

EtherCAT®

CANopen®

## Kuhnke FIO I/O System

### System Manual

E 747 GB

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# 1 Preface

## 1.1 Legal Notice

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### Document History

#### Modification History

Date	Comments / Modifications
12.03.2024	New document structure created according to module groups

## 1.2 About this Manual

This technical information is primarily directed to system designers, project engineers and device developers. It does not contain any availability information. We reserve the rights for errors, omissions and modifications. Pictures are similar.

### 1.2.1 Limitation of Liability

Specifications are for description only and are not to be understood as guaranteed product properties in a legal sense. Exact properties and characteristics shall be agreed in the specific contract. Claims for damages against us – on whatever grounds – are excluded, except in instances of deliberate intent or gross negligence on our part.

### 1.2.2 Terms of Delivery

The general conditions of sales and service of Kendrion Kuhnke Automation GmbH shall apply.

### 1.2.3 Copyright

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The companies mentioned herein own the property rights in their company, product and trade names.

### 1.2.4 Licences

#### Firmware

The units' firmware contains open source software.

To find a list of the packages involved and their licences, run the unit's web interface and check the menu for item Home/Packages and Licenses.

Within three years of delivery, customers may buy the source code of the free software from Kendrion Kuhnke's product management at net costs.

#### CODESYS

Like all other CODESYS products, the CODESYS runtime version installed in this system is subject to CODESYS GmbH's end user licence agreement (EULA) as published on the CODESYS website.

### 1.2.5 Warranty

Warranty is subject to the provisions of the conditions of sale of Kendrion Kuhnke Automation GmbH or any contractual agreements between the parties.

## 1.3 Reliability, Safety

### 1.3.1 Applicability

For reasons of personal safety and to avoid material damages when working with or handling this Kendrion Kuhnke product, you are advised to take heed of the notes and information contained in this instruction manual.

### 1.3.2 Target Group of the Instruction Manual

This instruction manual contains all information necessary for the use of the described product (control unit, control terminal, software, etc.) according to instructions. It is written for design, project planning, servicing and commissioning experts. For proper understanding and error-free application of technical descriptions, instructions for use and particularly of notes of danger and warning, extensive knowledge of automation technology is compulsory.


### 1.3.3 Intended Use

Kendrion Kuhnke's products are designed, developed and manufactured for standard industrial use. They must not be used for any other purposes than the ones specified in the catalogue or the associated technical documentation. Proper and safe operation depends on the products being transported, stored, lined up, mounted, installed, put into service, operated, and serviced correctly. Ambient conditions must be within the admissible limits. Notes and information in the associated documentation apply at all times.

### 1.3.4 Transport and Storage

At times of transport and storage, protect the Kuhnke FIO Modules against inadmissible exposure such as mechanical stress, temperature, humidity and/or aggressive atmospheres. Keep and transport them in their original packaging if possible.

Verify that the contacts are neither soiled nor damaged when consigning the unit to stock or re-packaging it. Keep and transport the Kuhnke FIO modules in a container/packaging ensuring electrostatic discharge (ESD) compliance. Some parts of the units are sensitive to ESD and may be damaged if handled inappropriately. Thus, best transport practice is to place open assemblies in statically shielded transport bags with a metal coating which avoid contamination by amines, amides or silicone. When putting the Kuhnke FIO Safety modules into service and performing any maintenance, you should also take the appropriate ESD precautions.

	<b>CAUTION</b>
	<p><b><i>Electrostatic discharge</i></b>  <i>Destruction of or damage to the unit.</i></p> <ul style="list-style-type: none"> <li>⇒ <i>Transport and keep the FIO modules in their original packaging.</i></li> <li>⇒ <i>Ensure that the ambient conditions are as specified at all times during transport and storage (see supplement).</i></li> <li>⇒ <i>Handle the FIO modules in a well-earthed environment (persons, place of work, packaging).</i></li> <li>⇒ <i>Do not touch electrically conductive parts such as data contacts. Some of the electronic components may be destroyed if exposed to electrostatic discharge.</i></li> </ul>

### 1.3.5 Reliability

Reliability of Kendrion Kuhnke products is brought to the highest possible standards by extensive and cost-effective means in their design and manufacture.

These include:

- selecting high-quality components,
- quality agreements with our suppliers,
- actions to avoid static charges when handling MOS circuits,
- worst case planning and design of all circuits,
- visual inspections at various stages of fabrication,
- computer-aided tests of all assemblies and their interaction in the circuit,
- statistical assessment of the quality of fabrication and of all returned goods for the immediate taking of appropriate corrective actions.

