(EN) **OPERATING MANUAL**

KEYPILOT
ETHERCAT VARIANTS

Read carefully before use.
Keep for future reference.

Last revision: 17.07.2023

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1. Introduction

This manual describes the functions and characteristics of the KeyPilot variant EtherCAT. KeyPilot is used to record and control access to machines and systems. KeyPilot is easy to use and easy to integrate into control systems.

Please read this manual carefully before start-up and keep it where it is easily accessible for future reference.

1.1 Contact to the manufacturer

Heckner Electronics GmbH

Address: Säntisstraße 25
                   D-88079 Kressbronn am Bodensee

Telephone: +49 (0)7543 9620-600

E-Mail: info@KeyPilot.de

Internet: www.KeyPilot.de

1.2 Further information

Further information on KeyPilot EtherCAT and other variants can be found on the Internet at:

www.KeyPilot.de

1.3   Symbols and warning notices

The following illustrations are used in this operating manual for important warning notices:

	DANGER
⚠	**Hazard with a high degree of risk, which may result in death or serious injury.**

	WARNING
⚠	**Hazard with medium degree of risk, which may result in death or serious injury.**

	CAUTION
⚠	**Hazard with a low degree of risk, which may result in minor injuries.**

	ATTENTION
🛈	**Hazard which may result in property damage.**

2. Safety Instructions

2.1 Target audience

This document is intended primarily for electricians, technicians and engineers with experience in the design, installation, start-up and maintenance of industrial control systems.

2.2 Intended use

KeyPilot can be used to control and record access to protected parts and functions on machinery and equipment. The customer is responsible for assigning authorizations to keys and assigning keys to persons.

	WARNING
⚠️	**KeyPilot is not a safety component within the meaning of the Machinery Directive.** • Do not operate where failure or malfunction could jeopardize the safety or health of a person within the working range of the unit. • Please consult the manufacturer or your supplier if you are not sure whether KeyPilot is suitable for your application.

Observe national and international safety and accident prevention regulations when using KeyPilot.

The KeyPilot components are designed for installation in industrial switch cabinets and control panels.

Conversion or other modifications of the KeyPilot is not allowed.

2.3 Transport

	ATTENTION
🛈	**Improper handling may damage the KeyPilot.** • Use the enclosed packaging. • Handle the KeyPilot with care. • Avoid impacts, blows or falling.

2.4   Installation and Start-up

WARNING
Risk of injury, damage to the KeyPilot and damages to the environment of the KeyPilot due to improper electrical connection. • The electrical connection must be made only by qualified specialist personnel. • Electrical connections must be made only when de–energized. • Please note the technical specifications of the device. • Make sure the connections are made correctly and are tight.

ATTENTION
Reverse polarity electrical connection may damage the KeyPilot. • Disconnect the power supply if the LED on the KeyPilot does not light up after switching on. • Check the power supply.

ATTENTION
Exchanging components of the KeyPilot EtherCAT with those of other variants of the KeyPilot may damage the components or other connected systems. • Exchange components between different variants only after consultation with the manufacturer or your supplier. • When replacing a component, check whether the type description of the new component matches the one to be replaced.

2.5   Repair

Damaged components of the KeyPilot may be repaired only by the manufacturer. Please contact your supplier if needed.

2.6   Warranty

- The warranty period for KeyPilot is 12 months from the date of purchase. Except for damage caused by improper use.

- Never open the device without proper authorization. The opening of the housing will void the warranty claim.

- There is no warranty claim for damage to the KeyPilot caused by improper operation resulting from non-compliance with the operating instructions or by disregarding the above instructions.

- In principle, there is no liability for consequential damages.

3. System description

3.1 Scope of application

KeyPilot system is used for access control and for identifying users and those using a machine or plant.

Typical application

- User login and authorization for control panels and input systems.

- Access authorization for plants or plant components.

KeyPilot can be used everywhere where previously passwords or mechanical key switches have been used.

