Electronic-Key-System

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

Order no. 2094485

EKS.
USB

EUCHNER

More than safety.

Table of contents

1 General notes

1.1 Use of the manual

This manual describes the technical features and the function of the EKS USB read/write stations listed below (also referred to as "devices" for short in the rest of the text). The complete evaluation and interface electronics for data transmission are accommodated in these units.

▶ Compact Electronic-Key adapter in G01 housing EKS-A-IUX-G01-ST01 (order no. 092750)
   with USB interface
▶ Compact Electronic-Key adapter in G01 housing EKS-A-IUXA-G01-ST01/04 (order no. 098513)
   with USB interface version *FSA* (**F**or **S**afety **A**pplications)
▶ Compact Electronic-Key adapter in G30 housing EKS-A-IUX-G30-STBM (order no. 157195)
   with USB interface

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.

Attention!
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** **A**lternating **C**urrent
- **BCC** **B**lock **C**heck **C**haracter
- **CTS** **C**lear **T**o **S**end
- **DC** **D**irect **C**urrent / **D**iagnostic **C**overage
- **DIP** **D**ual **I**nline **P**ackage
- **DLE** **D**ata **L**ink **E**scape (acknowledgment)
- **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 **TeX**t
- **FHC** **F**ront **H**ook **C**ompact
- **FSA** **F**or **S**afety **A**pplications
- **LED** **L**ight **E**mitting **D**iode
- **MTTF$_d$** **M**ean **T**ime **T**o **D**angerous **F**ailure
- **NAK** **N**egative **A**c**K**nowledgment
- **PA** **P**oly**A**mide
- **ADT** **A**cknowledgment **D**elay **T**ime
- **ROM** **R**ead-**O**nly **M**emory
- **STX** **S**tart of **TeX**t
- **USB** **U**niversal **S**erial **B**us
- **CDT** **C**haracter **D**elay **T**ime

1.2 CE conformity

The EKS devices with USB interface correspond to the Radio Equipment Directive (RED) 2014/53/EU and the RoHS Directive 2011/65/EU. The devices comply with the following European standards:

- EN 55011 Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement
- EN 61000-6-2 Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
- EN 50364 Product standard for human exposure to electromagnetic fields from devices operating in the frequency range 0 Hz to 300 GHz, used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar applications
- EN 300330 V2.1.1 Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
- EN 50581 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

1.3 Approvals

The EKS devices with USB interface are certified in accordance with c**ℝ**us (UL file number E240367).

For use and operation as per the c**ℝ**us requirements, a power supply with the feature **"for use in Class 2 circuits"** must be used.

1.4 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 the selection of the operating mode. However, it is not permitted to derive the operating mode directly from the access rights on the Electronic-Key. If the selection of the operating mode is relevant for safety, this must not be performed by means of the EKS; instead an additional device must be used to select the operating mode.

> **Information!**
> The Machinery Directive 2006/42/EC provides information on selection of the operating mode. It is imperative that this information be 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 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 be employed and used only 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 device could endanger the safety or health of people in the operating area of a machine.

1.5 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 device 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 chapter 1.4) and *Electrical connection* (see chapter 6).

Warning!

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

Furthermore, mounting and electrical connection of the version EKS *FSA* must be performed only 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 of 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 visualization 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 into 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 also offers the Electronic-Key-Manager EKM software.

EKS USB devices are read/write systems with electronics for the inductive bidirectional interface to the transponder and interface electronics.

Due to the non-contact transfer of data, the Electronic-Key adapter is designed with a high degree of protection suitable for industry from the access side. The Electronic-Key adapter is fastened from the rear side of the panel in order to exclude unauthorized tampering from the operator side.

The system is connected via 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.

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

The Electronic-Key is inserted into the Electronic-Key adapter in housing G01 and is held securely in place by a spring clip. With the Front-Hook-Compact (FHC) mini Electronic-Key adapter in housing G30, the Electronic key is held in front or dropped into place. The power supply for the transponder and the data are transferred between the Electronic-Key adapter and the Electronic-Key without using any contacts.
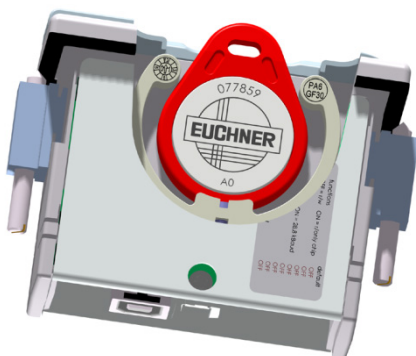
Figure: Cut-away illustration of an Electronic-Key adapter with Electronic-Key in the compact G01 housing

Figure: Illustration of an Electronic-Key adapter with Electronic-Key in the compact G30 housing

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.

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

▶ 116 bytes E^{2}PROM (programmable) plus 8 bytes ROM (serial number)

The programmable memory of 116 bytes is organized in 4-byte blocks. This means a multiple of 4-byte-sized blocks must always be written.

3.1.2 Additional functions of version EKS *FSA* (only in G01 housing)

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

The switching contacts are electrically isolated from the device electronics and from each other. Either AC or DC can be switched.

