

# Application Manual

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**be in motion**    **be in motion**



  
**BAUMÜLLER**

**b maXX<sup>®</sup> Systems**

**EtherCAT Bus Coupler  
ECK0000**

<b>E</b>	5.07026.02
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**Read the application manual before starting work!**

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# 1

## INTRODUCTION

This Application Manual is an important component of your b maXX system; this means that you must thoroughly read this document, not least to ensure your own safety.

In this chapter, we will describe the first steps that you should carry out after getting this unit. We will define terms that are used in this documentation on a consistent basis and will inform you about the responsibilities you must consider when using this system.

### 1.1 First Steps

---

#### The Bus Terminal System

Currently, the input/output signals are wired locally at fieldbus devices and centrally at programmable control devices. The manufacturer-specific fieldbus devices with fixed input/output configuration and design that are currently available often make it necessary to install an entire group of devices with similar functionality.

This costly method of signal acquisition gives rise to high material, installation, planning and documentation costs as well as high costs for subsequent modification or expansion. Inventory management and service staff are put under unnecessary strain.

#### Flexible and stable

The Baumüller Bus Terminal is an open and fieldbus-neutral periphery concept consisting of electronic terminal blocks. The head of an electronic terminal block is the Bus Coupler with the interface to the fieldbus.

### 1.2 Legend

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#### Warnings

Warnings are marked by symbols in this application manual. The warnings are introduced by signal words, which express the extent of the hazard.

Comply with the warnings under all circumstances and act with caution in order to avoid accidents, personal injury and property damage.

**DANGER!**

...notifies of an imminent dangerous situation, which will lead to death or serious injuries if not avoided.

**WARNING!**

...notifies of a potentially dangerous situation, which can lead to death or serious injuries if not avoided.

**CAUTION!**

...notifies of a potentially dangerous situation, which can lead to minor or slight injuries if not avoided.

**NOTICE!**

...notifies of a potentially dangerous situation, which can lead to property damage if not avoided.

#### Recommendations

**NOTE!**

...draws attention to useful tips and recommendations as well as information for efficient and trouble-free operation.

### 1.3 Limitation of liability

All statements and instructions in this application manual have been compiled in compliance with the applicable standards and legislation while taking the current level of technology and our long-term experience and findings into account.

The manufacturer assumes no liability for damages resulting from:

- failure to follow the application manual
- application for purposes other than those intended
- untrained personnel

The actual scope of materials delivered can vary from the explanations and illustrations described here in the event of custom designs, the use of additional ordering options or due to the most recent changes in technology.

The user assumes the responsibility of conducting maintenance and commissioning in accordance with the safety regulations of the applicable standards and all other relevant national or regional legislation relating to conductor dimensioning and protection, grounding, circuit breakers, overvoltage protection, etc.

The person who conducted the assembly or installation shall be accountable for damages occurring during assembly or connection.

### 1.4 Preliminary information



#### NOTICE!

The following shall apply if the document you are reading is designated as preliminary information:

This version pertains to preliminary technical information, which the user of the described devices and functions should receive ahead of time, in order to be able to adjust to potential changes and/or all expansions.

This information is to be seen as preliminary, since it has not yet been subjected to the Baumüller internal review process. In particular, this information is still subject to changes, meaning that this preliminary information cannot be construed as legally binding. Baumüller assumes no liability for damages resulting from this potentially incorrect or incomplete version.

Should you detect or suspect content-related and/or serious formal errors in this preliminary information, please contact the contact person at Baumüller assigned to you and inform us of your findings and comments, so that they can be taken into account and potentially incorporated during the transition from the preliminary information to the final (reviewed by Baumüller) information.

### 1.5 Copyright

---

Treat the application manual as confidential. It is intended exclusively for those working with the device. It is not permissible to transfer the application manual to third parties without the written approval of the manufacturer.



#### **NOTE!**

The content-related statements, texts, diagrams, images and other illustrations are copyright protected and subject to industrial property rights. Any improper use is liable to prosecution.

b maXX® is a registered trademark of Baumüller Nürnberg GmbH

### 1.6 Further applicable documents from other manufacturers

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Components from other manufacturers are built into the device. Hazard evaluations for these bought-in parts have been conducted by the applicable manufacturers. The conformity of the designs with the applicable European and national legislation has been declared by the respective component manufacturers.

### 1.7 Spare parts

---



#### **WARNING!**

Improper or defective spare parts can lead to damage, malfunctions or total failure as well as jeopardize safety.

Therefore:

- Only use original spare parts from the manufacturer

Procure replacement parts from authorized dealers or directly at the manufacturer.

### 1.8 Disposal

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If no return or disposal agreement has been made, dismantled components can be taken for recycling after proper disassembly.

See also [▶Disposal◀](#) on page 79.



## 1.9 Warranty provisions

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The warranty provisions are found as a separate document in the sales documents.

The operation of the devices described here in accordance with the specified methods/procedures/requirements is permitted. Everything else, even the operation of devices in installation positions not depicted here, for instance, is not permissible and must be clarified with the factor on a case-by-case base. The warranty will be rendered null and void if the devices are operated differently than described here.

## 1.10 Customer service

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Our customer service is available for technical support.

Information on the competent contact person can be found at any time via telephone, fax, E-mail or over the internet.

## 1.11 Terms Used

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In this documentation, we will also refer to Baumüller's "**EtherCAT Bus Coupler**" product as „ECK0000", or "plug-in module".



# 2

## SAFETY

This section provides an overview of all of the important safety aspects for optimum protection of personnel as well as for the safe and problem-free operation.

### 2.1 Contents of the application manual

---

Each person who is tasked with performing work on or with the device must have read and understood the application manual before working with the device. This also applies if the person involved with this kind of device or a similar one, or has been trained by the manufacturer.

### 2.2 Changes and modifications to the device

---

In order to prevent hazards and to ensure optimum performance, no changes, additions or modifications may be undertaken on the device that have not been explicitly approved by the manufacturer.

### 2.3 Usage for the intended purpose

The device is conceived and constructed exclusively for usage compliant with its intended purpose described in this application manual.

A device is considered as being used compliant with its intended purpose if all notes and information of this operating manual are adhered to.



#### **WARNING!**

##### **Danger arising from usage for an unintended purpose!**

Any usage that goes beyond the intended purpose and/or any non-compliant use of the device can lead to dangerous situations.

Therefore:

- Only use the device compliant with its intended purpose.
- Observe all specifications of this operating manual.
- Ensure that only qualified personnel work with/on this device.
- When configuring, ensure that the device is always operated within its specifications.
- Mount the device or the mounting rail on a wall that can sufficiently bear the load
- The device must always be operated within a control cabinet.
- Only operate the device in combination with components approved by Baumüller Nürnberg GmbH.
- Only operate the devices in secondary surroundings (e.g. an industrial environment). The device has been developed in such a manner that it fulfills the requirements of the category C3 according to IEC 61800-3:2005. The device is not intended to be connected to the public mains. To operate the device in primary surroundings of the category C2/C1 (residential, business and commercial areas, directly on a public low-voltage mains without an intermediate transformer), special measures to reduce the transient emissions (line-internal and radiated) must be provided for and certifiable by the system builder. Otherwise, EMC interference could occur without such additional measures. Whether a device described here can qualify for category C2/C1 even with additional measures cannot be guaranteed.

## 2.4 Responsibility of the operator

The device will be used in commercial areas. Thus, the proprietor of the device is subject to the legal work safety regulations.

Along with the notes on work safety in this operating manual, the safety, accident prevention and environmental protection regulations valid for the area of application of this device must be complied with. Whereby:

- The proprietor must inform himself about the applicable work health and safety regulations and ascertain, in a hazard assessment, any additional hazards that could arise from the special working conditions in the use area of the device. These must then be implemented in the form of operating instruction for operation of the device.
- This application manual must be kept accessible to personnel working with the device at all times in the immediate vicinity of the device.
- The specifications of the application manual must be adhered to completely and without exception.
- The device may only be operated in a technically faultless and operationally safe condition.

## 2.5 Protective devices

Protection rating	
ECK0000	IP 20

All devices must be installed in an appropriate control cabinet to meet the protection ratings required in EN61800-5-1, chapter 4.2.3.3 (IP22).



### **DANGER!**

Risk of fatal injury from electrical current!

There is an immediate risk of fatal injury if live electrical parts are contacted.

Therefore:

- The device must be operated inside a control cabinet that provides protection against direct contact of the devices and that meets at a minimum the requirements of EN 61800-5-1, Chapter 4.2.3.3.

### 2.6 Training of the personnel

---



**WARNING!**

Risk of injury due to insufficient qualifications!

Improper handling can lead to significant personal injury and material damage.

Therefore:

- Certain activities can only be performed by the persons stated in the respective chapters of this application manual.

In this application manual, the following qualifications are stipulated for various areas of activity:

- Operating personnel
  - The drive system may only be operated by persons who have been specially trained, familiarized and authorized.
  - Troubleshooting, maintenance, cleaning, maintenance and replacement may only be performed by trained or familiarized personnel. These persons must be familiar with the application manual and act accordingly.
  - Initial operation and familiarization may only be performed by qualified personnel.
- Qualified personnel
  - Electrical engineers authorized by Baumüller Nürnberg GmbH, and qualified electricians of the customer or a third party who have learned to install and maintain Baumüller drive systems and are authorized to ground and identify electrical power circuits and devices in accordance with the safety engineering standards of the company.
  - Qualified personnel have had occupational training or instruction in accordance with the respective locally applicable safety engineering standards for the upkeep and use of appropriate safety equipment.

