

Electronic-Key-System

Manual

Electronic-Key Adapter EKS and EKS *FSA* with USB Interface

Order No. 094 485



EKS.
USB



More than safety.



EUCHNER

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1 General notes

1.1 Use of the manual

This manual describes the technical features and the function of the EKS Electronic-Key adapter EKS-A-IUX-G01-ST01 with USB interface (order. no. 092 750) as well as the version EKS-A-IUXA-G01-ST01/04, EKS For Safety Applications (EKS FSA, order no. 098 513). The complete evaluation and interface electronics for data transmission are integrated into these units.

1.1.1 Explanation of symbols

The following symbols are used in this manual to identify important instructions and useful information:

**Danger!**

Identifies an immediate hazard. If not avoided, the consequence will be fatality or very serious injuries.

**Warning!**

Identifies a possible hazard. If not avoided, the consequence may be fatality or very serious injuries.

**Caution!**

Identifies a possible hazard. If not avoided, minor injuries or damage may result.

**Warning!**

Risk of damage to material or machine or degradation of function.

**Information!**

Important information is provided to the user here.

1.1.2 Abbreviations

The following abbreviations are used in this manual:

- ▶ **AC** Alternating **C**urrent
- ▶ **BCC** **B**lock **C**heck **C**harter
- ▶ **CTS** **C**lear **T**o **S**end
- ▶ **DC** **D**irect **C**urrent
- ▶ **DIP** **D**ual **I**ncline **P**ackage
- ▶ **DLE** **D**ata **L**ink **E**scape
- ▶ **E²PROM** **E**lectrically **E**rasable **P**rogrammable **R**ead-**O**nly **M**emory
- ▶ **EKS** **E**lectronic-**K**ey-**S**ystem
- ▶ **EKS FSA** **E**lectronic-**K**ey-**S**ystem **F**or **S**afety **A**pplications
- ▶ **ETX** **E**nd of **T**e**X**t
- ▶ **LED** **L**ight **E**mitting **D**iode
- ▶ **NAK** **N**egative **A**cknowledgement
- ▶ **PA** **P**oly**A**amide
- ▶ **ADT** **A**cknowledgement **D**elay **T**ime)
- ▶ **ROM** **R**ead-**O**nly **M**emory
- ▶ **STX** **S**tart of **T**e**X**t
- ▶ **USB** **U**niversal **S**erial **B**us
- ▶ **CDT** **C**harter **D**elay **T**ime

1.2 CE conformity

The EKS Electronic-Key adapters with USB interface conform to the **EMC directive** 89/336/EEC (92/31/EEC, 93/68/EEC) and the **low voltage directive** 73/23/EEC (93/68/EEC, 98/79/EC).

The Electronic-Key adapters comply with the following European / international standards:

- ▶ EN 61000-6-2 Electromagnetic compatibility (EMC). Generic standards - Immunity for industrial environments
- ▶ EN 55011 Industrial, scientific and medical (ISM) radio-frequency equipment - Radio disturbance characteristics - Limits and methods of measurement


1.3 Correct use

As part of a higher-level overall system, the EKS Electronic-Key adapter is used for access control and monitoring on PC-based control systems or parts of control systems for machine installations. EKS can be used, for example, as part of an overall system for checking access rights on operating mode selection. However, it is not allowed to directly derive the operating mode from the access rights on the Electronic-Key. If the selection of the operating mode is safety-related, the selection is not allowed to be made by the EKS; instead an additional device for the selection of the operating mode must be used. This could, e. g., be the graphical user interface on the control system.

The version EKS *FSA* has outputs that can be utilized to form a safe shut-down signal (for block diagram see section 3.1.2). For this purpose a safe evaluation must be included downstream. The EKS *FSA* can then be used for safety-related tasks. The machine must be reset to a safe operating mode by removing the Electronic-Key. A hazard analysis on this aspect must be prepared as per the requirements in the machinery directive. The risk and the necessary risk minimization by technical means must be determined using a suitable standard. The following requirements must be met for usage:

- ▶ The data signal (channel LB) and the switched output LA1/LA2 (channel LA) must be polled by a safe downstream evaluation to suit the risk determined. The data wire (channel LB) is used to supply the information as to whether or not an Electronic-Key is inserted and which access rights are assigned to the Electronic-Key. The output LA1/LA2 (channel LA) is used for the redundant supply of the information as to whether or not an Electronic-Key is inserted (independent of the access rights). The data wire or, alternatively, the switched output LB1/LB2 can be used as channel LB. The output LB1/LB2 is used to supply (like LA1/LA2) only the information as to whether or not an Electronic-Key is inserted (independent of the access rights). The usage of the output LB1/LB2 is optional.
- ▶ The control system must check whether the Electronic-Key inserted is authorized to select the operating mode and whether the access rights on the Electronic Key permit operation in the operating mode currently selected.
- ▶ The user must select the related operating mode using the control system or another suitable circuit.
- ▶ The manufacturer of the system must check which safety level is reached with the overall system and whether the overall system provides adequate safety against hazards in the intended application.

Information!

 The machinery directive 98/37/EC provides information on the selection of the operating mode. It is imperative this information is followed.

When designing machines and using the Electronic-Key adapter, the national and international regulations and standards specific to the application must be observed, e.g.:

- ▶ EN 60204, Safety of machinery. Electrical equipment of machines
- ▶ EN 12100-1, Safety of machinery. Basic concepts, general principles for design - part 1: basic terminology, methodology
- ▶ EN 954-1, Safety of machinery. Safety related parts of control systems - part 1: general principles for design
- ▶ EN 62061, Safety of machinery. Functional safety of safety-related electrical, electronic and programmable electronic control systems
- ▶ EN ISO 13849-1, Safety of machinery. Safety related parts of control systems - part 1: general principles for design

Modifications to the electronics of the Electronic-Key adapter and any other changes, especially mechanical modifications and reworking, are not permissible and will result in the loss of the warranty and exclusion of liability.

The Electronic-Key adapter must only be employed and used in accordance

- ▶ with this manual and
- ▶ other documentation referred to in this manual.

The EKS Electronic-Key adapter is not a safety component in the context of the machinery directive.

Without additional precautions the EKS Electronic-Key adapter must not be used to provide a safety function, particularly if failure or malfunction of the unit could endanger the safety or health of people in the operating area of a machine.

1.4 Obligations on the operating organization

The manufacturer and the organization operating the higher-level overall system, e.g. a machine installation, are responsible for the observance of national and international safety and accident prevention regulations applicable in the specific case.

2 Safety precautions

**Warning!**

The EKS Electronic-Key adapter is not a safety component in the context of the machinery directive. Without additional precautions the EKS Electronic-Key adapter must not be used to provide a safety function, particularly if failure or malfunction of the unit could endanger the safety or health of persons in the operating area of a machine. On this topic pay particular attention to the sections *Correct use* (see section 1.3) and *Electrical connection* (see section 6).

**Warning!**

Mounting and electrical connection are only allowed to be performed by authorized personnel who are familiar with the applicable regulations on accident prevention and have read and understood this manual.

Furthermore, the mounting and electrical connection of the version EKS *FSA* are only allowed to be performed by personnel familiar with handling safety components.

**Caution!**

Modifications to the electronics of the Electronic-Key adapter and any other changes, especially mechanical modifications and reworking, are not permissible and will result in the loss of the warranty.

3 Function

3.1 Functional description

3.1.1 Common functions EKS standard and version EKS FSA

The EKS is used for access control and monitoring on PC-based control systems or parts of control systems for machine installations.

Instead of passwords, coded Electronic-Keys are assigned. In this way unauthorized access to control and display systems is prevented to the greatest possible extent.


The EKS uses a non-contact, inductive read/write identification system.

It comprises:

- ▶ Electronic-Key
- ▶ Electronic-Key adapter

The user is responsible for organizing the programming of the application, integration in an overall system and the assignment and use of the freely programmable memory in the Electronic-Key.

Information!

-  For easier organization and management of your Electronic-Keys and the data they contain, EUCHNER provides the Electronic-Key-Manager software, (EKM).

The Electronic-Key adapter is a read/write system with integrated evaluation electronics and interface.

Due to the transfer of data without using any contacts, from the access side the Electronic-Key adapter has the high degree of protection of IP 67, i.e. it is suitable for industrial use. The Electronic-Key adapter can be installed in accordance with DIN 43700 in any control panel with a standard cut-out of 33 mm x 68 mm. The Electronic-Key adapter is fastened by means of screw clamp elements from the rear side of the panel in order to exclude unauthorized manipulation from the operator side.

The system is connected using the integrated USB interface that is designed as a virtual COM port in Windows[®]-based systems. The power supply is also provided via the USB connection.

Setup and system integration can be realized straightforwardly and quickly on the Electronic-Key adapter with USB interface. Data communication is in accordance with the transfer protocol 3964R.

On Electronic-Keys read/write with 116 bytes, the memory is organized in 4-byte blocks. This means a multiple of 4-byte sized blocks must always be written.

The current state of the Electronic-Key adapter is displayed using a 2-color LED.

The Electronic-Keys are tag shaped. The complete transponder with memory chip and antenna is integrated into the Electronic-Key. The transponder does not have a battery.

For operation, the Electronic-Key is inserted in the Electronic-Key adapter and is held in place by a spring clip. The power supply for the transponder and the data are transferred without contact between the Electronic-Key adapter and the Electronic-Key.



Figure: Cut-away illustration of Electronic-Key adapter

The data carrier in the Electronic-Key is equipped with a combined memory:

- ▶ 116 bytes E²PROM (programmable) plus 8 bytes ROM (serial number)

3.1.2 Additional functions of the version EKS FSA

The version EKS FSA has two additional semiconductor relay outputs (LA1/LA2 and optionally LB1/LB2) that are switched off as long as there is no Electronic-Key in the Electronic-Key adapter or it is not possible to read the Electronic-Key.

