Electronic-Key-System

Manual
Electronic-Key Adapter EKS and EKS *FSA* with Profibus-DP Interface

Order No. 092 009

More than safety.

EUCHNER

Table of contents

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-IDX-G01-ST09/03 with Profibus-DP interface (order no. 084 800) as well as the version EKS-A-IDXA-G01-ST09/03/04, EKS **F**or **S**afety **A**pplications (EKS *FSA*, order no. 100 378). The complete evaluation and interface electronics are integrated in 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.

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:

- **DIP** **D**ual **I**nline **P**ackage
- **DP** **D**ecentral **P**eripheral
- **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
- **GSD** **G**eräte**S**tamm**D**aten (device data)
- **LED** **L**ight **E**mitting **D**iode
- **LSB** **L**east **S**ignificant **B**it
- **MSB** **M**ost **S**ignificant **B**it
- **PA** **P**oly**A**mide
- **ROM** **R**ead-**O**nly **M**emory
- **SRD** **S**end and **R**equest **D**ata with acknowledge
- **SDN** **S**end **D**ata with **N**o acknowledge

1.2 CE conformity

The EKS Electronic-Key adapter with Profibus-DP interface conforms to the **EMC directive** 2004/108/EC (89/336/EEC, 92/31/EEC, 93/68/EEC) and the **low voltage directive** 2006/95/EC (73/23/EEC, 93/68/EEC, 98/79/EC).

The Electronic-Key adapter complies 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 Approvals

The EKS Electronic-Key adapter with Profibus interface is certified to c UL us (certificate number 170205 – E240367).

For use and operation as per the c UL us requirements, a power supply **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 controllers or parts of controllers for machine installations. EKS can be used, for example, as part of an overall system for checking access rights for operating mode selection. However, it is not permitted to directly derive the operating mode 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. This is possible via the graphical user interface on the control system, for example.

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 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 sense 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.

1.5 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 sense 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 1.4) and *Electrical connection* (see section 6).

Warning!

Installation and electrical connection must be performed only 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 of EKS Standard and version EKS *FSA*

The EKS is used for access control and monitoring on controllers or parts of controllers 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 also offers the Electronic Key Manager (EKM) software. To enter data in the EKM software, an Electronic-Key adapter with serial interface or USB interface must be in operation on the PC.

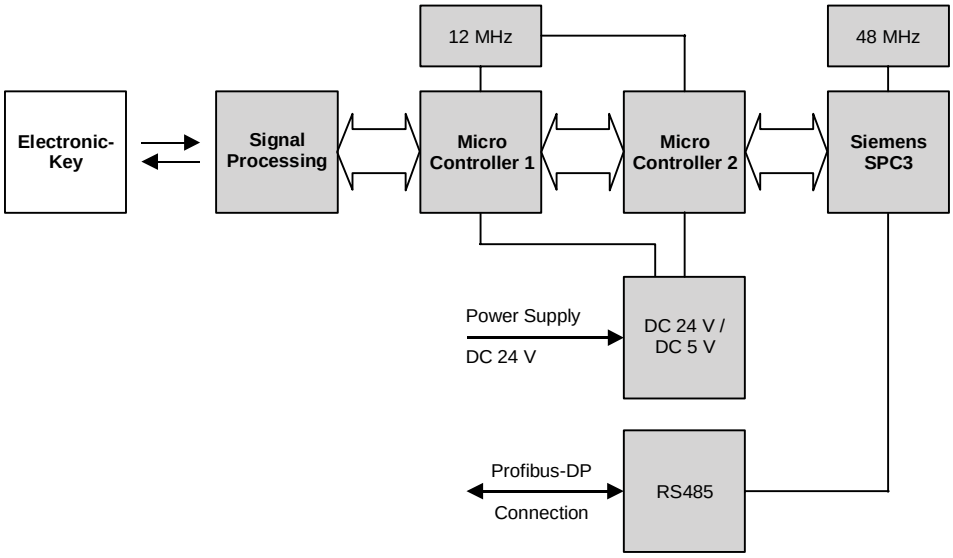


Figure 1: Block diagram EKS

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 connection to the system is made using the integrated Profibus-DP interface. The Electronic-Key adapter is connected to the field bus as a subscriber (DP slave) using a standard Profibus cable. The Electronic-Key adapter can thus also be used remotely from the controller, e.g. at assembly workstations.

Setup and system integration can be realized very straightforwardly and quickly on the Electronic-Key adapter with Profibus-DP interface. The bus address is simply set at the Electronic-Key adapter and the device data file (GSD file) loaded into the bus master. The transmission protocol complies with Profibus-DP according to DIN EN 50170. The system automatically synchronizes itself to the data transfer rate of the bus master. The data is available in the input area of the bus master immediately after connection.

Two transfer messages are supported based on the Profibus-DP **SRD** and **SND** transfer services:

- Program (write) Electronic-Key read/write
- Read Electronic-Key

The current state of the Electronic-Key adapter is displayed using a 3-color LED. If an error is detected when the Electronic-Key is written or read (e.g. due to premature removal of the key from the Electronic-Key adapter or a faulty key), the LED flashes red for approx. 5 s. After this, the LED is illuminated green again and the Electronic-Key adapter is again ready for use.

The Electronic-Keys are tag-shaped. The complete transponder without batteries with memory chip and antenna is integrated into the Electronic-Key.

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 using any contacts between the Electronic-Key adapter and Electronic-Key.

Figure 2: Cut-away illustration of Electronic-Key adapter with Electronic-Key inserted

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

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

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.

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 if 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 with diversity by a dedicated processor that switches off the outputs on removal of the Electronic-Key (see Figure Block diagram EKS *FSA*).