3.2 General function

The KeyPilot system basically consists of two parts. These are the respective reading station and the keys.

A key is placed on the reading station and held in place magnetically. The key is read out using the built-in contacts in the reading station. Each key has an individual identifier (ID). This ID is unique worldwide, is provided by the manufacturer and cannot be changed.

3.3 Reading stations

The reading stations are an essential part of the system. The key is held on the reading station by a magnet and is read out via the contacts.

Several variants are offered with different interfaces to the process. Depending on the interface to the process, the data is evaluated on the reading station or communicated to a higher-level controller via the communication interface.

The following sections provide an overview of all KeyPilot variants, including the KeyPilot EtherCAT variant described in this manual.

3.3.1 Switch variants

The switch variants are particularly suitable for all applications where no system-side data communication is possible or necessary at the place of use.

The key information is read out when the key is set up. An authorization matching is then carried out in the reading station and the switching output is switched according to the specified authorization. The original switching state is restored when the key is removed.

The following switch variants are available:

Figure 1: Design of the level, RS232 and PROFIBUS variants

- **KeyPilot Level**
  7 different authorization levels can be identified through three digital outputs.

3.3.2 Communication variants

Instead of the switching outputs, these variants have a communication interface for direct integration into a machine control. The key information can be read into a control system via the respective communication interface and reused on a customer-specific basis. No authorization matching takes place in the device.

The communication variants are available in a compact design or with a remote reading head, depending on the communication interface. The key is held on the reading head using a magnet and is read out via the contacts. In case of devices with remote reading head this reading head is connected to the so-called electronics unit via a cable connection.

Figure 2: Design of the USB variant and the reading head of the PROFIBUS AL, PROFINET and EtherCAT variants

Following communication variants are available:

- **KeyPilot USB**
  The ID can be read out via the USB interface. Keys with memory can be written and deleted. Reading stations with a USB interface are also used as set-up stations to store authorizations on other reading stations using a setup key.

- **KeyPilot RS232**
  The ID can be read out via the RS232 interface. Keys with memory can be written and deleted.

- **KeyPilot PROFIBUS**
  The ID can be read out via the PROFIBUS DP interface.

- **KeyPilot PROFIBUS AL**
  Variants with remote reading head. The ID can be read out via the PROFIBUS DP interface.

- **KeyPilot PROFINET**
  Variants with remote reading head. The ID can be read out via the PROFINET IO interface.

- **KeyPilot EtherCAT**
  Variants with remote reading head. The ID can be read out via the EtherCAT interface.

3.4 Keys

Each key has a worldwide unique identifier (ID), which is provided by the manufacturer. This ID has 2^{48} different possibilities and cannot be manipulated. Using the ID the key is clearly identifiable. Thus, the owner of the key can be clearly determined and his actions can get logged.

Currently, the keys listed in the following table are supported:

Figure 3: Keys

Key type	Family code	Memory area
ID-only authorization key	01	–
Authorization key with memory area	14	256 B EEPROM
	23	4 kB EEPROM
Setup key with memory area	37	32 kB EEPROM
Evaluation key with memory area		

Table 1: Key types, family codes and memory areas

All key types can be used in the application and all different key types can be mixed.

The key type can be distinguished using the imprinted family code.