Each of the switching contacts is operated with diversity by a dedicated processor that opens the contacts on removal of the Electronic-Key (see figure Block diagram EKS *FSA*).
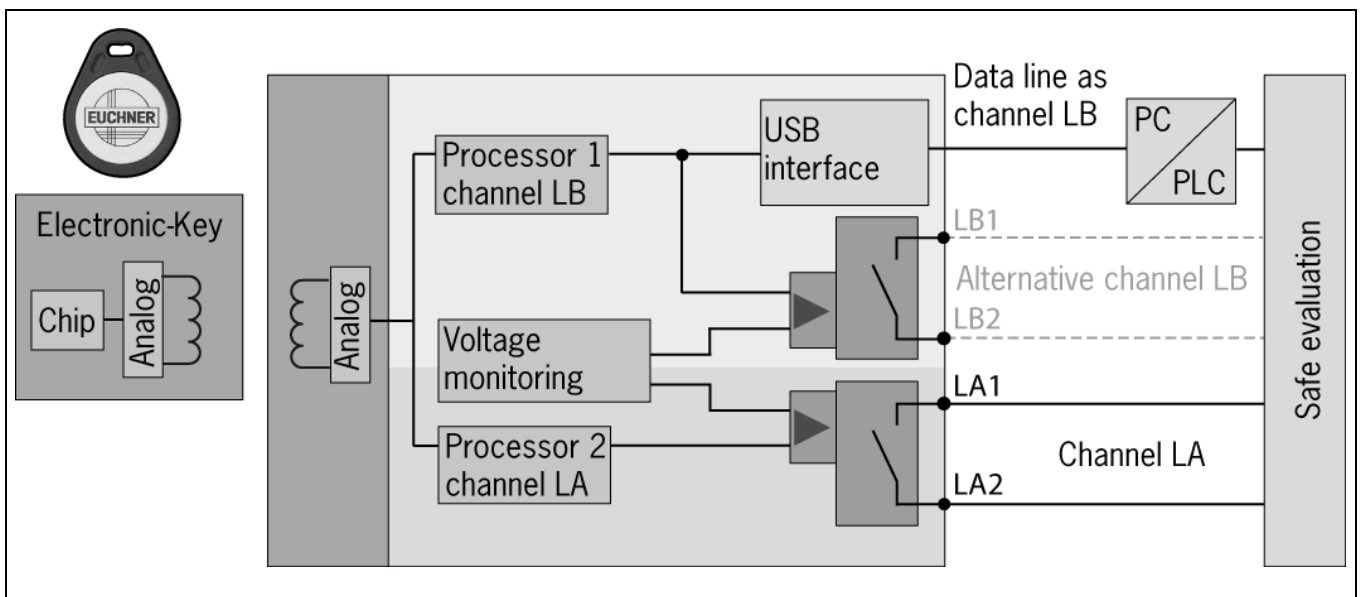
Figure: Block diagram EKS *FSA*

Due to separate evaluation of channel LA and channel LB, the EKS *FSA* device can be used in conjunction with a safe evaluation device in safety-related applications. Integrated voltage monitoring switches off the switching contacts LA and LB if the power supply is outside the permitted tolerance (see chapter 4.2.1).

> **Information!**
> The switching contacts *FSA* close when the Electronic-Key is in place, irrespective of the data allocation in the memory.

4 Technical data

4.1 Dimension drawing of Electronic-Key adapter

4.1.1 Design in G01 housing EKS-A-IUX-G01-ST01 with USB interface

For installation in a control panel, you must provide a cut-out measuring 33 mm x 68 mm according to DIN IEC 61554.
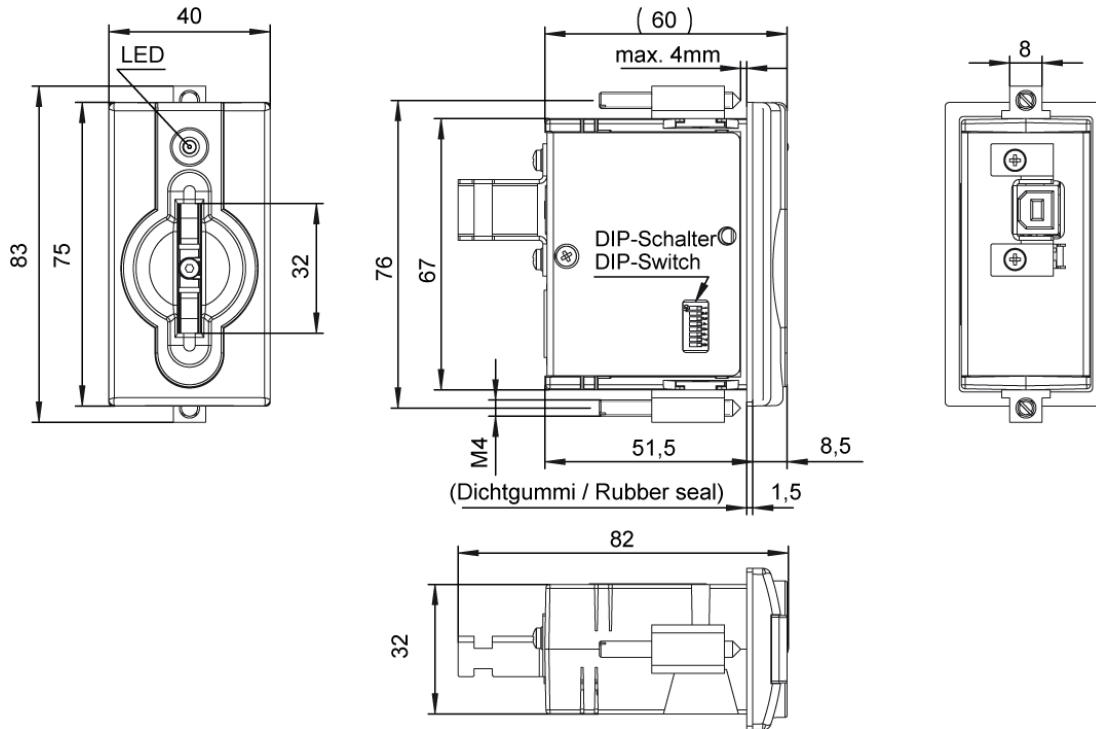
4.1.2 Design in G01 housing EKS-A-IUXA-G01-ST01/04 (EKS *FSA*) with USB interface
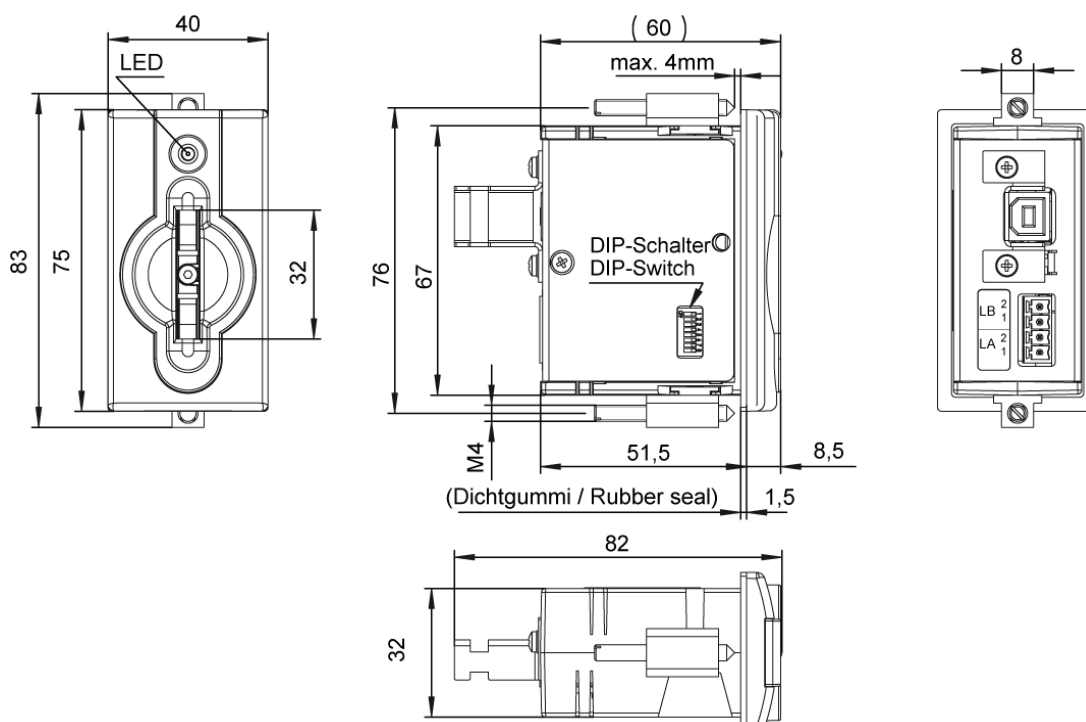
4.1.3 Design in G30 housing EKS-A-IUX-G30-STBM with USB interface

