FACTORY AUTOMATION

Manual

IPI-KED2-4H with U-KE-RX

Control interface with remote read/write heads

PEPPERL+FUCHS

The general conditions of supply for products and services of the electrical industry apply,
as issued by the central association of the electrical engineering and electrical industry (ZVEI) e.V.,
in the latest version, including the supplementary clause: "Erweiterter Eigentumsvorbehalt".

We at Pepperl+Fuchs recognise a duty to make a contribution to the future,
for this reason, this printed matter is produced on paper bleached without the use of chlorine.

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1 Declaration of conformity

The control interface IPI-KED2-4H and the interface converter U-KE-RX inside the IDENT-I System P inductive identification systems have been developed and manufactured with regards to the European Standards and Directives.

Note

An appropriate declaration of conformity can be obtained from the manufacturer.

The manufacturer of the product, Pepperl+Fuchs GmbH in D-68301 Mannheim, possesses a certified quality assurance system in accordance with ISO 9001.

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2 The symbols used

Warning

This symbol warns the user of possible danger.

If the instruction given in this warning is not heeded, the result could be the injury or death of personnel and/or the severe damage or destruction of equipment.

Attention

This symbol warns the user of a possible failure.

If the instruction given in this warning is not heeded, the device and any plant or systems connected to it could develop a fault or even fail completely.

Note

This symbol indicates important information.

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3 Safety

3.1 Intended use

Warning

The protection of operating personnel and plant is not guaranteed if the equipment is used for a purpose for which is was not intended.

The devices IPI-KED2-4H and U-KE-RX must only be operated by authorized specialist personnel in accordance with these operating instructions.

3.2 General safety instructions

Warning

Operation other than that described in these instructions may place the function and safety of the device and any connected system at risk.

The connection of the device and maintenance work under power must only be carried out by a qualified electrical specialist.

If faults cannot be eliminated, the device is to be taken out of operation and protected against further unintentional operation.

Repairs must only be carried out by the manufacturer. Access inside the device and modifications to it are not permissible and render the guarantee null and void.

The operator is responsible for complying with local safety regulations.

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4 Product description

4.1 Accessory/product family

The IDENT-I System P inductive identification system from Pepperl+Fuchs offers various combination options using the individual components within the System P.

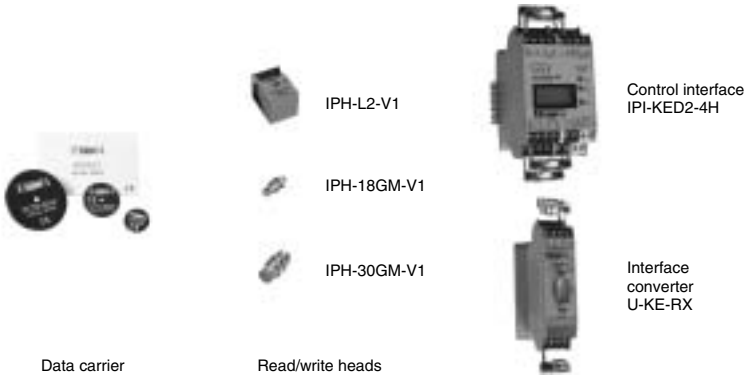

Figure 4.1: Components of the inductive identification system IDENT-I System P.

Note

Detailed information on the components of the identification system Ident-I System P can be found in the Sensor Systems 1 catalogue.

Suitable mating connectors with screening for the connection of the read/write heads are available:

V1-G-IVH-5M-PUR-ABG
V1-G-IVH-15M-PUR-ABG.

A hand-held device IPT-HH9 or IPT-HH6 is used for the process control (read/write function, initialization, data carrier).

Figure 4.2: Hand-held device IPT-HH9 and hand-held device IPT-HH6

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4.2 Delivery package

The delivery package contains:

- 1 control interface IPI-KED2-4H with 4 shielded terminals
- 1 CD-ROM including a manual (German, English) and GSD files for devices with PROFIBUS DP.

Note

The U-KE-RX interface converter must be ordered separately.

4.3 Range of application

The system is suitable for applications including the following:

- Automation
- Material flow control in production
- Acquisition of operating data
- Access control
- Identification of storage vessels, pallets, work piece carriers, refuse containers, tanks, containers.

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4.4 External view

4.4.1 Control interface IPI-KED2-4H

The following displays, control elements and interfaces are located on the control interface (see Figure 4.3).

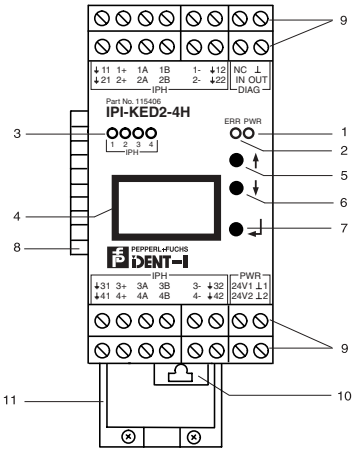

Figure 4.3: Display and control elements of the control interface

LED displays		
Item 1	Power on	green
Item 2	Error	red
Item 3	Function display of the read heads • Command is activated • Command has been successfully executed	dual (green/yellow) green yellow
Display		
Item 4	Two-line multi-function display with 12 characters per line for displaying various states and operating information (for description see Section 6.1) and 4 Icons for displaying the connected read/write heads.	
Push buttons		
	Push buttons are used to control the display or to select commands used when programming the control interface.	
Item 5	Menu item up	↑
Item 6	Menu item down	↓
Item 7	RETURN (confirmation of input)	↵
Connections		
Item 8	Connector	
Item 9	Terminal series	
Other		
Item 10	Metal clip bolt for top hat section rail	
Item 11	Shielding terminal for read/write head connection	

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4.4.2 Interface converter U-KE-RX

The following displays and interfaces are located on the interface converter (see Figure 4.4):

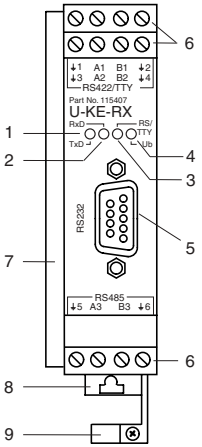

Figure 4.4: Display elements and interfaces of the U-KE-RX interface converter

LED displays		
Item 1	Transmission data (TxD)	yellow
Item 2	Receiver data (RxD)	green
Item 3	RS/TTY selection • RS 422/RS 485/RS 232 • TTY (20 mA current loop)	dual (green/yellow) green yellow
Item 4	Voltage supply	green
Connections		
Item 5	Sub-D connector (RS 232)	
Item 6	Terminal series	
Item 7	Connector cover (included with delivery of interface converter)	
Other		
Item 8	Metal clip bolt for top hat section rail	
Item 9	Shielding terminal for connection to serial interface (RS 485)	

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5 Installation

5.1 Storage and transportation

The device should be well packed for transportation and storage, so that protection is provided against shock and dampness. Optimum protection is afforded by the original packaging.

In addition, the permissible ambient conditions must prevail (see Chapter 8 "Technical data"

5.2 Unpacking

Inspect the contents for damage. In the event of damage, the postal service or goods transport service should be informed and the supplier notified.

Inspect the contents of the delivery package against your order and the delivery documents:

- Quantity supplied
- Device type and version in accordance with the type plate
- Accessories
- Manual/manuals

Retain the original packaging in case the items have to be stored or further transported at a later date.

In the event of problems arising, please contact Pepperl+Fuchs GmbH.

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5.3 EMC shielding concept

The control interface and the U-KE-RX interface converter must be grounded so as to ensure problem-free operation in accordance with CE directives. Grounding is facilitated by an integrated functional ground contact on the back of the device above the top hat section rail on which the device is fitted.

Attention

It should be noted that the top hat section rail is connected to a functional ground (low-resistance and low-inductance).

The connection leads of the read/write heads must be shielded. The shielding of the line is connected to the terminals for the functional ground (⏚) of the control interface by means of the shielding terminal included with delivery.

Figure 5.1: Shielding the data cable to the read/write heads

Note

To avoid interference created by the connection, it is advisable to use shielded cable for the interface leads and the read/write leads. This is the only way to achieve the required CE values. When shielding a cable, both sides of the shield must be connected to the earth with low resistance and low inductance.

If you are using a shielding terminal or the Sub-D connector, it should be secured on the device side (control interface, interface converter).

If you are using leads with double shielding, for example braided wire and metalized foil, the two shields must be connected to each other with low resistance on the end of the lines when the cables are made up before wiring.

A good deal of interference is generated from power supply wires, for example when a three-phase motor is turned on. For this reason, you should avoid the parallel laying of power supply cables with data and signal cables, particularly in the same cable duct.

The shielding of the serial interface should be connected to the terminal for the functional ground (⏚) of the U-KE-RX interface converter.

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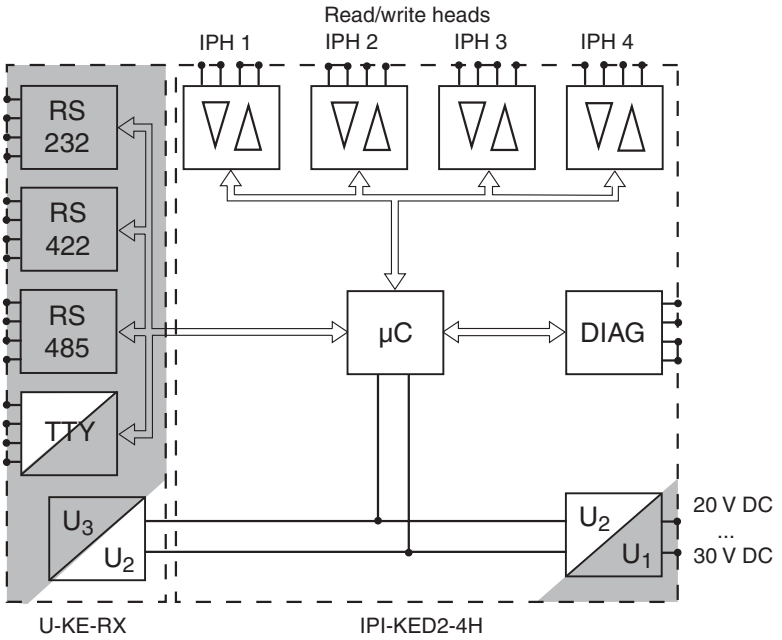
5.4 Galvanic isolation



The galvanic isolation of areas is identified by the light/dark transition.

Figure 5.2: Block diagram of the galvanic isolation

Galvanic isolation areas refer to the input voltage U_1 to isolation areas U_2 and U_3. A special feature is the additional isolation in the TTY interface.