Figure 4: Meaning of lasered labeling of the key

4. Technical data

4.1 Type plate

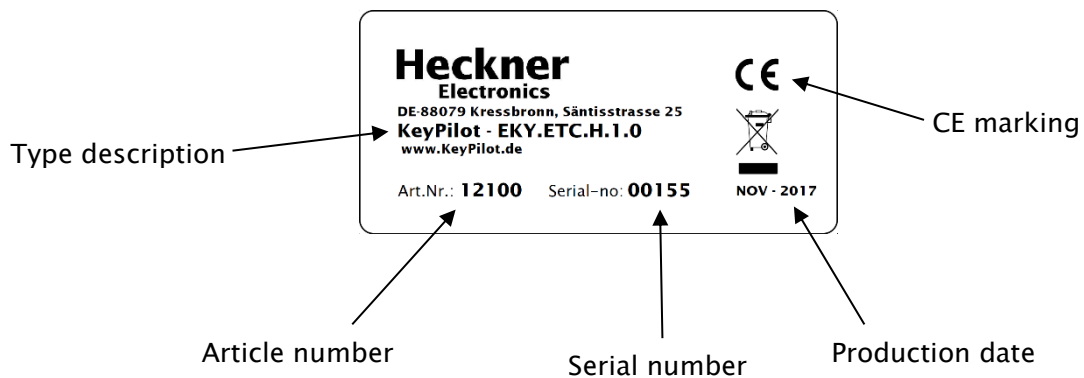The type plate can be found on the side of the electronics unit.

Figure 5: Type plate

4.2 Electrical specifications

Voltage power supply	24 V DC ±1 V
Power consumption (typ.)	2 W
Operating temperature	−20...+50 ℃
Galvanically isolated supply voltage	Yes
Short−circuit−proof reading contacts	Yes

4.3 Protection class

Reading head	IP67
Electronics unit	IP20

4.4 Mechanical specifications

4.4.1 Reading head
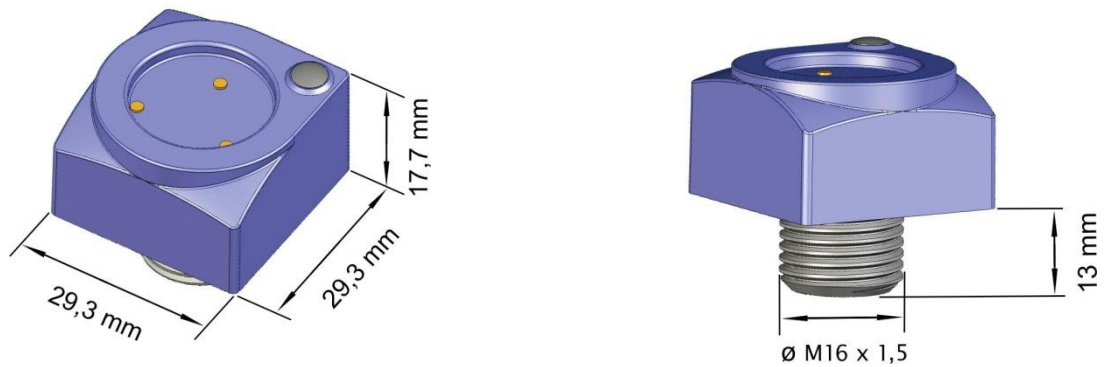
Figure 6: Reading head dimensions

For mounting in installation openings with a diameter of 22.5 mm, a reducer ring is supplied for centering.