The semiconductor relay outputs are electrically isolated from the device electronics and from each other. Either AC or DC can be switched.

Each of the outputs is operated diversely by a dedicated processor that switches off the outputs on the removal of the Electronic-Key (see Figure Block diagram EKS FSA).

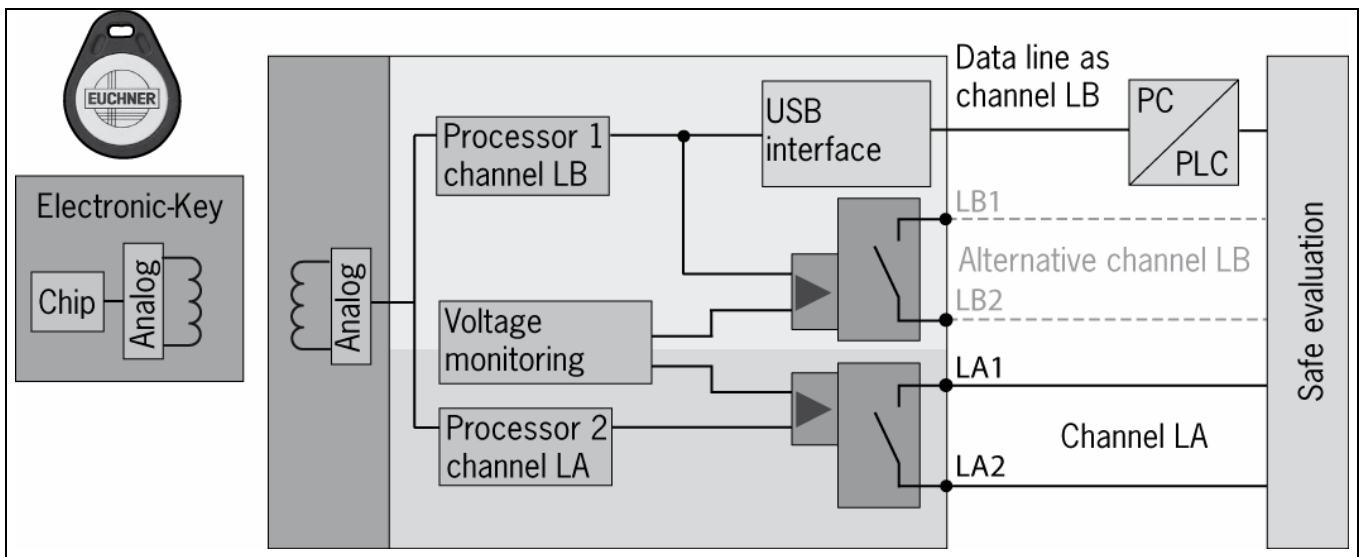


Figure: Block diagram EKS FSA

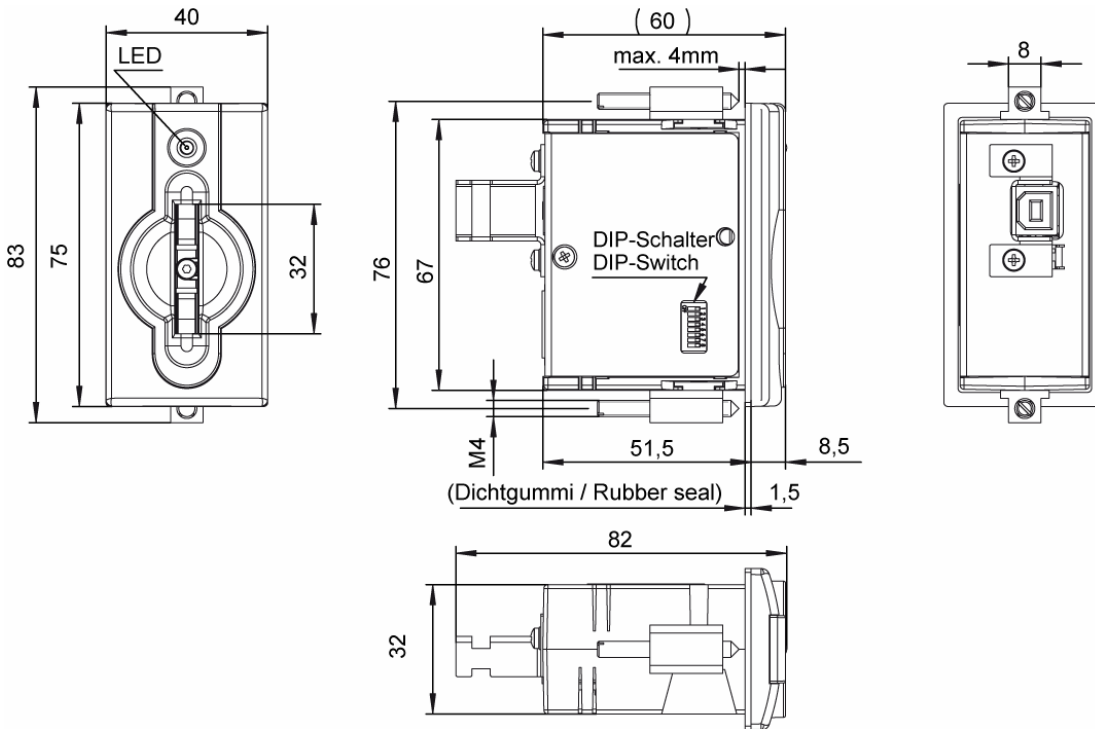
By separately evaluating channel LA and channel LB, the EKS FSA device can be used in conjunction with a safe evaluation in safety-related applications. Integrated voltage monitoring switches off the switching contacts LA and LB if the power supply drops below 4.5 V or exceeds 5.5 V.

4 Technical data

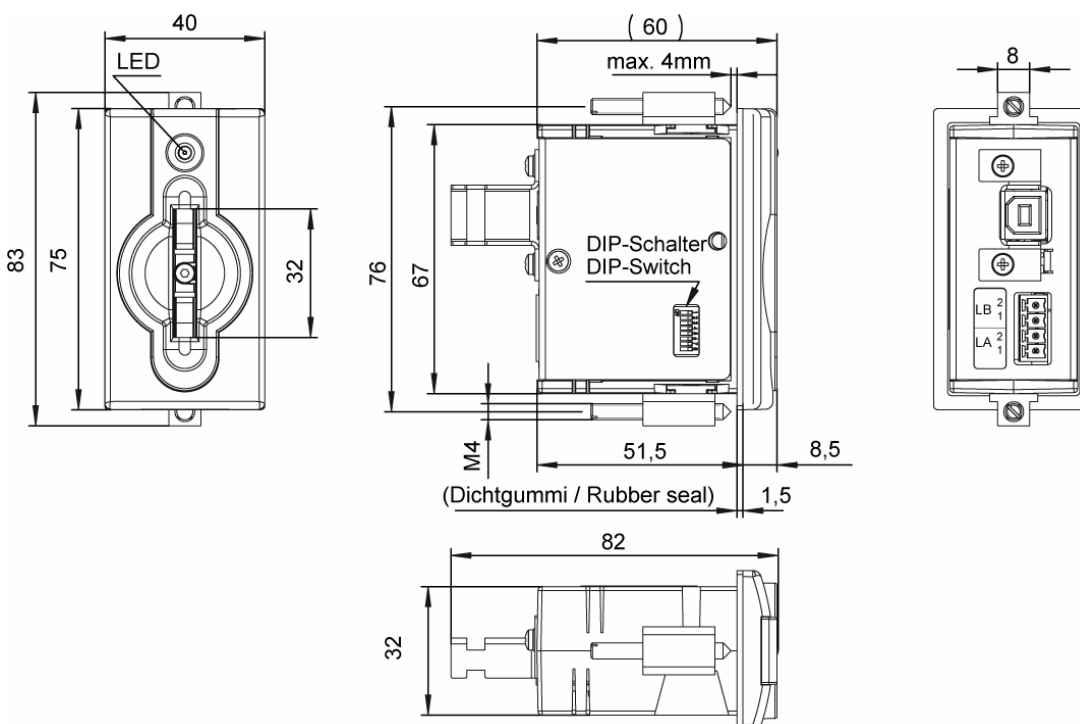
4.1 Dimension drawing Electronic-Key adapter

For installation in a control panel you must provide a cut-out 33 mm x 68 mm in accordance with DIN 43700.

4.1.1 Version EKS-A-IUX-G01-ST01 with USB interface



4.1.2 Version EKS-A-IUXA-G01-ST01/04 (EKS FSA) with USB interface



4.2 Technical data, Electronic-Key adapter

Attention!

- ! All the electrical connections must either be isolated from the mains supply by a safety transformer according to EN IEC 61558-2-6 with limited output voltage in the event of a fault, or by other equivalent isolation measures.

General parameters	Value			Unit
	min.	typ.	max.	
Housing	Plastic (PA 6 GF30 gray)			
Degree of protection according to EN 60529	IP 67 in mounted condition			
Ambient temperature	0		+ 55	°C
Mounting cut-out according to DIN 43700	33 x 68			mm
Power supply	Via USB			
Current consumption			100	mA
Interface, data transfer				
Interface to the PC	USB full speed (USB 1.1 and USB 2.0 compatible)			
Transfer protocol	3964R			
Data transfer rate		9.6		kbaud
Data format	1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit			
USB interface connection type	Type B			
Cable length			3	m
LED indicator	Green: "Ready" (in operation) Yellow: "Electronic-Key active" *			
Parameters for the outputs LA and LB (version EKS FSA only)				
Power supply for load U (LA, LB)		24	30	V
Switching current per output	1		50	mA
Number of actuations of the overload protection		100		
Output voltage high for U (LA, LB)	U x 0.9		U	V
Resistance in switched on state		35		Ohm
Capacitance per output			2	nF
Additional capacitive load per output			1	µF
Utilization category according to EN IEC 60947-5-2	AC-12 AC-15 DC-12 DC-13	50 mA / 24 V		
Difference time between the outputs** (LB first)		200		ms
Connection type screw terminals, 2 x 2-pole	0.14		1.5	mm ²

* The LED illuminates yellow if there is a functional Electronic-Key in the Electronic-Key adapter.