Attention

In order to achieve interference immunity for devices, the ground connections of the voltage supply, the interfaces and the read/write heads must be galvanically isolated and must not be connected to each other.

This also applies for the position opposite the serial interface.

Galvanic isolation ensures that a high level of interference immunity will be achieved.

5.5 Mounting

Like all devices of Pepperl+Fuchs in the housing of the KE system, the control interface and U-KE-RX interface converter can easily be snapped onto 35-mm standard top hat rails in accordance with EN 50022.

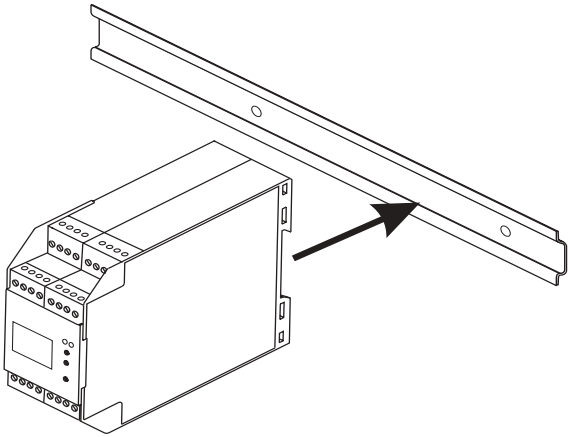


Figure 5.3: Mounting on top hat section rails according to EN 50022 (schematic diagram)

To mount the device, simply attach it on the upper edge of the top hat section rail and press the lower part of the housing against the rail until you hear it click into place.

Attention

The top hat section rail must be grounded in accordance with applicable standards.

The terminals for the functional ground (⏚) of the control interface are then connected with the functional ground by means of the integrated functional ground contact on the back of the control interface.

It must also be ensured that the shielding of the read/write head cable is grounded.

After the control interface has been mounted, the U-KE-RX interface converter is mounted in a similar manner and is connected with the control interface that is integrated into the housing by moving it laterally on the top hat section rail. It is also possible to connect the two devices together before mounting them.

Attention

Care must be taken while mounting the devices not to damage the connectors on the housing side of either device or to place them under mechanical stress.

A proper electrical connection must be created.

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5.6 Connecting

Warning

Only adequately trained professional electricians may work while voltage is connected or create the connection to the mains power supply.

Before connecting the device, make certain that the mains power voltage is the same as the value indicated on the manufacturer's rating plate.

A mains power isolation device must be installed in the vicinity of the mounting location and must be identified as an isolating unit for the devices.

5.6.1 Connecting the control interface IPI-KED2-4H

The electrical connection type for the IPI-KED2-4H control interface is made by self-opening screw terminals on the upper and lower sides of the device with a maximum conductor cross section of 2.5 mm^2.

Connect the read/write heads and the power supply voltage as described in the connection diagram and in the terminal assignment list.

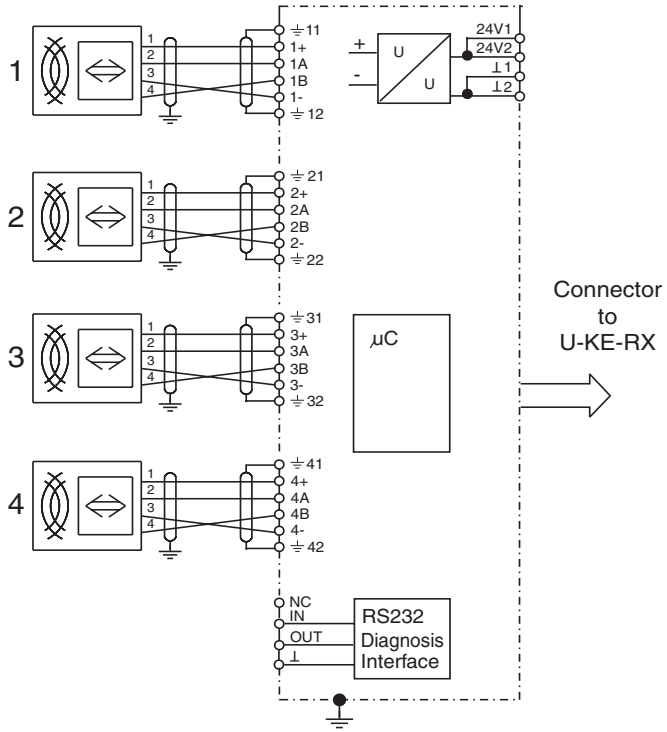

Figure 5.4: Connection diagram for control interface

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Position of the connection terminals

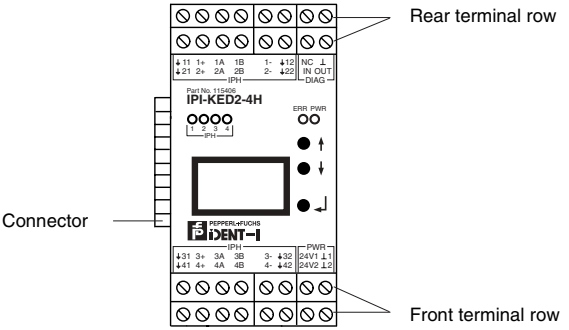

Figure 5.5: Arrangement of connection terminals

Terminal assignment list

Terminal	Function
Rear terminal row:	
⏚11	Functional ground for read/write head 1 (shield)
1+	Voltage supply for read/write head 1
1A	Signal connection A for read/write head 1
1B	Signal connection B for read/write head 1
1-	Voltage supply for read/write head 1
⏚12	Functional ground for read/write head 1 (shield)
NC	Not used
⊥	Ground for diagnostics interface
⏚21	Functional ground for read/write head 2 (shield)
2+	Voltage supply for read/write head 2
2A	Signal connection A for read/write head 2
2B	Signal connection B for read/write head 2
2-	Voltage supply for read/write head 2
⏚22	Functional ground for read/write head 2 (shield)
IN	Input for diagnostics interface
OUT	Output for diagnostics interface
Front terminal row:	
⏚31	Functional ground for read/write head 3 (shield)
3+	Voltage supply for read/write head 3
3A	Signal connection A for read/write head 3
3B	Signal connection B for read/write head 3
3-	Voltage supply for read/write head 3
⏚32	Functional ground for read/write head 3 (shield)

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Terminal	Function
24V1	24 V DC power supply plus
⊥1	24 V DC power supply minus
⏚41	Functional ground for read/write head 4 (shield)
4+	Voltage supply for read/write head 4
4A	Signal connection A for read/write head 4
4B	Signal connection B for read/write head 4
4-	Voltage supply for read/write head 4
⏚42	Functional ground for read/write head 4 (shield)
24V2	24 V DC power supply plus
⊥2	24 V DC power supply minus

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5.6.2 Connection information for read/write heads

Turn the power supply to device off to make the connection of the read/write heads.

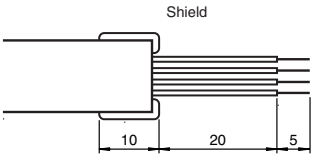
Connect the read/write head 1 with terminals 1+, 1A, 1B, 1- and apply the shield to both grounding terminals.

If they are present, connect the additional read/write head 2 through 4 before turning on the power supply voltage again.

The leads to the read/write heads must be shielded. The conductor cross section should be at least 0.25 mm^2.

The shield for the read/write head lead must be connected to ground on both sides with low resistance and low inductance. Care must be taken to keep the shield as short as possible.

To improve EMC properties, you should also connect the shield terminals even if no read/write head is connected.



Note:
use insulated cable ends

Figure 5.6: Connecting the read/write head with a grounding clamp

The overall resistance of the power supply leads (in and back) must be less than 7.5 Ohms. This will be ensured for the maximum possible cable length of 50 m by a wire cross section of 4 x 0.25 mm^2. You will find matching plug-in connectors from Pepperl+Fuchs under the type codes:

Type code	Line length
V1-G-IVH-5M-PUR-ABG	5 m
V1-G-IVH-15M-PUR-ABG	15 m

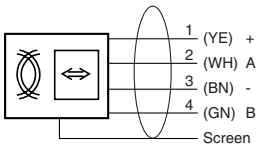


Figure 5.7: Read/write head connection assignment

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Attention

Since significantly more electromagnetic interference can be captured by longer cable lengths, you should bear in mind that the cable lengths specified above cannot be used in some applications.

Note

If you are using leads with double shielding, for example braided wire and metalized foil, the two shields must be connected to each other with low resistance on the end of the lines when the cables are made up before wiring.

A good deal of interference is generated from power supply wires, for example when a three-phase motor is turned on. For this reason, you should avoid the parallel laying of power supply cables with data and signal cables, particularly in the same cable duct.

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5.6.3 Connecting the interface converter U-KE-RX

The electrical connection for the U-KE-RX interface converter is made by self-opening screw terminals on the upper and lower side of the device with a maximum conductor cross section of 2.5 mm^2.

Connect the serial interface and the power supply voltage as described in the connection diagram and in the terminal assignment list.

The connection with the control interface is made with the connector built in on the side of the device. This connection also ensures the power supply.

Only one of the interfaces RS 232, RS 422, RS 485 or TTY may be connected. If you are using RSxxx interfaces, the changeover switch located inside the device must be in the "RS" setting (RS is the factory setting). If you will be using the TTY interface, the changeover switch must be moved to the "TTY" setting. The RS 422 or TTY interfaces are connected to the same terminals and the interface type is selected by means of the changeover switch.