## 2.7 Personal protective equipment

---

The wearing of personal protective equipment is required when working in order to minimize health and safety risks.

- The protective equipment necessary for each respective type of work shall always be worn during work.
- The personal safety signs present in each working area must be observed.



### Protective work clothing

should be snug-fitting work clothes, with low tearing resistance, narrow sleeves and with no extending parts.

No rings or chains may be worn.



### Hard hat

protection against falling and flying objects.



### Safety shoes

protection against heavy falling objects.



### Protective gloves

to protect hands against friction, abrasion, puncturing or more severe injuries, as well as the contact with hot objects.

### Wear for special tasks



### Protective glasses

protection of the eyes against objects, which are flying around and against splashing liquids.

### 2.8 Special hazards

In the following section the residual risks are specified, which result from the hazard analysis.

Observe the safety notes listed here and the warning notes in the further chapters of this manual to reduce health risks and dangerous situations.

#### Electricity



#### **DANGER!**

Risk of fatal injury from electricity!

There is an immediate risk of fatal injury if live electrical parts are contacted. Damage to the insulation or individual components can be life-threatening.

Therefore:

- Switch off the electrical power immediately in case of damage to the power supply insulation.
- Only allow work on the electrical system to be performed by qualified personnel.
- Switch off the current when any kind of work is being performed on the electrical system and secure it against being started again.

#### Danger from residual energy



#### **DANGER!**

Risk of fatal injury from electrical current!

After separation of the device from the mains parts under voltage as e. g. power connections may only be touched if the capacitors in the device have been discharged.

Therefore:

- Do not touch before taking the discharge time of the capacitors and the electrically live parts into account.
- Pay attention to corresponding notes on the equipment.
- If additional capacitors are connected to the intermediate circuit, the DC-link discharge can take much longer. In this case, the necessary waiting period must be determined itself or a measurement made as to whether the equipment is de-energized.



## Moving components



### WARNING!

Risk of injury from moving components!

Rotating components and/or those moving linearly can result in severe injury.

Therefore:

- Do not intervene in moving components during operation.
- Do not open any covering during operation.
- The amount of residual mechanical energy depends on the application. Powered components still turn/move for a certain length of time even after the power supply has been switched off. Ensure that adequate safety measures are taken.

## 2.9 Noise level of the device

---

The option module does not make any noise.

## 2.10 Fire fighting

---



### DANGER

Risk of fatal injury from electrical current!

There is a risk of electric shock if an electrically-conductive, fire-extinguishing agent is used.

Therefore:

- Use the following fire-extinguishing agent:



Firefighting equipment

### 2.11 Electrical safety

---

The option module is laid out for degree of pollution 2 accordant to EN 50178. This means, that only non-conductive pollutions may occur during operating time. Short-term conductivity by condensation is permitted only, if the control is out of operation.



**WARNING!**

Risk of injury due to conductive pollutions!

No conductive pollutions may occur during operating time.

Therefore:

- If necessary, assure with additional measures that the degree of pollution 2 is not exceeded before installing the system.

#### 2.11.1 Notes according to the power supply

---



**WARNING!**

Risk of injury from electrical current!

Only those devices may be connected to the option module, which ensure a reliable electrical isolation to the 230 V system.

The power-supply unit for that generates the 24 volt-supply must be in accordance with the requirements for PELV referring to EN 50178.

### 2.12 Safety equipment

---



**WARNING!**

Risk of fatal injury due to non-functional safety equipment!

Safety equipment provides for the highest level of safety in a facility. Even if safety equipment makes work processes more awkward, under no circumstances may they be circumvented. Safety can only be ensured by intact safety equipment.

Therefore:

- Before starting to work, check whether the safety equipment in good working order and properly installed.

## 2.13 Rules of conduct in case of danger or accidents

---

### Preventive measures

- Always be prepared for accidents or fire!
- Keep first-aid equipment (e.g. first-aid kits, blankets, etc.) and fire extinguishers readily accessible.
- Familiarize personnel with accident alarm, first aid and rescue equipment.

### And if something does happen: respond properly

- Stop operation of the device immediately with an EMERGENCY Stop.
- Initiate first aid measures.
- Evacuate persons from the danger zone.
- Notify the responsible persons at the scene of operations.
- Alarm medical personnel and/or the fire department.
- Keep access routes clear for rescue vehicles.

### 2.14 Signs and labels

The following symbols and information signs are located in the working area. They refer to the immediate vicinity in which they are affixed.



#### **WARNING!**

Risk of injury due to illegible symbols!

Over the course of time, stickers and symbols on the device can become dirty or otherwise unrecognizable.

Therefore:

- Maintain all safety, warning and operating labels on the device in easily readable condition



Electrical voltage

The working area, which is marked with this sign, is authorized for qualified personnel to work in it, only

Unauthorized persons may not touch the marked work equipment.



#### **DANGER!**

Risk of fatal injury from electrical current!

Discharge time > 1 minute

Stored electrical current!

Therefore:

- Do not touch before taking into account the discharge time of the capacitors and electrically live parts.
- Heed corresponding notes on the equipment.
- If additional capacitors are connected to the intermediate circuit, the intermediate circuit discharge can take a much longer time. In this case, the necessary waiting period must itself be determined or a measurement made as to whether the equipment is de-energized. This discharge time must be posted, together with an IEC 60417-5036 (2002-10) warning symbol, on a clearly visible location of the control cabinet.

## BASICS

This chapter informs about data exchange over EtherCAT.

### 3.1 General information on EtherCAT and the use of the EtherCAT-networks

EtherCAT is an Ethernet-based field bus system that combines the advantages of Ethernet (high speed, easy configuration) with real-time capability and suitability for small amounts of data. The use of internet technologies on the I/O level is also possible with EtherCAT. As with other field busses, device profiles are used for communication with EtherCAT.

New device profiles were not defined for EtherCAT, however. Instead, interfaces for existing device profiles (already familiar to the user) are provided. This facilitates the migration from the existing field bus to EtherCAT, both for the user and for the device manufacturer.

The Ethernet with EtherCAT master option module supports CANopen over EtherCAT (CoE) and Ethernet over EtherCAT (EoE).

Additional information is found on the website of the EtherCAT Technology Group (ETG) at [www.EtherCAT.org](http://www.EtherCAT.org).

#### **CANopen over EtherCAT (CoE)**

CANopen devices and application profiles are available for a wide variety of device classes and applications, such as

- I/O modules
- drives
- encoders
- proportional valves and hydraulic regulators

and application profiles as

- plastics processing
- textile machines

EtherCAT can provide the same communication mechanisms as CANopen:

- object directory
- PDO (process data objects)
- SDO (service data objects)

Even the network management is comparable.

### **Ethernet over EtherCAT (EoE)**

The EtherCAT technology is Ethernet-compatible. The protocol is compatible with other Ethernet-based services and protocols on the same physical network, generally with a minimum loss of performance. Any required Ethernet devices can be connected within the EtherCAT line via a switch port. The Ethernet frames are tunneled via the EtherCAT protocol, as it is usual with internet technologies. The EtherCAT network is fully transparent to the Ethernet device, and the real-time properties are not taken into account. EtherCAT devices can also use other Ethernet protocols, and thus act like an external standard Ethernet station. Here, the master functions as a layer 2 switch that passes on the frames to the corresponding stations, using the address information.

This means that all internet technologies, e.g.

- integrated webservers
- FTP-transfer

can be used in the EtherCAT-environment.

### **Telegrams**

EtherCAT overcomes the principle limitations of other Ethernet solutions. An Ethernet telegram (containing the EtherCAT protocol) no longer receives, interprets and then copies the process data after each switch-on. Instead of that, each EtherCAT slave takes the related data from the telegram (e.g. set values) while the telegram is running through the EtherCAT slave. The input data (e.g. actual values) is also written in the telegram, while the telegram is running through the EtherCAT-slave.

Thereby, the Ethernet telegrams are delayed by a few nanoseconds, only.

Since an Ethernet telegram reaches many EtherCAT slaves in the transmitting direction as well as in the receiving direction, the user data rate rises to over 90%.

### **Protocol**

The EtherCAT protocol, optimized for process data is directly transmitted in the Ethernet telegram. EtherCAT uses standard telegrams (standard frames) pursuant to IEEE802.3, only.

## Network

EtherCAT supports the bus and line configuration used for field busses. Fast Ethernet physics (100BaseTX) allow a cable length up to 100 m between two devices on the EtherCAT bus. With the BM4-O-ECT-02 option module up to 1023 devices can be connected to the EtherCAT bus. EtherCAT supports the bus or line configuration, which is also used by the field busses.

## Distributed Clocks

High-precision synchronization is possible with "Distributed Clocks". The slave's EtherCAT-ASIC contains a real-time clock with a capture/compare unit and generation of HW-cycle signals. These real-time clocks of the slave are compared with one another. There-with, the slave's event generation can be synchronized to <100 ns.