The reading head can be ordered with different lengths of the connection cable. The connection cable is permanently connected to the reading head and is max. 10 m long.
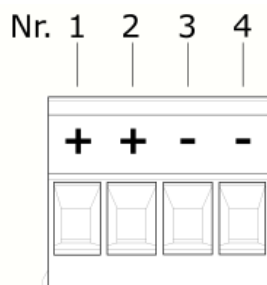
4.4.2 Electronics unit
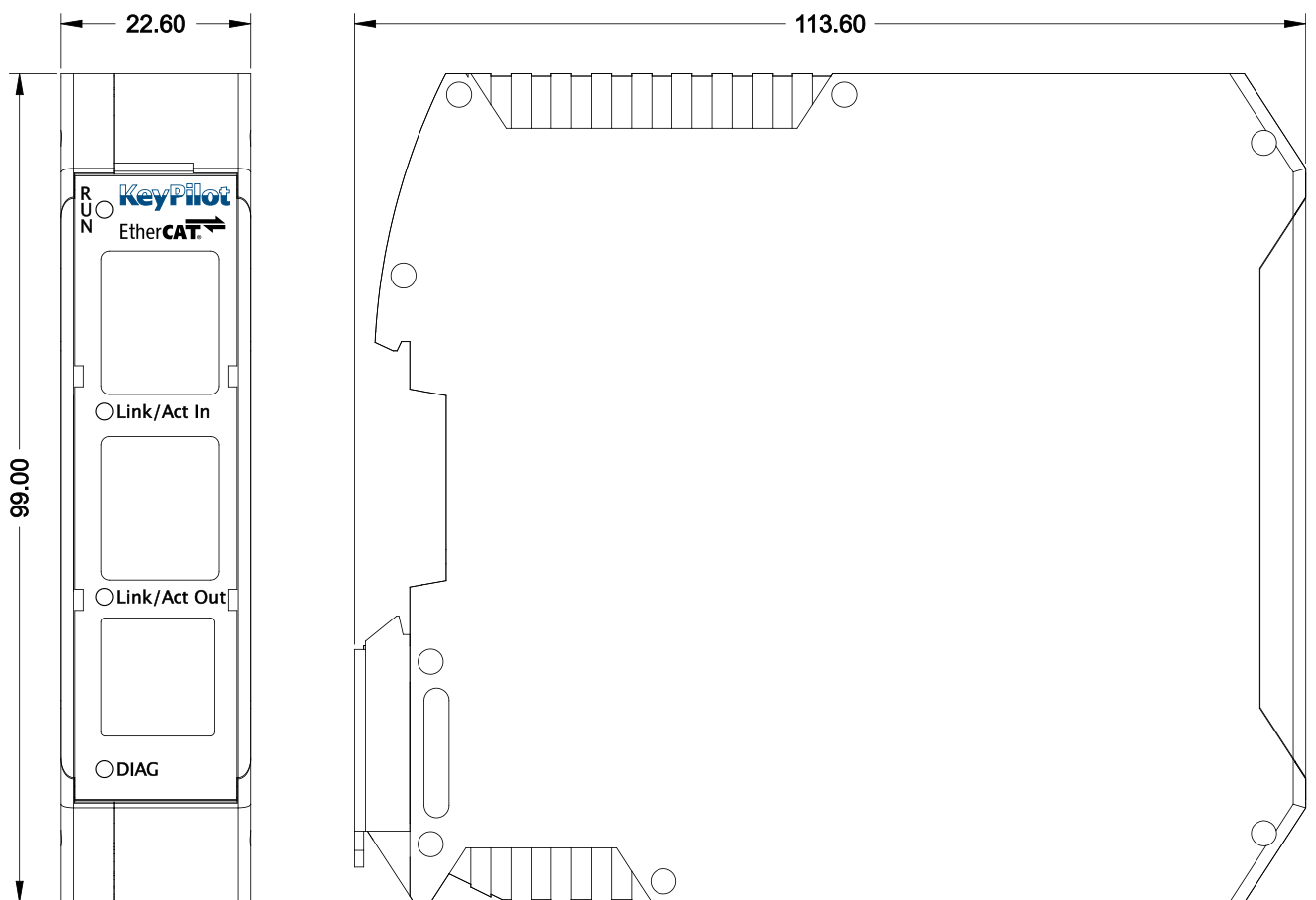
Figure 7: Electronics unit dimensions

The electronics unit can be mounted on TH 35–15 and TH 35–7.5 DIN top–hat rails according to DIN EN 60715: 2001.

4.5   Pin assignment

4.5.1 Power supply connection

Power is supplied to the KeyPilot via the screw contacts on the underside of the electronics unit with 24V DC.