Schalttafelausschnitt /
Control panel cut-out

4.2 Technical data

4.2.1 Technical data for Electronic-Key adapter in G01 housing

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.

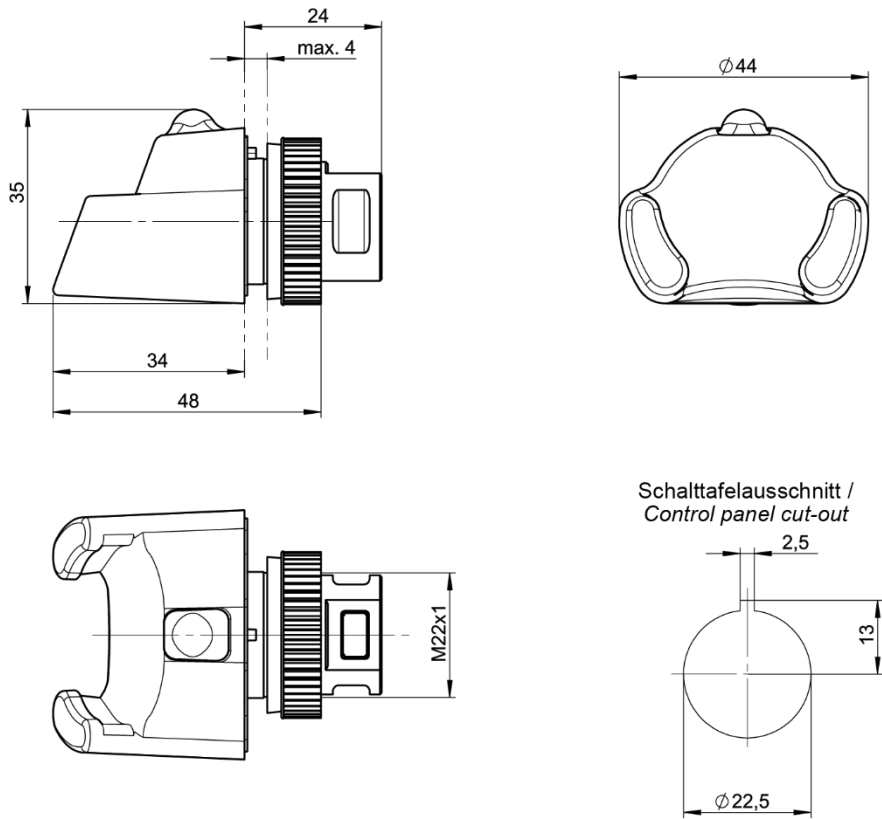|	Value			Unit
	min.	typ.	max.	
General parameters				
Housing	Plastic (PA 6 GF30 gray)			
Degree of protection	IP65/IP67 in installed state			
Ambient temperature	0		+ 55	°C
Mounting cut-out acc. to DIN IEC 61554	33 x 68			mm
Power supply via USB	4.5	5	5.5	V
Current consumption			100	mA
Interface, data transfer				
Interface to the PC	USB Full Speed (compatible with all USB versions)			
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 B socket			
Cable length			3	m
LED indicator	Green: "Ready" (in operation) Yellow: "Electronic-Key active" *			
Version *FSA* (For Safety Applications) – parameters for floating semiconductor switching contacts LA and LB				
Switching contact connection	Plug-in connection terminal, 4-pin, with screw terminal (tightening torque 0.22 Nm), conductor cross-section 0.14 ... 1.5 mm²			
Power supply U for load (LA, LB)		24	30	V
Switching current (with overload protection)	1	10	50	mA
Output voltage U_A (LA, LB) in switched state	U x 0.9		U	V
Resistance in switched state		35		ohms
Capacitive load			1	µF
Utilization category acc. to EN IEC 60947-5-2 AC-12 AC-15 DC-12 DC-13	50 mA / 24 V			
Difference time of the outputs** (LB first)		200		ms
Reliability values acc. to EN ISO 13849-1 (*FSA* version only)				
Category (with downstream safe evaluation)	3			
$MTTF_d$ Evaluation of data channel and one switching contact LA	416			years
Evaluation of data channel and both switching contacts LA and LB	803			years
DC	92			%

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

** If the USB interface is accessed during placement or removal of the Electronic-Key, the difference time can be more than 200 ms.