## 3.2 EtherCAT State Machine

---

The state of the EtherCAT slave is controlled via the EtherCAT State Machine (ESM). A distinction is made between the following states:

- Init
- Pre-Operational
- Safe-Operational and
- Operational

### Init

After switch-on the EtherCAT slave in the Init state. No mailbox or process data communication is possible. The EtherCAT master initializes sync manager channels 0 and 1 for mailbox communication.

### Pre-Operational (Pre-Op)

During the transition between Init and Pre-Op the EtherCAT slave checks whether the mailbox was initialized correctly.

In Pre-Op state mailbox communication is possible, but not process data communication. The EtherCAT master initializes the sync manager channels for process data (from sync manager channel 2), the FMMU channels and, if the slave supports configurable mapping, PDO mapping or the sync manager PDO assignment. In this state the settings for the process data transfer and perhaps terminal-specific parameters that may differ from the default settings are also transferred.

### **Safe-Operational (Safe-Op)**

During transition between Pre-Op and Safe-Op the EtherCAT slave checks whether the sync manager channels for process data communication and, if required, the distributed clocks settings are correct. Before it acknowledges the change of state, the EtherCAT slave copies current input data into the associated DP-RAM areas of the EtherCAT slave controller (ECSC).

In Safe-Op state mailbox and process data communication is possible, although the slave keeps its outputs in a safe state, while the input data are updated cyclically.

### **Operational (Op)**

Before the EtherCAT master switches the EtherCAT slave from Safe-Op to Op it must transfer valid output data.

In the Op state the slave copies the output data of the masters to its outputs. Process data and mailbox communication is possible.



## I/O BUS TERMINALS

### 4.1 EtherCAT Bus Coupler for I/O-Bus Terminals

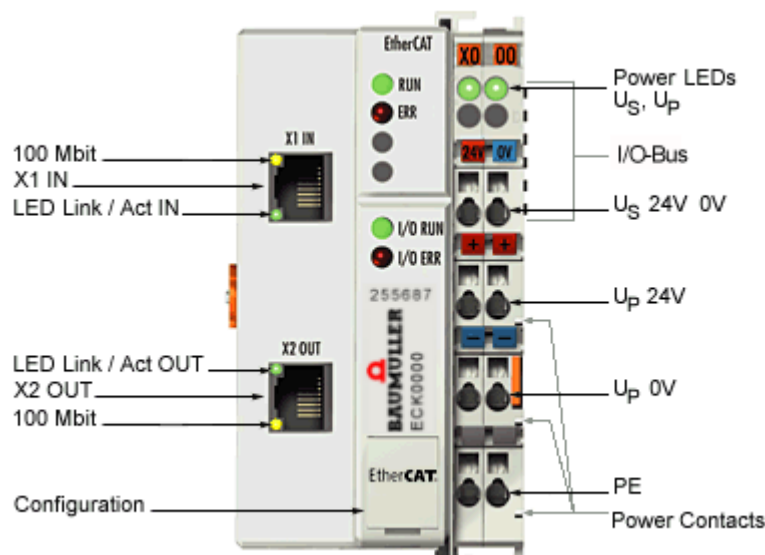


Figure 1:

The ECK000 Bus Coupler connects EtherCAT, the real-time Ethernet system, with the modular, extendable electronic terminal blocks. A block of terminals consists of a Bus Coupler, up to 64 terminals (255 with I/O-Bus extension) and one end terminal.

The Bus Coupler recognizes the connected Bus Terminals and automatically allocates them into the EtherCAT process image. The Bus Coupler is connected to the network via the upper Ethernet interface. The lower RJ 45 socket may be used to connect further EtherCAT devices in the same strand.

In the EtherCAT network, the ECK000 Bus Coupler can be installed anywhere in the Ethernet signal transfer section (100BASE-TX) – except directly at the switch.

## 4.2 System overview

---

### 4.1.1 Pin assignment

---

Terminal connection		Description
Designation	No.	
U <sub>s</sub> 24 V	1	Supply for Bus Coupler and E-bus circuit
U <sub>p</sub> 24 V	2	Supply for power contacts (internally connected with terminal point 6)
U <sub>p</sub> 0 V	3	Supply for power contacts (internally connected with terminal point 7)
PE	4	PE connection (internally connected with terminal point 8)
U <sub>s</sub> 0 V	5	Supply for Bus Coupler and E-bus circuit
U <sub>p</sub> 24 V	6	Supply for power contacts (internally connected with terminal point 2)
U <sub>p</sub> 0 V	7	Supply for power contacts (internally connected with terminal point 3)
PE	8	PE connection (internally connected with terminal point 4)

## 4.2 System overview

---

### 4.2.1 Up to 64 Bus Terminals each having 2 I/O channels for each signal form

---

The Bus Coupler ECK0000 connects the fieldbus EtherCAT with the sensor / actuator level. A unit consists of a Bus Coupler as the head station, and up to 64 electronic series terminals, the last one being an end terminal.

For each technical signal form, terminals are available each having two I/O channels, and these can be mixed in any order. All the terminal types have the same mechanical construction. The height and depth match the dimensions of compact terminal boxes.

### 4.2.2 Decentralized wiring of each I/O level

---

Fieldbus technology allows more compact forms of controller to be used. The I/O level does not have to be brought to the controller. The sensors and actuators can be wired decentrally, using minimum cable lengths. The controller can be installed at any location within the plant.

### 4.2.3 Assembly on standardized mounting rails

---

The easy, space-saving, assembly on a standardized mounting rail (EN 50022, 35 mm), and the direct wiring of actuators and sensors, without cross-connections between the terminals, standardizes the installation. The consistent labelling scheme also contributes.

The small physical size and the great flexibility of the Bus Terminal system allows it to be used wherever a series terminal is also used. Every type of connection, such as analog, digital, serial or the direct connection of sensors can be implemented.

#### 4.2.4 Modularity

---

The modular assembly of the terminal strip with Bus Terminals of various functions limits the number of unused channels to a maximum of one per function. The presence of two channels in one terminal is the optimum compromise of unused channels and the cost of each channel.

The possibility of electrical isolation through potential feed terminals also helps to keep the number of unused channels low.

#### 4.2.5 Display of the channel state

---

The integrated LEDs show the state of the channel at a location close to the sensors and actuators.

#### 4.2.6 I/O-Bus

---

The I/O-Bus is the data path within a terminal strip. The I/O-Bus is led through from the Bus Coupler through all the terminals via six contacts on the terminals' side walls. The end terminal terminates the I/O-Bus. Many software tools that can be supplied make project planning, configuration and operation easy.

#### 4.2.7 Potential feed terminals for isolated groups

---

The operating voltage is passed on to following terminals via three power contacts. The terminals can be divided into isolated groups by means of potential feed terminals.

Up to 64 terminals can be used within one terminal strip. This count does include potential feed terminals, but not the end terminal.

#### 4.2.8 Bus Couplers for various fieldbus systems

---

Various Bus Couplers can be used to couple the electronic terminal strip quickly and easily to different fieldbus systems. It is also possible to convert to another fieldbus system at a later time. The Bus Coupler performs all the monitoring and control tasks that are necessary for operation of the connected Bus Terminals. The operation and configuration of the Bus Terminals is carried out exclusively by the Bus Coupler. Nevertheless, the parameters that have been set are stored in each Bus Terminal, and are retained in the event of voltage drop-out.

Fieldbus, I/O-Bus and I/O level are electrically isolated.

If the exchange of data over the fieldbus is prone to errors or fails for a period of time, register contents (such as counter states) are retained, digital outputs are cleared, and analog outputs take a value that can be configured for each output when commissioning. The default setting for analog outputs is 0 V or 0 mA. Digital outputs return in the inactive state. The timeout periods for the Bus Couplers correspond to the usual settings for the fieldbus system. When converting to a different bus system it is necessary to bear in mind the need to change the timeout periods if the bus cycle time is longer.

In addition to the EtherCAT bus coupler ECK0000 a CANopen bus coupler CK0000 is also available.

# ASSEMBLY AND INSTALLATION

## 5.1 Mechanical Installation

### 5.1.1 Dimensions

The system of the Baumüller Bus Terminals is characterized by low physical volume and high modularity. When planning a project it must be assumed that at least one Bus Coupler and a number of Bus Terminals will be used. The mechanical dimensions of the Bus Couplers are independent of the fieldbus system.