No.	Assignment
1	Supply voltage +24V
2	
3	Supply voltage GND
4	

Table 2: Power supply connection assignment

4.5.2 Interface to the reading head

The reading head is supplied with a pre–assembled cable. The required cable length can be specified upon ordering (max 10 m). The plug of this cable must be plugged into the RJ25 socket (6P6C) on the front of the electronics unit.
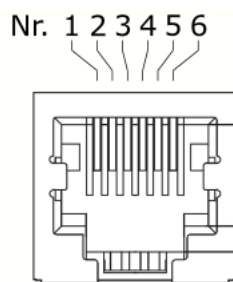
No.	Wire color
1	–
2	▨ brown
3	▨ yellow
4	▨ green
5	white
6	–

Table 3: Reading head cable connection assignment

4.5.3 EtherCAT Ports

The connection to EtherCAT is made via two RJ45 sockets analogous to a standard Ethernet connection.
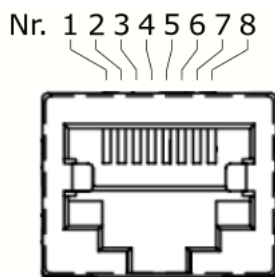
No.	Assignment	Wire color IEC 61918	T568A-code	T568B-code
1	Tx+	yellow	white-green	white-orange
2	Tx-	orange	green	orange
3	Rx+	white	white-orange	white-green
4			blue	blue
5			white-blue	white-blue
6	Rx-	blue	orange	green
7			white-brown	white-brown
8			brown	brown

Table 4: EtherCAT assignment

4.5.4 USB service interface

The USB service interface is designed as a USB 2 Micro-B socket. Upon connecting to a PC a USB data carrier is detected. The configuration file stored on the electronics unit and the operating instructions can be read out via the USB service interface.
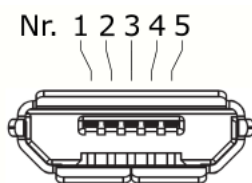
No.	Assignment	Wire color
1	VBUS	red
2	D-	white
3	D+	green
4	ID	-
5	GND	black

Table 5: USB assignment

5. Preparation

5.1   Scope of Delivery

Description	Figure
Electronics unit	
Reading head with connecting cable Type EKY.C16.Q.1.0	
Plastic nut M16x1.5	
Reducer ring 16.2 mm to 22.2 mm	
Quick Reference Guide	

Table 6: Scope of Delivery

5.2   Packaging

The packaging has been designed to protect the KeyPilot during transport by freight carrier or parcel delivery service. Nevertheless, please check all supplied components for damage after unpacking.

The packaging must be disposed of separately according to the applicable rules for cardboard and plastic.

5.3   Installation

5.3.1 Reading head

A mounting hole with a diameter of 16.2 mm is sufficient for mounting the reading head. The mounting in holes with 22.3 mm diameter is possible with the enclosed reducer ring.

Procedure:

1. Pull the connection cable completely from the front through the mounting hole.
2. Insert the reading head into the mounting hole from the front. The thread of the reading head must protrude on the back of the mounting hole.
3. If necessary, slide the reducer ring over the connection cable to the mounting hole.
4. Slide the plastic nut over the connection cable and screw the reading head into the plastic nut.

5.3.2 Electronics unit

To mount the electronics unit, simply snap them into place on a TH 35 DIN top-hat rail.

5.4 Connection

5.4.1 Connect reading head to the electronics unit

The reading head is supplied with a pre-assembled cable. The plug of this cable must be plugged into the RJ25 socket (6P6C) on the front of the electronics unit. Make sure the plug latch correctly.

5.4.2 Connection to the EtherCAT

The connection to EtherCAT is made via the two RJ45 sockets on the front of the electronics unit. It is recommended to use shielded twisted pair cables. Make sure the plugs latch correctly.

Details on permissible cables and possible topologies of the cabling can be obtained from the EtherCAT Technology Group (see chapter 5.5.1).

5.4.3 Power supply

WARNING
Risk of injury, damage to the KeyPilot and damages to the environment of the KeyPilot due to improper electrical connection. • The electrical connection must be made only by qualified specialist personnel. • Electrical connections must be made only when de-energized. • Please note the technical specifications of the device. • Make sure the connections are made correctly and are tight.