The following connections are available for individual interfaces:

Interface	Connection	Changeover switch setting
RS 232	Sub-D connector, connection 2, 3, 5	"RS"
RS 422	Terminal bar: IN: A1, B1; OUT: A2, B2	"RS"
RS 485	Terminal bar: A3, B3	"RS"
TTY	Terminal bar: IN: A1, B1; OUT: A2, B2	"TTY"

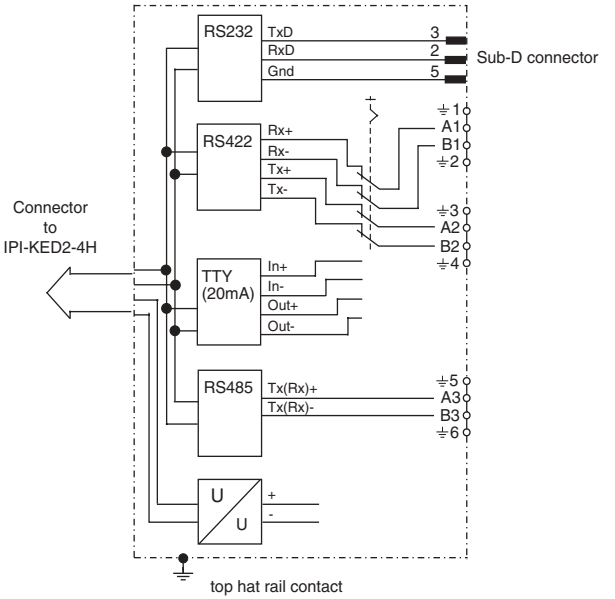

Figure 5.8: Connection diagram of the U-KE-RX interface converter

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Position of the connection terminals

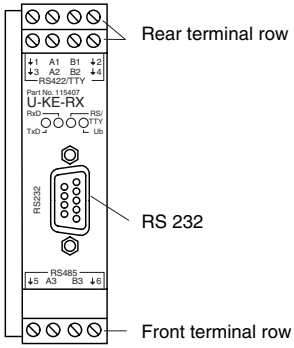

Figure 5.9: Arrangement of the connection terminals

Terminal assignment list

Terminal	Function
Rear terminal row:	
⏚1	Shielding connection
A1	Signal connection RS 422 Rx + / TTY IN +
B1	Signal connection RS 422 Rx - / TTY IN -
⏚2	Shielding connection
⏚3	Shielding connection
A2	Signal connection RS 422 Tx + / TTY OUT +
B2	Signal connection RS 422 Tx - / TTY OUT -
⏚4	Shielding connection
Front terminal row:	
⏚5	Shielding connection
A3	Signal connection RS 485 Rx/Tx +
B3	Signal connection RS 485 Rx/Tx -
⏚6	Shielding connection

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Assignment of the 9-pin Sub-D connector (RS 232)

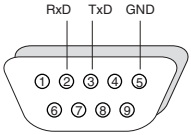

Figure 5.10: View of Sub-D connector, view of contacts

Contact assignment list

PIN	Function
1	not used
2	Data signal input RxD
3	Data signal output TxD
4	not used
5	Ground GND
6	not used
7	not used
8	not used
9	not used

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5.6.4 Connection instructions for serial interface

Only the various versions of the serial interface are used in the configuration under discussion here.

The RS 232 serial interface is connected by means of the 9-pin Sub-D connector. It is also possible to connect RS 422, RS 485 or 20 mA connections (TTY) using connection terminals.

Since the control interface has only one serial interface that works with different drivers and receivers for differing standards, only one of the standards can ever be connected.

The transfer speed (baudrate) is thus selected by the software. The following transfer rates are available:

1200, 2400, 4800, 9600, 19200, 38400 bits/s

The device is set to 9600 baud when it leaves the factory.

The device runs at 8 data bits with no parity, one start bit and one stop bit.

RS 232 interface

A 9-pin Sub-D connector is used for the connection to the RS 232 serial interface. The layout of the connections is shown in the table for the assignment of the 9-pin Sub-D connector on Page 22.

The RS/TTY changeover switch in the U-KE-RX interface converter is in the "RS" setting (device leaves the factory with this setting). Only the connection for the RS 232 interface is used.

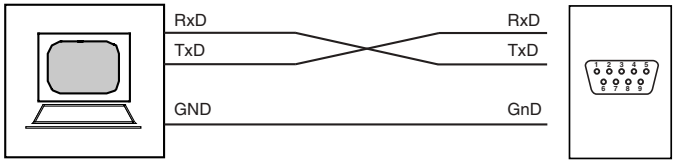

Figure 5.11: RS 232 cable connector to the shown without shielding

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RS 422 interface

The data signal for the RS 422 standard is defined as the difference in voltage between two leads. Since any interference arising when the twisted wires are used in a confined space will affect both leads equally, the data transfer will be more secure than with the RS 232 interface, especially at high transmission speeds and with long cable lengths.

The RS 422 standard offers a symmetrical 4-wire connection that is not sensitive to interference. The transmission and reception lines are separate, which allows for full duplex operation.

The RS/TTY changeover switch in the U-KE-RX interface converter is in the "RS" setting (device leaves the factory with this setting). Only the connection for the RS 422 interface is used.

Terminals A1, B1, A2 and B2 should be used for the RS 422 standard.

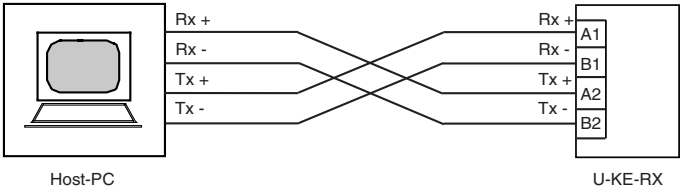

Figure 5.12: Connection of the RS 422 interface, shown without shielding

RS 485 interface

The data signal for the RS 485 standard is defined as the difference in voltage between two leads. Since any interference arising when the twisted wires are used in a confined space will affect both leads equally, the data transfer will be more secure than with the RS 232 interface, especially at high transmission speeds and with long cable lengths.

The transmission and reception lines are switched together for the RS 485 standard. Because of this, only semi-duplex is possible. To be able to receive data, the transmission driver is turned off. The option of a multi-point connection is not supported by the control interface.

The RS/TTY changeover switch in the U-KE-RX interface converter is in the "RS" setting (device leaves the factory with this setting). Only the connection for the RS 485 interface is used.

Terminals A3 and B3 should be connected for the RS 485 standard.

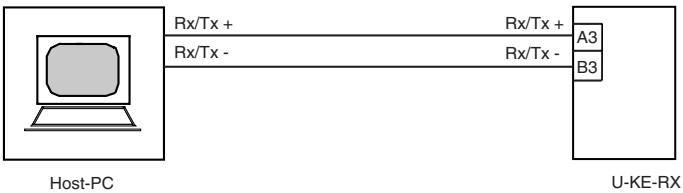

Figure 5.13: Connection of the RS 485 interface, shown without shielding

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20 mA current loop or TTY interface

One line pair is available each for transmission data and reception data. Data transfer is implemented in the full duplex process.

Current loop transfer is not sensitive to interference and therefore offers secure data transfer even in connection with long line lengths.

The current loop connections of the control interface are galvanically isolated by optocouplers. The control interface represents the passive side of the transfer, i. e. the coupling partner must make the current or voltage available for the transfer.

The RS/TTY changeover switch in the U-KE-RX interface converter must be moved to the "TTY" setting. Only the connection for the TTY interface is used.

Terminals A1, B1, A2 and B2 should be connected for the TTY interface.

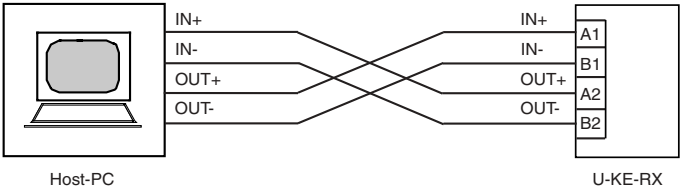

Figure 5.14: Connection of the TTY interface, shown without shielding

Interface cable

The maximum cable length between the control interface and the higher-level computer depends on the data rate, the interface standard and the interference level. Because of this, we can only suggest rough values here:

Standard	Max. cable length
RS 232	15 m
RS 422	1000 m
RS 485	1000 m
20 mA current loop	1000 m

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RS/TTY changeover switch

The housing of the U-KE-RX interface converter contains the switch for switching the RS/TTY interface mode (located on the motherboard).

Note

When it leaves the factory, the switch is in the "RS" setting.

To be able to activate this switch, the housing of the device must be opened. To do this, use a suitable screwdriver to unlock the straps on the right and left side of the housing head under the cable terminal.

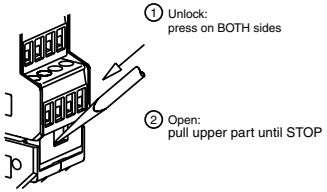

Figure 5.15: Open the housing of the U-KE-RX interface converter

Pull the printed circuit board carefully out of the housing.
This will provide you with access to the switch on the printed circuit board of the interface converter.

Using a small screwdriver, you can set the desired operating mode for the interface (see the marking on the printed circuit board).

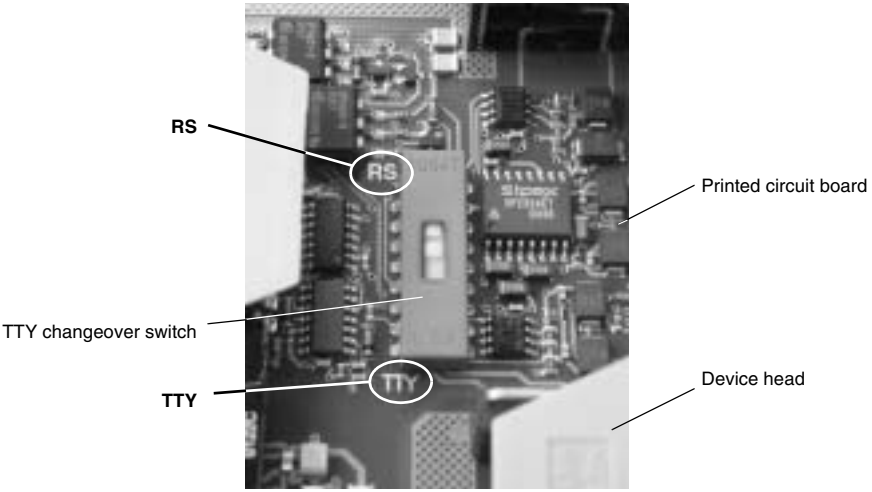

Figure 5.16: RS/TTY changeover switch

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5.7 Dismantling, packing and re-packing

Dismantling

You can use a screwdriver to pull back the metal clip ring, after which the devices can be removed from their hinges.

Attention

When disassembling, please note that the two devices are connected with each other by connectors on the side.

Before removing from hinges, it is helpful to separate the devices from each other by moving them laterally.

Re-packing

If the device is to be stored for later re-use, the device should be packed in such a way as to ensure protection from shock and dampness. Optimum protection is afforded by the original packaging.

Disposal

Note

Electronic waste is classified as special refuse. Observe the local regulations for the disposal of such waste.

The control interface IPI-KED2-4H and the interface converter U-KE-RX contain no internal batteries that would have to be removed prior to disposal.

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6 Commissioning

Warning

Before commissioning, ensure that there will be no risk to the plant to which the device is connected, e. g. due to the uncontrolled initiation of processes.

Attention

Before commissioning, check once again that the connections are correct.

Check whether the read/write heads are completely and correctly connected. If the read/write heads are correctly connected, after you turn the device on the symbol **IPH1** or **IPH2** or **IPH3** or **IPH4** will appear in the bottom line of the display.