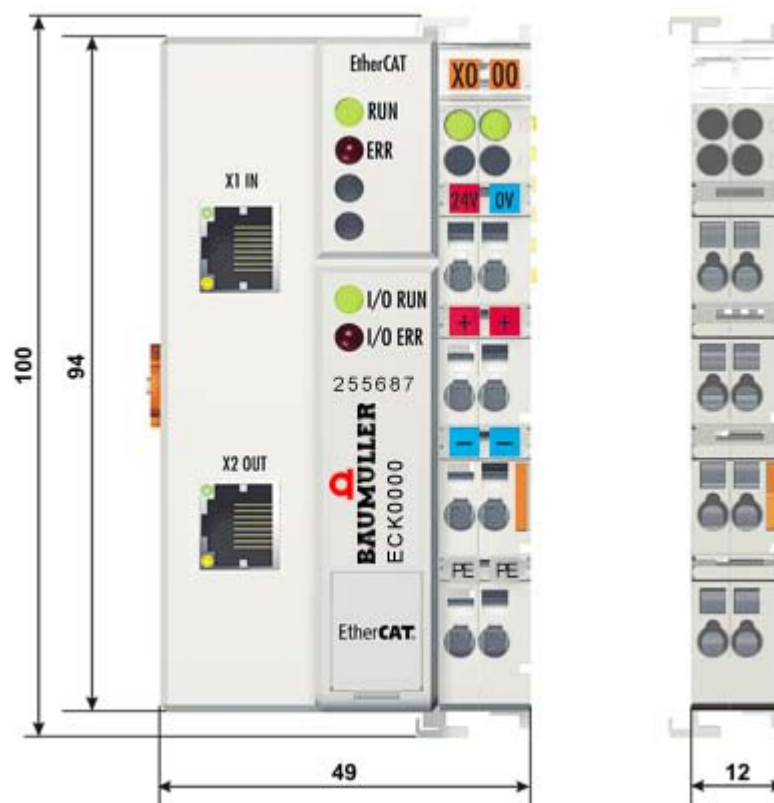


Figure 2: Dimensions

## 5.1 Mechanical Installation

The total width in practical cases is composed of the width of the Bus Coupler, the EK0000 bus end terminal and the width of the Bus Terminals in use. Depending on function, the Bus Terminals are 12 or 24 mm wide. The front wiring increases the total height of 68 mm by about 5 to 10 mm, depending on the wire thickness.

### 5.1.2 Installation of Bus Terminals on C mounting rails



#### **WARNING!**

##### **Risk of injury due to electricity.**

The Bus Terminals and the vicinity of the control cabinet may carry dangerous voltages.

Therefore:

- Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!
- Assure that all electrical connections are disconnected from the mains and protected against being switched on again.
- Before starting work on the electrical connections, use appropriate measuring equipment to assure that the connections are de-energized
- The connections may not be demounted unless they are de-energized.

#### **Assembly**

The Bus Coupler and the Bus Terminals are attached to commercially available 35 mm C mounting rails (EN 50022):

- 1 First attach the Fieldbus Coupler to the mounting rail.
- 2 The Bus Terminals are now attached on the right-hand side of the Fieldbus Coupler. Join the components with tongue and groove and push the terminals against the mounting rail by applying slight pressure, until the lock clicks onto the mounting rail. If the Terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

During the installation of the Bus Terminals, the locking mechanism of the terminals must not come into conflict with the fixing bolts of the mounting rail.

#### **Disassembly**

Each terminal is secured by a lock on the mounting rail, which must be released for disassembly:

- 1 Carefully pull the orange-colored lug approximately 1 cm out of the disassembled terminal, until it protrudes loosely. The lock with the mounting rail is now released for this terminal, and the terminal can be pulled from the mounting rail without excessive force.
- 2 Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal away from the mounting rail.

## Connections within a bus terminal block

The electric connections between the Bus Coupler and the Bus Terminals are automatically realised by joining the components:

- The six spring contacts of the I/O-Bus / E-Bus deal with the transfer of the data and the supply of the Bus Terminal electronics.
- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the bus terminal block. The power contacts are supplied via terminals on the Bus Coupler.



### NOTE!

During the design of a bus terminal block, the pin assignment of the individual Bus Terminals must be taken account of, since some types (e.g. analog Bus Terminals or digital 4-channel Bus Terminals) do not or not fully loop through the power contacts.

Power Feed Terminals (ES0000) interrupt the power contacts and thus represent the start of a new supply rail.

## PE power contact

The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.



### CAUTION!

#### Damage due to electrical destruction.

The terminals may get destroyed electrically if they are not disconnected for insulation testing.

Therefore:

- Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a nominal voltage of 230 V).
- For insulation testing, disconnect the PE supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.

The PE power contact must not be used for other potentials!

## Wiring

Up to eight connections enable the connection of solid or finely stranded cables to the Bus Terminals. The terminals are implemented in spring force technology. Connect the cables as follows:

- 1 Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.

## 5.1 Mechanical Installation

- 2 The wire can now be inserted into the round terminal opening without any force.
- 3 The terminal closes automatically when the pressure is released, holding the wire securely and permanently.



### NOTE!

Analog sensors and actors should always be connected with shielded, twisted paired wires.

### 5.1.3 Installation

The Bus Coupler and all the Bus Terminals can be clipped, with a light press, onto a 35 mm mounting rail. A locking mechanism prevents the individual housings from being pulled off again. For removal from the mounting rail the orange colored tension strap releases the latching mechanism, allowing the housing to be pulled off the rail without any force.

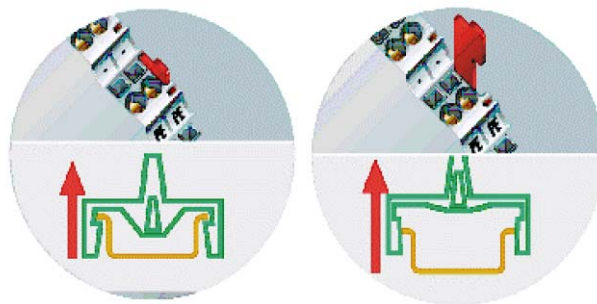


Figure 3:

Up to 64 Bus Terminals can be attached to the Bus Coupler on the right hand side. When plugging the components together, be sure to assemble the housings with groove and tongue against each other. A properly working connection can not be made by pushing the housings together on the mounting rail. When correctly assembled, no significant gap can be seen between the attached housings.

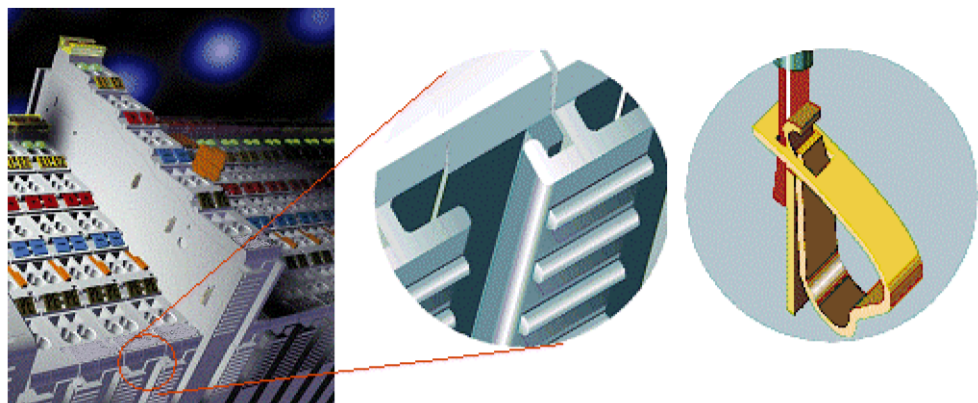


Figure 4:



**CAUTION!****Damage due to electrostatic discharge.**

The terminals may get destroyed electrically if they are plugged in under power.

Therefore:

- Insertion and removal of Bus Terminals is only permitted when switched off. The electronics in the Bus Terminals and in the Bus Coupler are protected to a large measure against damage, but incorrect function and damage cannot be ruled out if they are plugged in under power.

The right hand part of the Bus Coupler can be compared to a Bus Terminal. Eight connections at the top enable the connection with solid or fine wires from 0.08 mm<sup>2</sup> to 2.5 mm<sup>2</sup>. The connection is implemented with the aid of a spring device. The spring-loaded terminal is opened with a screwdriver or rod, by exerting gentle pressure in the opening above the terminal. The wire can be inserted into the terminal without any force. The terminal closes automatically when the pressure is released, holding the wire securely and permanently.

## 5.2 Wiring

### 5.2.1 Power Supply, Potential Groups

#### Bus Coupler power supply

The Bus Couplers require a 24 V DC supply for their operation. The connection is made by means of the upper spring-loaded terminals labelled 24 V and 0 V. The supply voltage feeds the Bus Coupler electronics and, over the I/O-Bus, the Bus Terminals. The power supply for the Bus Coupler electronics and that of the I/O-Bus are electrically separated from the potential of the field level.

#### Input for Power Contacts

The bottom six connections with spring-loaded terminals can be used to feed the supply for the peripherals. The spring-loaded terminals are joined in pairs to a power contact. The feed for the power contacts has no connection to the voltage supply for the Bus Coupler. The design of the feed permits voltages of up to 24 V. The assignment in pairs and the electrical connection between feed terminal contacts allows the connection wires to be looped through to various terminal points. The current drawn from the power contacts must not exceed 10 A for long periods. The current carrying capacity between two spring-loaded terminals is identical to that of the connecting wires.

### Power contacts

On the right hand face of the Bus Coupler there are three spring contacts for the power contact connections. The spring contacts are hidden in slots so that they can not be accidentally touched. By attaching a Bus Terminal the blade contacts on the left hand side of the Bus Terminal are connected to the spring contacts. The tongue and groove guides on the top and bottom of the Bus Coupler and of the Bus Terminals guarantees that the power contacts mate securely.

