures are rerouted to traversing without encoder and timed.
	Observation:	-In *encoder error* display mode, eight criteria for the cause of the fault are shown. Deletion is carried out once you have deleted the last error in the display from the keyboard.
	Remedy:	-Check the cabling for loose contacts if the error occurs frequently and particularly after mechanical vibrations.
8	**Cause:**	-Magnet of LA bar not in acquirable range.
	Observation:	-FFFFFF hexadecimal is displayed as the position value.
	Remedy:	-Place magnet of LA bar in acquirable range.
9	**Cause:**	-At switch-on of the cassette, the system checks all the encoder parameters for identity with the ones stored internally. If errors are acknowledged but not removed, disturbances may occur that cannot be easily classified.
	Observation:	-If the data in the cassette still seems OK, you can carry out programming again using the *encoder settings/encoder data transfer* structure parameter. With this programming item, it is, however, possible to read back the encoder into the cassette.
	Remedy:	-Check the values and adapt them
10	**Cause:**	-At transfer of encoder frames, experience has shown that disturbances occur. The *Encoder settings/time constant for F3* structure parameter specifies the number of faulty transmissions in succession after which an error must be reported. The system counts all faulty transmissions (checksums or parity) and evaluations (timeout, speed, acceleration). In some (very rare) cases, a frame can pass the CRC and doesn't show a parity error and still be caused by a transfer disturbance. If these errors occur frequently, they may be caused by a faulty encoder.
	Observation:	-In *encoder error* display mode, eight criteria for the cause of the fault are shown (A = acceleration error, V = speed error). Deletion is carried out once you have deleted the last error in the display from the keyboard.
	Remedy:	-If the error occurs very frequently , change the encoder.
11	**Cause:**	-A preset (i.e. setting the current encoder value to a desired value) can only be programmed if the system physically detects the encoder, since this reprograms it. A listener can only shift its encoder value, compared to the original axis, via the zero offset structure parameter.
	Remedy:	-All system ready inputs = 0 for all axes.

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4.7.2 Programming errors

No		
401	**Cause:**	-For safety reasons, the execution of functions was locked to prevent accidental triggering. This applies to execution on the keypad as well as from the PC.
	Remedy:	-First, the function must be activated. One-off execution is then enabled. After execution, the system is locked again.
408	**Cause:**	-Out of range on the upper or lower permissible extreme value. Normally, the error only occurs with AKxx devices.
409	**Cause:**	-The extreme values are not exceeded, however, some specific intermediate values are not allowed. (Example: for desired encoder revolutions, only powers of 2 are allowed, i.e. 1,2,4,8,16 ... 8192)
410	**Cause:**	-The preset value must be less than the measuring length. The value scale cannot be shifted by an addition across all the measured values. In other words, the first measured value is always zero.
413	**Cause:**	-The desired application program cannot be implemented in this software version.
414	**Cause:**	-Each application program needs a minimum amount of memory to be able to run reasonably. This is the current list: 1KB AV axis management 2KB NSW cam controller 1KB DIFF difference monitoring
415	**Cause:**	-Access to these axis numbers is not possible in principle in this device.
	Remedy:	-Contact TR-Electronic.
417	**Cause:** several	-Access for this file runs via the program pointer and the line pointer within the program. One line can have columns. Depending on the file type, the limit values may change. In addition, the limit values may be dependent on programming (specification of the total entries and their distribution in programs).
	Observation:	-Check the axis memory and programming in mode *structure ,file lengths* and *file distributions* [90-95, 80-84].
	Remedy: memory	-Increase the amount of axis memory if the existing amount is too small (maximum of 64 KB); -redistribute within the axis if it is not completely used.
426	**Cause:**	-An axis exists as soon as you reserve memory and specify an application program.