If the IPI-KED2-4H device is correctly connected to the power supply voltage, the "PWR" LED comes on (green) and the text with the switching on message appears on the display.

If the device detects an error during the self-test, the error will appear on the display.

The interface converter U-KE-RX receives power after the two devices have been connected together through the integrated connector.

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6.1 Operating using keys and the display

Note

All device settings are possible either on the device (using keys and the display) or by using the serial communication interface.

The LC display can only be adjusted directly on the device.

After turning the device on or after a reset, the device displays a message identifying the version. Now you can operate the device by using push buttons on the front side of the device and the LC display.

Note

As soon as the first command has been given by the host, direct command input on the device is disabled for reasons of safety.

The meaning of the icons for menu navigation are as follow:

Menu item up

Menu item down

RETURN (confirmation of input)

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6.1.1 Version message and main menu

After turning the device on or after a reset, the device displays a message identifying the version. You can "scroll" the lines of the version message with the arrow keys or go to the main menu with the RETURN key.

You can use the push buttons on the front side of the device to set parameters for the control interface, to bring up states or to run commands. The main menu has three menu items, some of which branch to additional sub-menus.

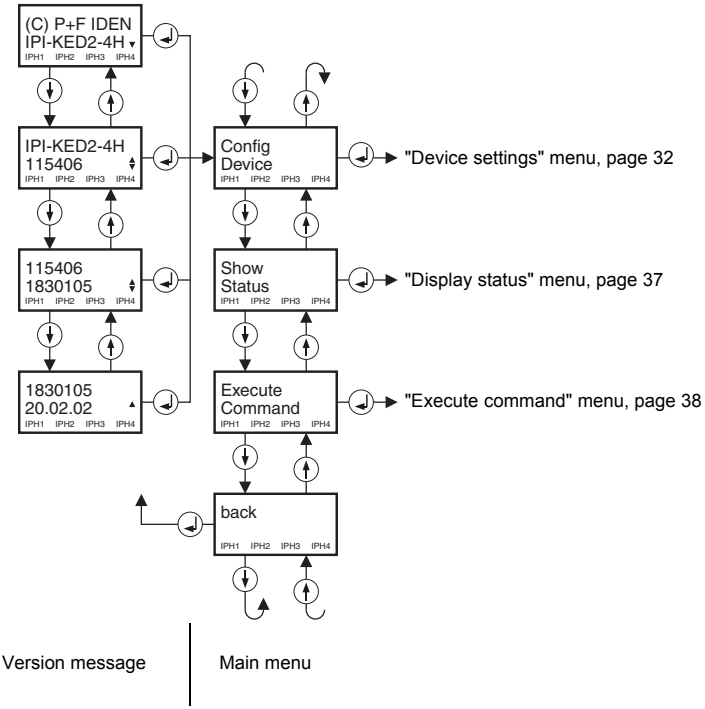

Figure 6.1: Version message and main menu

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6.1.2 "Device settings" menu

All system settings are stored in non-volatile memory. When changed, they do not become active until after a reset.

Note

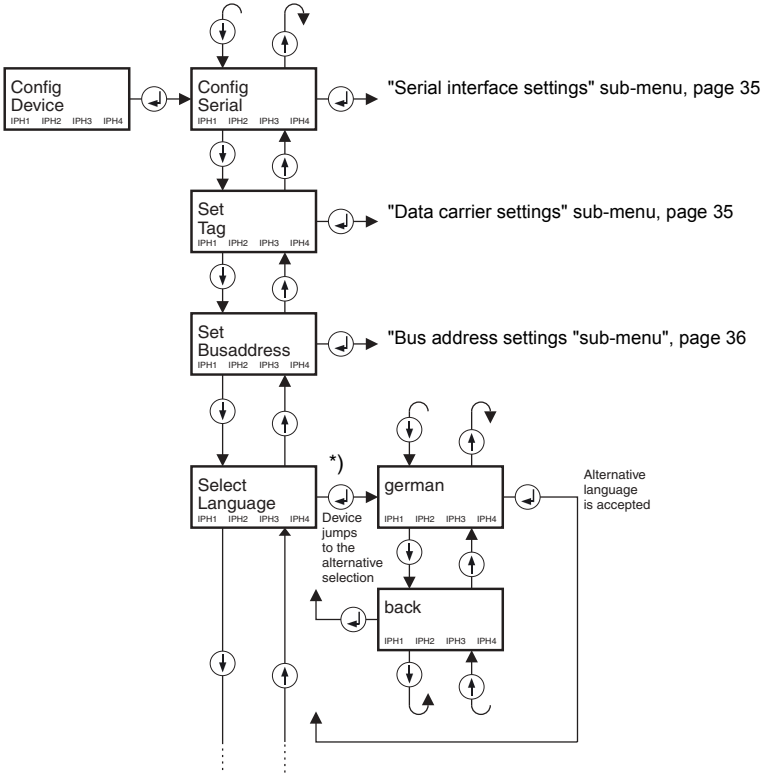

Figure 6.2: "Device settings" menu (Part 1 of 3)

*) Language is "English" when the device leaves the factory.

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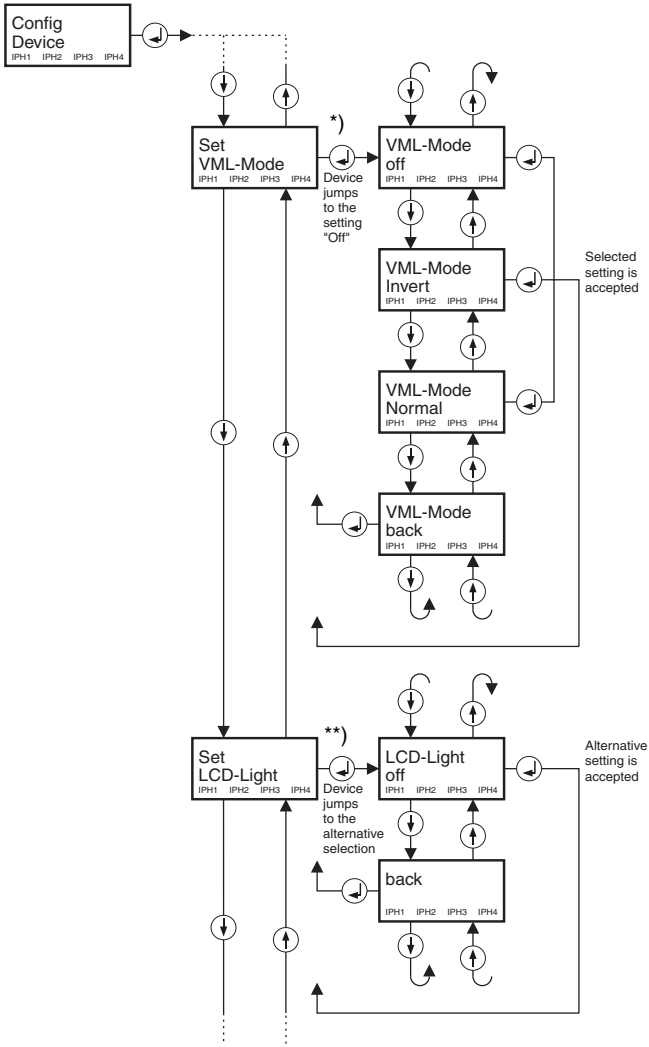

Figure 6.3: "Device settings" menu (Part 2 of 3)

*) Set to "VML-Mode off" when the device leaves the factory. For a description of VML mode, please refer to Chapter 6.1.5 VML mode, page 40.

**) Set to "LCD-light on" when the device leaves the factory.

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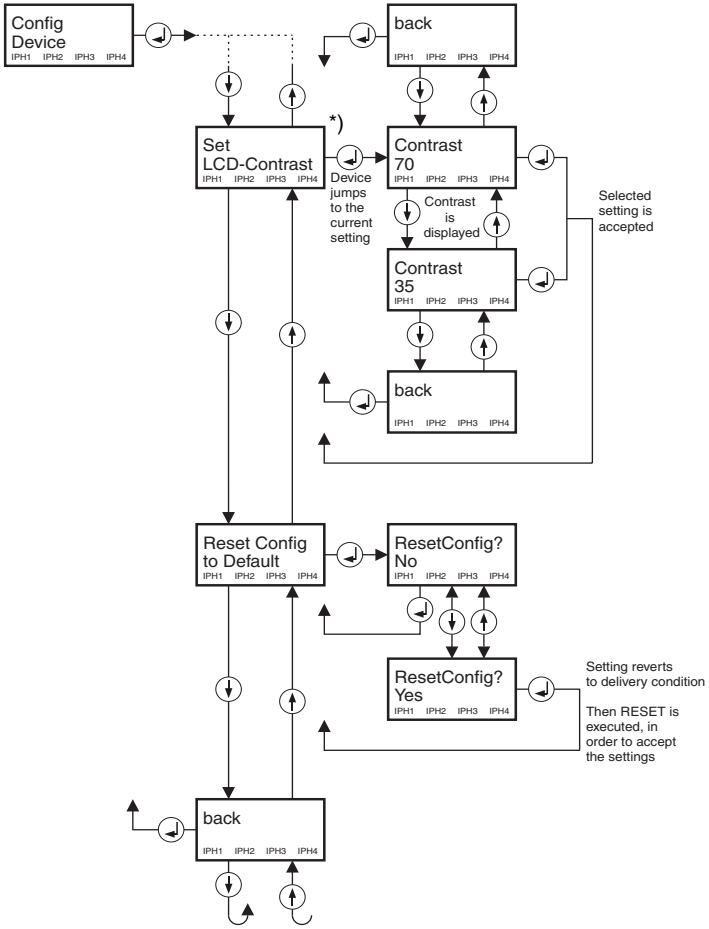

Figure 6.4: "Device settings" menu (Part 3 of 3)

*) Set to "Contrast 50" when the device leaves the factory.

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"Serial interface settings" sub-menu

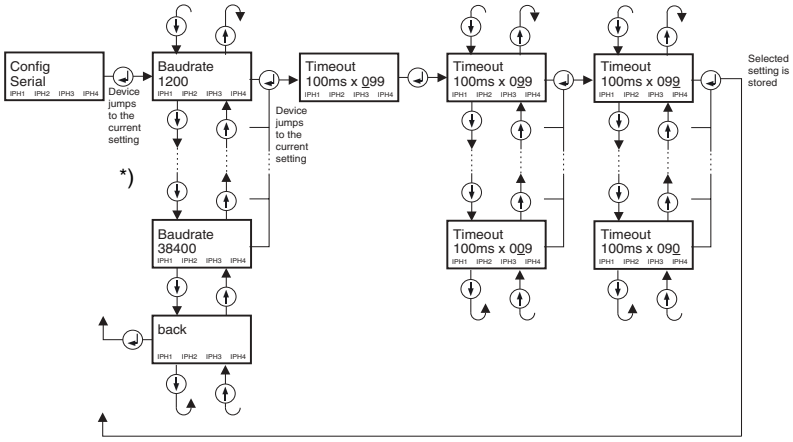

Figure 6.5: "Serial interface settings" menu

*) The device is set to "Baudrate 9600" when it leaves the factory.