### Configuration Interface

The standard Bus Couplers have an RS232 interface at the bottom of the front face. The miniature connector can be joined to a PC with the aid of a connecting cable and the configuration software. The interface permits the Bus Terminals to be configured, for example adjusting the amplification factors of the analog channels. The interface can also be used to change the assignments of the Bus Terminal data to the process image in the Bus Coupler. The functionality of the configuration interface can also be reached via the fieldbus.

### Electrical isolation

The Bus Couplers operate by means of three independent potential groups. The supply voltage feeds the I/O-Bus electronics in the Bus Coupler and the I/O-Bus itself, which are electrically isolated. The supply voltage is also used to generate the operating voltage for the fieldbus.

Remark: All the Bus Terminals are electrically isolated from the I/O-Bus. The I/O-Bus is thus electrically isolated from everything else.

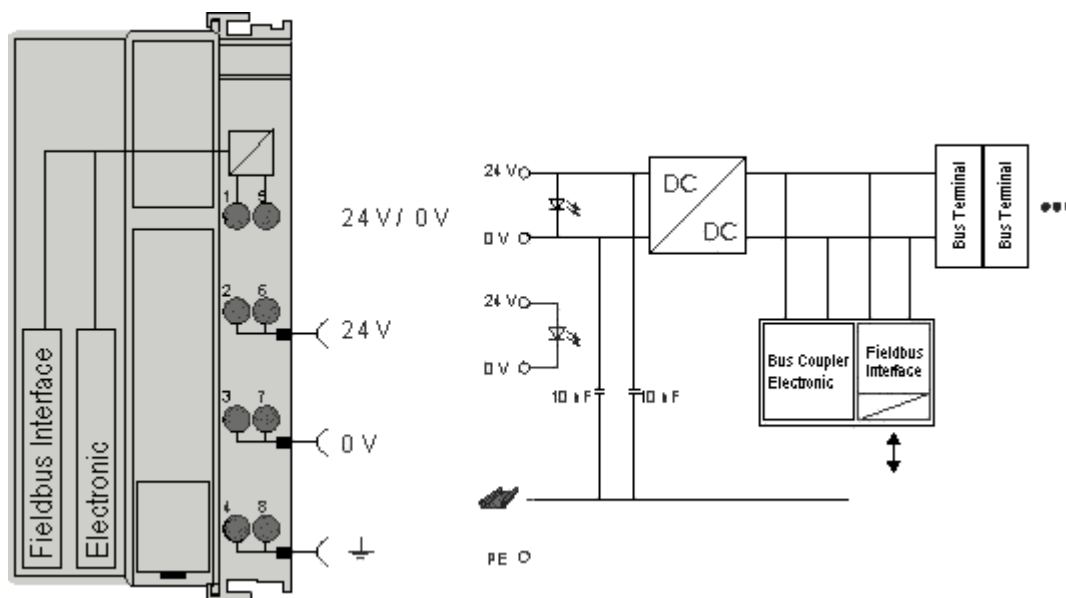


Figure 5:

## 5.2.2 Requirements of the connection cable

Baumüller has released the following cables for use:

- Ethernet cable K-ETH-33-0-xx

Line type: K-ETH-33-0-xx (RJ45 male connector, RJ45 male connector):

Type	Length [m]	Article Number
K-ETH-33-0-0,5	0,5	325160
K-ETH-33-0-01	1	325161
K-ETH-33-0-02	2	325162
K-ETH-33-0-03	3	325163
K-ETH-33-0-04	4	325317
K-ETH-33-0-05	5	325164
K-ETH-33-0-10	10	325165

Further types available on request.



# PARAMETERIZATION AND COMMISSIONING

## 6.1 Start-up Behaviour of the Bus Coupler

Immediately after being switched on, the Bus Coupler checks, in the course of a self test, all the functions of its components and the communication on the I/O-Bus. The red I/O LED blinks while this is happening. After completion of the self-test, the Bus Coupler starts to test the attached Bus Terminals (the Bus Terminal Test), and reads in the configuration. The Bus Terminal configuration is used to generate an internal structure list, which is not accessible from outside. In case of an error, the Bus Coupler enters the STOP state. Once the start-up has completed without error, the Bus Coupler enters the fieldbus start state.

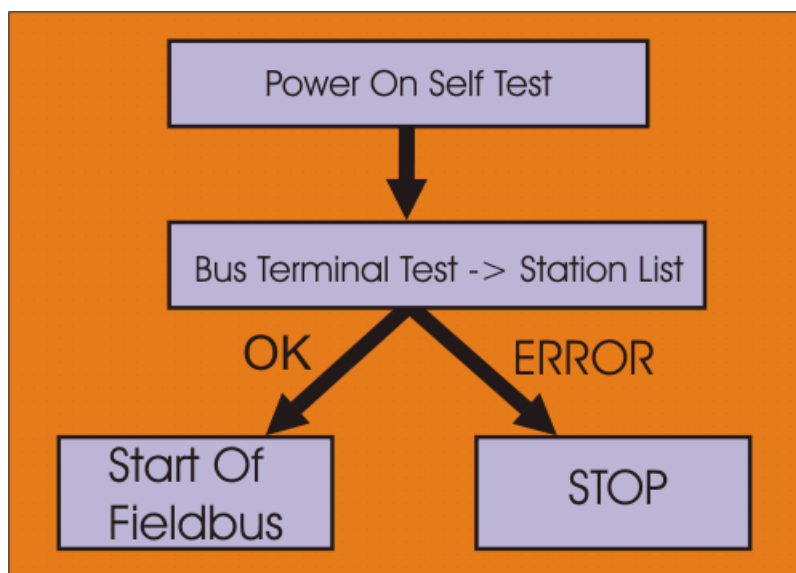


Figure 6: Start-up Behaviour

The Bus Coupler can be made to enter the normal operating state by switching it on again once the fault has been rectified.

### 6.2 Objects

The object directory of the EtherCAT bus coupler ECK0000 is readable and (in parts) writable via the CoE protocol (CANopen over EtherCAT).

#### 6.2.1 Object Overview

Index		Name	Flags	Default or sample value
1000		Device type	RO	0x00000000 (0 <sub>dec</sub> )
1008		Device name	RO	ECK000-0000-0000
1009		Hardware version	RO	01
100A		Software version	RO	B7
1018:0	<b>Subindex</b>	Identity object	RO	>4<
	1018:01	Vendor ID	RO	0x00000002 (2 <sub>dec</sub> )
	1018:02	Product code	RO	0x04602C22 (73411618 <sub>dec</sub> )
	1018:03	Revision number	RO	0x00000000 (0 <sub>dec</sub> )
	1018:04	Serial number	RO	0x00000000 (0 <sub>dec</sub> )
1C00:0	<b>Subindex</b>	Sync Manager Type	RO	>4<
	1C00:01	SM parameter 1	RO	0x01 (1 <sub>dec</sub> )
	1C00:02	SM parameter 2	RO	0x02 (2 <sub>dec</sub> )
	1C00:03	SM parameter 3	RO	0x03 (3 <sub>dec</sub> )
	1C00:04	SM parameter 4	RO	0x04 (4 <sub>dec</sub> )
4000:0	<b>Subindex</b>	Coupler table 0 [LO]	RW	>128<
	4000:01	Register 0	RW	0x0000 (0 <sub>dec</sub> )
	4000:02	Register 1	RW	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	4000:80	Register 127	RW	0x0000 (0 <sub>dec</sub> )
4001:0	<b>Subindex</b>	Coupler table 0 [HI]	RW	>128<
	4001:01	Register 128	RW	0xFFFF (65535 <sub>dec</sub> )
	4001:02	Register 129	RW	0xFFFF (65535 <sub>dec</sub> )
	...	...	...	
	4001:80	Register 255	RW	0xB700 (46848 <sub>dec</sub> )
4012:0	<b>Subindex</b>	Coupler table 9 [LO]	RO	>4<
	4002:01	Register 000	RO	0x0460 (1120 <sub>dec</sub> )
	4002:02	Register 001	RO	e.g.: 0x8201 (33281 <sub>dec</sub> )
	4002:03	Register 003	RO	e.g.: 0x0BBA (3002 <sub>dec</sub> )
	4002:04	Register 004	RO	e.g.: 0x0C84 (3204 <sub>dec</sub> )