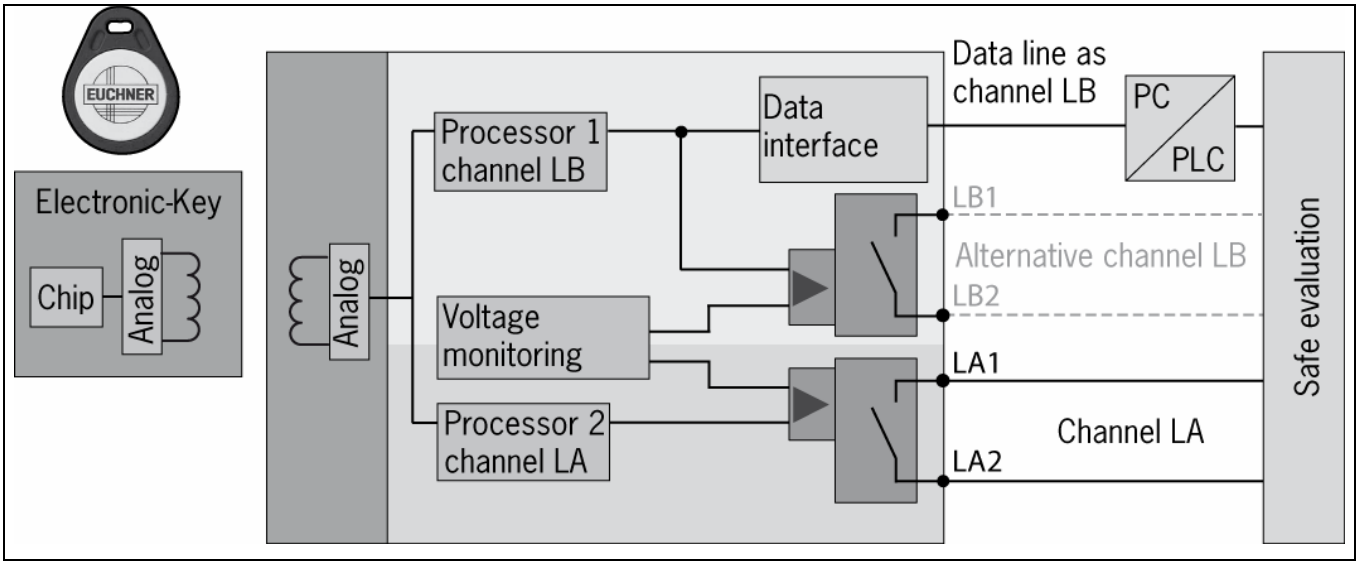


Figure 3: Block diagram EKS *FSA*

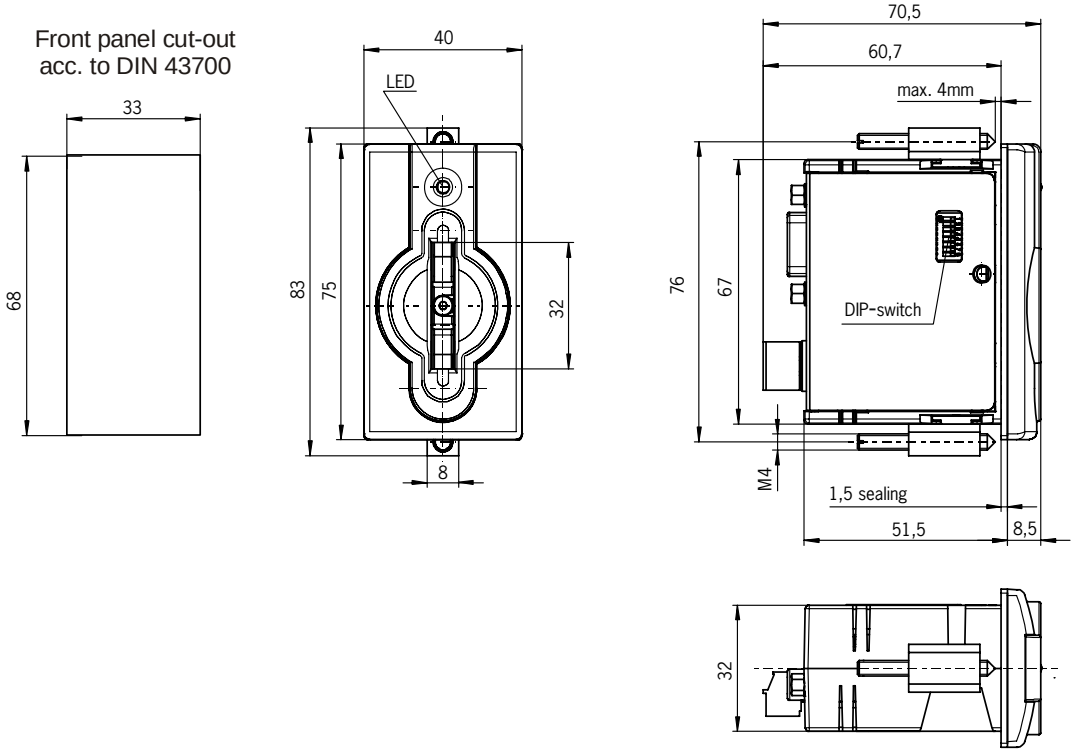
By separately evaluating channel LA and channel LB, the EKS *FSA* device can be used in conjunction with a safe evaluation in safety-related applications. Integrated voltage monitoring switches off the switching contacts LA and LB if the power supply is outside the permitted tolerance (see section 4.2).

4 Technical Data

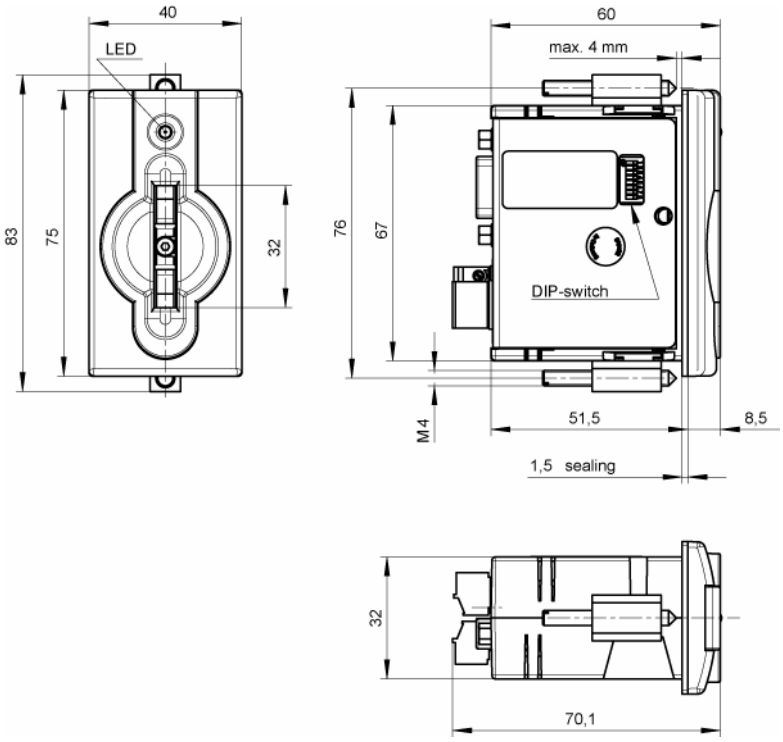
4.1 Dimension drawing of Electronic-Key adapter

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

4.1.1 Version EKS-A-IDX-G01-ST09/03 with Profibus-DP interface



4.1.2 Version EKS-A-IDXA-G01-ST09/03/04 (EKS *FSA*) with Profibus-DP 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.

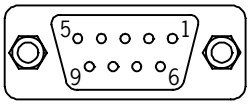
General parameters	Value			Unit
	min.	typ.	max.	
Housing	Plastic (PA 6 GF30 gray)			
Degree of protection according to EN 60529	IP 67 in installed condition			
Ambient temperature at UB = 24 V DC	0		+ 55	°C
Mounting cut-out acc. to DIN 43700	33 x 68			mm
Connection for power supply	Plug-in screw terminal, 3-pole, max. conductor cross-section 1.5 mm², tightening torque 0.22 Nm			
Operating voltage UB (regulated, residual ripple < 5 %)	20	24	28	DC V
Current consumption			150	mA
Interface, data transfer				
Interface to host control	RS485 (address selectable via DIP switch)			
Address range	0 ... 126			
Transfer protocol	Profibus-DP according to EN 50170			
Data transfer rate	9.6/19.2/45.45/93.75/187.5/500			kbps
	1.5/3/6/12			Mbps
Connection for Profibus-DP	Sub-D 9-pin			
Cable length max.	100 ... 1200 according to Profibus-DP, depending on data transfer rate			m
LED display	Green: "Ready" (in operation) Yellow: "Electronic key active" * Red: "Error"			
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 screw terminals, 2 x 2-pole	0.14		1.5	mm²

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

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

4.3 Pin assignment

4.3.1 Socket, Profibus-DP



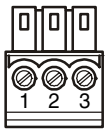
SUB-D socket
9-pin

PIN	Designation	Function (according to EIA RS-485)
1	Not used	-
2	Not used	-
3	RxD/TxD-P	Transmit/receive data P, B-wire
4	CNTR-P	Direction detection signal for repeater
5	DGND	Data ground
6	VP	Power supply DC +5 V for termination resistor plug
7	Not used	-
8	RxD/TxD-N	Transmit/receive data N, A-wire
9	Not used	-
Housing	Function earth	Electrically connected to the housing

4.3.2 Plug-in screw terminals for power supply

Information!

The coded plug for connection of the power supply is included with the Electronic-Key adapter.



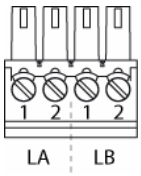
Coded plug, 3-pin
with screw terminals
Cond. cross-section 0.14 ... 1.5 mm²
Tightening torque 0.22 Nm

PIN	Designation	Function
1	UB	Power supply DC + 24 V
2	0V	Power supply DC 0 V
3	Function earth	Electrically connected to the housing

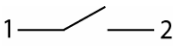
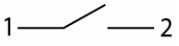
4.3.3 Plug-in screw terminals for outputs LA1/LA2 and LB1/LB2 (EKS *FSA* only)

Information!

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



Coded plug 2 x 2-pin
with screw terminals
Cond. cross-section 0.14 … 1.5 mm²
Tightening torque 0.22 Nm

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

4.4 DIP switch settings

The device address 0...126 (decimal) can be set using the DIP switches S1 to S7. The device address is given by the sum of the address values on each DIP switch.

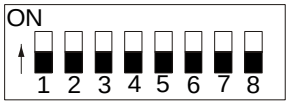
Write protection can be enabled using DIP switch S8. In this way the writing of data to the Electronic-Key read/write is prevented.

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

DIP switches, 8-pole:

DIP switch	Functions	Factory setting address 3
S8	ON = write protection for Electronic-Key read/write	OFF
S7	ON = address 64 decimal	OFF
S6	ON = address 32 decimal	OFF
S5	ON = address 16 decimal	OFF
S4	ON = address 8 decimal	OFF
S3	ON = address 4 decimal	OFF
S2	ON = address 2 decimal	ON
S1	ON = address 1 decimal	ON

The device addresses 0 to 126 (decimal) are set using the following scheme:



Device address	LSB S1	S2	S3	S4	S5	S6	MSB S7	S8
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Write protection for Electronic-Key read/write
1	ON	OFF	OFF	OFF	OFF	OFF	OFF	
2	OFF	ON	OFF	OFF	OFF	OFF	OFF	
3	ON	ON	OFF	OFF	OFF	OFF	OFF	
:								
32	OFF	OFF	OFF	OFF	OFF	ON	OFF	
:								
126	OFF	ON	ON	ON	ON	ON	ON	

Information!
The address 126 is only intended to be used for setup purposes.