** If access on the USB interface takes place during the insertion or removal of the Electronic-Key, the difference time can be more than 200 ms.

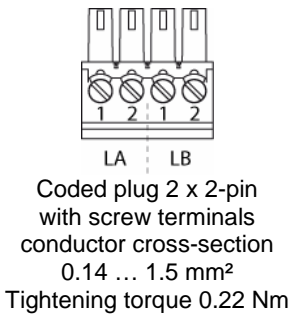
4.3 Connector configuration

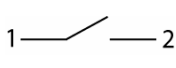
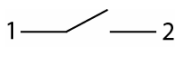
4.3.1 Socket USB interface

The socket on the Electronic-Key adapter is designed as USB type B.

4.3.2 Screw terminals outputs LA1/LA2 and LB1/LB2 (only EKS FSA)

Information!
 The coded plug for the connection of the outputs is included with the Electronic-Key adapter.



Channel	Pin	Function
LA	1	 Normally open contact channel LA
	2	
LB	1	 Normally open contact channel LB
	2	

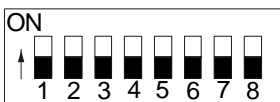
4.4 DIP switch settings

Using the DIP switches S1 to S8, various parameters can be set.

Write protection can be enabled using DIP switch S1. In this way the writing of data to the Electronic-Key read/write is prevented.


The settings are only applied when the power supply is switched on.

DIP switches, 8-pole:



DIP switch	Functions	Factory setting
S8	OFF = Electronic-Key read/write ON = Electronic-Key read-only *	OFF
S7		OFF
S6		OFF
S5		OFF
S4		OFF
S3		OFF
S2		OFF
S1	ON = write protection for Electronic-Key read/write	OFF

* The read-only transponder type can also be read using the Electronic-Key adapter with USB interface. However, we do not recommend using this transponder type in new installations. The read-only transponder cannot be used in conjunction with the version EKS FSA.

Information!
 It is **imperative** that all DIP switches without a function (S2 to S7) are set to **OFF!** In this way problems with any functions added in the future will be avoided.

4.5 LED indicator

The Electronic-Key adapter operating states are indicated using a 2-color LED on the front. The illumination of the LED in any color indicates the presence of the operating voltage.

Color	Operating status	Description
Green	Ready	Electronic-Key adapter supplied with power and ready.
Yellow	Electronic-Key active	There is an Electronic-Key in the Electronic-Key adapter and it has been detected.

5 Mounting

**Warning!**

Mounting must be performed only by authorized personnel.

**Warning!**

To achieve the degree of protection IP 67, it is necessary to install the electronic key adapter in a clean, flat metal panel at least 2 mm thick and to tighten the screws with a tightening torque of 0.25 ... 0.35 Nm.

A suitable strain relief must be provided for the connection cables in order to avoid damage to the connection sockets or malfunctions.

The electronic key adapter is intended for mounting in control panels with a cut-out measuring 33 mm x 68 mm according to DIN 43700 (see section 4.1). The device is fastened using screw clamp elements from the rear side of the panel.

**Information!**

The screw clamp elements for front panel mounting are included with the Electronic-Key adapter.

1. Insert Electronic-Key adapter, **with seal already bonded in place**, into the mounting cut-out from the front.
2. Insert screw clamp elements in the housing of the Electronic-Key adapter from the side up to the stop and tighten with 0.25 ... 0.35 Nm.

**Warning!**

The device may be damaged if the tightening torque applied exceeds 0.35 Nm.

3. After mounting, again check the Electronic-Key adapter for firm seating and correct sealing of the front panel.

6 Electrical connection



Warning!

If connected incorrectly, the Electronic-Key adapter may be damaged.

- ▶ Pay attention to electrical data and pin assignments (see section 4)
- ▶ When making connections, the operating organization must ensure compliance with the EMC safety requirements in accordance with EN 55011 and EN 61000-6-2.
- ▶ Do not lay connection cables close to sources of interference.

6.1 USB connection

The interface for the Electronic-Key adapter is compatible with the standards USB 1.1 and USB 2.0.



Information!

- ▶ Only a USB 1.1 or USB 2.0 cable with a maximum length of 3 m is allowed to be used for the connection cable.
- ▶ The Electronic-Key adapter must always be connected to the same USB port to ensure the correct allocation of the virtual COM port in Windows®-based systems.
- ▶ If a USB hub is connected in between, or the Electronic-Key adapter must be moved, a new COM port allocation must be made. This action can only be performed with administrator rights (only for Windows®).

6.2 Connection of the outputs (only for EKS FSA)



Warning!

Incorrect connection or errors in the safety-related integration of the EKS FSA can have fatal results. For this reason note the following safety aspects:

- ▶ It is not possible to generate a safe signal by using only the switched outputs LA1/LA2 and LB1/LB2. Safe, downstream evaluation is always necessary (e. g. using a safety relay). The usage of the switched output LB1/LB2 as an alternative to the data wire is optional.
- ▶ The safe evaluation must always be dual-channel. For this purpose there are two alternatives:
 - Evaluation of output LA1/LA2 as channel LA together with an evaluation of the data wire as channel LB (recommended)
 - Evaluation of output LA1/LA2 as channel LA together with the output LB1/LB2 as channel LB
- ▶ Integrate the EKS FSA as defined in the following connection examples from EUCHNER.



Warning!

The power is also supplied via the USB connection. If the power supply drops below 4.5 V or exceeds 5.5 V, the outputs LA1/LA2 and LB1/LB2 are switched off.

6.2.1 Connection example with enabling switch

Note:
The related control system output is only set if the related EKS-Electronic-Key is inserted and a suitable operating mode selected.

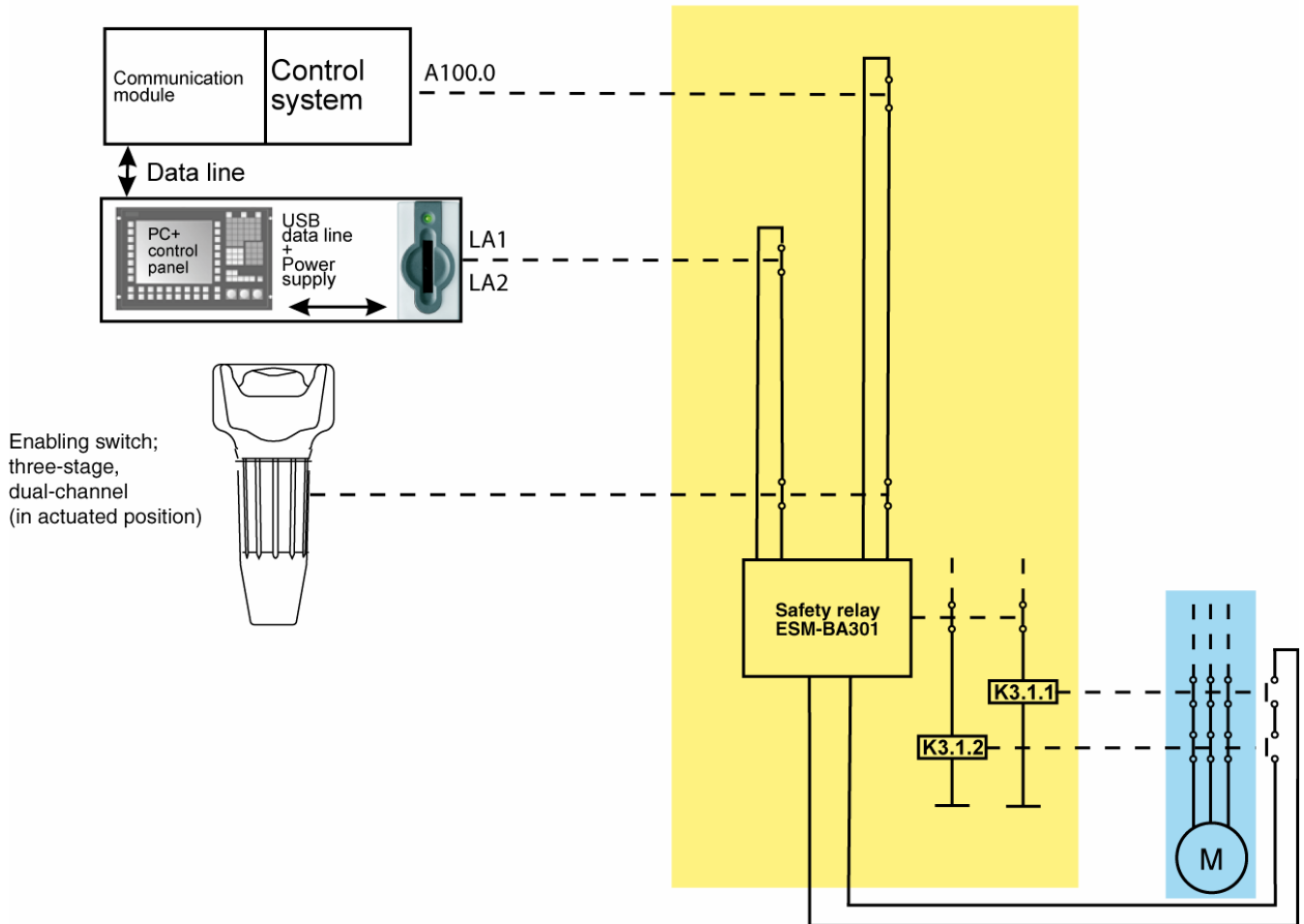


Figure: Principle of operation (illustration with selected operating mode and all parts in actuated position)

6.2.1.1 Description of the application example with enabling switch

The danger area on a machine is secured with a fence. To make set-up work on the machine possible with the guard open, an EKS FSA system is integrated in conjunction with a control system, an enabling switch and a safety relay. The safety relay must comply with the following requirements:

- ▶ Detection of short-circuits and earth faults. A short-circuit can be detected in the safety path in the circuit described due to the fact that both, the positive path and earth path, of the safety relay are switched. In this case, the safety relay deactivates its safety outputs.
- ▶ Simultaneity monitoring: the safety relay must detect whether the safety inputs are switched practically simultaneously. If this is not the case, the safety outputs are not switched and the unit switches to fault state. A renewed start is possible only after the enabling switch has been enabled and then operated again.