"Data carrier settings" sub-menu

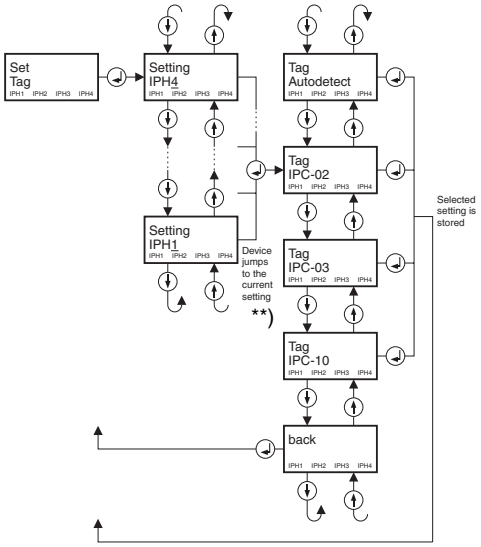

Figure 6.6: "Data carrier type setting for each read/write head" menu

**) Set to "Tag IPC-02" when the device leaves the factory.

"Bus address settings "sub-menu"

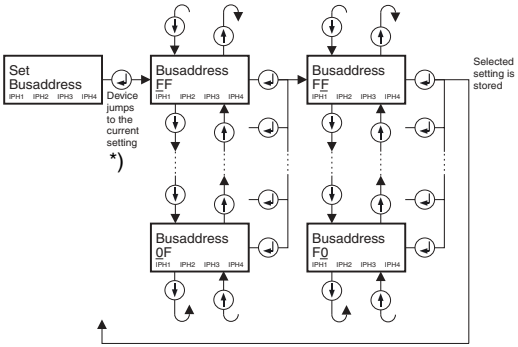

Figure 6.7: "Bus address settings" menu

*) Set to "Busaddress 00" (hexadecimal) when the device leaves the factory.

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6.1.3 "Display status" menu

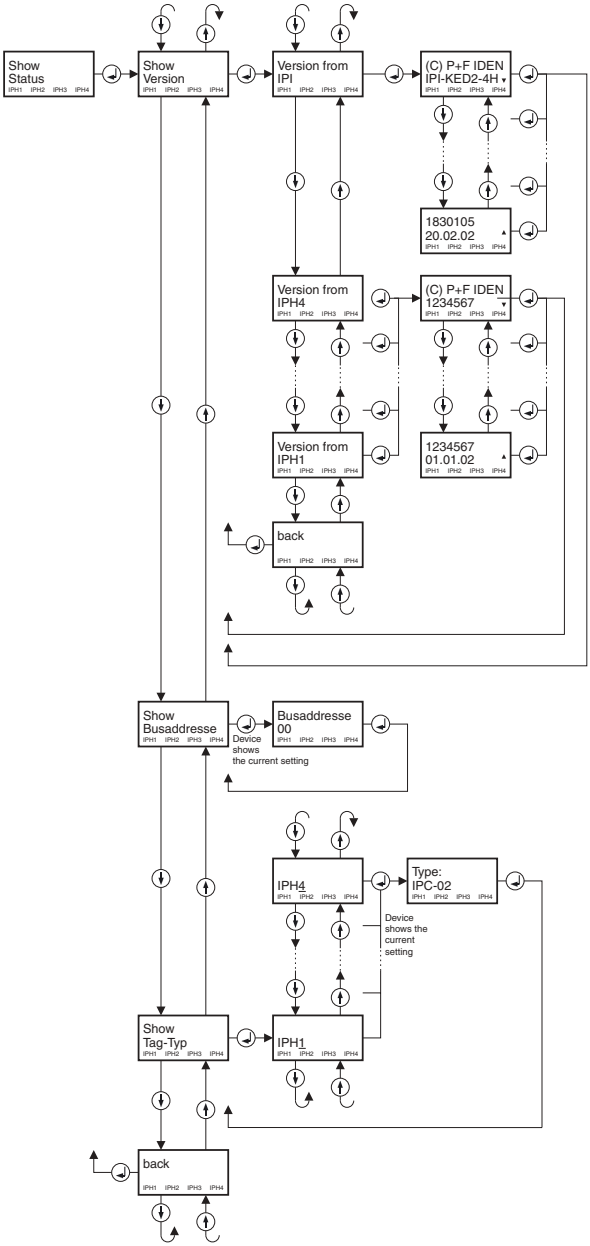

Figure 6.8: "Display status" menu

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6.1.4 "Execute command" menu

As soon as the first command has been given by the host, direct command input on the device is disabled for reasons of safety.

Note

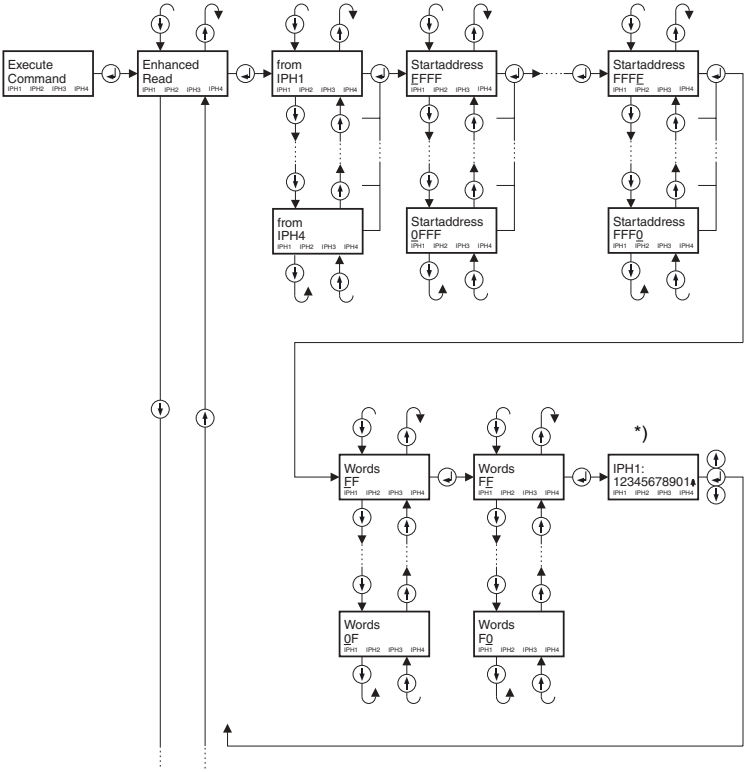


Figure 6.9: "Execute command" menu (Part 1 of 2)

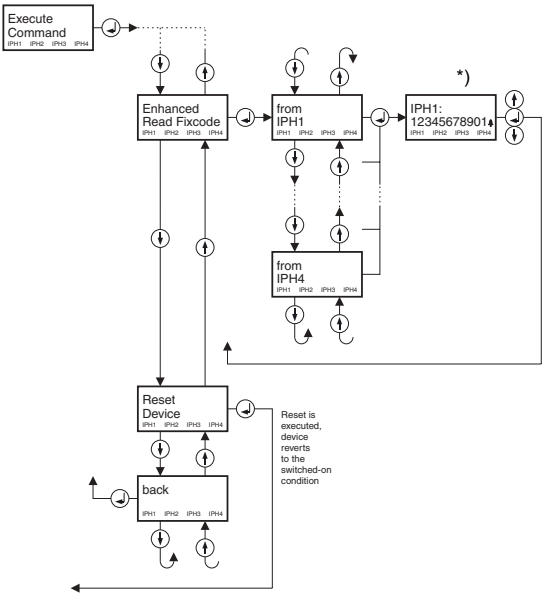


Figure 6.10: "Execute command" menu (Part 2 of 2)

*)

If the selected read/write head is not connected or is defective, the message appears

If the data carrier is outside the detection range of the read/write head, the message appears

6.1.5 VML mode

If VML mode (**V**isual **M**enu **L**ocator) is activated, a bar in the upper right corner of the LC display indicates the current position in the menu structure graphically.

With the setting "VML-Mode Normal", a dark horizontal bar becomes longer and longer as you go deeper into the menu structure. If you select another menu item within the same menu level, the vertical position of the bar changes.

If "VML-Mode Inverted" is activated, a light bar is displayed against a dark background. The width of the bar indicates the current depth of the level in the menu structure. In addition, the number of dark lines indicates the number of possible menu items on this menu level.

Example:
With "VML-Mode Inverted", the bar indicates that you are in the fifth of 7 possible menu items on the second menu level.

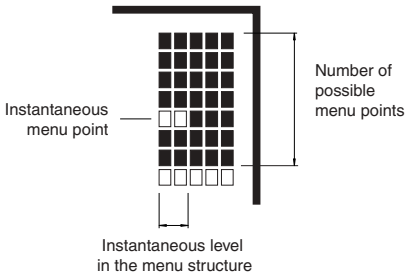


Figure 6.11: Example of VML mode inverted

6.2 Operating using the communication interface

The process for placing the IPI-KED2-4H control interface and the interface converter U-KE-RX in service is described in the following section based on the serial interface with the aid of a PC using the IPC03 data carrier type. All following steps assume the settings of both devices are as they were when delivered.

The factory set transfer rate is 9600 baud and no timeout. The data carrier type is set to '02', "IPC02".

Check whether you have connected an RS 232 interface to the Sub-D connector on the front side of the U-KE-RX interface converter with a null modem cable.

The transfer speed (baudrate) is thus selected by the software. The following transfer rates are available:

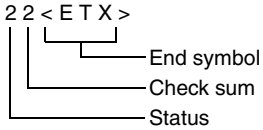
1200, 2400, 4800, 9600, 19200, 38400 bits/s

The device is set to 9600 baud when it leaves the factory. The device runs at 8 data bits with no parity, one start bit and one stop bit.

6.2.1 First operating steps

Open a terminal program on the PC(for example Hyperterminal). Set the interface configuration on the terminal program to 9600 baud, 8 data bits, no parity, 1 stop bit and no protocol/handshake.