### 1.3.6 Hazard and Other Warnings

Despite the actions described in section 0, the occurrence of faults or errors in electronic control units - even if most highly improbable - must be taken into consideration.





Please pay particular attention to the additional notices which we have marked by symbols throughout this instruction manual. While some of these notices make you aware of possible dangers, others are intended as a means of orientation. They are described further down below in descending order of importance.

Every alert and hazard warning is made up as follows:


**Type and source of risk**

*Potential consequences of non-observance*

⇒ Preventive measures


	<b>DANGER</b>
	<b><i>A DANGER warning makes you aware of an immediately hazardous situation which WILL cause a serious or fatal accident if not observed.</i></b>
	<b>WARNING</b>
	<b><i>A WARNING makes you aware of a potentially hazardous situation which MAY cause a serious or fatal accident or damage to this or other devices if not observed.</i></b>
	<b>CAUTION</b>
	<b><i>A CAUTION alert makes you aware of a potentially hazardous situation which MAY cause an accident or damage to this or other devices if not observed.</i></b>
	<b>NOTE</b>
	<b><i>A NOTE makes you aware of a potentially hazardous situation which MAY cause damage to this or other devices if not observed.</i></b>


### 1.3.7 Other Notices

	<b>Information</b>
	<i>This symbol draws your attention to additional information concerning the use of the described product. This may include cross references to information found elsewhere (e.g. in other manuals).</i>

### 1.3.8 Electrical Safety

Our products normally become part of larger systems or installations. The information below is intended to help you integrate the product into its environment without dangers to humans or material/equipment.

	<b>DANGER</b>
	<p><b>Non-observance of the instruction manual</b></p> <p><i>Measures for the prevention of dangerous faults or errors may be rendered ineffective or new hazard sources created.</i></p> <ul style="list-style-type: none"> <li>⇒ <i>Thoroughly read the instruction manual</i></li> <li>⇒ <i>Take particular heed of the hazard warnings</i></li> </ul>

	<b>Information</b>
	<i>To achieve a high degree of conceptual safety in planning and installing an electronic controller, it is essential to exactly follow the instructions given in the manual because wrong handling could lead to rendering measures against dangers ineffective or to creating additional dangers.</i>

### Project Planning

- 24 VDC power supply: generate as electrically safely separated low voltage. Suitable devices include split-winding transformers built in compliance with European Standard EN 60742 (corresponds to VDE 0551).
- Power breakdowns or power fades: the program structure is to ensure that a defined state at restart excludes all dangerous states.
- Emergency-off installations must comply with EN 60204/IEC 204 (VDE 0113). They must be operative at any time.
- Safety and precautions regulations for qualified applications have to be complied with.
- Please pay particular attention to the notices of warning which, at relevant places, will make you aware of possible sources of dangerous mistakes or faults.
- Relevant standards and VDE regulations are to be complied with in every case.
- Control elements are to be installed in such a way as to exclude unintended operation.
- Lay control cables such that interference (inductive or capacitive) is excluded if this interference could influence controller operation or its functionality.

### Maintenance and Servicing

- Precautions regulation BGV A3 (Elektrische Anlagen und Betriebsmittel) to be observed when measuring or checking a controller after power-up. This applies to section 8 (Admissible deviations when working on parts) in particular.
- Spare parts: Only use parts approved of by Kendrion Kuhnke. Only genuine Kendrion Kuhnke modules may be used in modular controllers.
- Modular systems: always plug or unplug modules in a power-down state. You may otherwise damage the modules or (possibly not immediately recognisably!) inhibit their functionality.




- Always dispose of (rechargeable) batteries as hazardous waste.

### 1.3.9 IT Security

Kendrion Kuhnke products are designed for use in closed (private) industrial network environments.

In case such industrial networks are open to public access (e.g. via fully accessible network interfaces) or otherwise externally accessible (e.g. via data links and public (Internet) traffic), the integrator and operator must take appropriate organisational and technical precautions to protect the in-house network and ensure IT security.

	<b>Information</b>
	<i>To find information about how to safely operate equipment, systems and networks, please refer to the texts published by BSI (Federal Office for Information Security), other publicly available sources and IEC 62443.</i>

### 1.3.10 CODESYS Security


Automation devices contain functional units that should be protected. These include the conventional control and regulation functions and algorithms but also the facility users' production and other data. Since there is no automation solution without faults, some potential weak points and causes of risks remain.