4.5 LED indicator

The Electronic-Key adapter operating states are indicated using a 3-color LED on the front.
Illumination of the LED in any color indicates the presence of the operating voltage.

Color	Operating state	Description
Red	Fault	General bus error. No communication with the bus master or error when the Electronic-Key is written or read (e.g. due to premature removal of the key from the Electronic-Key adapter or a faulty key). The LED then flashes red for approx. 5 s. After this, the LED is illuminated green again and the Electronic-Key adapter is again ready for use.
Green	Ready	Communication with the bus master without Electronic-Key, Electronic-Key adapter ready.
Yellow	Electronic-Key active	Communication with the bus master with Electronic-Key. There is an Electronic-Key in the Electronic-Key adapter and it has been detected.

4.6 Profibus-DP

Specification for bus cables

A cable specified as cable type A according to EN 50170 must be used for the bus connection:

Parameter	Cable type A	Unit
Cable structure	Two core twisted, screened	
Effective capacitance	≤ 30	pF/m
Characteristic impedance	135 ... 165 (at a frequency of 3 ... 20 MHz)	Ω
Loop impedance	≤ 110	Ω/km
Core diameter	> 0.64	mm
Core cross-section	> 0.34	mm^2

4.6.1 Bus connection

On Profibus-DP every bus segment must be terminated at the start and end with a resistor.

Information!

The Electronic-Key adapter does not contain an internal switchable bus termination resistor!
If the Electronic-Key adapter is the last device on the cable, a bus plug with switchable bus termination resistor must be used.

Information!

To enable subscribers to be coupled and uncoupled to and from the Profibus as required while it is in operation, **active RS485 termination elements are available**. With the active RS485 termination element, the termination resistor is permanently supplied with power separately from the other peripheral subscribers. As it is operated independently of the bus subscribers, it can be coupled and uncoupled without interaction.

4.6.2 Permissible cable lengths

The permissible cable length in a bus segment is dependent on the cable type, the data transfer rate, the number of bus subscribers and external interference.

The table gives the maximum cable length for a bus segment as a function of the data transfer rate with the maximum number of subscribers of 32:

Parameter	Value					Unit
Data transfer rate	93.75	187.5	500	1500	3000/ 6000/12000	kbps
Cable type A	1200	1000	400	200	100	m

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 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 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

Electrical connection may only be performed by **authorized personnel trained in EMC and with the device and wiring isolated**.

For use and operation as per the cULus requirements, a power supply **for use in class 2 circuits** must be used.

The Electronic-Key adapter is only allowed to be connected if it is electrically isolated.
Otherwise the Electronic-Key adapter may be damaged.

If connected incorrectly, the Electronic-Key adapter may be damaged.
Observe electrical characteristics and the pin assignment (see section 4.2 Technical data, Electronic-Key adapter).

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

When installing connections, the operating organization must ensure compliance with the EMC safety requirements in accordance with EN 55011 and EN 61000-6-2.

The electrical connection must be made according to EN 50170 or the technical guidelines in the *User and Installation Guide Profibus-DP* from the Profibus User Organization.

The equipotential bonding system of the machine installation must comply with EN 60204-1, section 8, Equipotential bonding.

Do not lay connection cables in the immediate vicinity of sources of interference.

6.1 Connection of Profibus-DP

(For information on pin assignment see section 4.3.1 Socket, Profibus-DP)

Information!

In general spurs are to be avoided!
The ends of the cable must be terminated with a resistor.

Information!

The Electronic-Key adapter does not contain an internal switchable bus termination resistor!
If the Electronic-Key adapter is the last device on the cable, a bus plug with switchable bus termination resistor must be used.

It is imperative that the following points are observed:

- A cable specified as cable type A according to EN 50170 must be used for the bus connection.
- Only use bus cables with plugs according to EN 50170.
- When assembling cables, it is imperative that the assembly instructions from the plug manufacturer are observed.
- The bus connection plug must be inserted **and** the screw thread tightened. Only in this way is it ensured that the function earth between cable screen and housing of the Electronic-Key adapter is connected.
-

6.2 Connection of power supply

(For information on pin assignment see section 4.3.2 Plug-in screw terminals for power supply)

It is imperative that the following points are observed:

- The connections must be made as appropriate to maintain EMC performance.
- A power supply of suitable EMC performance must be used for the power supply.
- Conductor cross-section maximum 1.5 mm².
- Tighten the terminal screws on the plug to 0.22 Nm.

6.3 Connection of function earth

The function earth is connected via terminal 3 on the plug-in screw terminals for the power supply. This connection is electrically connected internally to the housing of the Electronic-Key adapter.

Information!
The function earth must be connected to PE!

6.4 Connection of the switched outputs (for EKS *FSA* only)

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 switched outputs LA1/LA2 and LB1/LB2. Safe, downstream evaluation is always necessary (e. g. using a safety relay). Use of the switched output LB1/LB2 as an alternative to the data line is optional.
- The safe evaluation must always be dual-channel. For this purpose, there are two alternatives:
  1. Evaluation of output LA1/LA2 as channel LA together with an evaluation of the data line as channel LB (recommended)
  2. 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.

6.4.1 Connection example with enabling switch

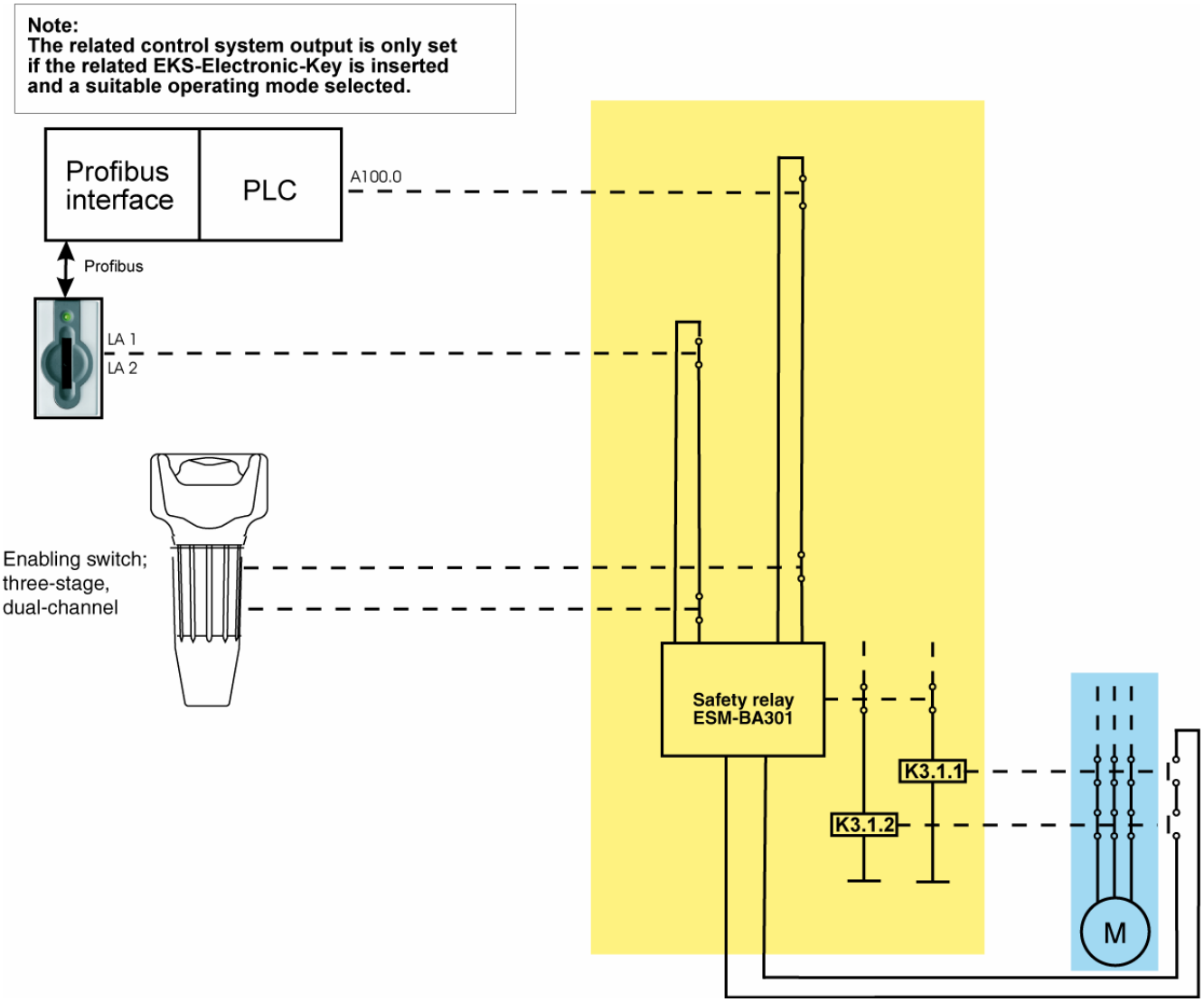


Figure 4: Principle of operation (illustration with selected operating mode and all parts in actuated position)

6.4.1.1 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 released and then operated again.