4.2.2 Technical data for Electronic-Key adapter in G30 housing

	Value			Unit
	min.	typ.	max.	
General parameters				
Housing	Plastic (PVDF GF30, gray)			
Degree of protection	IP65/IP67/IP69K in installed state			
Ambient temperature	-20		+70/+100 *	°C
Mounting bore	Ø 22.5			mm
Power supply via USB	4.5	5	5.5	V
Current consumption			100	mA
Interface, data transfer				
Interface to the PC	USB Full Speed (compatible with all USB versions)			
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 Mini-B socket			
Cable length			3	m
LED indicator	Green: "Ready" (in operation) Yellow: "Electronic-Key active" **			

* This is not an ambient temperature for operation. It is valid for a time of no more than 3 minutes, e.g. for cleaning purposes.

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

4.3   Connector assignment

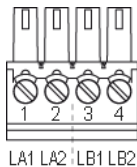### 4.3.1   USB interface socket in G01 housing

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

4.3.2   Screw terminals of switching contacts LA1/LA2 and LB1/LB2 (EKS *FSA* only)

Information!
The plug-in connection terminal is included with the Electronic-Key adapter.

Plug-in connection terminal,
2 x 2-pin,
with screw terminal

Pin	Channel	Function	
1	LA	LA1 ⟋ LA2	NO contact, channel LA
2			
3	LB	LB1 ⟋ LB2	NO contact, channel LB
4			

4.3.3   USB interface socket in G30 housing

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

4.4   DIP switch settings (only in G01 housing)

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 adopted only when the power supply is switched on.

DIP switches, 8-switch:
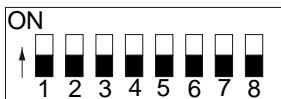
DIP switch	Functions	Factory setting
S8	OFF = Electronic-Key read/write ON = Electronic-Key read-only *	OFF
S7		OFF
S6		OFF
S5		OFF
S4		OFF
S3		OFF
S2		OFF
S1	ON = write protection for Electronic-Key read/write	OFF

* 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 two-color LED on the front.
The illumination of the LED in any color indicates the presence of the operating voltage.

Color	Operating state	Description
Green	Ready	Electronic-Key adapter is 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.
>
> After mounting, again check the Electronic-Key adapter for firm seating and correct sealing of the front panel.

5.1.1 Compact Electronic-Key adapter in G01 housing

> **Attention!**
>
> To achieve the degree of protection IP65/IP67, it is necessary to install the Electronic-Key adapter in a clean, flat metal plate 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 connecting 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 IEC 61554 (see chapters 4.1.1 and 4.1.2). 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 the Electronic-Key adapter, **with seal already bonded in place**, into the mounting cut-out from the front.

2. Insert screw clamp elements into the housing of the Electronic-Key adapter from the side up to the stop and tighten with 0.25 …0.35 Nm.

> **Attention!**
>
> The device may be damaged if the tightening torque exceeds 0.35 Nm.

5.1.2 Compact Electronic-Key adapter in G30 housing (FHC)

> **Attention!**
>
> To achieve the degree of protection IP65/IP67/IP69K, it is necessary to install the FHC Electronic-Key adapter in a clean, flat metal plate at least 2 mm thick and to tighten the central fixing nut with a tightening torque of 2 Nm.
>
> Suitable strain relief must be provided for the connecting 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 Ø 22.5 mm (see chapter 4.1.3).

6 Electrical connection

! Attention!

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

> ▶ Observe electrical characteristics and terminal assignment (see chapter 4)
> ▶ When installing 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 connecting cables in the immediate vicinity of sources of interference.

6.1 USB connection

The Electronic-Key adapter interface is compatible with all USB versions.

Information!

> ▶ Only a USB-compatible cable with a maximum length of 3 m is allowed to be used as the connecting 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 be performed only with administrator rights (only for Windows®).

6.2 Connection of the semiconductor switching contacts (only for EKS G01 *FSA*)

Warning!

Incorrect connection or errors in the safety-related integration of the EKS *FSA* can lead to fatal injury. For this reason, observe the following safety aspects:

> ▶ It is not possible to generate a safe signal by using only the switching contacts LA1/LA2 and LB1/LB2. Safe, downstream evaluation is always necessary. Use of the switching contact LB1/LB2 is optional.
> ▶ Safe evaluation must always be dual-channel: evaluation of switching contact LA1/LA2 as channel LA together with evaluation of the data line as channel LB.

Information!

The switching contact LA1/LA2 is used in combination with functionally safe applications. The function that can be evaluated in terms of safety engineering is the reliable detection that an Electronic-Key has not been placed.

! Attention!

The power is supplied via the USB connection. If the power supply drops below 4.5 V or exceeds 5.5 V, the switching contacts LA1/LA2 and LB1/LB2 will be switched off.

7 Setup

Perform setup in the following sequence:

1. Set the DIP switches on the Electronic-Key adapter
   (see chapter 4.4 DIP switch setting).

2. Check whether mounting and electrical connection are correct (see chapter 5 Mounting and chapter 6 Electrical connection).

3. After the USB connecting cable is plugged in and the EKS USB drivers are installed, the LED on the front of the Electronic-Key adapter illuminates green. This indicates that the power supply is present.