The switching contact LA1/LA2 is closed on the insertion of the Electronic-Key. The EKS FSA is coupled to a PC. After the insertion of the Electronic-Key the PC checks whether the key is authorized for work in the selected operating mode. If this is not the case, the operating mode cannot be set. If suitable access rights are available, the control system gives the instruction to the switching contact A100.0 to close.

The switching contact LA1/LA2, in series with a switching contact on the enabling switch, is connected to the first input on the safety relay. The switching contact A100.0, in series with the second switching contact on the enabling switch, is connected to the second input on the safety relay. The result is that these inputs on the safety relay are only enabled if

- ▶ the EKS *FSA* (switching contact LA1/LA2) and
- ▶ the control system (switching contact A100.0) provide the related release and
- ▶ the enabling switch is actuated.

The output contacts on the safety relay are only enabled on the actuation of the enabling switch.

The safety relay is de-energized without a time delay (stop category 0) and the machine movement is stopped if

- ▶ the Electronic-Key is removed or
- ▶ the enabling switch is released or
- ▶ the machine control system withdraws the release (contact A100.0 is opened).



Note!

The control system output A100.0 is only allowed to be set if

- ▶ the related Electronic-Key is inserted and
- ▶ a suitable operating mode is selected.

6.2.1.2 Feedback loop

The safety relay can only be started with the feedback loop closed. A welded contactor contact in the release path will thus be detected when a start request is made and a start is then prevented. The power contactor must have positively driven contacts.

6.2.1.3 Start

The safety relay start takes place after release by the EKS *FSA* and by the control and after operation of the enabling switch.

6.2.2 Connection example without enabling switch

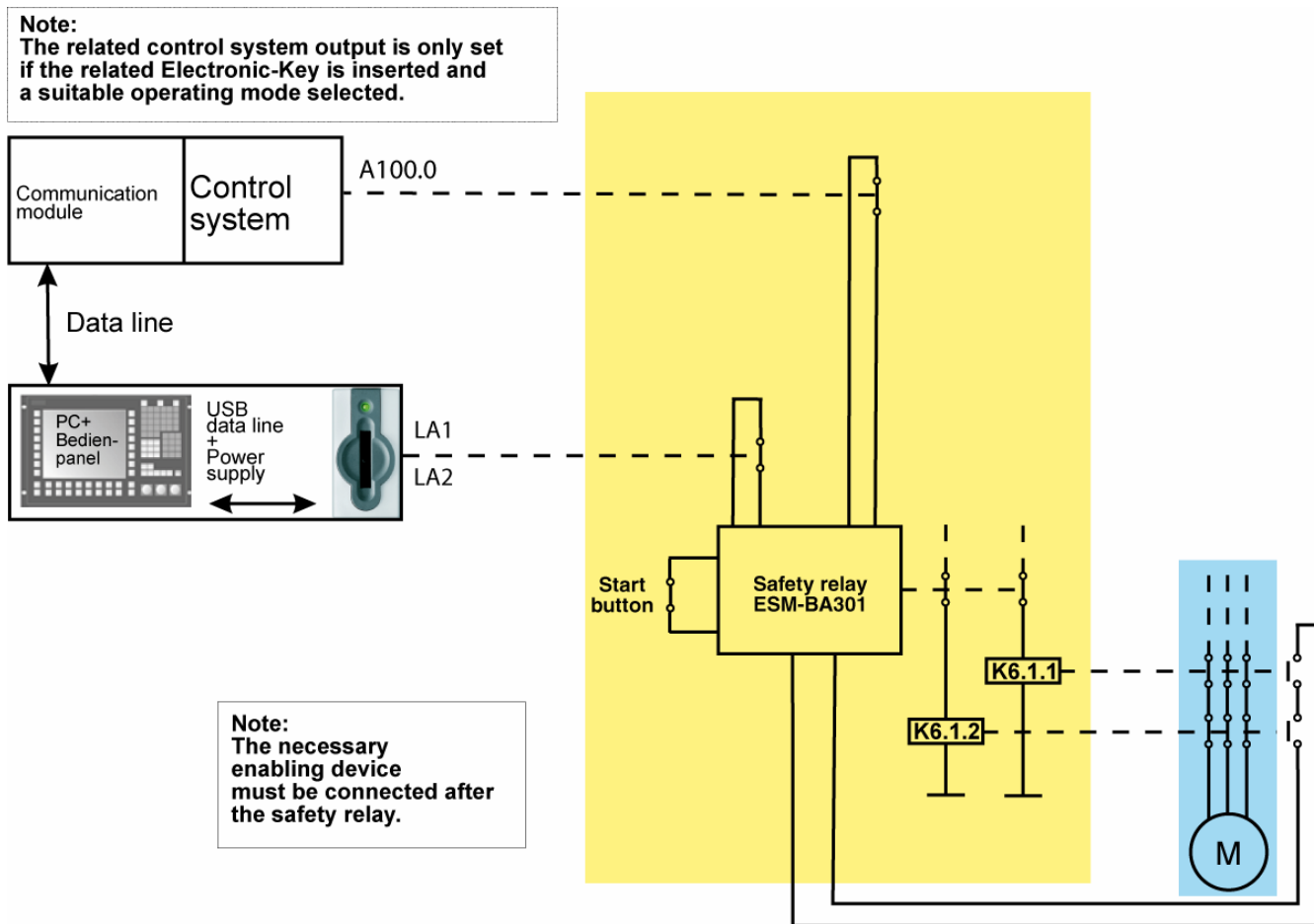


Figure: Principle of operation (illustration with selected operating mode and all parts in actuated position)

6.2.2.1 Description of the application example without enabling switch

The danger area on a machine is secured with a fence. To make set-up work on the machine possible with the guard open, an EKS FSA system is integrated in conjunction with a control system and a safety relay. The safety relay must comply with the following requirements:

- ▶ Detection of short-circuits and earth faults. A short-circuit can be detected in the safety path in the circuit described due to the fact that both, the positive path and earth path, of the safety relay are switched. In this case, the safety relay deactivates its safety outputs.
- ▶ Simultaneity monitoring: the safety relay must detect whether the safety inputs are switched practically simultaneously. If this is not the case, the safety outputs are not switched and the unit switches to fault state. A renewed start is possible only after the key has been inserted again.
- ▶ Start button monitoring: the safety relay must detect when the start button is welded or jammed at the latest at the next start. If this is the case, the safety outputs are not switched and the unit switches to fault state. This prevents accidental starting of the system.

The switching contact LA1/LA2 is closed on the insertion of the Electronic-Key. The EKS FSA is coupled to a PC. After the insertion of the Electronic-Key the PC checks whether the key is authorized for work in the selected operating mode. If this is not the case, the operating mode cannot be set. If suitable access rights are available, the control system gives the instruction to the switching contact A100.0 to close.

The switching contact LA1/LA2 of the EKS FSA is connected to the first input on the safety relay. The switching contact A100.0 on the control system is connected to the second input on the safety relay. The control contact A100.0 and the switching contact LA1/LA2 are monitored for simultaneity.

The safety relay is de-energized without a time delay (stop category 0) and the machine movement is stopped if

- ▶ the Electronic-Key is removed or
- ▶ the machine control system withdraws the release (switching contact 0 is opened).

 **Note!**

The switching contact A100.0 is only allowed to be set if

- ▶ the related Electronic-Key is inserted and
- ▶ a suitable operating mode is selected.

6.2.2.2 Feedback loop

The safety relay can only be started with the feedback loop closed. A welded contactor contact in the release path will thus be detected when a start request is made and a start is then prevented. The power contactor must have positively driven contacts.

6.2.2.3 Start

The safety relay start takes place after release by the EKS *FSA* and by the control and after operation of the start button.