The switching contact LA1/LA2 is closed after insertion of the Electronic-Key. The EKS *FSA* is coupled with a control system. After the insertion of the Electronic-Key, the control system 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 is connected to the second input on the safety relay in series with the second switching contact on the enabling switch. 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) issue the related release and
- the enabling switch is actuated.

The output contacts on the safety relay are only released after 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 cancels 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.

6.4.1.2 Feedback loop

The safety relay can be started only with the feedback loop closed. A welded contactor contact in the enable 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.

6.4.1.3 Start

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

6.4.1.4 Circuit diagram

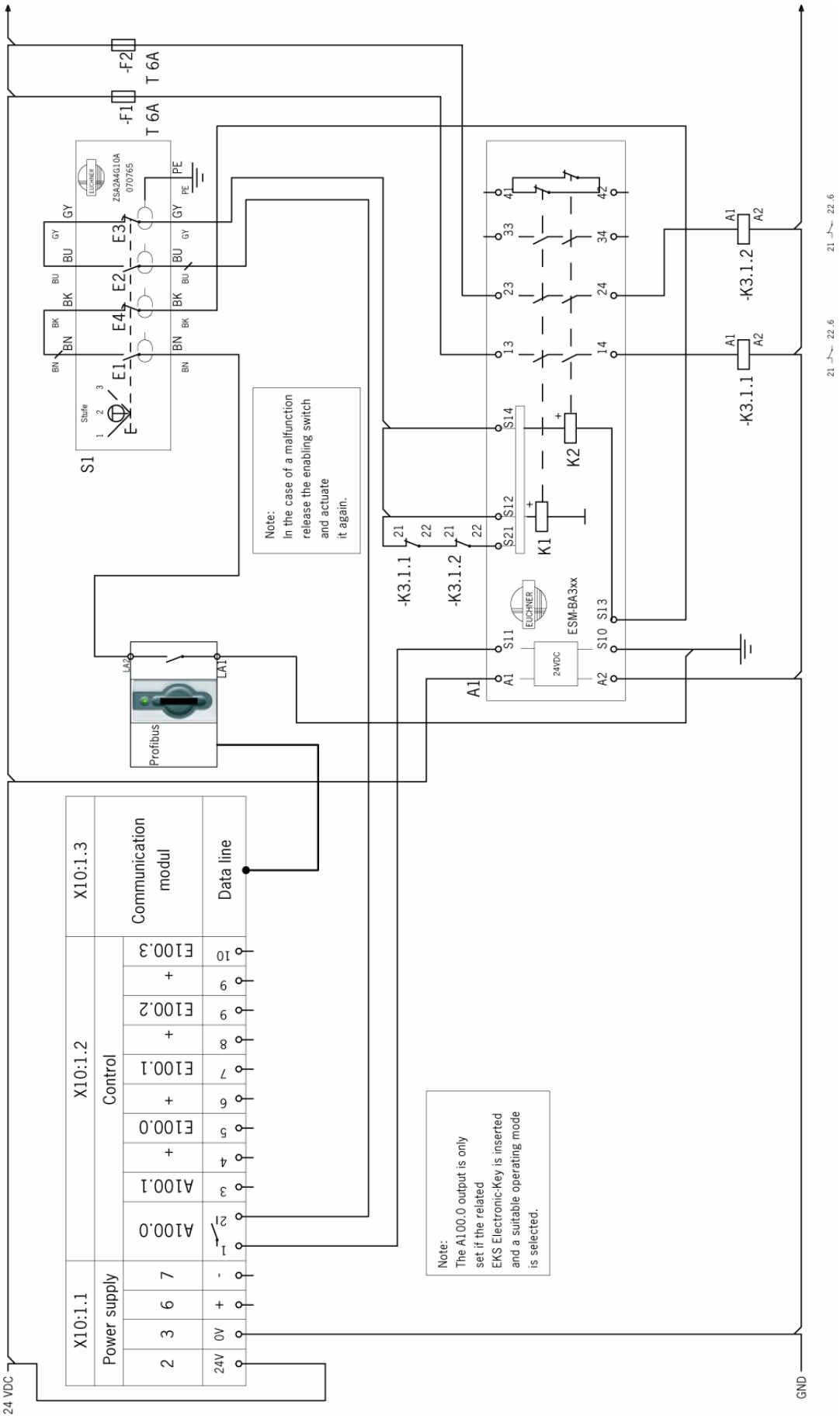


Figure 5: Circuit diagram with enabling switch

6.4.2 Connection example without enabling switch

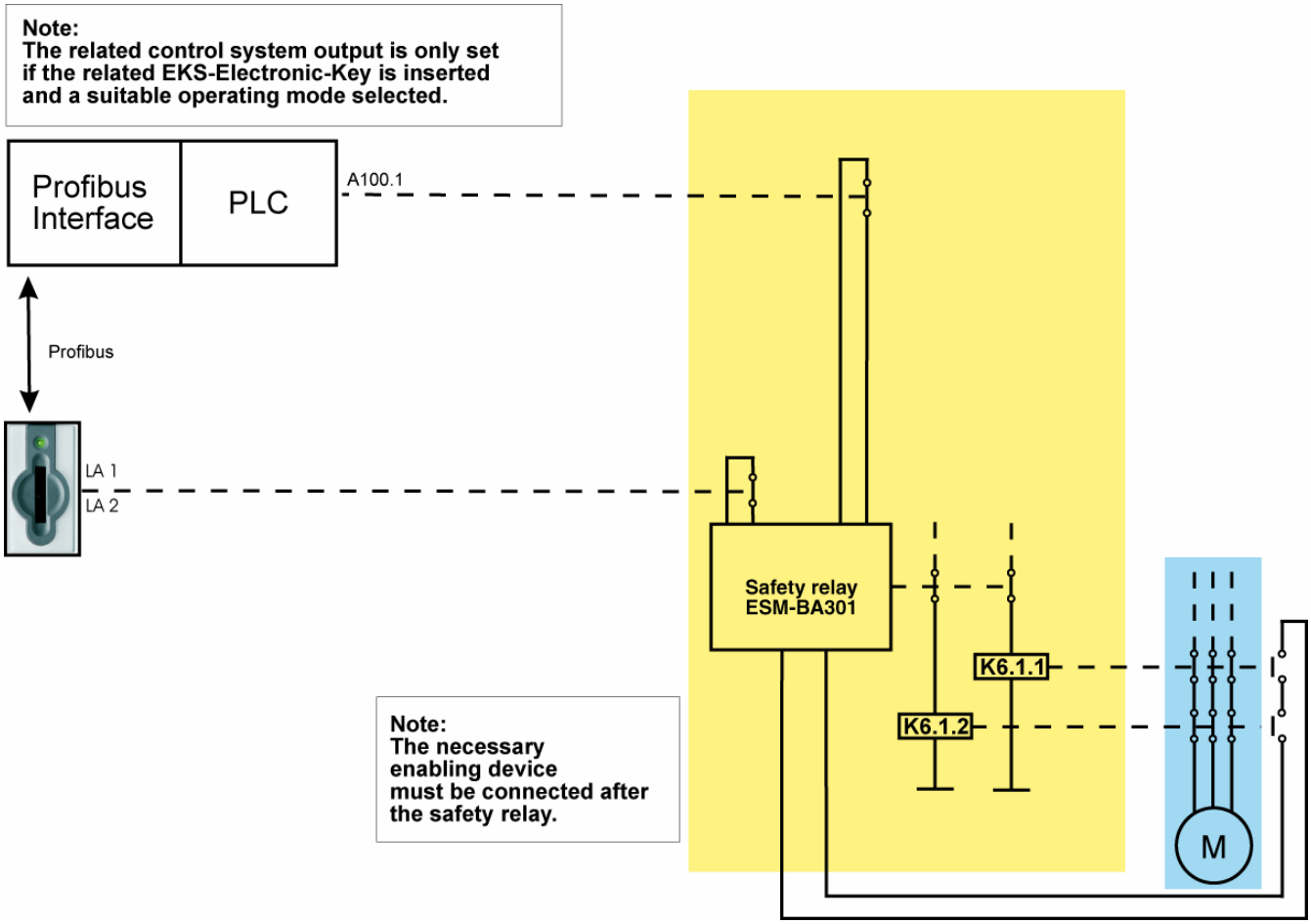


Figure 6: Principle of operation (illustration with selected operating mode and all parts in actuated position)

6.4.2.1 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 that 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 after insertion of the Electronic-Key. The EKS *FSA* is coupled with a control system. After the insertion of the Electronic-Key, the control system 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.