4. Place the 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 Installation of EKS USB drivers

The EKS USB drivers provided are certified by Microsoft (Windows Hardware Quality Labs / WHQL) and digitally signed. These drivers are therefore distributed via Windows updates and the Microsoft Update Catalog.

If an Internet connection and administrator rights are available when a read/write station is connected to a Windows PC, the drivers will automatically install themselves in the background.

Setting up a device
We're setting up 'EUCHNER Electronic-Key-System'.

You will be notified as soon as automatic installation is complete.

Device is ready
'EUCHNER Electronic-Key-System' is set up and ready to go.

Please proceed as follows if the EKS USB drivers do not install themselves automatically:

To begin installation, have the driver software (order no. 094376) at hand in a folder or on a data carrier. The driver software is available for download on the Internet at www.euchner.com or free of charge on request.

> **Information!**
> The user must be logged on as an administrator in order to install or uninstall the drivers.

▶ Connect the EKS read/write station to an unoccupied USB port on the PC using the corresponding USB cable. The device is shown as an unknown device under **Other devices** in the **Device Manager**.
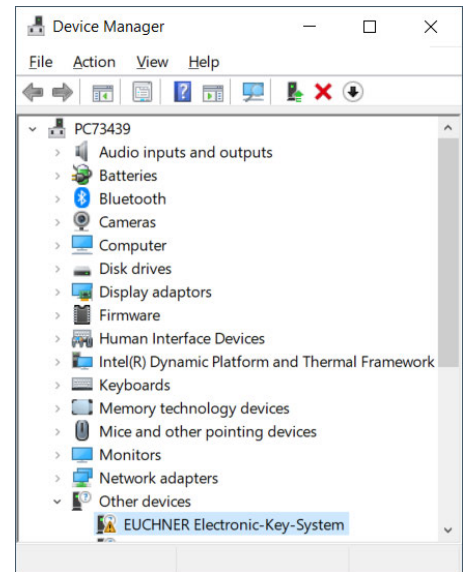
▶ In **File Explorer**, select the folder corresponding to the operating system architecture.
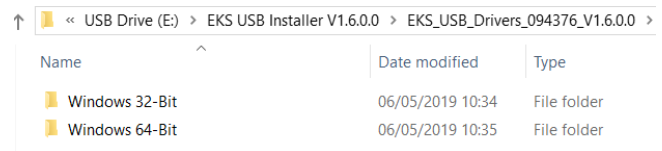
▶ Run **setup.exe**.
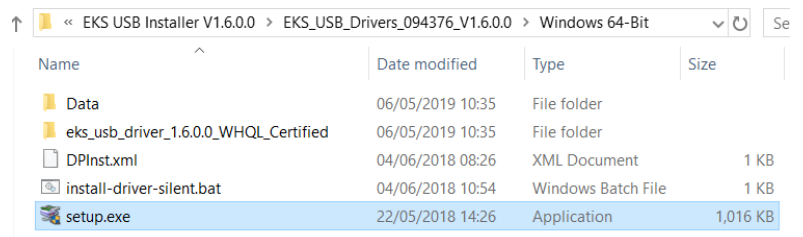
▶ Click **Next**.
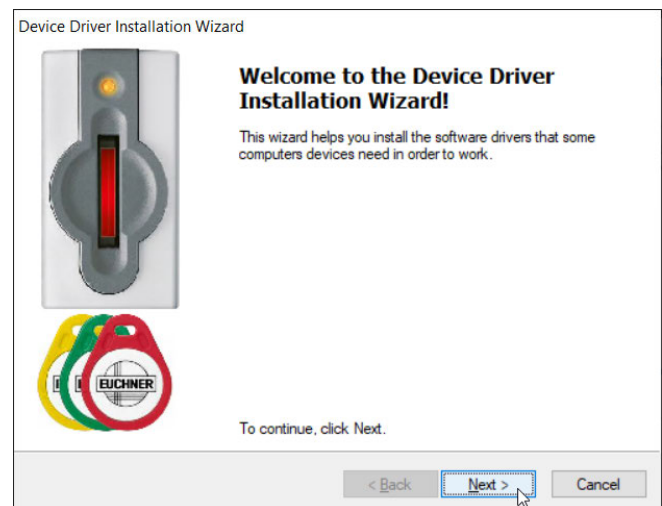
▶ The EKS USB drivers will be installed.
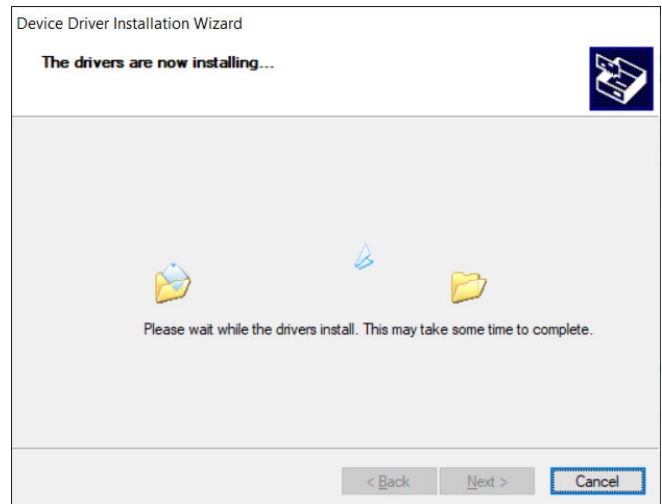
▶ After completing installation, click **Finish**.
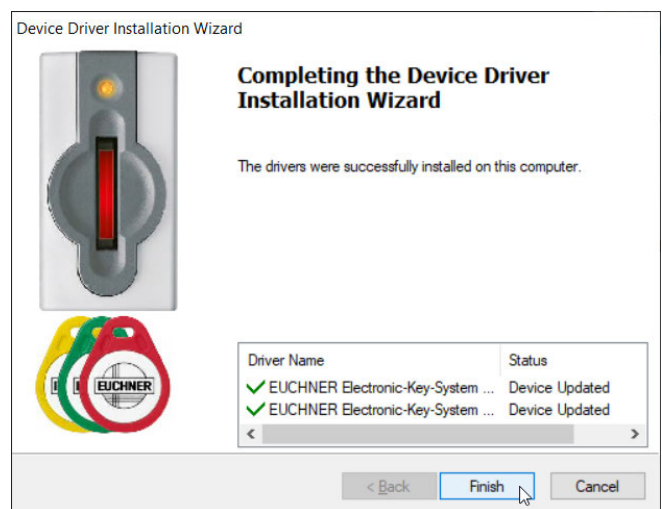
Two entries appear in the *Device Manager*. The EKS USB device driver is displayed under *Universal Serial Bus controllers*. The virtual serial COM port driver is displayed under *Ports (COM & LPT)*.