6.2.2.4 Circuit diagram

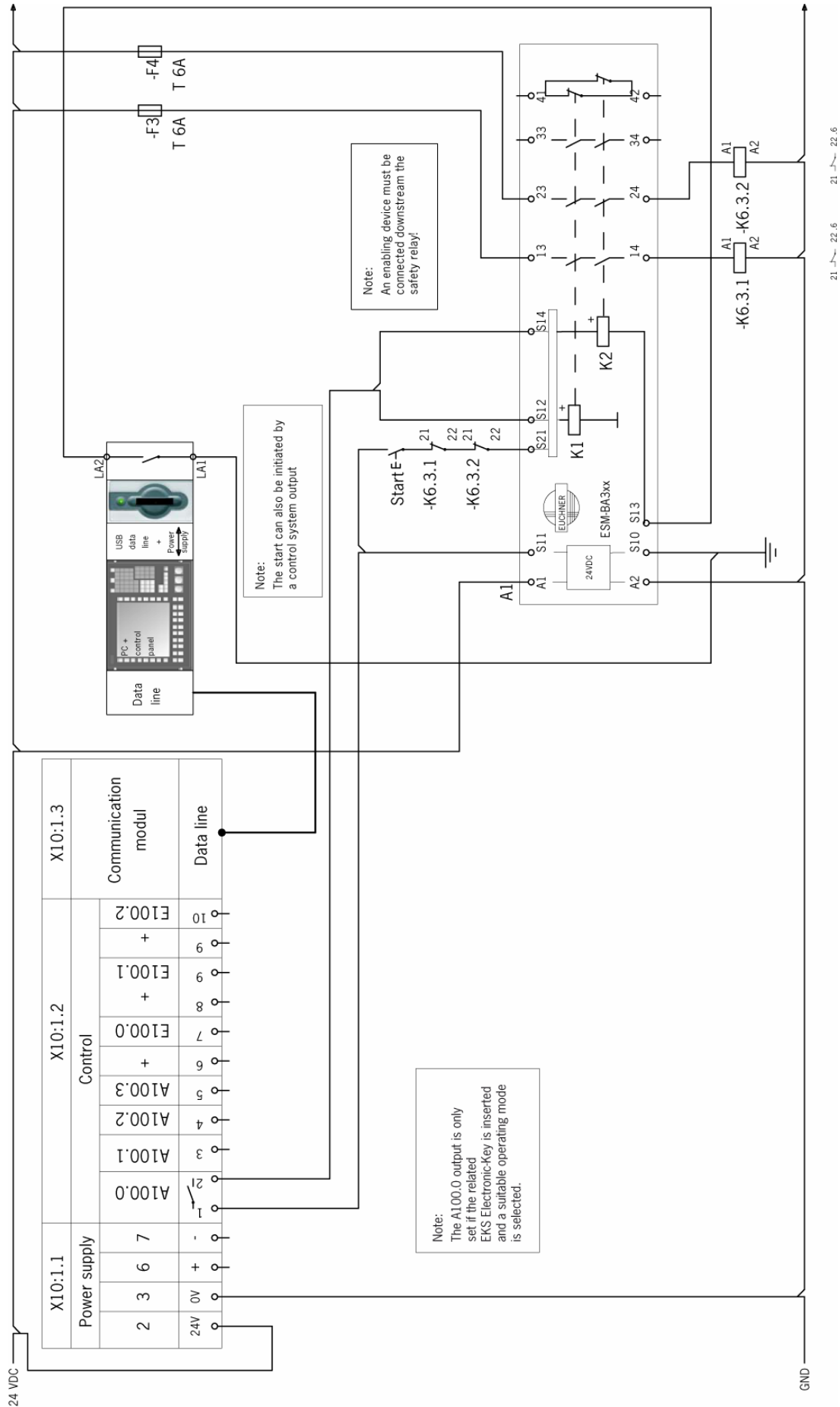


Figure: Circuit diagram

7 Setup

Setup is to be performed in the following sequence:

1. Set DIP switches on the Electronic-key adapter (see section 4.4 DIP switch settings).
2. Check assembly and electrical connection are correct (see section 5 Mounting and section 6 Electrical connection).
3. After connecting the USB connection cable and installation of the EKS USB drivers, the LED on the front of the Electronic-Key adapter illuminates green. This indicates that the power supply is present.
4. Insert Electronic-Key in the Electronic-Key adapter. The LED changes to yellow.
5. Important: for the version EKS FSA all safety functions must also be thoroughly tested.

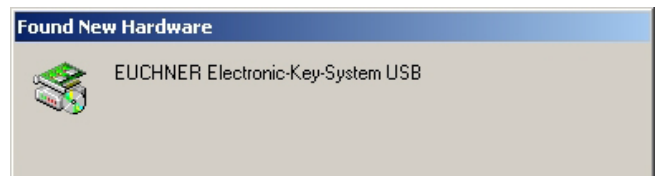
7.1 Installing the Electronic-Key-System USB on Windows® 2000

To start the installation, have the driver software order No. 094376 at hand on a data carrier or in a folder.

For installation from CD, insert the CD now.

In the routine described in the following, first a driver for the EUCHNER Electronic-Key-System USB is installed and then a driver for the virtual serial COM port.

- ▶ After the Electronic-Key adapter is plugged into a spare USB port, the following message appears:



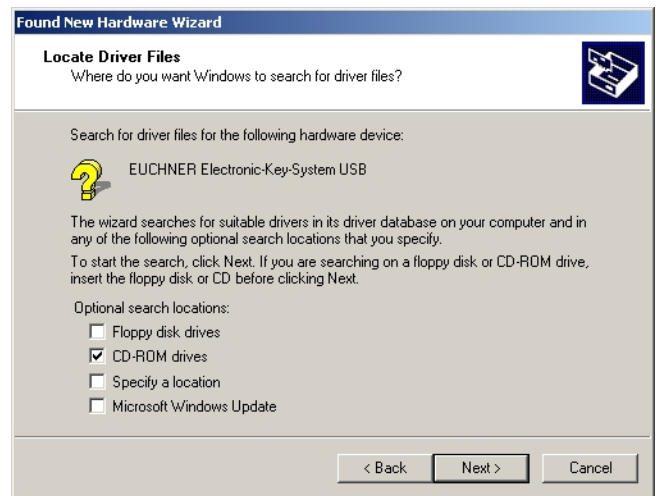
- ▶ The **Found New Hardware Wizard** is started automatically:



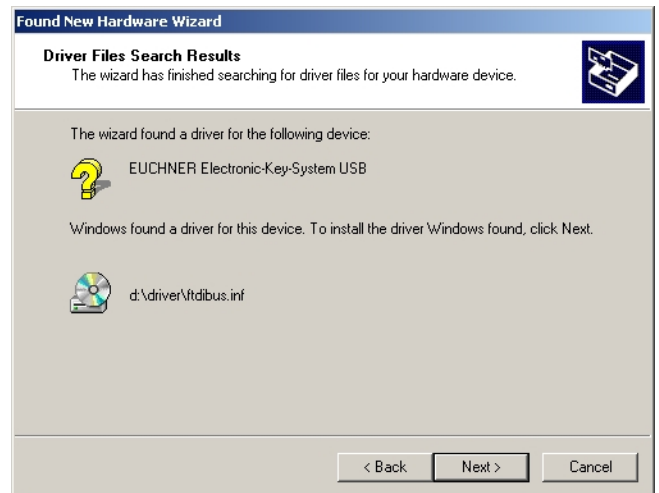
- ▶ Click **Next**.



► Click **Next**.



► Choose the location where the files are saved, e.g. **CD-ROM drives** and click **Next**.



► Click **Next**.

- ▶ The EKS USB driver is installed.



- ▶ Click **Finish**.

- ▶ After the installation of the EKS USB driver, a virtual COM port driver must be installed. The following message appears:



- ▶ The **Found New Hardware Wizard** is started automatically:

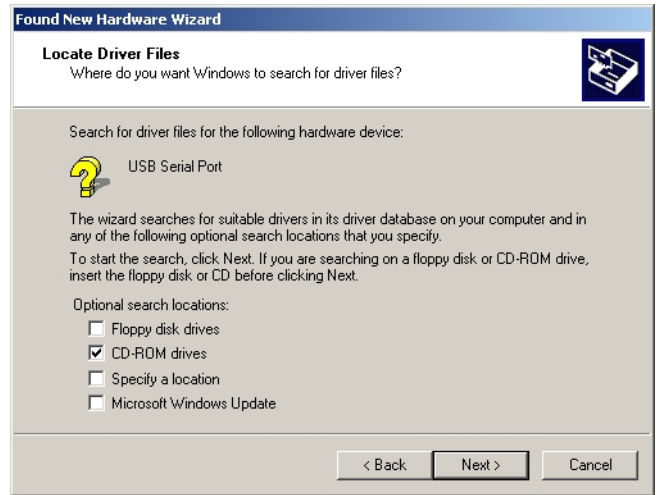


- ▶ Click **Next**.

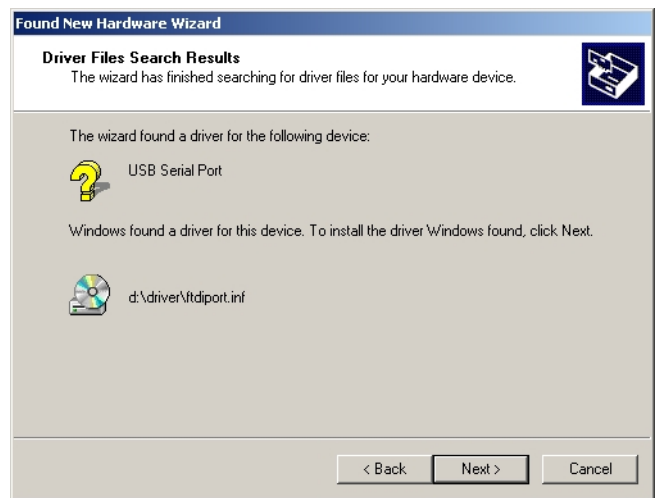


- ▶ Click **Next**.

- ▶ Choose the location where the files are saved, e. g. **CD-ROM drives** and click **Next**.



- ▶ Click **Next**.
- ▶ The virtual COM port driver is installed.



- ▶ When the installation process is complete, the following is displayed:

- ▶ Click **Finish**.