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4.7.3 PC - errors

No		
602	**Cause:**	-Commands comprise at least three characters followed by a closing ASCII CR character. (Axis number/command/checksum/CR). On receiving the closing character, the system processes the command.
	Observation:	-In mode *display, look through serial PC input buffer* [7A], the correctly received characters can be shown in the display.
603	**Cause:**	-In the serial commands, only the ASCII characters from 0 to 9 and A to z are valid. They can easily be output to a control screen.
605	**Cause:**	-A serial single command consists of a maximum of 12 characters. Overwriting is interpreted as a syntax error. The system doesn't process the command.
	Observation:	-In mode *display, look through serial PC input buffer* [7A], the correctly received characters can be shown in the display.
606	**Cause:**	-The serial command memory has a maximum capacity of 60 commands. If the sixtieth character isn't a closing character, the system rejects the entered characters.
	Observation:	-In mode *display, look through serial PC input buffer* [7A], the correctly received characters can be shown in the display.
608	**Cause:**	-The PC dialogue accesses the programming parameters via programming lists that often match the mode lists. The error indicates an invalid list has been chosen. The data cannot be assigned.
	Observation:	-In mode *display, look through serial PC input buffer* [7A], the correctly received characters can be shown in the display.
609	**Cause:** several	-Access for this file runs via the program pointer and the line pointer within the program. One line can have columns. Depending on the file type, the limit values may change. In addition, the limit values may be dependent on programming (specification of the total entries and their distribution in programs).
	Observation:	-Check the axis memory and programming in mode *structure ,file lengths* and *file distributions* [90-95, 80-84].
	Remedy: memory	-Increase the amount of axis memory if the existing amount is too small (maximum of 64 KB); -redistribute within the axis if it is not completely used.
611	**Cause:**	-The extreme values are not exceeded, however, some specific intermediate values are not allowed. (Example: for desired encoder revolutions, only powers of 2 are allowed, i.e. 1,2,4,8,16 ... 8192)
612	**Cause:**	-The preset value must be less than the measuring length. The value scale cannot be shifted by an addition across all the measured values. In other words, the first measured value is always zero.
614	**Cause:**	-Access to these axis numbers is not possible in principle in this device.
	Remedy:	-Contact TR-Electronic.
615	**Cause:**	-Each application program needs a minimum amount of memory to be able to run reasonably. This is the current list: 1KB AV axis management 2KB NSW cam controller 1KB DIFF difference monitoring

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4.7.4 Hardware and check errors

No		
900	**Cause:**	-This group of errors contains conflicts with the hardware and software: not enough memory, faulty hardware, unexpected function numbers, etc.
901	**Cause:**	-The desired output is busy or four axes have already each occupied an analog interface.
	Observation:	-Check in mode *structure parameters travel settings, number of analogue interface*. Use the MODE and > keys to move to the next axis (displayed in the status field at the top left), and check the other axes.
903	**Cause:**	-You can create a maximum of seven closed-loop control axes (programs: REGS, REGA, WZWZ, WZWA). Up to four of them can have analog closed-loop control (programs: REGA, WZWA). You can use the rest of the application programs in any way you like.
	Observation:	-In mode *memory allocation of individual axes, processing program*, you can check the used application program. Use the MODE and > keys to move to the next axis (displayed in the status field at the top left), and look through the other axes.
	Remedy:	-If you have created superfluous axes, you can delete them. In *mode memory allocation of individual axes, processing program,* you can delete the application program or cancel completely the memory allocation. **Important**: Before creating a new axis, you must back up to PC the ones that have already been programmed and restore them to the cassette after you have finished creation -Use another cassette
905	**Cause:**	-After switch-on, the system registers all the encoders that belong to a programmed axis ("edited axes"). These encoder numbers are blocked for non-associated encoders, i.e. ones that are connected but not used. If only one encoder is connected, it probably already has the desired number. In this case, you can continue data programming (mode structure encoder settings, encoder data transfer, programming the encoder).
	Observation:	-At switch-on of the cassette, keep pressing the MODE key until the text ENCODER X (where X is the number of the encoder) is shown in the display. Release the MODE key and keep pressing ENTER until the text is cleared.
	Remedy:	-
906	**Cause:**	-The cassette cannot find an axis that needs an actual value. The status may also occure briefly if the axes memory allocation is changed.
	Remedy:	-Define the application program in *memory allocation* mode.
907	**Cause:**	-There may be a disturbance in the serial interface chip (this may be due to a bad reset pulse) or the timeout interrupt isn't functioning or there is an, as yet, undetected software error.
	Remedy:	-
908	**Cause:**	-The serial interface for the TA-Mini does not respond as expected. The chip may be defective.
911	**Cause:**	-A maximum of 64 kB per axis can be used. Depending on the version, 32 or 128 kB is available. The memory reserved for this axis up to now is exhausted.
	Observation:	-
	Remedy:	-
913	**Cause:**	-The basic versions of these programs need more than 0.5 kB of memory.
	Remedy:	-In mode *memory allocation of individual axes*, assign more memory. First save the data of already programmed axes, since after changing memory the axes are initialized from scratch.
914	**Cause:**	-The reserved memory for this table is exhausted. In mode *structure parameters, file lengths*, the desired upper limit is set too low. You may have chosen a number of subfiles in mode *structure parameters, file lengths* that is too high.
	Observation:	-With the cam controller, the system shows the number of available switching points in *mode display, free positions.*
	Remedy:	-Adapt the parameters. Before changing memory sizes, back up already programmed data to the PC and restore it to the cassette after making your changes. **Important**: If mode *memory allocation of individual axes* is involved, you must back up **all** the axes!
923	**Cause:**	-An entered parameter was probably not saved correctly.
	Remedy:	-You should report this error to TR-Electronic immediately, since this is an error in the softwaref. Send TR a copy of the programming data, check the circumstances of the error and try to reproduce and document them.