The automatically assigned COM port number # (3 in this example) can be found in the entry *EUCHNER Electronic-Key-System USB (COM#)* under *Ports (COM & LPT)*. The application can communicate with the device using this COM port.

Information!
This entry is visible only if the Electronic-Key adapter is plugged in.
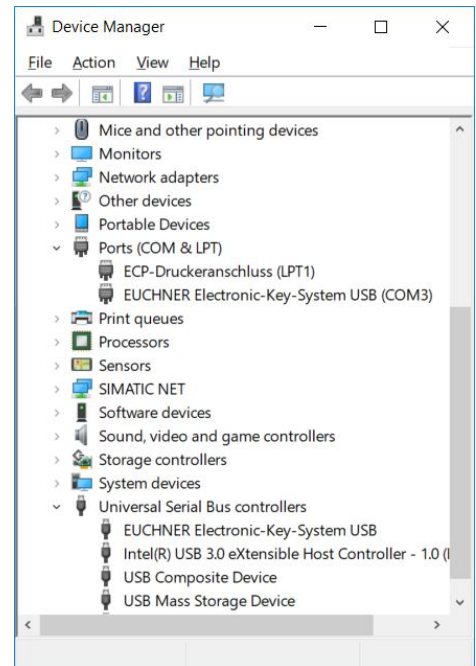
7.2 Changing the virtual COM port and driver version number under Windows®

> ⓘ **Information!**
> The user must be logged on as an administrator in order to be able to change a COM port number.

> ⓘ **Information!**
> This is possible only if an Electronic-Key adapter is plugged in.

▶ Begin by opening the **Device Manager**.

▶ Find the entry **EUCHNER Electronic-Key-System USB (COM#)** in the list of **Ports (COM & LPT)**.

▶ Select **Properties** from the context menu.
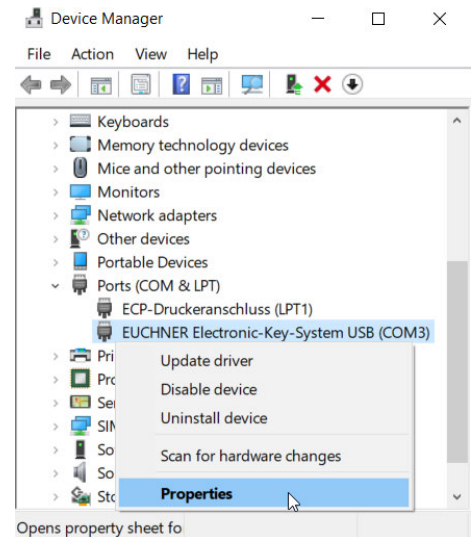
▶ Select the **Port Settings** tab in **EUCHNER Electronic-Key-System USB (COM#) Properties**.

▶ When you select **Advanced...** a window is opened where you can change the virtual COM port.
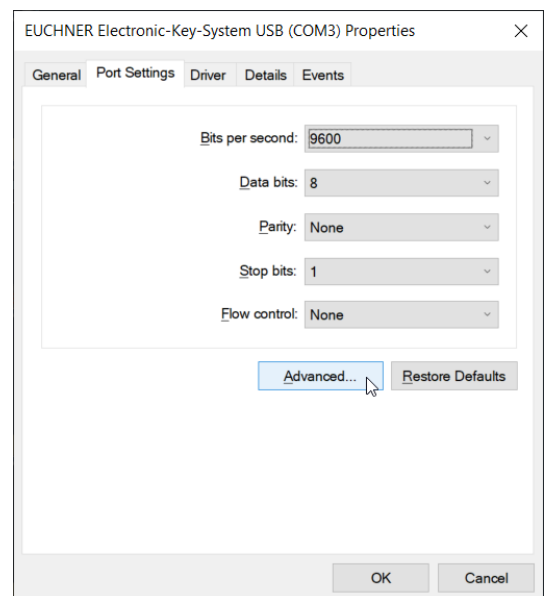
▶ The required virtual COM port can be selected from the **COM Port Number:** selection field. Confirm with **OK**.

▶ The change is then immediately visible and active in the **Device Manager**.

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

Information!
This COM port also must be selected in the ActiveX module, for example.

Advanced Settings for COM3

COM Port Number: COM3

COM3
COM4
COM5
COM6
COM7
COM8
COM9
COM10
COM11
COM12
COM13
COM14
COM15
COM16
COM17
COM18
COM19
COM20
COM21
COM22
COM23
COM24
COM25
COM26
COM27
COM28
COM29
COM30
COM31

USB Transfer Sizes
Select lower settings to corre
Select higher settings for fast

Receive (Bytes):

Transmit (Bytes):

BM Options
Select lower settings to corre

Latency Timer (msec):

Timeouts
Minimum Read Timeout (mse
Minimum Write Timeout (mse

Miscellaneous Options
Serial Enumerator   ☑
Serial Printer   ☐
Cancel If Power Off   ☐
Event On Surprise Removal   ☐
Set RTS On Close   ☐
Disable Modem Ctrl At Startup   ☐
Enable Selective Suspend   ☐
Selective Suspend Idle Timeout (secs):   5

OK
Cancel
Defaults

▶ The **Driver** tab shows the installed driver version (1.6.0.0 in this example).