7.2 Installing the Electronic-Key-System USB on Windows® XP

To start the installation, have the driver software order No. 094376 at hand on a data carrier or in a folder.

For installation from CD, insert the CD now.

In the routine described in the following, first a driver for the EUCHNER Electronic-Key-System USB is installed and then a driver for the virtual serial COM port.

- ▶ After the Electronic-Key adapter is plugged into a spare USB port, the following message appears:



- ▶ The **Found New Hardware Wizard** is started automatically:



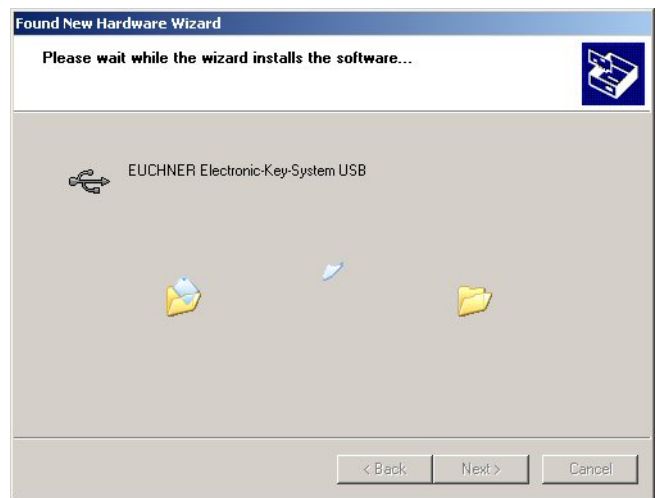
- ▶ Click **Next**.



- ▶ When this message is displayed, click **Continue Anyway**.



- ▶ The EKS USB driver is installed.

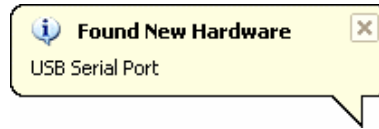


- ▶ Click **Finish**.



After the installation of the EKS USB driver, a virtual COM port driver must be installed.
The following message appears:

- ▶ The **Found New Hardware Wizard** is started automatically:



- ▶ Click **Next**.



- ▶ When this message is displayed, click **Continue Anyway**.



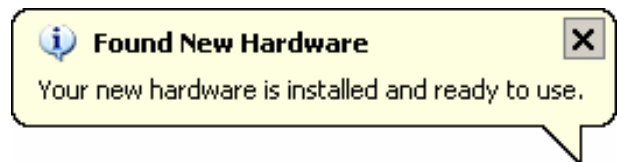
- ▶ The virtual COM port driver is installed.




- ▶ When the installation process is complete, the following is displayed:



- ▶ Click **Finish**.



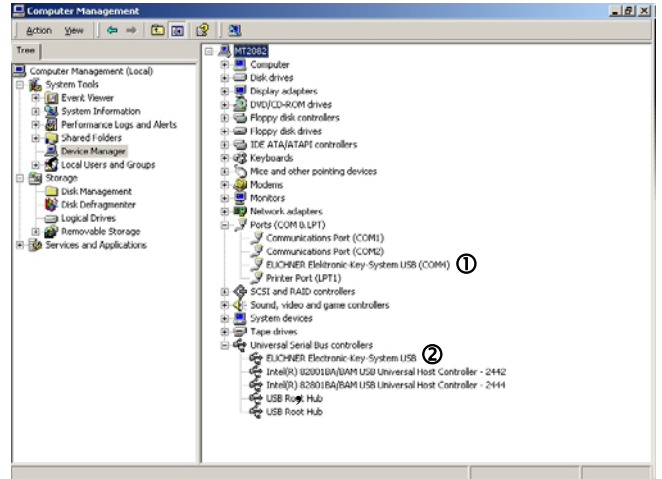
7.3 Changing the virtual COM port (Windows® 2000 and XP)

 To be able to select a COM port number, you must be logged on as an administrator.


You can open the Geräte-Manager (Device Manager) using the following steps:

1. **Setup**
2. **Control Panel**
3. **Management**
4. **Computer Management**

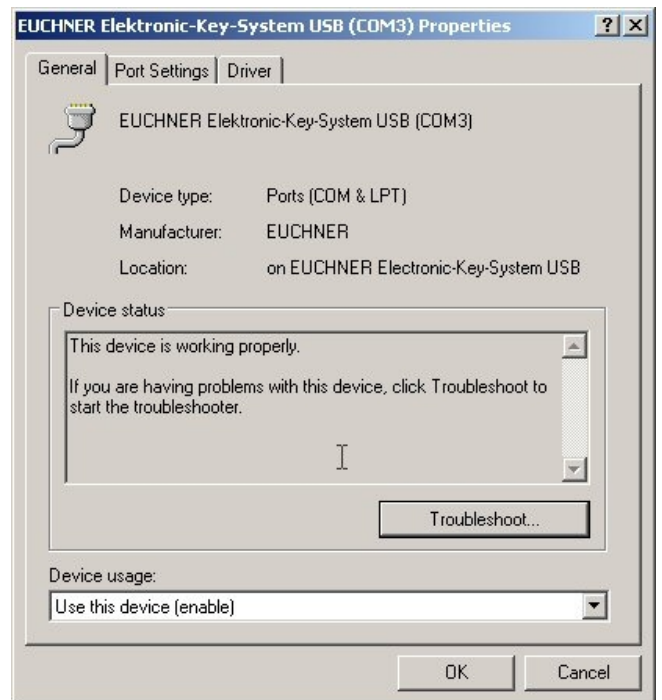
After the installation, the entry **EUCHNER Electronic-Key-System USB** appears in the list of ports ① and in the list of USB controllers ②. The COM port number assigned is also shown in the list of ports. The application can communicate with the device using this COM port.

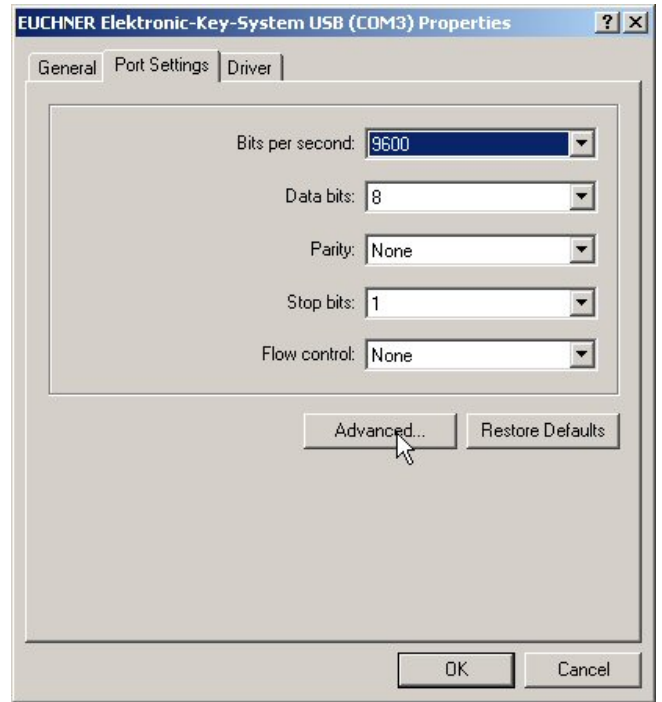


To change the COM port number assigned automatically, proceed as follows:

 This COM port number can only be changed with administrator rights.

- ▶ Choose **Port Settings**




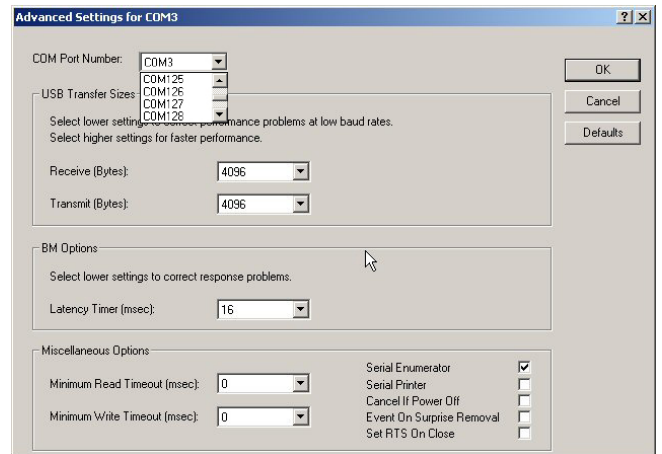


- ▶ When you select **Advanced...** a window is opened where you can change the virtual COM port.

- ▶ The virtual COM port can be selected in the **COM Port Number** list box.

 The EKS communicates with the user software over the COM port selected here.

 This COM port must, e.g., also be selected in the ActiveX module.



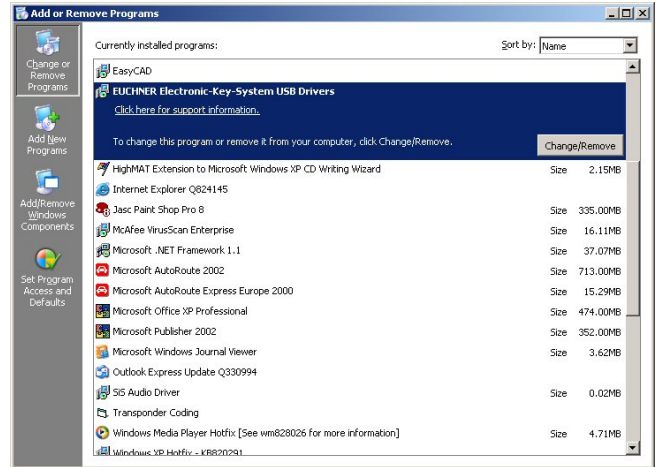
7.4 Support information and uninstalling (Windows® 2000 and XP)

You will find support information on the EKS USB driver in the overview of the software and Windows components installed.