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934	**Cause:**	-The system can't find an encoder. In this case the readiness relay trips. Encoders are registered at switch on. The system doesn't detect encoders that are clipped on at a later time (mode display actual value = 0). Encoders that
		go down after registration, on the other hand, are regularly polled (at approximately 0.2- to 0.5-second intervals). The failure may be due to: -a wire break; -too low encoder power supply (with relatively long lines and too small a cable cross-section); -relatively severe disturbances of the measuring lines; -high-resistance or loose connecting contacts in the encoder line (plug!); -encoder being wrongly addressed;
	Observation:	-Mode *display, actual value*. -Check the polling signals on the serial address lines on the encoder. (Channels A and B are inverted in each case, i.e. if a line is at approximately 3.5 - 4.5 V, the other one goes to 0 - 1.5 V). Only one polling byte is transferred: the encoder number is coded in it.
	Remedy:	-
937	**Cause:**	-The checking bridge from 32a to 32c is missing on the output plug or the checking input for it is electrically disturbed. The relay output of the readiness contact trips.
	Remedy:	-Close the bridge with a short wire (press the pins in the mating connector together and solder them). The relay closes after the disturbance has been removed and you acknowledge the error.
938	**Cause:**	-Under certain circumstances, the system may not process the application program.
	Observation:	-
	Remedy: document	-Send TR a copy of the programming data, check the circumstances of the error and try to reproduce and them.
960	**Cause:**	-The programming options have already checked the data for consistency. For this reason, a cassette program-med via a PC or keypad should not show this error. There may be a disturbance in the memory allocation (e.g. HF radiation into the memory, or similar) that leads to access errors to memory. -The memory may have been created by an old software version but is being managed by a newer one. -It may be that this is a software error that hasn't yet been detected.
	Remedy: document	-Send TR a copy of the programming data, check the circumstances of the error and try to reproduce and them.
962	**Cause:**	-The current standard of field bus links using the Phoenix-Contact ASIC only allows processing of 1, 2, or 4 encoders on the Interbus-S. Any additional existing encoders are automatically reduced to four.
968	**Cause:**	-Under normal conditions, this system interrupt may not appear.
	Remedy:	-You should report this error to TR-Electronic, since it is a software or hardware error.
970	**Cause:**	-This is a classical software crash. Normally functioning hardware should not show this error.
	Observation:	-After the reset, an error is in the ring buffer.
	Remedy:	-If programming of a particular parameter leads to the error, program it back to the old value. If programming no longer responds, reboot the system.(At switch-on, keep the bottom three keys pressed).

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