Power is supplied to the KeyPilot via the screw contacts on the underside of the electronics unit with 24V DC.

5.5   Configuration of the EtherCAT communication

5.5.1 Contact data of the EtherCAT Technology Group

Further information on the EtherCAT basics and protocols can be found at the EtherCAT Technology Group (ETG).

ETG headquarters

Address: Ostendstraße 196
             D–90482 Nürnberg Germany

Telephone: +49 (0)911 540 56 20

Fax: +49 (0)911 540 56 29

E–Mail: info@ethercat.org

Internet: www.ethercat.org

5.5.2 Supported functions

KeyPilot can be integrated into an EtherCAT network as a Slave. The standard is supported according to IEC 61158 and IEC 61784.

5.5.3 EtherCAT Slave Information (ESI)

The XML device description file required for configuring and operating the KeyPilot is available via the USB service interface. The latest version can also be obtained on the Internet via the address www.KeyPilot.de.

6. Operation

6.1   Function description

The KeyPilot EtherCAT function can be summarized as follows:

- On the reading head of the KeyPilot the key is held by a magnet. The key ID is read out via the contacts.

- The electronics unit works as an EtherCAT slave and transmits the read ID over the bus. The ID therefore appears in the input process image of the EtherCAT master.

- ID can be used arbitrarily in the master.

- Optionally, the master can control the status LED on the reading head via the output process data.

The ID is permanently transmitted as long as a key rests on the reading station. If there is no key, the ID is set to zero.

As with all communication variants of the KeyPilot, there is no authorization matching in the device. This must be implemented customer-specific in the master.

6.2   EtherCAT process data

The following section describes the KeyPilot user data available in the input/output process image of the EtherCAT master.

Description	Data type	Length
KeyFamilyCode	BYTE	8 Bit
ID1	BYTE	8 Bit
ID2	BYTE	8 Bit
ID3	BYTE	8 Bit
ID4	BYTE	8 Bit
ID5	BYTE	8 Bit
ID6	BYTE	8 Bit
CRC	BYTE	8 Bit
DEVICESTATUS	WORD	16 Bit

Table 7: Input process data (TxPDO)

Description	Data type	Length
LEDCmd	BYTE	8 Bit

Table 8: Output process data (RxPDO)

6.2.1 Key ID

The ID of the issued key is completely transferred via the process data objects (PDO) "KeyFamilyCode", "ID1" to "ID6" and "CRC". If all values are zero, then either there is no key or there is an error.

6.2.2 Device status

The current status of the KeyPilot is signaled via the PDO "DEVICESTATUS".

Bit	Meaning
0	If this bit is set, then there is a connection problem between the electronics unit and the reading head.
1…15	Reserved

Table 9: DEVICESTATUS

6.2.3 Controlling status LED

The status LED of the reading head can be controlled via the PDO "LEDCmd" (see chapter 6.3.5).

Value	Meaning
0x00	Status LED shows the operating status of the KeyPilot.
0x01	Status LED is permanently red.
0x02	Status LED is permanently green.
0x03…0xFF	Status LED shows the operating status of the KeyPilot.

Table 10: LEDCmd

6.3   Status display

The status of the KeyPilot is signaled through several LEDs on the electronics unit and on the reading head.

6.3.1 RUN

The "RUN" LED on the front of the electronics unit signals the functional state of the KeyPilot as a EtherCAT–Slave.

RUN display		Meaning
⚪	Permanently off	The EtherCAT slave is in the "Init" state
🟢	Blinking GREEN (2.5 Hz)	The EtherCAT slave is in the "Pre–Operational" state
🟢	Single flash GREEN	The EtherCAT slave is in the "Safe–Operational" state
🟢	Flickering GREEN	The EtherCAT slave is in the "Bootstrap" state
🟢	Steady GREEN light	The EtherCAT slave is in the "Operational" state

Table 11: LED RUN

6.3.2 Link/Act In

The "Link/Act In" LED on the front of the electronics unit shows the status of the physical connection at the upper EtherCAT port.