Whereas the main threat is from LAN networks, attackers may also use local interfaces.

Consider the following routes of attack:

- Interfaces (USB, LAN, WLAN, Bluetooth,.....)
- Services, drivers, protocols (RPC, HTTP(S),...)
- Authentication, encoding (compulsory registration, encrypted password)
- Physical access (closed rooms, cabinets)
- Third-party systems or personnel

Take every effort to avoid exposing the PLC and controller networks to open networks or the Internet. Safeguarding should include extra data link layers such as remote access via VPN as well as sophisticated firewalls. As a basic rule, you should disable or restrict the access to all interfaces you do not need. Segmentation (e.g. by a router with a firewall) may be another effective means of protection.

	<b>NOTE</b>
	<p><b><i>Unauthorised access to the computer</i></b></p> <p><i>Controller failure and data loss</i></p> <p>⇒ <i>Integration in networks granting public access requires the user to take appropriate measures aimed at preventing unauthorised access.</i></p>

	<b>NOTE</b>
	<p><b><i>Consider the security information issued and continuously updated by CODESYS at:</i></b></p> <p><b><i><a href="https://www.codesys.com/security">https://www.codesys.com/security</a></i></b></p>

### 1.3.11 Electromagnetic Compatibility


#### Definition

Electromagnetic compatibility is the ability of a device to function satisfactorily in its electromagnetic environment without itself causing any electromagnetic interference that would be intolerable to other devices in this environment.

Of all known phenomena of electromagnetic noise, only a certain range occurs at the location of a given device. It is defined in the relevant product standards.


The design and immunity to interference of programmable logic controllers are internationally governed by standard

IEC 61131-2 which, in Europe, has been the basis for European Standard EN 61131-2.

	<b>Information</b>
	<i>Refer to IEC 61131-4, User's Guideline, for general installation instructions to be complied with to ensure that hardware interface factors and the ensuing noise voltages are limited to tolerable levels.</i>

## Interfering Emission

Interfering emission of electromagnetic fields, HF  
compliant to EN 55011, limiting value class A, Group 1

	<b>Information</b>
	<i>If the controller is designed for use in residential areas, high-frequency emissions must comply with limiting value class B as described in EN 55011. Fitting the controller into earthed metal cabinets and installing filters in the supply lines may produce a shielding compliant to the above standard.</i>

## General Notes on Installation

Electronic control systems, if run as component parts of machines, facilities and systems, must comply with valid rules and regulations, depending on their field of application.

General requirements concerning the electrical equipment of machines and aiming at the safety of these machines are contained in Part 1 of European Standard EN 60204 (same as VDE 0113).

## Electrical Immission Safeguard

To eliminate electromagnetic interference, connect the control system to the protective earth conductor. Practice best cable routing.

## Cable Routing and Wiring

Keep power circuits separate from control circuits:

- DC voltages 60 V ... 400 V
- AC voltages 25 V ... 400 V

Joint laying of control circuits is allowed for:

- shielded data signals
- shielded encoder signals
- shielded analogue signals
- unshielded digital I/O lines
- unshielded DC voltages < 60 V
- unshielded AC voltages < 25 V



### **NOTE**

*In the case of EtherCAT data links, we recommend using Cat5e SF/UTP network cables. Do not use unshielded cables.*

## Location of Installation

Ensure that temperatures, contaminations, impact, vibration or electromagnetic interference are no impediment to the installation.

## Temperature

Consider heat sources such as general heating of rooms, sunlight, heat accumulation in assembly rooms or control cabinets.

## Contamination

Use suitable casings to avoid possible negative influences due to humidity, corrosive gas, liquid or conducting dust.

## Impact and Vibration

Consider possible influences caused by motors, compressors, transfer lines, presses, ramming machines and vehicles.

## Electromagnetic Interference

Consider electromagnetic interference from various local sources: motors, switching devices, switching thyristors, radio-controlled devices, welding equipment, arcing, switched-mode power supplies, converters / inverters.

## Particular Sources of Interference

### Inductive Actuators

Switching off inductances (such as from relays, contactors, solenoids or switching magnets) produces surge voltages. It is necessary to reduce these extra voltages to a minimum.

Reducing elements may be diodes, Z-diodes, varistors or RC elements. Their rating should conform to the specifications provided by the manufacturer or supplier of the actuators.