Index		Name	Flags	Default or sample value
4013:0	<b>Subindex</b>	Coupler table 9 [HI]	RO	>0<
40B4:0	<b>Subindex</b>	Coupler table 90 [LO]	RO	>128<
	40B4:01	Register 0	RO	0x0000 (0 <sub>dec</sub> )
	40B4:02	Register 1	RO	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	40B4:80	Register 127	RO	0x0000 (0 <sub>dec</sub> )
40B5:0	<b>Subindex</b>	Coupler table 90 [HI]	RO	>128<
	40B5:01	Register 128	RO	0x0000 (0 <sub>dec</sub> )
	40B5:02	Register 129	RO	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	40B5:80	Register 255	RO	0x0000 (0 <sub>dec</sub> )
40C4:0	<b>Subindex</b>	Coupler table 98 [LO]	RW	>5<
	40C4:01	Min. I/O-Bus time	RW	e.g. 0x0355 (853 <sub>dec</sub> )
	40C4:02	Max. I/O-Bus time	RW	e.g. 0x059A (1434 <sub>dec</sub> )
	40C4:03	Curr. I/O-Bus time	RW	e.g. 0x036A (874 <sub>dec</sub> )
	40C4:04	reserviert	RW	0x0000 (0 <sub>dec</sub> )
	40C4:05	reserviert	RW	0x09F8 (2552 <sub>dec</sub> )
40C5:0	<b>Subindex</b>	Coupler table 98 [HI]	RW	>0<
40C8:0	<b>Subindex</b>	Coupler table 100 [LO]	RW	>128<
	40C8:01	Register 0	RW	0x0000 (0 <sub>dec</sub> )
	40C8:02	Register 1	RW	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	40C8:80	Register 127	RW	0x0000 (0 <sub>dec</sub> )
40C9:0	<b>Subindex</b>	Coupler table 100 [HI]	RW	>128<
	40C9:01	Register 128	RW	0x0000 (0 <sub>dec</sub> )
	40C9:02	Register 129	RW	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	40C9:80	Register 255	RW	0x0000 (0 <sub>dec</sub> )
40FE:0	<b>Subindex</b>	Coupler table 127 [LO]	RO	>128<
	40FE:01	Register 0	RO	0x0100 (256 <sub>dec</sub> )
	40FE:02	Register 1	RO	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	40FE:80	Register 127	RO	0x0000 (0 <sub>dec</sub> )

Index		Name	Flags	Default or sample value
40FF:0	<b>Subindex</b>	Coupler table 127 [HI]	RO	>128<
	40FF:01	Register 128	RO	0x0000 (0 <sub>dec</sub> )
	40FF:02	Register 129	RO	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	40FF:80	Register 255	RO	0x0000 (0 <sub>dec</sub> )
427F		Terminal No	RW	0x0003 (3 <sub>dec</sub> )
4280:0	<b>Subindex</b>	Terminal table 0 [LO]	RW	>64<
	4280:01	Register 0	RW	0x0000 (0 <sub>dec</sub> )
	4280:02	Register 1	RW	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	4280:40	Register 63	RW	0x0000 (0 <sub>dec</sub> )
4281:0	<b>Subindex</b>	Terminal table 0 [HI]	RW	>0<
4282:0	<b>Subindex</b>	Terminal table 1 [LO]	RW	>64<
	4280:01	Register 0	RW	0x0000 (0 <sub>dec</sub> )
	4280:02	Register 1	RW	0x0000 (0 <sub>dec</sub> )
	...	...	...	
	4280:40	Register 63	RW	0x0000 (0 <sub>dec</sub> )
4283:0	<b>Subindex</b>	Terminal table 1 [HI]	RW	>0<
4284:0	<b>Subindex</b>	Terminal table 2 [LO]	RW	>64<
	4280:01	Register 0	RW	
	4280:02	Register 1	RW	
	...	...	...	
	4280:40	Register 63	RW	
4285:0	<b>Subindex</b>	Terminal table 2 [HI]	RW	>0<
4286:0	<b>Subindex</b>	Terminal table 3 [LO]	RW	>64<
	4280:01	Register 0	RW	
	4280:02	Register 1	RW	
	...	...	...	
	4280:40	Register 63	RW	
4287:0	<b>Subindex</b>	Terminal table 3 [HI]	RW	>0<

Legend

Flags: RO = Read Only

RW = Read/Write



## 6.2.2 Object Description

### 6.2.2.1 Standard objects

#### Object 1000: Device type

Device type (read only) of the EtherCAT slave.

#### Object 1008: Device name

Device name (read only, value: EL2521-xxxx) of the EtherCAT slave.

#### Object 1009: Hardware version

Hardware version (read only) of the EtherCAT slave.

#### Object 100A: Software version

Version (read only) of the PIC firmware (processing of the I/O signals) of the EtherCAT slave.

#### Objects 1018: Identity object

Index	Name	Meaning	Flags	Default
1018:0	Identity object	Length of this object	RO	4
1018:01	Vendor id	Vendor ID of the EtherCAT slave	RO	0x00000002 (2 <sub>dec</sub> )
1018:02	Product code	Product code of the EtherCAT slave	RO	0x04602C22 (73411618 <sub>dec</sub> )
1018:03	Revision number	Revision number of the EtherCAT slave	RO	0x00000000 (0 <sub>dec</sub> )
1018:04	Serial number	Serial number of the EtherCAT slave	RO	0x00000000 (0 <sub>dec</sub> )

#### Object 1C00: SM type

Index	Name	Meaning	Flags	Default
1C00:0	SM type	Length of this object	RO	4
1C00:01	SM-Parameter 1	Sync Manager, parameter 1	RO	0x01 (1 <sub>dec</sub> )
1C00:02	SM-Parameter 2	Sync Manager, parameter 2	RO	0x02 (2 <sub>dec</sub> )

Index	Name	Meaning	Flags	Default
1C00:03	SM-Parameter 3	Sync Manager, parameter 3	RO	0x03 (3 <sub>dec</sub> )
1C00:04	SM-Parameter 4	Sync Manager, parameter 4	RO	0x04 (4 <sub>dec</sub> )

### Object 4000: Coupler Table 0 [LO]: General configuration of Bus Coupler

Index	Name	Meaning	Flags	Default
4000:0	Coupler Table 0 [LO]	Length of this object	RW	128
4000:01	SubIndex 001	Register 0	RW	
4000:02	SubIndex 002	Register 1	RW	
...	...	...	...	
4000:80	SubIndex 128	Register 127	RW	

### Object 4001: Coupler Table 0 [HI]: General configuration of Bus Coupler (continuance)

Index	Name	Meaning	Flags	Default
4001:0	Coupler Table 0 [HI]	Length of this object	RW	128
4001:01	SubIndex 001	Register 128	RW	
4001:02	SubIndex 002	Register 129	RW	
...	...	...	...	
4001:80	SubIndex 128	Register 256	RW	

### Object 4012: Coupler Table 9 [LO]: Structure of the terminal block

Index	Name	Meaning	Flags	Default
4012:0	Coupler Table 9 [LO]	Length of this object	RO	max. 128
4012:01	SubIndex 001	Register 0: identification the of Bus Coupler	RO	0x0460 (1120 <sub>dec</sub> <sup>1</sup> )
4012:02	SubIndex 002	Register 1: identification of the 1st terminal	RO	e.g.: 0x8201 (33281 <sub>dec</sub> <sup>2</sup> )
4012:03	SubIndex 003	Register 2: identification of the 2nd terminal	RO	e.g.: 0x0BBA (3002 <sub>dec</sub> <sup>1</sup> )

Index	Name	Meaning	Flags	Default
4012:04	SubIndex 004	Register 3: identification of the 3rd terminal	RO	e.g.: 0x0D7E (3454 <sub>dec</sub> <sup>1</sup> )
...	...	...	...	...
4012:80	SubIndex 128	Register 127: identification of the 127th terminal	RO	

<sup>1</sup>) For Bus Couplers and intelligent (e.g. analog) terminals the terminal identification is shown as plain text; e.g. 0x0D7E (3454<sub>dec</sub>) means AI4420.

<sup>2</sup>) For non-intelligent (digital) terminals, the following coding is essential :

Bit	Wert	Meaning
15	0 <sub>bin</sub>	intelligent (e.g. analog) terminal
	1 <sub>bin</sub>	non-intelligent (digital) terminal
14...8	xxxxxx <sub>bin</sub>	Size of terminal in bit (range: 0 to 63 bit)
7	1 <sub>bin</sub>	Shift register extension for control panels
6...3	0 <sub>bin</sub>	reserved
2	1 <sub>bin</sub>	reserved
1	1 <sub>bin</sub>	Output terminal
0	1 <sub>bin</sub>	Input terminal

**Object 4013: Coupler Table 9 [HI]: Structure of the terminal block (continuance if more than 127 terminals)**

Index	Name	Meaning	Flags	Default
4013:0	Coupler Table 9 [HI]	Length of this object	RO	max. 128 <sub>dec</sub>
4013:01	SubIndex 001	Register 128: identification of the 128th terminal	RO	
4013:02	SubIndex 002	Register 129: identification of the 129th terminal	RO	
...	...	...	...	
4013:80	SubIndex 128	Register 255: identification of the 255th terminal	RO	

### Object 40B4: Coupler Table 90 [LO]: Internal diagnostic information of the Bus Coupler

Index	Name	Meaning	Flags	Default
40B4:0	Coupler Table 90 [LO]	Length of this object	RO	128 <sub>dec</sub>
40B4:01	SubIndex 001	Register 0: reserved	RO	
40B4:02	SubIndex 002	Register 1: reserved	RO	
...	...	...	...	...
40B4:80	SubIndex 128	Register 127: reserved	RO	

### Object 40B5: Coupler Table 90 [HI]: Internal diagnostic information of the Bus Coupler

Index	Name	Meaning	Flags	Default
40B5:0	Coupler Table 90 [HI]	Length of this object	RO	128 <sub>dec</sub>
40B5:01	SubIndex 001	Register 128: reserved	RO	
40B5:02	SubIndex 002	Register 129: reserved	RO	
...	...	...	...	...
40B5:80	SubIndex 128	Register 255: reserved	RO	