EUCHNER Electronic-Key-System USB (COM3) Properties

General | Port Settings | Driver | Details | Events

EUCHNER Electronic-Key-System USB (COM3)

Driver Provider: EUCHNER
Driver Date: 24/10/2018
Driver Version: 1.6.0.0
Digital Signer: Microsoft Windows Hardware Compatibility Publisher

Driver Details   View details about the installed driver files.

Update Driver   Update the driver for this device.

Roll Back Driver   If the device fails after updating the driver, roll back to the previously installed driver.

Disable Device   Disable the device.

Uninstall Device   Uninstall the device from the system (Advanced).

OK   Cancel

7.3 Uninstalling the EKS USB drivers under Windows®

ℹ **Information!**
The user must be logged on as an administrator in order to uninstall the EKS USB drivers.

ℹ **Information!**
This is possible only if an Electronic-Key adapter is plugged in.

▶ Begin the uninstalling process by opening the **Device Manager**.

▶ Find the entry **EUCHNER Electronic-Key-System USB (COM#)** in the **Ports (COM & LPT)** list.

▶ Select **Uninstall device** from the context menu.
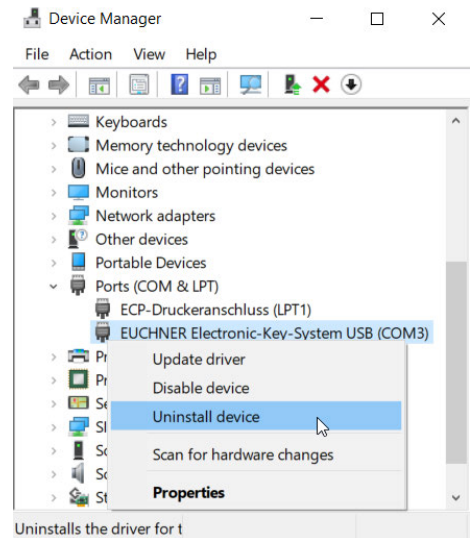
▶ Confirm that you wish to uninstall **EUCHNER Electronic-Key-System USB (COM#)** by ticking **Delete the driver software for this device**.

▶ Click **Uninstall**.
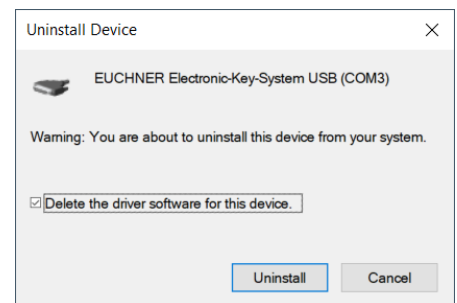
▶ Find the entry **EUCHNER Electronic-Key-System USB** in the **Universal Serial Bus controllers** list.

▶ Select **Uninstall device** from the context menu.
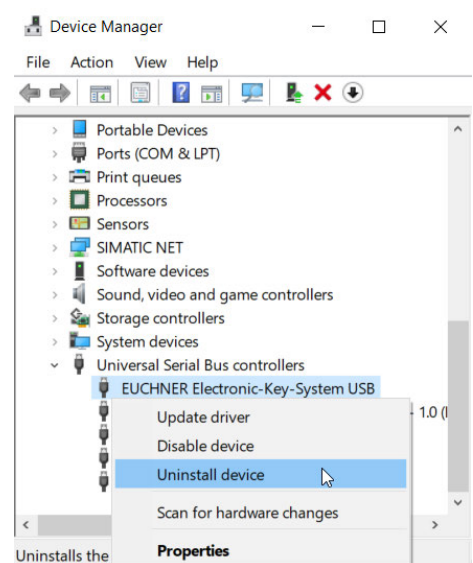
▶ Confirm that you wish to uninstall **EUCHNER Electronic-Key-System USB** by ticking **Delete the driver software for this device**.

▶ Click **Uninstall**.

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 se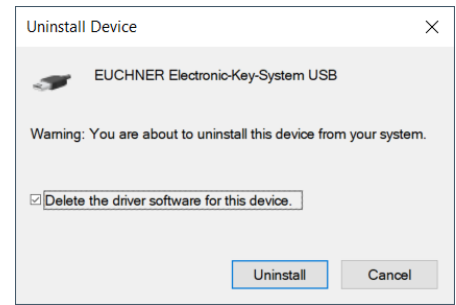rial interface. This signal can be used for control purposes to detect whether there is an Electronic-Key in the Electronic-Key adapter.

8.2 Communication

This chapter primarily describes communication between a PC and the Electronic-Key adapter.

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 device with USB interface into the user's PC application is supported by an optionally available ActiveX® module (order no. 098708) (usable for ActiveX®-capable user programs under MS Windows®). The EKS can thus be used in conjunction with process visualization, for example. **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 device 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 acknowledgment character (DLE). If the acknowledgment 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.	Transmit data in ASCII format	Acknowledgment from 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 items		
	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 connected peripheral device, because 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 data transfer:

► Connection setup: request from A to B for data transfer

► Data transfer from A to B

► Connection termination: conclusion of data transfer

8.3.1.2 The 3964R transfer protocol [1]

Unlike protocol-free data transfer procedures, 3964R is a data transfer procedure 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 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}) Acknowledgment (**D**ata **L**ink **E**scape)

▶ **STX**   (02_{hex}) **S**tart of **T**ext

▶ **NAK**   (15_{hex}) **N**egative **Ack**nowledgement

▶ **ETX**   (03_{hex}) **E**nd of **T**ext

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 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 set up and **ends after** the characters **DLE** and **ETX** during connection termination.