Now when you turn the operating voltage of the device off and back on again, the message appears when the power is turned on



on the terminal. You can use this to check that communication from the terminal program is working and that it is ready for operation. To see if it is working, send the version command

VE#<CR>

from the terminal. You should then receive a response from the device, for example displayed as the version message:

0 (C) P+F IDENT-I <CR><LF>
IPI-KED2-4H <CR><LF>
115406 <CR><LF>
1830105 <CR><LF>
20.02.02 #<CR> ....

This is followed by information on the read/write heads connected. You will find the complete response in the command description “version:” on page 51.

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Note

If you receive any other responses, communication between your PC and the device is not functioning properly.

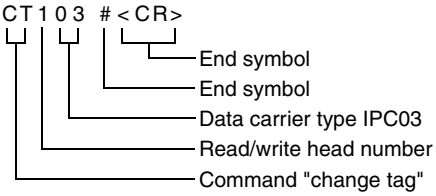
Check the installation and perform the steps for placing the device in service again.

Note

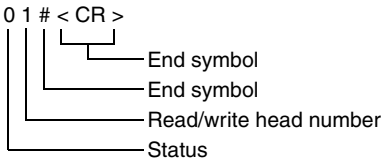
The device makes no distinction between upper and lower case letters. Make certain that all parameters follow after the command without any spaces in between.

6.2.2 Data carrier type settings

The data carrier type is set to IPC02 when the device leaves the factory. For read/write head 1, for example, set the data carrier type to IPC03. To do this, send the command "change tag"



As a response you will receive



This indicates that read/write head 1 has correctly received the command (status = '0'). You can find an overview of states in Legend, page 63.

The data carrier type for each read/write head is stored in the control interface in non-volatile memory.

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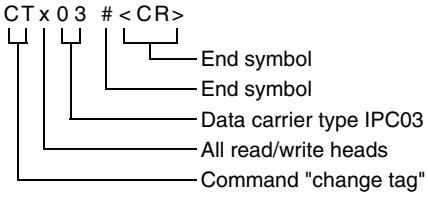
The command is used for all read/write heads with read/write head number "x":



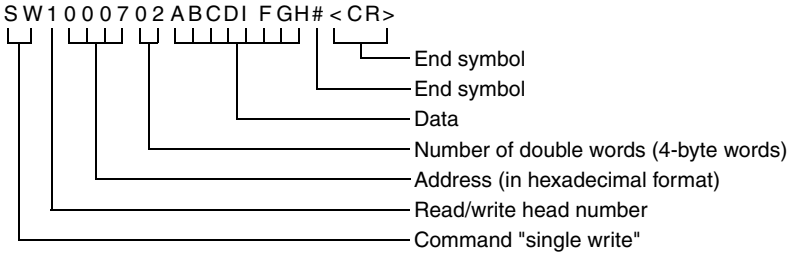
As response, you will then receive

<Status><LkNo>#<CR>
<Status><LkNo>#<CR>
<Status><LkNo>#<CR>
<Status><LkNo>#<CR>

for all four read/write heads.

6.2.3 Write 2 double words starting at address 7 with read/write head 1

Now place an IPC03 data carrier in front of the read/write head 1. Send the command "single write"



If the data carrier is in the detection range, the following message will appear:

01#<CR>.

Otherwise

51#<CR>

will be generated to indicate that it was not possible to write because the Data carrier was outside the detection range (status = '5'). An overview of the status youl will find in Legend, page 63

The IPH1 LED on the control interface and the LED on the read/write head are lit briefly - green when the read command is being activated and yellow when it has been successfully performed.

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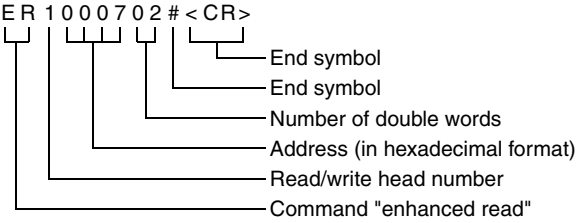
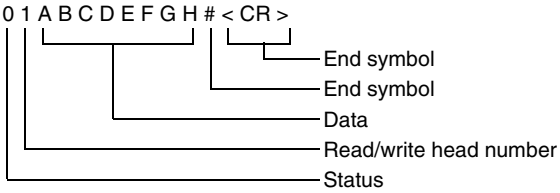
6.2.4 Read 2 double words starting at address 7 with read/write head 1

Send the read command "enhanced read"



Now if you bring a data carrier into the detection range, the data that has previously been written in will appear with the message



6.2.5 Protocol with checksum

All commands are terminated with the symbol <CHCK> = 'checksum' and <ETX> = 'End of Text'. These are provided for data protection during the serial transfer.

The device can be operated with two different end characters. Either with checksum <CHCK> and <ETX> (<ETX> = 03h) or without checksum with #<CR>. For simple operation with a standard terminal, the control interface also accepts a #<CR> [<LF>] instead of <CHCK><ETX>.

Note

Using the checksum increases data protection on the interface.

The checksum is formed by simple addition using all preceding characters without overflow.

Example of calculating the checksum:

For the telegram without checksum

VE#<CR> or ve#<CR>

the checksum will be determined. First, the hexadecimal values for the characters "V"=56h and "E"=45h or "v"=76h and "e"=65h are required from an ASCII table. When these are added, the result is

"V" = 56h plus "E" = 45h equals 9Bh or
"v" = 76h plus "e" = 65h equals DBh.

The checksum telegram would then be

VE<9Bh><ETX> or
ve<DBh><ETX>.

If a longer telegram is transferred, the checksum will probably overflow, i. e. the value calculated by addition can no longer be represented in a single byte. The overflow is not transferred with the telegram.

If the telegram

ER1000702#<CR>

is to be transferred with a checksum, the checksum will be as follows:

45h + 52h + 31h + 30h + 30h + 30h + 37h + 30h + 32h = 1F1h.

After the overflow is truncated, the result is the following telegram:

ER1000702<F1h><ETX>.

Note

The device makes no distinction between upper and lower case letters. It should be noted, however, that different checksums will result from upper or lower case letters.

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7 Instruction

When making use of commands, a fundamental distinction is drawn between the two operating modes "Single mode" and "Enhanced mode". These are represented as flow charts in the following section.

7.1 Single mode

The command in question is executed once, after which an immediate response is given.

The following flow chart gives an example of how the command is integrated into a control program.

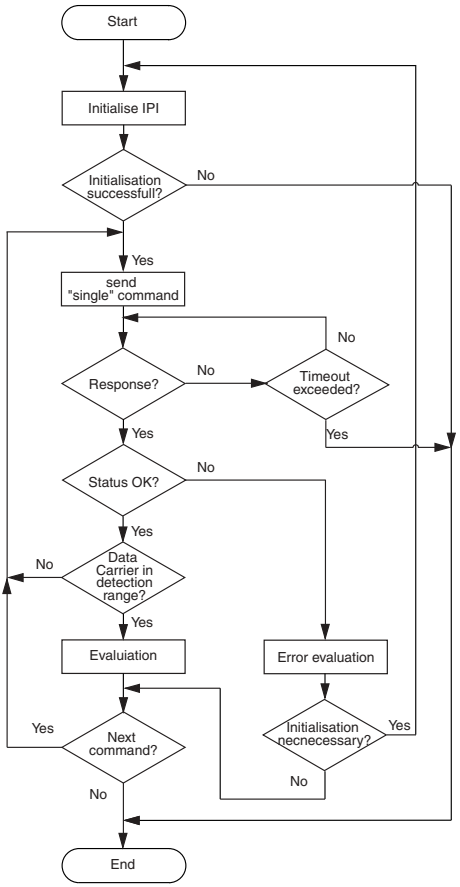

Figure 7.1: Flow chart for command type "Single mode"

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7.2 Enhanced mode

The question in command remains permanently active until it is interrupted by the user or by an error message. A response is given immediately.

After the response, the command remains active. Only changed data is transferred via the interface. This ensures that there is no double reading of data carriers. If a data carrier leaves the reading range, the status '5' is generated.

The following flow chart gives an example of how the command is integrated into a control program.

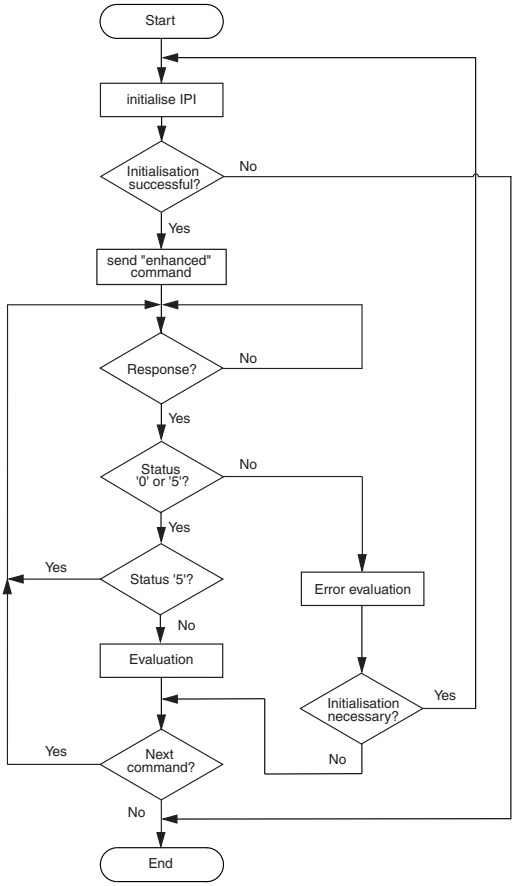

Figure 7.2: Flow chart of the operating mode "Enhanced mode"

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7.3 Command list

The commands executed in the list are further described below in detail on the pages indicated.

System commands

Description of command	Com-mand	Page
version	**VE**	Page 51
change tag	**CT**	Page 52
quit	**QU**	Page 52
configure interface	**CI**	Page 53
get state	**GS**	Page 53
reset	**RS**	Page 53

Read/write commands

Read data

Description of command	Com-mand	Page
single read	**SR**	Page 55
enhanced read	**ER**	Page 55

Write data

Description of command	Com-mand	Page
single write	**SW**	Page 55
enhanced write	**EW**	Page 55

read fixed code

Description of command	Com-mand	Page
single read fixed code	**SF**	Page 55
enhanced read fixed code	**EF**	Page 56

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Special command modes

read configuration IPC03

Description of command	Command	Page
single get configuration	**SG**	Page 59
enhanced get configuration	**EG**	Page 60

write configuration IPC03

Description of command	Command	Page
single configuration	**SC**	Page 59
enhanced configuration	**EC**	Page 59

IPC03 password mode

Description of command	Command	Page
password mode	**PM**	Page 61
password set	**PS**	Page 61
password change	**PC**	Page 61

Write fixed code IPC10 (only once per data possible!)