The driver is also uninstalled on this menu.

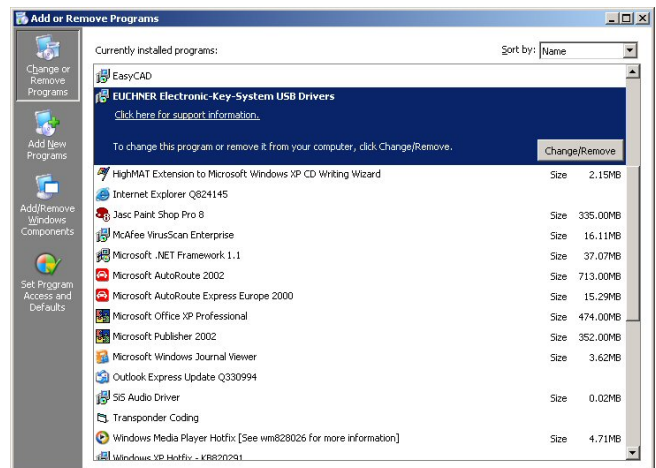
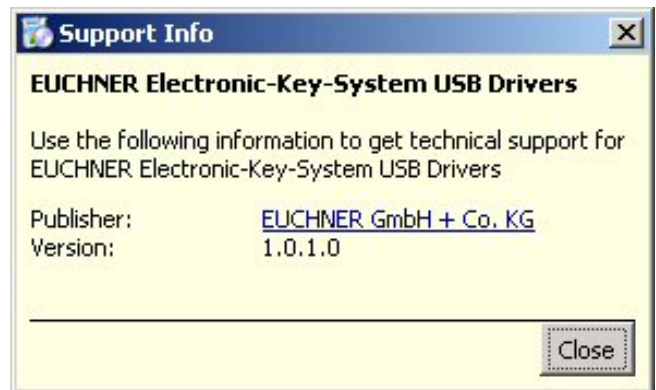
You can open the overview of the software installed with the following steps:

1. **Setup**
2. **Control Panel**
3. **Software**
 - ▶ Select **EUCHNER Electronic-Key-System USB Drivers**.
 - ▶ For support information click **Click here for support information**.



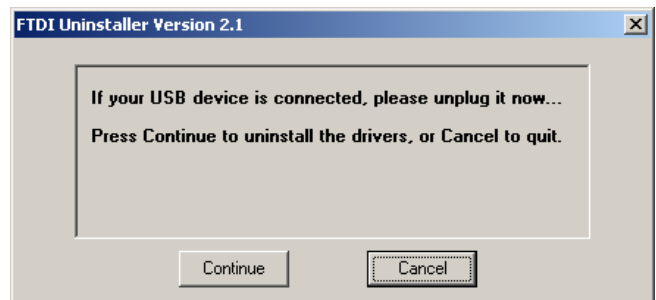
Support information on the EKS USB driver is displayed. Here, e. g., the currently installed driver version can be checked.

- ▶ Click **Close**.
- ▶ To uninstall the EKS USB driver, click **Change/Remove**.

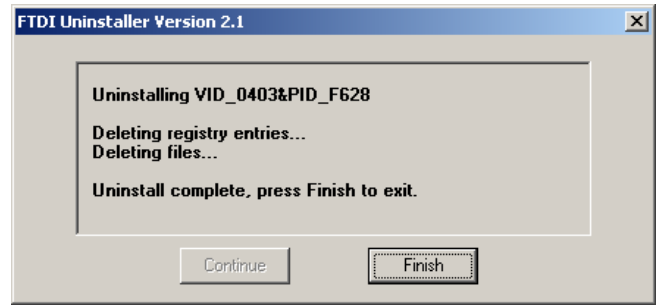


The following message appears:

- ▶ Disconnect the USB connection for the Electronic-Key adapter from the USB port on the PC.
- ▶ Click **Continue**.



- ▶ The EKS USB driver is uninstalled.



- ▶ When the uninstall is complete, click **Finish**.

8 Operating the Electronic-Key-System with the aid of the virtual COM port

8.1 Special features of the USB interface

The USB interface is designed as a virtual serial COM port. The communication is exactly the same as for the device with serial RS232 interface.

If there is an Electronic-Key within the operating distance of the Electronic-Key adapter, the LED on the front changes from green to yellow. At the same time the **CTS** handshake signal changes from inactive (0) to active (1). This signal corresponds to the CTS / OUT signal with RS232 level on the Electronic-Key adapter with serial interface. This signal can be used for control purposes to detect whether there is an Electronic-Key in the Electronic-Key adapter.

8.2 Communication

In this section primarily the communication between PC and the Electronic-Key adapter (referred to as the *device* in the following) is described.

Communication with the Electronic-Key adapter is performed via a virtual COM port. The commands are given over this COM port. It is possible to communicate with several devices over different COM ports. In principle COM 1 to COM 128 can be used.

The transfer messages for the commands

- ▶ Program (write) Electronic-Key
- ▶ Read Electronic-Key

are based on the transfer protocol 3964R [1]

Integration of the Electronic-Key adapter with USB interface into the user's PC application is supported by an optionally available ActiveX[®] module (order no. 098 708) (usable for MS Windows[®] based programs with ActiveX[®] capability). EKS can thus be used in conjunction with process visualization. **The ActiveX[®] module is used as a protocol driver for the 3964R data transfer protocol described in the following.**

8.3 Basic message structure

Every command and any related data blocks are transferred from and to the Electronic-Key adapter in a message core within the message frame as per the protocol 3964R (Figure 1: Basic command structure in the 3964R protocol).

In the 3964R protocol, the recipient acknowledges the message received by sending back an acknowledgement character (DLE). If the acknowledgement is negative (NAK), the complete protocol is repeated. If it is not possible to correctly transfer the protocol after a total of six attempts, the process is aborted.

	Description	Byte no.	Send data in ASCII format	Acknowledgment from the recipient	
				+	-
Connection setup	3964R procedure start		STX		
				DLE	NAK
Message core	Number of message bytes	0			
	Command identification	1 2	T or R command		
	Device address	3	01 _{hex}		
	User data description	4 5 6	Start address Start address Number of data		
	User data	7 ... n			
Connection termination	3964R procedure termination		DLE ETX BCC		
				DLE	NAK

Figure 1: Basic command structure in the 3964R protocol

8.3.1 Special features of the 3964R data transfer protocol [1]

The 3964R data transfer protocol is a comparatively reliable procedure for the electronic exchange of data between PC/control system and a peripheral connected, because the data transfer is performed using a standardized protocol.

8.3.1.1 Basic information on data transfer procedures using a protocol [1]

Numerous conventions must be agreed for a data transfer procedure; codes, operating modes, transfer speeds and the algorithmic process for the transfer. The definition of this algorithmic process is termed the **transfer protocol** (for short: protocol).

A transfer protocol in general defines the following phases of the data transfer:

- ▶ Connection setup: request from A to B for the transfer of data
- ▶ Data transfer from A to B
- ▶ Connection termination: conclusion of the transfer of data

8.3.1.2 The 3964R transfer protocol [1]

Unlike protocol-free data transfer procedures, 3964R is a data transfer with protocol. This means that the actual data that need to be transferred are enclosed in specific control characters. The 3964R driver permits comparatively reliable data transfer as the recipient must signal to the sender readiness to receive (connection setup) and acknowledge correct reception after completion of the data transfer. With the 3964R transfer protocol, data integrity is increased by an additional block check character.

The 3964R driver interprets the following control characters:

- ▶ **DLE** (10_{hex}) **Data Link Escape**
- ▶ **STX** (02_{hex}) **Start of Text**
- ▶ **NAK** (15_{hex}) **Negative Acknowledgement**
- ▶ **ETX** (03_{hex}) **End of Text**

At the end of each data block in the 3964R transfer protocol, a **block check character** (for short: BCC) is sent to assure data integrity. The block check character BCC is the **even longitudinal parity** (XOR operator on all data bytes) of a block sent or received. The block check character is formed **starting** with the **first byte** of the message core after the connection is setup and **ends after** the characters **DLE** and **ETX** during connection termination.

8.3.1.3 The control system sends [1]

To setup the connection, the control system sends the control character **STX**. If, before the acknowledgement delay time (ADT, typically: 2 s) elapses the peripheral responds with the control character **DLE**, the control system switches to transfer mode. If the peripheral responds with the control character **NAK**, any other character (except **DLE**) or the acknowledgement delay time elapses without a reaction, the attempt to setup the connection has failed. After a total of 6 unsuccessful attempts (3964R protocol specification) the process is aborted. If the attempt to setup the connection is successful, the characters with the information as contained in the send buffer in the control system are transferred to the peripheral at the selected transfer speed. The peripheral monitors the amount of time between the incoming characters. The gap between two characters must not be more than the character delay time (CDT, typically: 100 ms).

All 10_{hex} values contained in the message core **must be sent twice** so that the recipient recognizes that here user data is being transferred and not the control character **DLE (DLE duplication)**.

After the user data has been sent, the control system adds the following characters as an **end identifier: DLE ETX BCC**.

Then the control system waits for an acknowledgement character from the peripheral. If the peripheral sends the control character **DLE** within the acknowledgement delay time (ADT, typically: 2 s), the data block has been received correctly. If, on the other hand, the peripheral responds with the control character **NAK**, any other character or the acknowledgement delay time elapses without a reaction, the control system starts again from the beginning by setting up a connection with **STX**. After a total of 6 unsuccessful attempts (3964R protocol specification) to send the data block, the process is aborted and the control system sends the control character **NAK** to the peripheral.