8.3.1.3 The control system sends [1]

To set up the connection, the control system sends the control character **STX**. If, before the acknowledgment delay time (ADT, typically: 2 s) elapses, the peripheral device responds with the control character **DLE**, the control system switches to transfer mode. If the peripheral device responds with the control character **NAK**, any other character (except **DLE**) or the acknowledgment delay time elapses without a reaction, the attempt to set up the connection has failed. After a total of six unsuccessful attempts (3964R protocol specification) the process is aborted. If the attempt to set up the connection is successful, the characters with the user information as contained in the send buffer in the control system are transferred to the peripheral device at the selected transfer speed. The peripheral device 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 user data are being transferred and not the control character **DLE (DLE duplication)**.

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

Then the control system waits for an acknowledgment character from the peripheral device. If the peripheral device sends the control character **DLE** within the acknowledgment delay time (ADT, typically: 2 s), the data block has been received correctly. If, on the other hand, the peripheral device responds with the control character **NAK**, any other character or the acknowledgment 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 six 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 device.

8.3.1.4 The control system receives [1]

If the control system receives the control character **STX** from the peripheral device 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 device.

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 device. A retry is then awaited. If it is not possible to receive the block correctly after a total of six attempts (3964R protocol specification) or the retry is not started by the peripheral device 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 device. Then a retry in the form described above is awaited.

8.3.1.5 Summary of the most important points

▶ **DLE duplication:**
For the control system 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 are interpreted by the receiving end as user data and not as control characters 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 **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 set up and **ends after** the characters **DLE** and **ETX** during connection termination.

▶ **Retries on errors:**
If an error occurs for any reason during data transfer, **a total of six 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.

PC/control system	Electronic-Key-System
Command message ⟶	
	Reply message ⟵
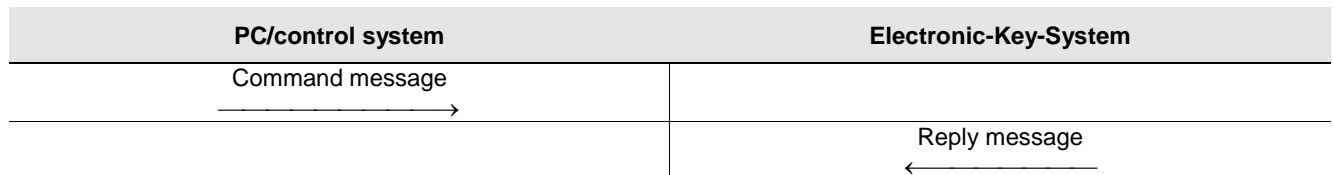
○
ⵌ **Information!**
On the Electronic-Key read/write with 116 bytes freely programmable, the memory is organized in 4-byte blocks. This means the start address for writing must be given in the range byte number 0 to byte number 112, always in 4-byte steps (byte number 0, 4, 8 ... 112). Also, a multiple of 4-byte-sized blocks must always be written (4, 8, 12 ... 116 bytes)!

However, during reading it is possible to access the memory byte-by-byte without the above-mentioned restriction for writing.

The Electronic-Key read/write also has a unique 8-byte serial number that is permanently written to the memory during the Electronic-Key production process. The serial number therefore cannot be changed. The serial number is used for secure distinction of every single Electronic-Key. It is necessary that all 8 bytes are completely evaluated for secure distinction. The serial number is appended to the freely programmable memory. The serial number can be read by entering the start address byte number 116 and the number of bytes 8.

8.4.1 Write process

When this command is used, the Electronic-Key must be placed in the Electronic-Key adapter, and must be removed from within the operating distance only after the reply message has been received.

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	Constant		01	1
4			00	0
5	Start address for the user data		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	Constant		01	1
4			00	0
5	Padding data		00	0
6	Status number		*	

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

* Status number 00_{hex}:   without errors

02_{hex}:   Electronic-Key not in the operating distance

(for further status numbers see chapter 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	ASCII	Contents hexadecimal	decimal
0	Number of message bytes		07	7
1	Command identification	T	54	84
2		L	4C	76
3	Constant		01	1
4			00	0
5	Start address for the user data		00 ... 74	0 ... 116
6	Number of bytes of user data		01 ... 7C	1 ... 124

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

Byte no.	Description	ASCII	Contents hexadecimal	decimal
0	Number of message bytes		08 ... 83	8 ... 131
1	Command identification	R	52	82
2		L	4C	76
3	Constant		01	1
4			00	0
5	Start address for the user data		00 ... 7C	0 ... 116
6	Number of bytes of user data		01 ... 7C	1 ... 124
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	ASCII	Contents hexadecimal	decimal
0	Number of message bytes		07	7
1	Command identification	R	52	82
2		F	46	70
3	Constant		01	1
4			00	0
5	Padding data		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 operating distance

                        (for further status numbers see chapter 8.6)

8.5 Command overview

Description	Command message	Reply message
Program Electronic-Key	**TP** (see chapter 8.4.1)	**RF** (see chapter 8.4.1)
Read Electronic-Key (also read the serial number)	**TL** (see chapters 8.4.2 and 8.4)	**RL** (see chapter 8.4.2) or **RF** (see chapter 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 read-only Electronic-Key
06$_{hex}$	Write process interrupted. 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 a read-only Electronic-Key is inserted
18$_{hex}$	Read attempt when the Electronic-Key adapter is set to read-only Electronic-Key and an Electronic-Key read/write is inserted
4x$_{hex}$	General Electronic-Key communication error (renewed write or read process necessary)
50$_{hex}$	Write attempt despite enabled write protection

9 Exclusion of liability

Exclusion of liability under the following circumstances:

▶ Incorrect use

▶ 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 to be made only 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

Automation system S7-300CPU-Data

CPUs 312C to 314C-2DP/PtP

Only RS422/485

Point-to-point coupling CP 340	SIEMENS order no.
Installation and parameter assignment	6ES7340-1AH00-8AA0

Point-to-point coupling CP 341	SIEMENS order no.
Installation and parameter assignment	6ES7341-1AH00-8AA0

Point-to-point coupling CP 441	SIEMENS order no.
Installation and parameter assignment	6ES7441-2AA00-8AA0

[2] Detailed application examples from EUCHNER

EUCHNER

More than safety.