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 cancels the enable state (switching contact A100.0 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.

6.4.2.2 Feedback loop

The safety relay can be started only with the feedback loop closed. A welded contactor contact in the enable 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.

6.4.2.3 Start

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

6.4.2.4 Circuit diagram

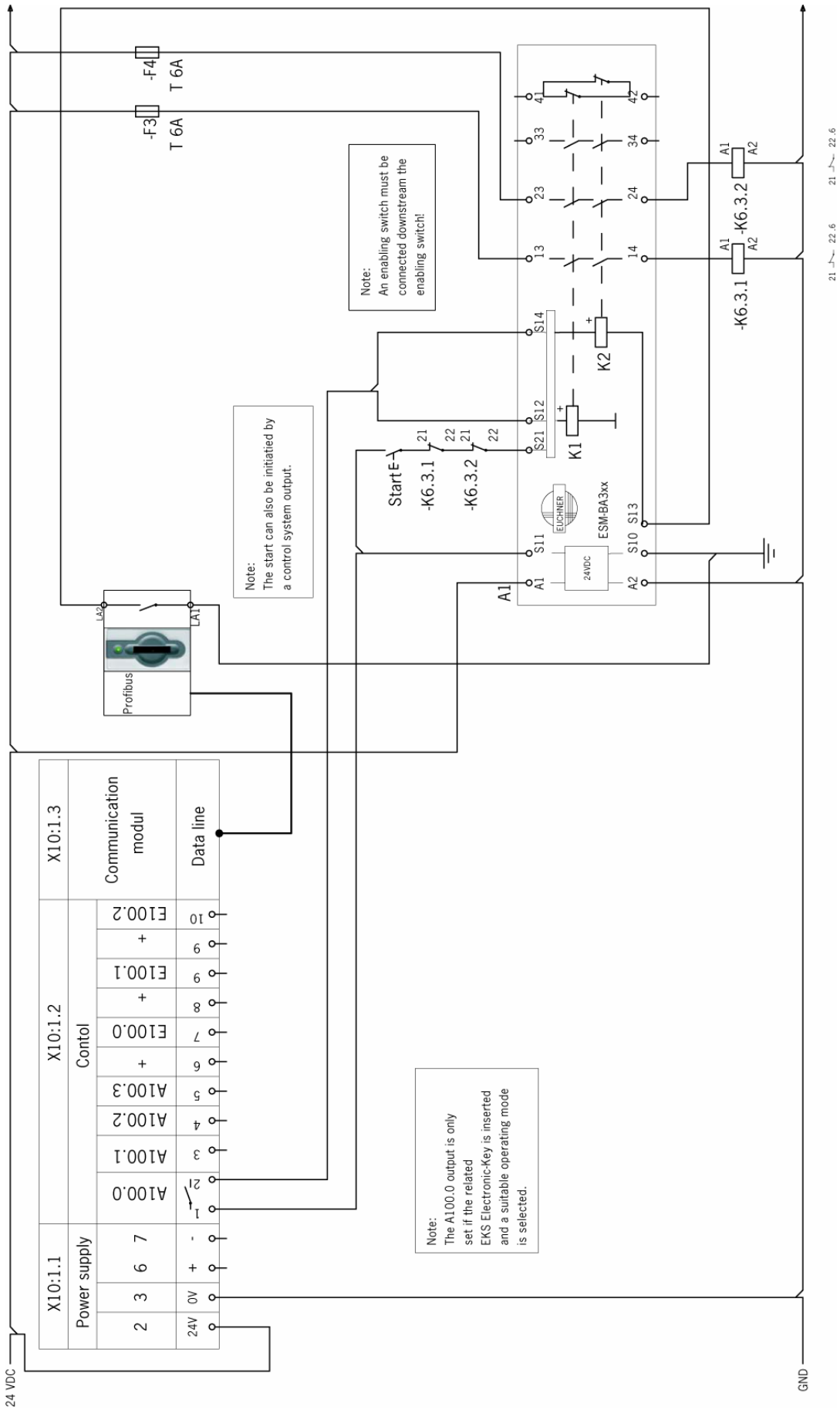


Figure 7: Circuit diagram without enabling switch

7 Setup

During setup proceed as follows:

Check mounting and electrical connection are correct
(see section 5 Mounting and section 6 Electrical connection).

Set device address on the DIP switches on the Electronic-Key adapter
(see section 4.4 DIP switch settings).

Switch on power supply.
After the power supply is switched on, the LED on the front of the Electronic-Key adapter illuminates red. This indicates that the supply voltage is present, but there is not yet any communication with the bus master. The LED only changes from red to green following successful configuration.

Insert Electronic-Key in the Electronic-Key adapter.
During communication with the bus master and transfer of the data, the LED changes to yellow.

8 Operation on the Profibus-DP

The Profibus-DP is a standardized field bus for decentral peripherals. Communication between the Electronic-Key adapter (DP slave) and bus master is performed according to DIN EN 50170 Vol. 2. Data transfer rates from 9.6 kbps to 12 Mbps are supported. The Electronic-Key adapter automatically synchronizes itself to the data transfer rate of the bus master.

To incorporate the Electronic-Key adapter in a Profibus system, the device data file (GSD file) is loaded into the bus master. The GSD file is available free of charge for download under order no. 092 054 on the Internet at www.euchner.de or on request. Different data field sizes are pre-defined in the GSD file for the read/write or read-only transponder type of the Electronic-Key.

The data read cyclically from the Electronic-Key is made available in the input area of the bus master. The Electronic-Key is also written cyclically via the output area of the bus master.

Other communication on the bus is controlled by the bus master. The bus master performs the following tasks:

- Initialization of the bus system
- Setting of parameters and configuration of the Electronic-Key adapter
- Cyclic data transfer to the Electronic-Key adapter
- Monitoring of the Electronic-Key adapter
- Provision of diagnostics information

8.1 Communication parameters (GSD file)

The device-specific parameters for the Electronic-Key adapter (device data) are stored in the GSD file (EUCH06CF.GSD); in this way straightforward "Plug and Play" configuration is possible. The image file EUCOEKS.BMP is also necessary to display the Electronic-Key adapter in the configuration software.

The GSD unambiguously describes the features of the Electronic-Key adapter in a standardized format.

The following modules (operating modes, data field sizes) are pre-defined in the GSD file:

Read/write operation in conjunction with Electronic-Key read/write (cyclic)

Max. 124 bytes user data can be read cyclically and max. 116 bytes user data written cyclically.

Data field size (GSD file selection) I/O area of bus master inputs / outputs	Electronic-Key user data
8 bytes	4 bytes
16 bytes	12 bytes
32 bytes	28 bytes
48 bytes	44 bytes
64 bytes	60 bytes
120 bytes	116 bytes
128/120 bytes	124/116 bytes

Read-only operation in conjunction with Electronic-Key read-only* (cyclic)

Five bytes of Electronic-Key content are read cyclically.

Data field size I/O area of bus master inputs / outputs	Key content
7 bytes	5 bytes

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

The required module is selected from these pre-defined modules in the GSD file using a configuration software tool.