### Object 40C4: Coupler Table 98 [LO]: Pd Update time (µs)

Index	Name	Meaning	Flags	Default
40C4:0	Coupler Table 98 Pd Update time (µs)	Length of this object	RW	5
40C4:01	Min time	min. I/O-Bus update time	RW	0x0355 (853 <sub>dec</sub> )
40C4:02	Max time	max. I/O-Bus update time	RW	0x059A (1434 <sub>dec</sub> )
40C4:03	Curr time	current I/O-Bus update time	RW	0x036A (874 <sub>dec</sub> )
40C4:04	-	reserved	RW	0x0000 (0 <sub>dec</sub> )
40C4:05	-	reserved	RW	0x09F8 (2552 <sub>dec</sub> )

## Object 40C5: Coupler Table 98 [HI]: Pd Update time (µs) (continuance)

Index	Name	Meaning	Flags	Default
40C5:0	Coupler Table 98 Pd Update time (µs)	Length of this object	RW	0

## Object 40C8: Coupler Table 100 [LO]: Reserved for internal fieldbus specific adjustments

Index	Name	Meaning	Flags	Default
40C8:0	Coupler Table 100 [LO]	Length of this object	RO	128 <sub>dec</sub>
40C8:01	SubIndex 001	Register 0: reserved	RO	
40C8:02	SubIndex 002	Register 1: reserved	RO	
...	...	...	...	...
40C8:80	SubIndex 128	Register 127: reserved	RO	

## Object 40C9: Coupler Table 100 [HI]: Reserved for internal fieldbus specific adjustments (continuance)

Index	Name	Meaning	Flags	Default
40C9:0	Coupler Table 100 [HI]	Length of this object	RO	128 <sub>dec</sub>
40C9:01	SubIndex 001	Register 128: reserved	RO	
40C9:02	SubIndex 002	Register 129: reserved	RO	
...	...	...	...	...
40C9:80	SubIndex 128	Register 255: reserved	RO	

## Object 40FE: Coupler Table 127 [LO]: Reserved for internal adjustments

Index	Name	Meaning	Flags	Default
40FE:0	Coupler Table 100 [LO]	Length of this object	RO	128 <sub>dec</sub>
40FE:01	SubIndex 001	Register 0: reserved	RO	
40FE:02	SubIndex 002	Register 1: reserved	RO	
...	...	...	...	...
40FE:80	SubIndex 128	Register 127: reserved	RO	

### Object 40FF: Coupler Table 127 [HI]: Reserved for internal adjustments (continuance)

Index	Name	Meaning	Flags	Default
40FF:0	Coupler Table 100 [HI]	Length of this object	RO	128 <sub>dec</sub>
40FF:01	SubIndex 001	Register 128: reserved	RO	
40FF:02	SubIndex 002	Register 129: reserved	RO	
...	...	...	...	...
40FF:80	SubIndex 128	Register 255: reserved	RO	

### Object 427F: Terminal No.

Index	Name	Meaning	Flags	Default
427F:0	Terminal No	Number of the terminal in the terminal block, which can be parameterized with the 4 following tables (object 4280 - 4287) Example: the Bus Coupler denomination in the terminal block is No. "0". The first terminal connected to the Bus Coupler has the No. "1", etc. Only intelligent terminals can be parameterized!	RO	3

### Object 4280: Terminal Table 0 [LO]: Parameterization of the terminal specified in object 427F

Index	Name	Meaning	Flags	Default
4280:0	Terminal Table 0	Length of this object	RW	64
4280:01	SubIndex 001	Register 0	RW	0x0000 (0 <sub>dec</sub> )
4280:02	SubIndex 002	Register 1	RW	0x0000 (0 <sub>dec</sub> )
...	...	...	...	...
4280:40	SubIndex 064	Register 63	RW	0x0000 (0 <sub>dec</sub> )

**Object 4281: Terminal Table 0 [HI]: Parameterization of the terminal specified in object 427F (continuance)**

Index	Name	Meaning	Flags	Default
4281:0	Terminal Table 0	Length of this object	RW	0

**Object 4282: Terminal Table 1 [LO]: Parameterization of the terminal specified in object 427F**

Index	Name	Meaning	Flags	Default
4282:0	Terminal Table 1	Length of this object	RW	64
4282:01	SubIndex 001	Register 0	RW	0x0000 (0 <sub>dec</sub> )
4282:02	SubIndex 002	Register 1	RW	0x0000 (0 <sub>dec</sub> )
...	...	...	...	...
4282:40	SubIndex 064	Register 63	RW	0x0000 (0 <sub>dec</sub> )

**Object 4283: Terminal Table 1 [HI]: Parameterization of the terminal specified in object 427F (continuance)**

Index	Name	Meaning	Flags	Default
4283:0	Terminal Table 1	Length of this object	RW	0

**Object 4284: Terminal Table 2 [LO]: Parameterization of the terminal specified in object 427F**

Index	Name	Meaning	Flags	Default
4284:0	Terminal Table 2	Length of this object	RW	64
4284:01	SubIndex 001	Register 0	RW	0x0000 (0 <sub>dec</sub> )
4284:02	SubIndex 002	Register 1	RW	0x0000 (0 <sub>dec</sub> )
...	...	...	...	...
4284:40	SubIndex 064	Register 63	RW	0x0000 (0 <sub>dec</sub> )

**Object 4285: Terminal Table 2 [HI]: Parameterization of the terminal specified in object 427F (continuance)**

Index	Name	Meaning	Flags	Default
4285:0	Terminal Table 2	Length of this object	RW	0

**Object 4286: Terminal Table 3 [LO]: Parameterization of the terminal specified in object 427F**

Index	Name	Meaning	Flags	Default
4286:0	Terminal Table 3	Length of this object	RW	64
4286:01	SubIndex 001	Register 0	RW	0x0000 (0 <sub>dec</sub> )
4286:02	SubIndex 002	Register 1	RW	0x0000 (0 <sub>dec</sub> )
...	...	...	...	...
4286:40	SubIndex 064	Register 63	RW	0x0000 (0 <sub>dec</sub> )

**Object 4287: Terminal Table 3 [HI]: Parameterization of the terminal specified in object 427F (continuance)**

Index	Name	Meaning	Flags	Default
4287:0	Terminal Table 3	Length of this object	RW	0



# DIAGNOSTICS AND ERROR HANDLING

## 7.1 Diagnostic LEDs

After switching on, the Bus Coupler immediately checks the connected configuration. Error-free start-up is indicated when the red I/O ERR LED goes out. If the I/O ERR LED blinks, an error in the area of the terminals is indicated. The error code can be determined from the frequency and number of blinks. This permits rapid rectification of the error.

The Bus Coupler has respectively a green and yellow LED at the RJ45 plug sockets, which indicate the state of the fieldbus. The RUN and ERROR LEDs (upper middle) indicate the state of the EtherCAT State Machine.

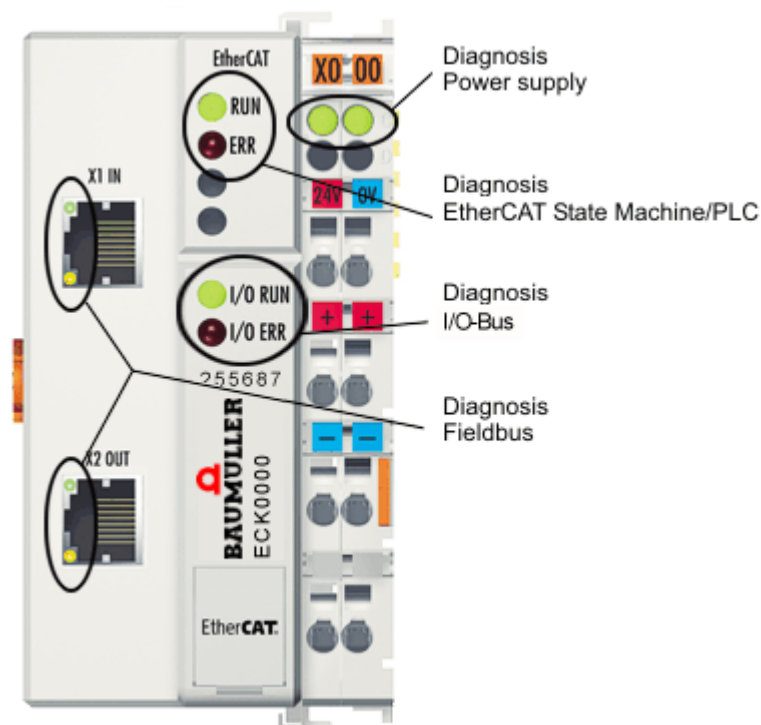


Figure 7:

## 7.1 Diagnostic LEDs

On the upper right hand side of the Bus Couplers are two more green LEDs that indicate the supply voltage. The left hand LED indicates the presence of the 24 V supply for the Bus Coupler. The right hand LED indicates the presence of the supply to the power contacts.