Description of command	Command	Page
single write fixed code	**SX**	Page 62
enhanced write fixed code	**EX**	Page 62

Note

The commands are shown in bold in the following descriptions.

Material shown in < ... > is explanatory text for the sequence of commands.

Note

The device makes no distinction between upper and lower case letters. Make certain that all parameters follow after the command without any spaces in between.

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7.3.1 System commands

version:

Command:	**VE**<CHCK><ETX>
Response:	<Status> (C) P+F IDENT-I
	IPI-KED2-4H
	#<Part-No>
	<SW-No>
	<SW-Date> <CHCK><ETX>
(head 1)	<Status><LkNo> <LkName>
	#<Part-No>
	<SW-No>
	<SW-Date> <CHCK><ETX>
(head 2)	<Status><LkNo> <LkName>
	#<Part-No>
	<SW-No>
	<SW-Date> <CHCK><ETX>
(head 3)	<Status><LkNo> <LkName>
	#<Part-No>
	<SW-No>
	<SW-Date> <CHCK><ETX>
(head 4)	<Status><LkNo> <LkName>
	#<Part-No>
	<SW-No>
	<SW-Date> <CHCK><ETX>

This command transfers device designations and the status of software versions.

If no read/write head is connected, the read/write head information is omitted an a
6<LkNo><CHCK><ETX>

will appear to indicate that the read/write head could not be reached (status = '6'). You can find an overview of states in Legend, page 63.

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change tag:

Command: **CT**<LkNo><TagType><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

This command is used to inform the read/write station which type of data carrier to communicate with. This setting is stored in non-volatile memory in the control interface. The setting of the control interface when it leaves the factory is Type '02'.

The following data carrier types are supported:

Type of tag		Description	Inset chip	Access	<WordAddr>	Bits
High byte	Low byte					
'0'	'0'	Auto detect				
'0'	'2'	IPC02	µEM V4001	fixed code		40
0	'3'	IPC03	µEM P4150/64	R/W fixed code	00 ... 1Ch	928 32
'1'	'0'	IPC10	µEM P4069	R/W	00	96

Note

It is advisable to set the corresponding data carrier type in a system in which only one data carrier type is used. This makes it possible to detect the data carrier more quickly.

The type <TagType> '00' allows for mixed operation of different code/data carriers. Since the read/write head requires a significantly longer time for autodetect, only static reading and writing is possible in this mode.

In the "Auto detect" operating mode, the word start address and word number parameters are first checked when a data carrier is read or written to, since the memory areas are different for the various types of data carriers. The error message "Status 4" can therefore not occur until a data carrier is located in front of the read/write head (see Chap. 7.4).

Note

The command is used for all read/write heads with read/write head number "x":

quit:

Command: **QU**<LkNo><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

The command running with this read/write head is interrupted.

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configure interface:

Command:	**CI**<Timeout>,<Baud><CHCK><ETX>
Response:	<Status><CHCK><ETX>

The timeout and the baudrate are set with this command. The values are stored in non-volatile memory in the control interface.

Note

The device settings stored in non-volatile memory never become active until after a reset.

The timeout command indicates that the amount of time after which the system will no longer wait for additional characters in a command. The user receives an error message on expiry of the timeout. The time must be set to "0" in order to deactivate the timeout.

The number of data bits is always 8. A parity bit is never used.
The following settings are possible:

<Timeout>:	"**0**" ... "100" (x 100 ms, Timeout in 100 ms steps)
<Baud>:	"1200" , "2400" , "4800" , "**9600**" , "19200", "38400"

A timeout of "**0**" and a baudrate of "**9600**" are prescribed as standard values.

get state:

Command:	**GS**<CHCK><ETX>
Response:	<Status> TO:<Timeout> BD:<Baud> HD1:<Status><TagType> HD2:<Status><TagType> HD3:<Status><TagType> HD4:<Status><TagType><CHCK><ETX>

This commands is used to read device settings stored in non-volatile memory in the control interface that become active after the next reset.

Note

The device settings stored in non-volatile memory never become active until after a reset.

reset:

Command:	**RS**<CHCK><ETX>
Response:	2<CHCK><ETX>

Resetting the control interface causes all commands in process to be interrupted. This command is used to reload device settings from non-volatile memory.

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7.3.2 Read/write commands

The following section describes the structure of memory for specific data carriers that are used. There will be no further description of the data carrier type IPC01, since it is no longer available.

Data carrier IPC02

Data range WordNum	Address	Structure of memory
-	-	Fixed code read range (5 bytes)

Data carrier IPC03

Max. data range WordNum	Address	Structure of memory
1D	0000	Read/write range (116 bytes) = 29 double words
1C	0001	
...	...	
	...	
	...	
01	001C	
01	001D	Fixed code/read range (4 bytes)

In addition to EEPROM memory consisting of 116 bytes, IPC03 data carriers contain a 4-byte fixed code that can be read either with the fixed code commands "SF" and "EF" or with the read commands "SR" and "ER".

Data carrier IPC10

Max. data range WordNum	Address	Structure of memory
1	0000	Read/write range (12 bytes) formattable in 1 or 3 double words
3		

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Issue date

single read:

Command: **SR**<LkNo><WordAddr><WordNum><CHCK><ETX>
Response: <Status><LkNo><Data><CHCK><ETX>

Exactly one attempt is made to read <WordNum> double words starting at address <WordAddr>.

enhanced read:

Command: **ER**<LkNo><WordAddr><WordNum><CHCK><ETX>
Response: <Status><LkNo><Data><CHCK><ETX>

A continuous attempt is made to read <WordNum> double words<WordAddr> from the address. Only changed data is transferred via the interface. This ensures that there is no double reading of data carriers. If a data carrier leaves the reading range, the status '5' is generated.

single write:

Command: **SW**<LkNo><WordAddr><WordNum><Data><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

Exactly one attempt is made to write <WordNum> double words starting at address <WordAddr>.

enhanced write:

Command: **EW**<LkNo><WordAddr><WordNum><Data><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

A continuous attempt is made to read <WordNum> double words<WordAddr> from the address. After each successful write, the status is evaluated and the system waits until a new data carrier is within the detection range. This ensures that there is no double writing to data carriers. The command sequence then starts again.

single read fixed code:

Command: **SF**<LkNo><CHCK><ETX>
Response: <Status><LkNo><Data><CHCK><ETX>

One attempt is made to read a fixed code.

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enhanced read fixed code:

Command:	**EF**<LkNo><CHCK><ETX>
Response:	<Status><LkNo><Data><CHCK><ETX>

A continuously attempt is made to read a fixed code. Only changed data is transferred via the interface. This ensures that there is no double reading of data carriers. If a data carrier leaves the reading range, the status '5' is generated.

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7.3.3 Configuration commands of the IPC03

Note

These commands can only be used if the data carrier type is set to '03' (IPC03). They cannot be used in autodetect mode (mixed operation, data carrier type '00')!

The memory of the data carrier IPC03 is constructed as follows:

Address	Meaning	<WordAddr>	<ConfAddr>	Remarks
Word 00	Password	-	-	Write only
Word 01	Protection word	-	'1'	Read/write
Word 02	Control word	-	'2'	Read/write
Word 03...31	Data range	'00' ... '1C'	-	Read/write
Word 32	Device serial number	'1D'	-	Read only
Word 33	Device identification	'1E'	-	Read only

Each "word" comprises 32 bits. The IPC03 has a "Protection word" and a "Control word". Access to both words can only be obtained with the correct password. The individual bits have the following meaning:

Control word

Bit	Meaning
0...7	Read range-start
8...15	Read range-end
16	Password protection on/off
17	Read-after-Write operating mode on/off
18...31	freely usable

Protection word

Bit	Meaning
0...7	First read-protected word
8...15	Last read-protected word
16...23	First write-protected word
24...31	Last write-protected word

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It should be noted with "Control" and "Protection Word" that for communication of a word, the highest order byte is transferred first and the lowest order byte is transferred last. When specifying read and write-protected words, the words are counted in the following manner:

00 Password

01 Protection Word

02 Control Word

03 1. Data word

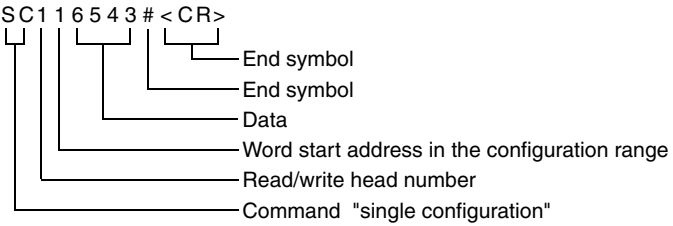
04 2. Data word

... ...

1F 29. Data word

Example:

Read/write head 1 is used to set the first two data words to read protected. The next two data words are write protected. To do this, send the command "single configuration"



It is possible to protect Control and Protection Word before writing. After that, the configuration can no longer be changed.

Access to the data in the data range can be obtained with the read commands and statements for the desired address and data numbers described above (selective read mode).

As soon as power is flowing to the data carrier, the data carrier sends the data range that is defined by specifying the beginning and end of the read range in the Control Word (default read mode). The data range between the beginning and end of the read range can be set with the read commands "single read" and "enhanced read" if <WordAddr> is set to '0000' and <WordNum> is set to '00'.

If the password protection is switched off, every data word that lies outside the write-protected range can be written in. If a word is to be written in this range, the "Protection word" must be changed accordingly.

With the password protection switched on, every data word can be written in that lies outside the write-protected range. The prerequisite is that the correct password has been set with the password-set command and the password mode has been switched on with the password-mode command.

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If the password protection has been switched off, each data word can be read.

When password protection is turned on, the read-protected range is active, i. e. reading is only possible from this range if the correct password has been set with the password-set command and password mode has been turned on with the password-mode command. If the read-protected range is read while password-mode is turned off, data is set to "0 x 000".

The read-after-write operating mode is not used by this read/write station, so that this bit has no significance here.

The start and end, respectively, of the read-protected and write-protected range are fixed with the "Protection word".

single configuration:

Command: **SC**<LkNo><ConfAddr><Data><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

Exactly one attempt is made to write a word in the configuration range from address . <ConfAddr> In order to write in the configuration range, the password-mode must be active.

enhanced configuration:

Command: **EC**<LkNo><ConfAddr><Data><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

A continuously attempt is made to write a word in the configuration range at address <ConfAddr>. After each successful write, the status is evaluated and the system waits until a new data carrier is within the detection range. This ensures that there is no double writing to data carriers. The command sequence then starts again. In order to write in the configuration range, the password-mode must be active.

single get configuration:

Command: **SG**<LkNo><ConfAddr><CHCK><ETX>
Response: <Status><LkNo><Data><CHCK><ETX>

Exactly one attempt is made to read a word in the configuration range ("Protection word" or "Control word") from address <ConfAddr>.