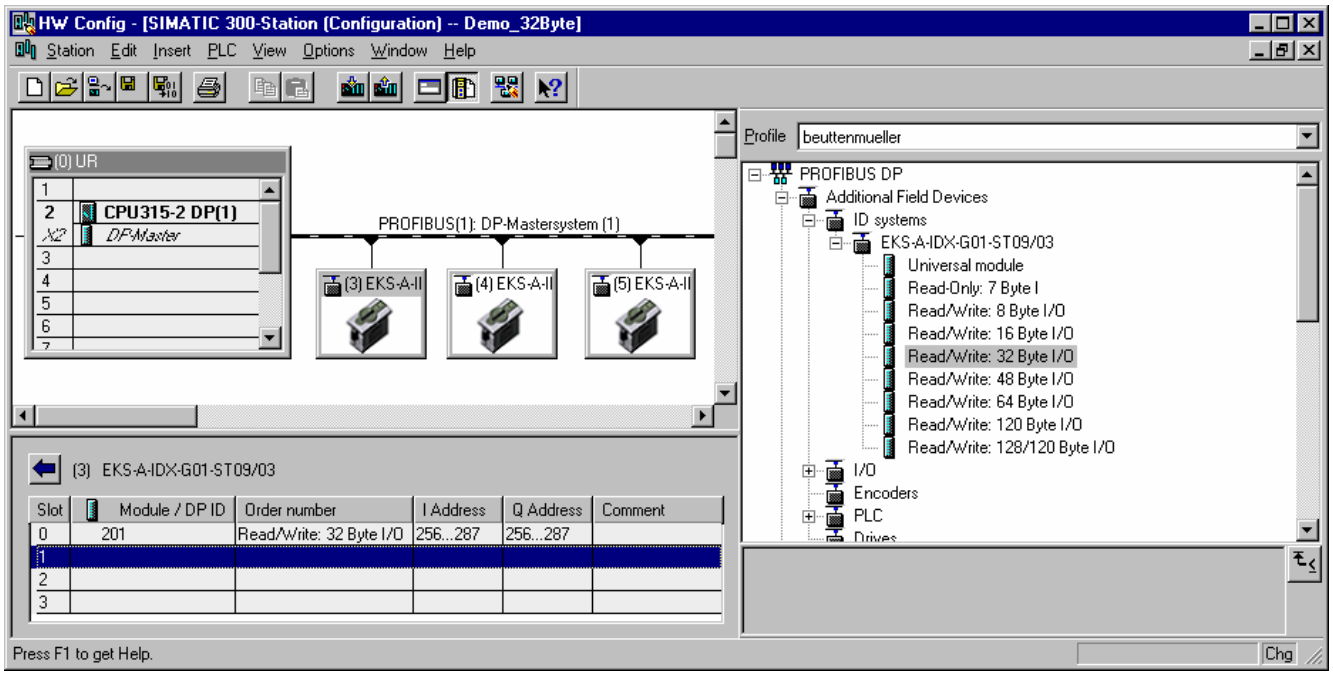


Figure 8: Module selection, example based on SIMATIC S7 hardware configuration

Select a software module in the GSD file, e. g. ***Read/Write: 32 Byte I/O***. The number of bytes defined here is transferred cyclically to the input area of the bus master. The number of bytes of user data that is transferred to the Electronic-Key is given by the data field size defined here minus 4 bytes. So on the selection of ***Read/Write: 32 Byte I/O***, 28 bytes user data are transferred from the Electronic-Key.

Information!

It is only possible to select the ***Read-Only: 7 Byte I*** module in conjunction with the read-only transponder type (see above).

8.2 Parameterization message

After being switched on, the Electronic-Key adapter expects a parameterization message from the bus master; this message contains the values for the parameters that can be set (global operating parameters) for the Electronic-Key adapter. The operating mode of the Electronic-Key adapter is defined based on this information.

8.3 Configuration message

After the parameters for the Electronic-Key adapter have been set, the bus master sends a configuration message. This message contains the configuration of the Electronic-Key adapter currently saved in the bus master. The Electronic-Key adapter compares the configuration message received with its own values. If the values match, the Electronic-Key adapter confirms the configuration.

8.4 Diagnostics message

If the Electronic-Key adapter detects an error, it automatically signals that there is an error after changing the status bytes using the diagnostics request "Extended diagnostics" to the bus master. The diagnostics data received is saved in the diagnostics area of the bus master. The total length of the diagnostics message is 32 bytes.

Byte no. 8 of the diagnostics message contains the EKS diagnostics byte. The content of the EKS diagnostics byte can be evaluated by the application.

Diagnostics area of the bus master		
Byte no.	**Function**	**Description**
0	Profibus slave diagnostics	Station status 1
1		Station status 2
2		Station status 3
3		Diag_Master_Adr
4		Ident-No_High
5		Ident-No_Low
6	Header Extended diagnostics	Length of the extended diagnostics
7		SPC3 error
8	Extended device specific diagnostics	EKS diagnostics byte
9 - 13		EKS software release
14 – 18		Bus interface software release
19 - 31		Internal device error

8.5 EKS diagnostics byte

The current state of the Electronic-Key adapter can be evaluated by the application via the content of the EKS diagnostics byte (byte no. 8, see section 8.4 Diagnostics message) in the diagnostics area of the bus master.

Value EKS diagnostics byte	**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
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
$C6_{hex}$	Area overflow on data read (renewed write or read necessary)
$C7_{hex}$	

Information!

A status change in the EKS diagnostics byte (value not 00_{hex}) will cause bit no. 5 in status byte no. 0 being set in the input area of the bus master (job status see section 8.6.1).

8.6 Read/write operation in conjunction with Electronic-Key read/write

8.6.1 Reading the content of the Electronic-Key

In read/write operation, following successful configuration, a transfer message with up to 128 bytes, depending on the parameters set, is continually transferred to the input area of the bus master during each bus cycle, i.e. the Electronic-Key adapter is read.

Information!

If a specific start address is not defined, the user data are cyclically transferred to the input area of the bus master from byte no. 0 on the key. The number of bytes transferred cyclically depends on the module selection in the GSD file (see section 8.1 Communication parameters (GSD file)).

Input area of the bus master

Byte no.	Description	Function
0	Status byte	(see below)
1	Execution counter	0 ... 255, the execution counter is increased by 1 for each newly read Electronic-Key. At a counter reading of 255 the counter is reset to 0. Using the execution counter, the user can ensure that no Electronic-Key is accidentally evaluated more than once.
2	Start address	First byte read in the memory area of the Electronic-Key. After configuration, the default start address for the user data is byte no. 0.
3	Number of bytes	Number of bytes read from start address. Max. number of bytes of user data (4/12/28/44/60/116/124 bytes) dependent on the module selected from the GSD file.
4 : 127	Receive data	User data from Electronic-Key. Max. number of bytes (4/12/28/44/60/116/124 bytes) dependent on the module selected from the GSD file.

The following status information is transferred in the status byte (byte no. 0, see above):

Status byte

Bit no.	Description (active with bit = 1)	Function
0	Electronic-Key adapter ready	After successful configuration the Electronic-Key adapter signals that it is ready via bit no. 0. Readiness should be continuously monitored by the application.
1	Electronic-Key detected	The detection of a valid Electronic-Key is signaled using bit no. 1. Using this bit, the application can detect that new data is available.
2 3	Reserve	
4	Operating mode	For read/write operation always set to 0.
5	Job status	Bit no. 5 is set on a status change in the EKS diagnostics byte (value not 00_{hex}, see section 8.5). This bit can be monitored by the application.
6	Job finished	Bit no. 6 indicates that a read or write has been successfully finished.
7	Job in progress	Bit no. 7 indicates that a read or write is currently in progress.

8.6.2 Reading/writing any data areas

Each time an Electronic-Key is inserted, the Electronic-Key user data area from byte no. 0 defined by the parameters via the GSD file is always transferred first from the EKS to the input area of the bus master. It is then possible to read or write any data area in the next step. This arbitrary area of the user data on the Electronic-Key is defined in the output area of the bus master.

Information!
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 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)!

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

For this purpose the following transfer message is sent from the bus master to the EKS:

Output area of the bus master

Byte no.	Description	Function
0	Command byte	(see below)
1	Start address	First byte in the memory area of the Electronic-Key that is read or written as per the command byte.
2	Number of bytes	Number of bytes that are read or written as per the command byte. Max. number of bytes of user data (4/12/28/44/60/116 bytes) dependent on the module selected from the GSD file.
3	Not used	
4	Transmit data	If bit no. 7 in the command byte is set to 1, the content of this byte is written to the Electronic-Key starting from the start address. Max. number of bytes of user data (4/12/28/44/60/116 bytes) dependent on the module selected from the GSD file.
:		
119		

In the command byte it is defined whether data is read from the Electronic-Key or written to the Electronic-Key.

Command byte

Bit no.	Description (active with bit = 1)	Function
0	Reserve	
1		
2		
3		
4		
5		
6	Read Electronic-Key	If bit no. 6 and bit no. 7 are set at the same time, data is read from the key.
7	Write Electronic-Key	

Information!

To transfer the data on reading an arbitrary data area:
After sending the transfer message from the output area of the bus master to the EKS, the data requested are read from the Electronic-Key by the EKS as per the area defined and transferred to the input area of the bus master (see section 8.6.1).

To transfer the data on writing an arbitrary data area:
After sending the transfer message from the output area of the bus master to the EKS, the transmit data are written to the Electronic-Key by the EKS as per the area defined. After data is successfully written to the Electronic-Key, the area written is automatically read again and the data transferred to the input area of the bus master (see section 8.6.1).

8.6.3 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. If you want to use the serial number, it is necessary to completely evaluate all 8 bytes. The serial number is appended to the freely programmable user data.

The serial number can be read using user data start address byte no. 116 and the number of bytes set to 8 (see section 8.6.2 Reading/writing any data areas).

8.7 Read-only operation in conjunction with Electronic-Key read-only

In read-only operation a 7-byte long communication message is transferred to the input area of the bus master on each bus cycle.