### 7.1.1 LEDs for power supply diagnosis

LED	Meaning
Left green LED off	Bus coupler has no power
Right green LED off	No 24 V DC power connected to the power contacts

### 7.1.2 LEDs for EtherCAT State Machine/PLC diagnosis

LED	Display	Status	Meaning	
RUN	green	off	Init	State of the EtherCAT State Machine: INIT = Initialization
		blinking	Pre-Operational	State of the EtherCAT State Machine: PREOP = Pre-Operational
		single flash	Safe-Operational	State of the EtherCAT State Machine: SAFEOP = Safe-Operational
		on	Operational	State of the EtherCAT State Machine: OP = Operational
		flashes	Bootstrap	State of the EtherCAT State Machine: BOOT = Bootstrap (Update of the coupler firmware)
ERROR	red	off	-	No errors
		blinking	Err-Operational No Communication	PLC error / Lost frames

### 7.1.3 LEDs for fieldbus diagnosis

LED	Display	Status	Meaning	
LINK (X1 IN)	yellow	off	-	no connection with the previous EtherCAT client
		on	linked	previous EtherCAT-client connected
ACT (X1 IN)	green	blinking	active	communication with the previous EtherCAT client
		off	-	no connection with the previous EtherCAT client
		on	-	no communication with the previous EtherCAT client

LED		Display	Status	Meaning
LINK (X2 OUT)	yellow	off	-	no connection with the next EtherCAT client
		on	linked	next EtherCAT client connected
ACT(X2 OUT)	green	blinking	active	communication with the next EtherCAT client
		off	-	no connection with the next EtherCAT client
		on	-	no communication with next previous EtherCAT client

#### 7.1.4 LEDs for I/O-Bus diagnosis

Error code	Error code argument	Description	Remedy
Persistent, continuous blinking		EMC problems	<ul style="list-style-type: none"> <li>• Check power supply for overvoltage or under-voltage peaks</li> <li>• Implement EMC measures</li> <li>• If a I/O-Bus error is present, it can be localised by a restart of the coupler (by switching it off and then on again)</li> </ul>
1 pulse	0	EEPROM checksum error	
	1	Code buffer overflow	Insert fewer Bus Terminals. The programmed configuration has too many entries in the table
	2	Unknown data type	Software update required for the Bus Coupler
2 pulses	0	Programmed configuration has an incorrect table entry	Check programmed configuration for correctness
	n (n > 0)	Table comparison (Bus Terminal n)	Incorrect table entry
3 pulses	0	I/O-Bus command error	<ul style="list-style-type: none"> <li>• No Bus Terminal inserted</li> <li>• One of the Bus Terminals is defective; halve the number of Bus Terminals attached and check whether the error is still present with the remaining Bus Terminals. Repeat until the defective Bus Terminal is located.</li> </ul>
4 pulses	0	I/O-Bus data error, break behind the Bus Coupler	Check whether the n+1 Bus Terminal is correctly connected; replace if necessary.
	n	Break behind Bus Terminal n	Check whether the Bus End Terminal EK0000 is connected.
5 pulses	n	I/O-Bus error in register communication with Bus Terminal n	Exchange the nth Bus Terminal

## 7.1 Diagnostic LEDs

---

Error code	Error code argument	Description	Remedy
14 pulses	n	nth Bus Terminal has the wrong format	Start the Bus Coupler again, and if the error occurs again then exchange the Bus Terminal
15 pulses	n	Number of Bus Terminals is no longer correct	Start the Bus Coupler again.
16 pulses	n	Length of the I/O-Bus data is no longer correct	Start the Bus Coupler again.

# 8

## APPENDIX

### 8.1 General Operating Conditions

---

The following conditions must be observed if the fieldbus components are to function without error.

#### 8.1.1 Environmental conditions

---

##### Operation

The components may not be used without additional protection in the following locations:

- in difficult environments, such as where there are corrosive vapors or gases, or high dust levels
- in the presence of high levels of ionizing radiation

Condition	Permissible range
Permissible ambient temperature range during operation	0°C ... +55°C
Permissible relative humidity during operation	95 %, no condensation
Installation position	variable
Vibration resistance	conforms to EN 60068-2-6
Shock resistance	conforms to EN 60068-2-27, EN 60068-2-29
EMC resistance burst	conforms to EN 61000-6-2
ESD emission	conforms to EN 61000-6-4

### Transport and storage

Condition	Permissible range
Permissible ambient temperature range during storage	-25 °C ... +85°C
Permissible relative humidity	95 %, no condensation
Free fall	up to 1 m in the original packaging

### Protection classes and types

Condition	Permissible range
Protection class in accordance with IEC 536 (VDE 0106, Part 1)	A protective conductor connection to the mounting rail is necessary!
Protection class according to IEC 529	IP20 (protection against contact with a standard test finger)
Protection against foreign objects	Less than 12 mm in diameter
Protection against water	No protection

## 8.2 Technical Data

Technical data	ECK000
Task in the EtherCAT-System	Coupling of I/O-Bus Terminals on 100BASE-TX EtherCAT networks
Number of I/O-Bus Terminals	64 (255 with I/O-Bus extension KVE000 and KVK000)
Digital peripheral signals	1020 inputs/outputs
Analog peripheral signals	128 inputs/outputs
Data transfer medium	Ethernet CAT-5 cable
Length between 2 modules	max. 100 m (100BASE-TX)
Protocols	EtherCAT (Direct mode)
Baud rate	100 MBaud
Configuration	Configuration software ProMaster
Bus connection	2 x RJ45 (for USA/Canada see UL requirements!)
Power supply	24 VDC (-15%/+20%) (for USA/Canada see UL requirements!)
Input current	70 mA + E-Bus current/4, max. 500 mA
I/O-Bus supply current up	max. 1750 mA

Technical data	ECK000
Power contacts	max. 24 VDC, maximal 10 A (for USA/Canada see UL requirements!)
Dielectric strength	500 V <sub>rms</sub> (power contact/supply voltage/Ethernet)
Weight	approx. 170 g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Dimensions (W x H x D)	approx. 49 mm x 100 mm x 70 mm
Mounting	on 35 mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	variable
Approvals	CE UL (see UL requirements!)

### 8.3 Product code

Bezeichnung / Name	Type	Product code		Art. no.
		Decimal	Hex	
CANopen Koppler / Coupler	CK0000	5150	<b>0x141E</b>	370880
EtherCAT Koppler / Coupler	ECK000	1120	<b>0x0460</b>	
2 DI	DI2000	1002	<b>0x03EA</b>	370882
4 DI	DI4000	1104	<b>0x0450</b>	381451
8 DI	DI8000	1408	<b>0x0580</b>	370883
2 DO	DO2000	2012	<b>0x07CD</b>	370884
4 DO	DO4000	2404	<b>0x0964</b>	381450
4 DO	DO4002	2114	<b>0x0842</b>	387769
8 DO	DO8000	2408	<b>0x0968</b>	370885
1 AI 0-10V	AI1010	3061	<b>0x0BF5</b>	381452
2 AI 0-10V	AI2010	3062	<b>0x0BF6</b>	370886
4 AI 0-10V	AI4010	3464	<b>0x0D88</b>	370887
2 AI -10V bis +10V	AI2±10	3002	<b>0x0BBA</b>	380675
4 AI -10V bis +10V	AI4±10	3404	<b>0x0D4C</b>	380676
2 AI 4-20mA	AI2420	3052	<b>0x0BEC</b>	370888
4 AI 4-20mA	AI4420	3454	<b>0x0D7E</b>	370889
2 AO -10V bis +10V	AO2±10	4032	<b>0x0FC0</b>	380677
4 AO -10V bis +10V	AO4±10	4434	<b>0x1152</b>	380678
2 AO 0-10V	AO2010	4002	<b>0x0FA2</b>	370890
4 AO 0-10V	AO4010	4404	<b>0x1134</b>	370891
2 AO 4-20mA	AO2420	4022	<b>0x0FB6</b>	370892
4 AO 4-20mA	AO4420	4424	<b>0x1148</b>	370893
End-Klemme / End Terminal	EK0000	9010	<b>0x2332</b>	370896
Einspeiseklemme / Power Supply 24VDC	ES0000	9100	<b>0x238C</b>	370897
I/O-Bus Verlängerung / Extension End	KVE000	9020	<b>0x233C</b>	370898
I/O-Bus Verlängerung / Extension Coupler	KVK000	9050	<b>0x235A</b>	370899
Zählerklemme / Incremental Encoder Interface	ZK0000	5101	<b>0x13ED</b>	370900





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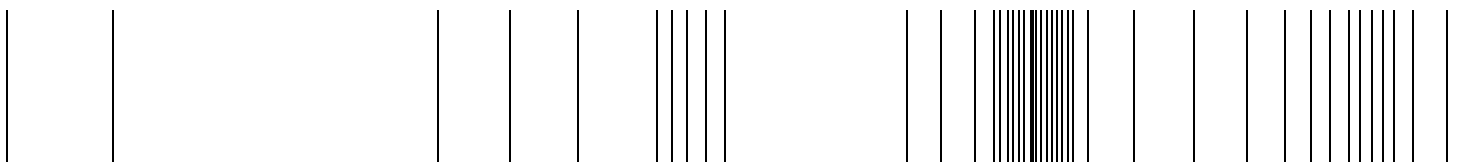


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