8.3.1.4 The control system receives [1]

If the control system receives the control character **STX** from the peripheral when the control system is idle, it responds with **DLE**. If the control system receives another character (except **STX**) when it is idle, it waits until the character delay time (CDT, typically: 100 ms) has elapsed and then sends the control character **NAK**.

After each character, the next character is awaited during the character delay time (CDT). If the character delay time elapses without the reception of a character, the control character **NAK** is sent to the peripheral.

When the control system detects the character string **DLE ETX BCC**, it ends reception. The control system compares the block check character **BCC** with the longitudinal parity calculated internally. If the block check character is correct and no other reception errors have occurred, the control system sends the control character **DLE**. If the **BCC** is erroneous, the control character **NAK** is sent to the peripheral. A retry is then expected. If it is not possible to receive the block correctly after a total of 6 attempts (3964R protocol specification) or the retry is not started by the peripheral within the block waiting time of 4 s, the control system interrupts the reception.

If transfer errors occur during reception (lost characters, frame errors, parity errors), the control system continues to receive data until the connection is terminated and then sends the control character **NAK** to the peripheral. Then a retry in the form described above is awaited.

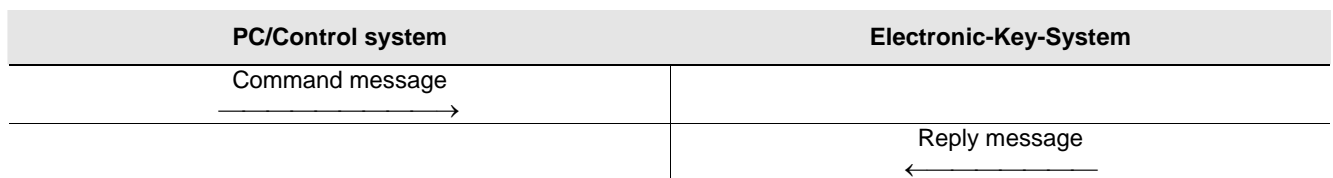
8.3.1.5 Summary of the most important points

- ▶ **DLE duplication:**
For the communication partner to be able to differentiate between the control character **DLE** and a randomly occurring 10_{hex} value in the message core, **a 10_{hex} value in the message core must be sent twice**. In this way it is achieved that the data is interpreted by the receiving end as user data and not as a control character for connection termination.
- ▶ **The BCC Block Check Character:**
At the end of each data block a block check character is sent to assure data integrity. The block check character is the **even longitudinal parity** (XOR operator on all data bytes) of a block sent or received. The block check character is formed **starting** with the **first byte** of the message core after the connection is setup and **ends after** the characters **DLE** and **ETX** during connection termination.
- ▶ **Retries on errors:**
If an error occurs for any reason during the data transfer, **a total of 6 attempts** are made to transfer the data correctly.

8.4 Commands for writing and reading an Electronic-Key read/write

Write and read processes are always initiated by the PC using a "command message".

The Electronic-Key-System then sends a reply message to the PC.



- **I** On Electronic-Keys read/write with 116 bytes, the memory is organized in 4-byte blocks. This means a multiple of 4-byte sized blocks must always be written.
- **I** The start address must be given in the range byte number 0 to byte number 112, always in 4-byte steps (byte number 0, 4, 8 ... 112)!
- **I** However, during **reading** it is possible to access the memory by bytes without the above mentioned restriction during writing.

8.4.1 Write process

- o II When this command is used, the Electronic-Key must be in the Electronic-Key adapter and is only allowed to be removed from within the operating distance after reception of the reply message.

Command message (message core, PC→ EKS, see Figure 2):

- ▶ TP (device addr.) (start addr. user data) (number of bytes of user data) (user data)

Reply message (message core, EKS → PC, see Figure 3):

- ▶ RF (device addr.) (00_{hex}, 00_{hex}) (status number)

Byte no.	Description	ASCII	Contents	
			hexadecimal	decimal
0	Number of message bytes		0B ... 7B	11 ... 123
1	Command identification	T	54	84
2		P	50	80
3	Device address		01	1
4	Start address for user data		00	0
5			00 ... 70	0 ... 112
6	Number of bytes of user data		04 ... 74	4 ... 116
7 ... 122	User data	ASCII or hexadecimal or BCD (code transparent)		

Figure 2: Command message **write Electronic-Key read/write** (message core)

Byte no.	Description	ASCII	Contents	
			hexadecimal	decimal
0	Number of message bytes		07	7
1	Command identification	R	52	82
2		F	46	70
3	Device address		01	1
4	Padding data		00	0
5			00	0
6	Status number		*	

Figure 3: Reply message **write Electronic-Key read/write - status** (message core)

- * Status number
 - 00_{hex}: No error
 - 02_{hex}: Electronic-Key not in the operating distance
 (For further status numbers see section 8.6)

8.4.2 Read process

Command message (message core, PC → EKS, see Figure 4):

- ▶ TL (device addr.) (start addr. user data) (number of bytes of user data)

Reply message (message core, EKS → PC, see Figure 5 or Figure 6):

For this command there are two possible replies:

- ▶ RL (device addr.) (start addr. user data) (number of bytes of user data) (user data)
or
- ▶ RF (device addr.) (00_{hex}, 00_{hex}) (status number)

The reply message RL (see Figure 5) stands for correct reception of the data.

If an Electronic-Key cannot be read, an RF reply message is received (see Figure 6). The status number then indicates the cause of the error.

Byte no.	Description	Contents		
		ASCII	hexadecimal	decimal
0	Number of message bytes		07	7
1	Command identification	T	54	84
2		L	4C	76
3	Device address		01	1
4	Start address for user data		00	0
5			00 ... 73	0 ... 115
6	Number of bytes of user data		01 ... 74	1 ... 116

Figure 4: Command message **read Electronic-Key read/write** (message core)

Byte no.	Description	Contents		
		ASCII	hexadecimal	decimal
0	Number of message bytes		08 ... 7B	8 ... 123
1	Command identification	R	52	82
2		L	4C	76
3	Device address		01	1
4	Start address for user data		00	0
5			00 ... 73	0 ... 115
6	Number of bytes of user data		01 ... 74	1 ... 116
7 ... 122	User data	ASCII or hexadecimal or BCD (code transparent)		

Figure 5: Reply message **read Electronic-Key read/write** (message core)

Byte no.	Description	Contents		
		ASCII	hexadecimal	decimal
0	Number of message bytes		07	7
1	Command identification	R	52	82
2		F	46	70
3	Device address		01	1
4	Padding data		00	0
5			00	0
6	Status number		*	

Figure 6: Reply message **read Electronic-Key read/write - status** (message core)

* Status number 02_{hex}: Electronic-Key not in the operating distance
(For further status number see section 8.6)

8.4.3 Reading the serial number

The Electronic-Key read/write contains a unique 8-byte serial number. This number is written by laser during the Electronic-Key production process and can never be changed or deleted. The serial number is used for secure distinction of every single Electronic-Key. It is necessary that all 8 bytes are completely evaluated for reliable differentiation. The serial number is appended to the freely programmable user data.

The serial number can be read by entering the start address byte no. 116 and the number of bytes as 8 (see section 8.4.2).

8.5 Command overview

Description	Command message	Reply message
Program (write) Electronic-Key	TP (see section 8.4.1)	RF (see section 8.4.1)
Read Electronic-Key (also read the serial number)	TL (see section 8.4.2 and 8.4.3)	RL (see section 8.4.2) or RF (see section 8.4.2)

8.6 Status numbers

Value	Description
00 _{hex}	No error
02 _{hex}	Electronic-Key not in the operating distance
03 _{hex}	Parity bit error on Electronic-Key read-only
06 _{hex}	Write process aborted. Start address or number of bytes is not a multiple of the block size 4
17 _{hex}	Read attempt when the Electronic-Key adapter is set to Electronic-Key read/write and an Electronic-Key read-only is inserted
18 _{hex}	Read attempt when the Electronic-Key adapter is set to Electronic-Key read-only and an Electronic-Key read/write is inserted
4x _{hex}	General Electronic-Key communication error (renewed write or read necessary)
50 _{hex}	Write attempt despite enabled write protection

9 Exclusion of liability

Exclusion of liability under the following conditions:

- ▶ if the unit is not used for its intended purpose
- ▶ non-compliance with safety regulations
- ▶ if mounting and electrical connection are carried out by unauthorized personnel
- ▶ if modifications are made

10 Service and repair

- ▶ No servicing is required,
- ▶ Remove dirt from the Electronic-Key and the Electronic-Key adapter using a soft cloth and solvent-free, non-abrasive cleaning agents.
- ▶ Repairs are only to be made by the manufacturer.
- ▶ On version EKS FSA devices, the safety-related functions must be checked at regular intervals.

11 Guarantee

The "General Terms and Conditions" of EUCHNER GmbH + Co. KG apply.

12 Bibliography

[1] SIEMENS AG manuals, connection components for S7 control systems

Controller (PLC) S7-300CPU-Data

CPUs 312C to 314C-2DP/PtP

Only RS422/485

Point-to-point communication CP 340

Installation and parameter assignment

SIEMENS order No.

6ES7340-1AH00-8AA0

Point-to-point communication CP 341

Installation and parameter assignment

SIEMENS order No.

6ES7341-1AH00-8AA0

Point-to-point communication CP 441

Installation and parameter assignment

SIEMENS order No.

6ES7441-2AA00-8AA0

[2] Detailed application examples from EUCHNER

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EUCHNER GmbH + Co. KG
Kohlhammerstraße 16
D-70771 Leinfelden-Echterdingen

Telephone +49 711 / 75 97 - 0
Fax +49 711 / 75 33 16
www.euchner.de · info@euchner.de

EUCHNER