Input area of the bus master		
Byte no.	**Description**	**Function**
0	Status byte	(see below)
1	Execution counter	0 ... 255, the execution counter is increased by 1 for each newly read Electronic-Key. At a counter reading of 255 the counter is reset to 0. Using the execution counter, the user can ensure that no Electronic-Key is accidentally evaluated more than once.
2 : 6	5 bytes receive data	Representation of the contents of the Electronic-Key

The following status information is transferred in the status byte:

Status byte		
Bit no.	**Description (active with bit = 1)**	**Function**
0	Electronic-Key adapter ready	After successful configuration the Electronic-Key adapter signals that it is ready via bit no. 0. Readiness should be continuously monitored by the application.
1	Electronic-Key detected	The detection of a valid Electronic-Key is signaled using bit no. 1. Using this bit the bus master can detect that new data is available.
2 3	Reserve	
4	Operating mode	For read-only operation always set to 1.
5	Job status	Bit no. 5 is set on a status change in the EKS diagnostics byte (value not 00_{hex}, see section 8.5). This bit can be monitored by the application.
6	Job finished	Bit no. 6 indicates that a read has been successfully finished.
7	Job in progress	Bit no. 7 indicates that a read is currently in progress.

9 Exclusion of liability

Exclusion of liability under the following conditions:

- if the device 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 must be performed 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] Manuals from PI INTERNATIONAL PROFIBUS & PROFINET

Handbook PROFIBUS Installation Guide

Download from:

http://www.profibus.com/pall/meta/downloads/article/00324/

13 Appendix

The procedure described below is to be followed when reading or writing arbitrary data areas (see section 8.6.2). The bits for the read or write job in the command byte in the output area of the bus master must be actively set and also reset again by the application.

13.1 Timing diagram

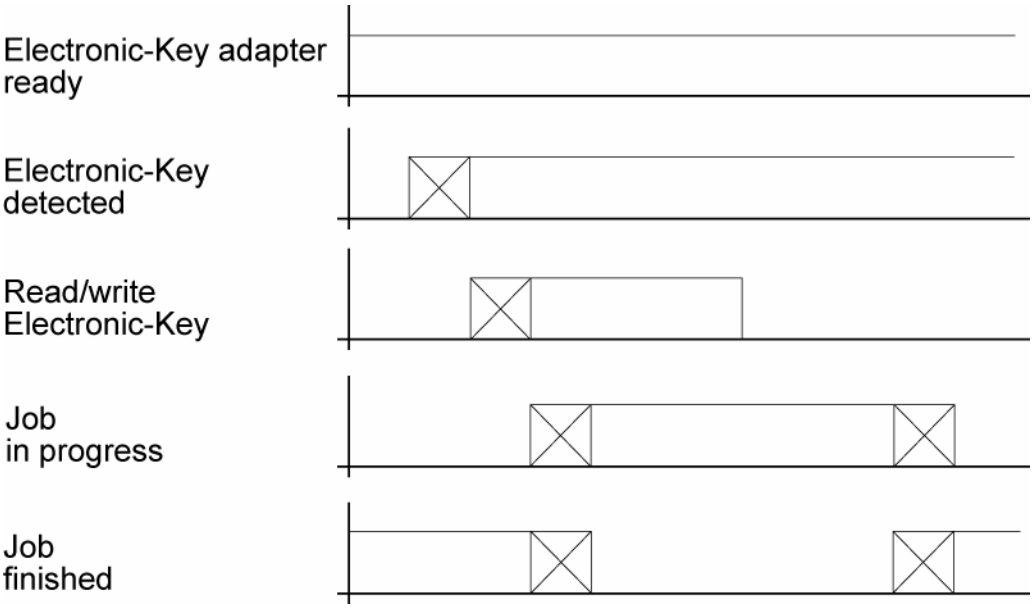


Figure 9: EKS timing diagram

13.1.1 Explanations

Electronic-Key adapter ready

The Electronic-Key adapter must basically be ready (see section 7 Setup). Readiness is signaled automatically in the input area of the bus master in byte no. 0 (status byte) (see section 8.6.1) by the value 1 in bit no. 0.

Electronic-Key detected

To read user data from the Electronic-Key or to write user data to the Electronic-Key, the Electronic-Key must be detected. Detection is signaled automatically in the input area of the bus master in byte no. 0 (status byte) (see section 8.6.1) by the value 1 in bit no. 1.

Read/write Electronic-Key

The job (read or write, start address user data, number of bytes of user data, data contents on writing) is defined in the output area of the bus master (see section 8.6.2). To start this job, bit no. 6 (read) or bit no. 7 (write) in byte no. 0 (command byte) in the output area of the bus master must be set to the value 1.

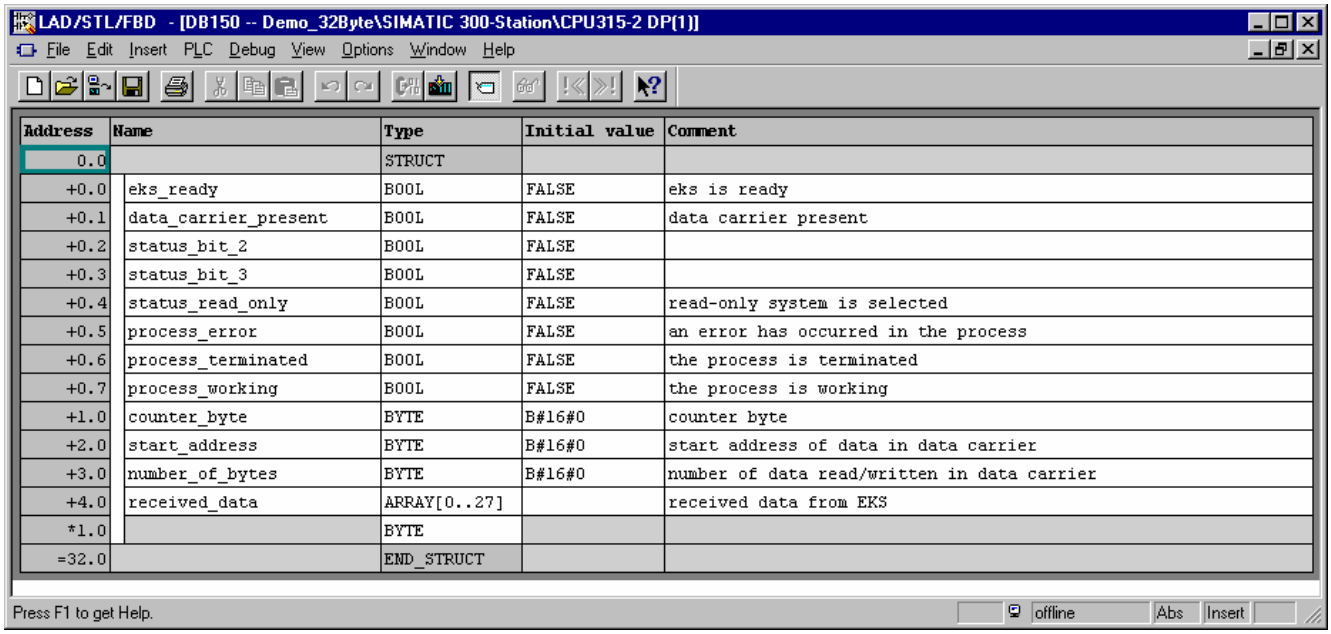
Job in progress

The job is now executed. The execution of the job is signaled automatically in the input area of the bus master in byte no. 0 (status byte) (see section 8.6.1) by the value 1 in bit no. 7. Once job execution has been started, bit no. 6 (read) or bit no. 7 (write) in byte no. 0 (command byte) in the output area of the bus master must be again reset to the value 0.

Job finished

The successful completion of the job is signaled automatically in the input area of the bus master in byte no. 0 (status byte) (see section 8.6.1) by the value 1 in bit no. 6 (job finished).