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enhanced get configuration:

Command:	**EG**<LkNo><ConfAddr><CHCK><ETX>
Response:	<Status><LkNo><Data><CHCK><ETX>

A continuously attempt is made to read a word in the configuration range from address <ConfAddr>. After each successful write, the status is evaluated and the system waits until a new data carrier is within the detection range. This ensures that there is no double reading of data carriers.

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7.3.4 Password mode of the IPC03

Note

The password is a 32 bit word that is set to "0" before a new IPC03 data carrier leaves the factory. The password cannot be read. In order to write the passwords for the "Control-Word" and the "Protection-Word", the processing must always be in password mode.

password mode:

Command: **PM**<LkNo><Mode><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

Activates (Mode= "1") and deactivates (Mode= "0") the password mode of the read/write heads. In the password mode, the password is transferred to the data carrier before each read/write access. If a data carrier is addressed with an incorrect password, then further access is also denied to data ranges for which no password protection is set.

password set:

Command: **PS**<LkNo><Password><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

Sets the password in the read/write head, which the read/write head communicates to the data carrier in the password mode.

password change:

Command: **PC**<LkNo><OldPW><NewPW><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

Changes the password in a data carrier. First the old and then the new password must be entered. If the password has been successfully written, then the password in the read/write head also changed. The command "password set" is no longer necessary. The IPC03 password can also be changed when the password mode is deactivated.

Password mode is deactivated when the read/write head is deactivated, i. e. when the control interface is turned off and the password is reset to '0000' in the read/write head.

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7.3.5 Commands for the IPC10 (Nova-Chip)

The IPC10 data carrier is formatted during the first write process. It can therefore only be read if it has previously been written.

The beginning word address must be set to '0' for write and read commands.
The number of words can be 1 or 3 for write commands. The number of words is set to ’0’ for read commands since exactly as many words are read as were previously written.

An IPC10 can be programmed so that it behaves as an IPC02. The commands "SX" and "EX" are used for this purpose. This programming takes place once only, i. e. it cannot be undone (code that is written once cannot be overwritten). The code is read with the commands "SF" and "EF" for an IPC02.

<Fixtype> is always "02" here and <Fixlen> is always "05", since 5 bytes must always be written.

single write fixed code:

Command: **SX**<LkNo><FixType><FixLen><Data><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

Exactly one attempt is made to read a fixed code.

enhanced write fixed code:

Command: **EX**<LkNo><FixType><FixLen><Data><CHCK><ETX>
Response: <Status><LkNo><CHCK><ETX>

A continuously attempt is made to write a fixed code. After each successful write, the status is evaluated and the system waits until a new data carrier is within the detection range. This ensures that there is no double writing to data carriers. The command sequence then starts again.

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7.4 Legend

<OldPW> : 4 Byte HEX, old password
<Baud> . Baudrate; 1200, 2400, 4800, 9600, 19200, 38400 (kbit/s)
<CHCK> : 1 byte HEX, 8-bit checksum derived by adding all previous characters, without overflow.
<ConfAddr> : Word start address in the configuration range of the data carrier. 1 ASCII character, range from ’0’ to ’F’ depending on the data carrier type.
<CR> : 1 ASCII character, 13d, carriage return
<Data> : <WordNum> times 4 bytes HEX
<ETX> : 1 ASCII character, 03d, End of Text
<FixLen> : 2 ASCII characters from ’0’ to ’F’,
Number of bytes of the fixed code, for IPC02=’05’
<FixType> : 2 ASCII characters, number of the fixed code, for IPC02=’02’
<LkName> : n ASCII characters (depending on the type order code)
<LF> : 1 ASCII character, 10d, Line feed
<LkNo> : 1 ASCII character, read/write number ('1', '2', '3', '4', 'x')
x - all connected read/write heads
<Mode> 1 ASCII character,
’0’ activates or ’1’ deactivates password mode
<NewPW> : 4 bytes HEX, new password
<Part-No> : Item number, 6 ASCII characters ’0’ to ’9’
<Password> : 4 bytes HEX, current password
<Status> : 1 character ASCII

Status	Error
'0'	No error
'2'	Switch-on message, device is ready for operation.
'4'	Wrong or incomplete command, or parameter not in the valid range.
'5'	Read error or write error.
'6'	Hardware error, read/write head not detected
'7'	Software error
'8'	Service interface

<SW-No> : Software number of the application software
<SW-Date> : Version date of the application software
<Timeout> : 1 to 3 ASCII characters
Timeout of interface (0 ... 100) x 100 ms, after this time expires, an error message will be sent.
’0’ deactivates the timeout
<TagType> : 2 ASCII characters (see the command "change tag")
<WordAddr> : 4 ASCII characters, work beginning address in the data carrier, range from ’0000’ to ’FFFF’ depending on the data carrier type
<WordNum> : 2 ASCII characters, number of words to be read or written, range from ’00’ to ’FF’ depending on the data carrier type.

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8 Technical data

8.1 Dimensions

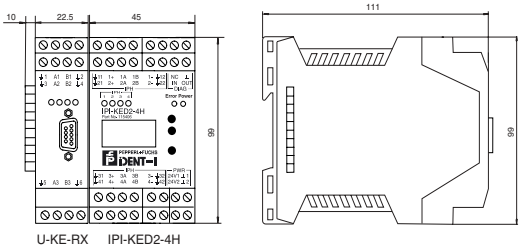

Figure 8.1: External dimensions

8.2 General data

Serial interface	
Type	RS 232, RS 485, RS 422 or TTY
Transfer rate in baud	1200, 2400, 4800, 9600, 19200, 38400
Permissible overall cable length	15 m for RS 232, otherwise 1000 m

Electrical data:	
Operating voltage U_B	20 V DC ... 30 V DC, PELV
Ripple	± 10 %, at U_B = 30 V
Current consumption for U_B= 24 V	< 300 mA with 1 read/write head < 750 mA with 4 active read/write heads

Mechanical data	
Housing material	PA (Polyamide)
Ambient temperature	-25 °C ... +55 °C
Storage temperature	-25 °C ... +80 °C
Protection class in accordance with EN 60529	IP20 in conjunction with U-KE-RX

Connection	**IPI-KED2-4H**	**U-KE-RX**
	Terminal strips, Fieldbus connector	Terminal strips, Fieldbus connector, Sub-D connector

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8.3 Reading distances

(in air at 25 °C)

Data carrier	Reading distance in mm		
	IPH-L2-V1 Varikont L	IPH-18GM-V1 M18	IPH-30GM-V1 M30
IPC02-20W	0 ... 30	0 ... 20	0 ... 25
IPC02-30W	0 ... 40	0 ... 25	0 ... 30
IPC02-50W	0 ... 60	0 ... 40	0 ... 50
IPC02-C1	0 ... 60	0 ... 40	0 ... 50
IPC02-68-T7	0 ... 40	0 ... 25	0 ... 30
IPC03-20W	0 ... 30	0 ... 20	0 ... 25
IPC03-30W	0 ... 40	0 ... 25	0 ... 30
IPC03-50W	0 ... 60	0 ... 40	0 ... 50
IPC03-C1	0 ... 60	0 ... 40	0 ... 50
IPC10-20	0 ... 30	0 ... 20	0 ... 25

8.4 Writing distance

(in air at 25 °C)

Data carrier	Writing distance in mm		
	IPH-L2-V1 Varikont L	IPH-18GM-V1 M18	IPH-30GM-V1 M30
IPC03-20W	0 ... 25	0 ... 15	0 ... 20
IPC03-30W	0 ... 30	0 ... 20	0 ... 25
IPC03-50W	0 ... 40	0 ... 30	0 ... 35
IPC03-C1	0 ... 40	0 ... 30	0 ... 35
IPC10-20	0 ... 25	0 ... 15	0 ... 20

Note

The read and write distance decreases when data carriers are mounted on metal.

The distance between the data carriers and metal must be at least 10 mm.

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9 ASCII table

hex	dec.	ASCII	hex	dec.	ASCII	hex	dec.	ASCII	hex	dec.	ASCII
00	0	NUL	20	32	Space	40	64	@	60	96	‘
01	1	SOH	21	33	!	41	65	A	61	97	a
02	2	STX	22	34	"	42	66	B	62	98	b
03	3	ETX	23	35	#	43	67	C	63	99	c
04	4	EOT	24	36	$	44	68	D	64	100	d
05	5	ENQ	25	37	%	45	69	I	65	101	e
06	6	ACK	26	38	&	46	70	F	66	102	f
07	7	BEL	27	39	‘	47	71	G	67	103	g
08	8	BS	28	40	(	48	72	H	68	104	h
09	9	HT	29	41	)	49	73	I	69	105	i
0A	10	LF	2A	42	*	4A	74	J	6A	106	j
0B	11	VT	2B	43	+	4B	75	K	6B	107	k
0C	12	FF	2C	44	,	4C	76	L	6C	108	L
0D	13	CR	2D	45	-	4D	77	M	6D	109	m
0E	14	SO	2E	46	.	4E	78	N	6E	110	N
0F	15	SI	2F	47	/	4F	79	O	6F	111	o
10	16	DLE	30	48	0	50	80	P	70	112	p
11	17	DC1	31	49	1	51	81	Q	71	113	q
12	18	DC2	32	50	2	52	82	R	72	114	r
13	19	DC3	33	51	3	53	83	S	73	115	s
14	20	DC4	34	52	4	54	84	T	74	116	T
15	21	NAK	35	53	5	55	85	U	75	117	u
16	22	SYN	36	54	6	56	86	V	76	118	v
17	23	ETB	37	55	7	57	87	W	77	119	w
18	24	CAN	38	56	8	58	88	X	78	120	x
19	25	EM	39	57	9	59	89	Y	79	121	y
1A	26	SUB	3A	58	:	5A	90	Z	7A	122	z
1B	27	ESC	3B	59	;	5B	91	[	7B	123	{
1C	28	FS	3C	60	<	5C	92	\	7C	124	|
1D	29	GS	3D	61	=	5D	93	]	7D	125	}
1E	30	RS	3E	62	>	5E	94	^	7E	126	~
1F	31	US	3F	63	?	5F	95	_	7F	127	DEL

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