Link/Act In display		Meaning
⚪	Permanently off	Port is not connected
🟢	Flickering GREEN	Communication with connected EtherCAT device
🟢	Steady GREEN light	Port is connected to an EtherCAT device

Table 12: LED Link/Act In

6.3.3 Link/Act Out

The "Link/Act Out" LED on the front of the electronics unit shows the status of the physical connection at the lower EtherCAT port.

Link/Act Out display		Meaning
⚪	Permanently off	Port is not connected
🟢	Flickering GREEN	Communication with connected EtherCAT device
🟢	Steady GREEN light	Port is connected to an EtherCAT device

Table 13: LED Link/Act Out

6.3.4 DIAG

The "DIAG" LED on the front of the electronics unit signals the operating status of the KeyPilot.

DIAG display		Meaning
○	Permanently off	No or faulty power supply or device is defective
◐	Slowly blinking GREEN (0.5 Hz)	Normal operation
◐	Rapidly blinking GREEN (5 Hz)	USB service interface is connected
◐	Single flash RED	Device reboots
◐	Slowly blinking RED (0.5 Hz)	No valid configuration available
●	Steady RED light	Internal error

Table 14: LED DIAG

6.3.5 Status LED on the reading head

The LED on the reading head indicates the operating status of the KeyPilot. In addition, the LED can also be controlled from the EtherCAT master, unless this is prevented by a fault condition.

| reading head display		Meaning
○	Permanently off	No or faulty power supply or reading head not connected to electronic unit or device is defective
◐	Single flash GREEN	Normal operation and no key detected
◐	Blinking GREEN (1 Hz)	Key read out successfully
●	Steady GREEN light	LED status controlled via the EtherCAT
◐	Single flash RED	Internal error
◐	Blinking RED (1 Hz)	Error when reading a key
●	Steady RED light	LED status controlled via the EtherCAT
◐	Blinking ORANGE (1 Hz)	Electronics unit not ready or connection error between electronics unit and reading head

Table 15: LED on the reading head

7. Maintenance

7.1 Cleaning

For reliable operation of the KeyPilot, the contact surfaces of the reading head and the key must be kept clean. Remove any soiling if you experience problems reading the key. Reading head and key can be cleaned using common cleaning agents. Avoid using corrosive detergents.

7.2 Maintenance

The components of the KeyPilot do not require any special maintenance.

7.3 Repair

Damaged components of the KeyPilot may be repaired only by the manufacturer. Please contact your supplier if needed.

8. Decommissioning and disposal

8.1 Disassembly

	WARNING
⚠	**Risk of injury and damage in the environment of the KeyPilot due to unconnected electrical wiring.** • The electrical connection may be changed only by qualified personnel. • Electrical connections must be made only when de–energized. • Make sure that disconnected connecting cables do not remain unprotected (insulate).

In case you want to remove the KeyPilot from your system, proceed as follows:

1. Switch off the power supply.

2. Disconnect the power supply to the screw terminals of the electronics unit.

3. Unlock the connectors of the EtherCAT cables and remove them.

4. Unlock the plug of the reading head connection cable and disconnect the cable.

5. To disassemble the electronics unit, pull the latch on the underside with a screwdriver. The electronics unit can then be swung upwards.

6. To disassemble the reading head unscrew the plastic nut. The reading head can then be pulled out of the mounting hole.

8.2 Disposal

All components of the KeyPilot (electronics unit, reading head and key) must be disposed of in accordance with the statutory regulations for electronic devices.

The packaging must be disposed of separately according to the applicable rules for cardboard and plastic.

9. CE declaration of conformity

Figure 8: CE declaration of conformity

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