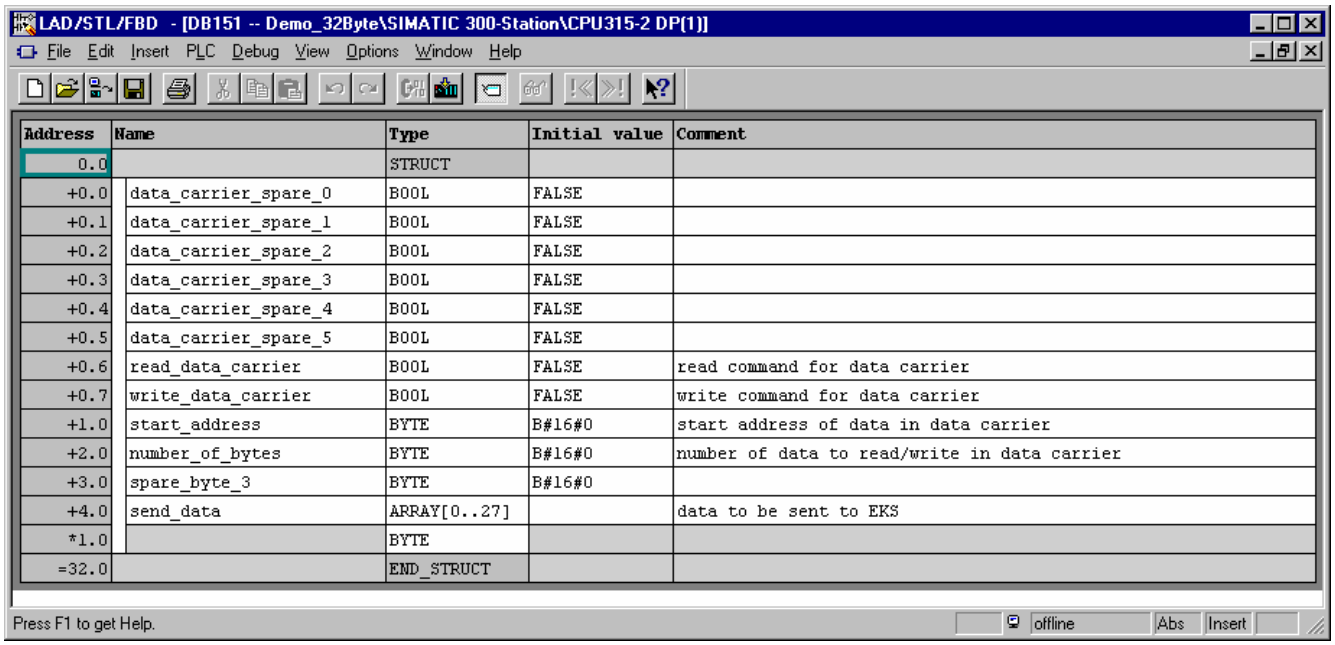
13.2 Input area of the bus master



Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	eks_ready	BOOL	FALSE	eks is ready
+0.1	data_carrier_present	BOOL	FALSE	data carrier present
+0.2	status_bit_2	BOOL	FALSE	
+0.3	status_bit_3	BOOL	FALSE	
+0.4	status_read_only	BOOL	FALSE	read-only system is selected
+0.5	process_error	BOOL	FALSE	an error has occurred in the process
+0.6	process_terminated	BOOL	FALSE	the process is terminated
+0.7	process_working	BOOL	FALSE	the process is working
+1.0	counter_byte	BYTE	B#16#0	counter byte
+2.0	start_address	BYTE	B#16#0	start address of data in data carrier
+3.0	number_of_bytes	BYTE	B#16#0	number of data read/written in data carrier
+4.0	received_data	ARRAY[0..27]		received data from EKS
*1.0		BYTE		
=32.0		END_STRUCT		

Figure 10: Input area of the bus master, example based on SIMATIC S7

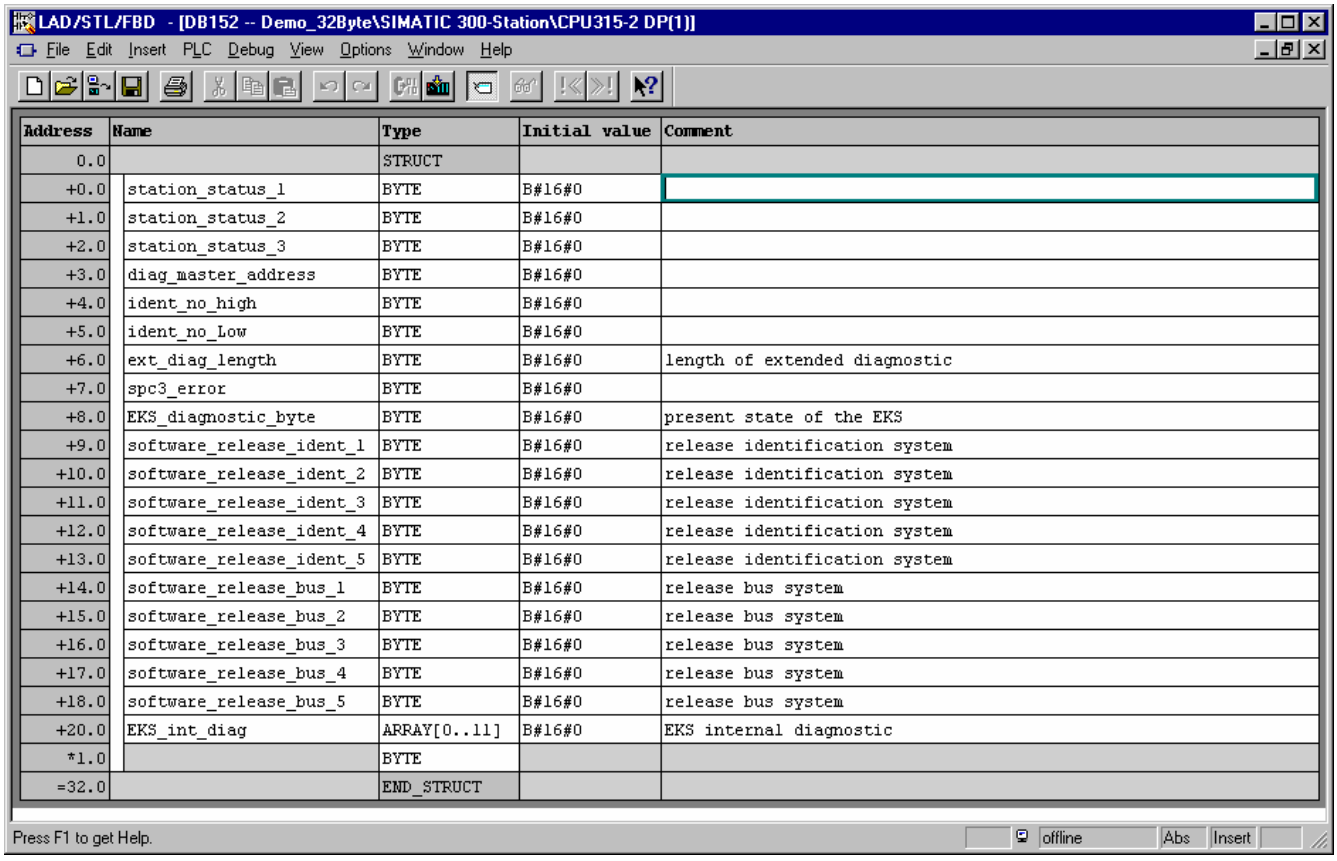
13.3 Output area of the bus master



Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	data_carrier_spare_0	BOOL	FALSE	
+0.1	data_carrier_spare_1	BOOL	FALSE	
+0.2	data_carrier_spare_2	BOOL	FALSE	
+0.3	data_carrier_spare_3	BOOL	FALSE	
+0.4	data_carrier_spare_4	BOOL	FALSE	
+0.5	data_carrier_spare_5	BOOL	FALSE	
+0.6	read_data_carrier	BOOL	FALSE	read command for data carrier
+0.7	write_data_carrier	BOOL	FALSE	write command for data carrier
+1.0	start_address	BYTE	B#16#0	start address of data in data carrier
+2.0	number_of_bytes	BYTE	B#16#0	number of data to read/write in data carrier
+3.0	spare_byte_3	BYTE	B#16#0	
+4.0	send_data	ARRAY[0..27]		data to be sent to EKS
*1.0		BYTE		
=32.0		END_STRUCT		

Figure 11: Output area of the bus master, example based on SIMATIC S7

13.4 Diagnostics area of the bus master



Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	station_status_1	BYTE	B#16#0	
+1.0	station_status_2	BYTE	B#16#0	
+2.0	station_status_3	BYTE	B#16#0	
+3.0	diag_master_address	BYTE	B#16#0	
+4.0	ident_no_high	BYTE	B#16#0	
+5.0	ident_no_Low	BYTE	B#16#0	
+6.0	ext_diag_length	BYTE	B#16#0	length of extended diagnostic
+7.0	spc3_error	BYTE	B#16#0	
+8.0	EKS_diagnostic_byte	BYTE	B#16#0	present state of the EKS
+9.0	software_release_ident_1	BYTE	B#16#0	release identification system
+10.0	software_release_ident_2	BYTE	B#16#0	release identification system
+11.0	software_release_ident_3	BYTE	B#16#0	release identification system
+12.0	software_release_ident_4	BYTE	B#16#0	release identification system
+13.0	software_release_ident_5	BYTE	B#16#0	release identification system
+14.0	software_release_bus_1	BYTE	B#16#0	release bus system
+15.0	software_release_bus_2	BYTE	B#16#0	release bus system
+16.0	software_release_bus_3	BYTE	B#16#0	release bus system
+17.0	software_release_bus_4	BYTE	B#16#0	release bus system
+18.0	software_release_bus_5	BYTE	B#16#0	release bus system
+20.0	EKS_int_diag	ARRAY[0..11]	B#16#0	EKS internal diagnostic
*1.0		BYTE		
=32.0		END_STRUCT		

Figure 12: Diagnostics area of the bus master, example based on SIMATIC S7

More than safety.

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