## 2 Technical Data

### 2.1 General Technical Data of the Kuhnke FIO I/O System

Function .....	modular I/O system
Fieldbus .....	EtherCAT
Signal indication .....	LED, local assignment to terminal
Housing.....	plastic housing with aluminium frame
Installation.....	35 mm mounting rail (EN 60715)
Protection .....	IP20
Shield connection .....	supports connection directly to the module
Dimensions (footprint / I/O modules):.....	25 x 120 x 190 [mm]
Dimensions (bus coupler with I/O) .....	37 x 120 x 190 [mm]
Ambient conditions	
Admissible temperature (operation) .....	0 ... 55 °C
Admissible temperature (storage) .....	-25 ... +85 °C
Admissible relative humidity .....	5...95 [%], non-condensing
Vibration / impact resistance .....	as per EN 60068-2-6/ EN 60068-2-27
EMC resistance / emission.....	as per EN 61000-6-2/ EN 61000-6-4

### 2.2 Module-specific Technical Data

Browse the product manuals for the module-specific data

## 3 Construction and Functionality

### 3.1 Brief Description

#### 3.1.1 Kuhnke FIO

Kuhnke FIO is a modular system equipped with I/O terminals and an EtherCAT fieldbus port. Every FIO I/O block comprises a bus coupler or a control unit plus various I/O modules that the process signals connect to. The EtherCAT protocol is retained right through to the last module. Safety I/O modules can be added to provide safety features as necessary. The distributed EtherCAT bus terminals are ready for modular extensions and support the connection of sensors and actuators in switching cabinets.



**Kuhnke FIO Controller 116 and several Kuhnke FIO I/O modules**

#### 3.1.2 EtherCAT® — Ethernet Control Automation Technology

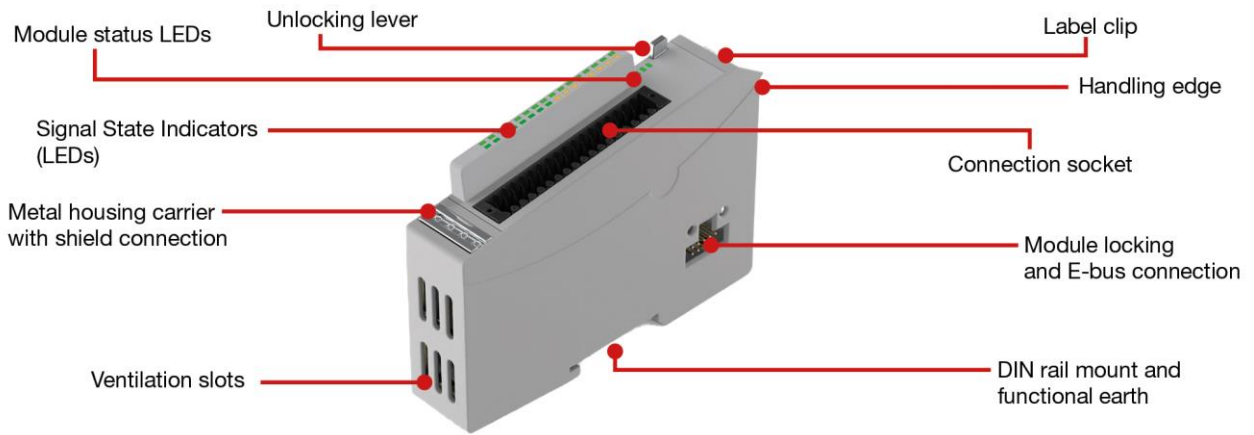
EtherCAT is the most powerful Ethernet-based fieldbus system currently available on the market. EtherCAT puts up the top speed mark, and its flexible topology and simple configuration make it the perfect means of controlling extremely fast processes. To give you a clue: 1000 I/Os can be addressed in 30  $\mu$ s.

Because of its high performance, the simple wiring and its open protocol support, EtherCAT is often used as a fast motion control and I/O bus driven by an industrial PC or in conjunction with control technology on a smaller scale. EtherCAT moves beyond the limits of conventional fieldbus systems. Its interconnections between the controller at one end and both the I/O modules and drives at the other are as fast as those of a backplane bus. EtherCAT controllers thus nearly act like centralised control systems, overcoming the issue of bus transfer times that conventional fieldbus systems are burdened with.

## 3.2 General View

The picture below shows the basic layout of the Kuhnke FIO modules.

The bus coupler and the I/O modules differ in their connectors and indicators, however.



**Mechanical design**

The housing mount consists of an aluminium profile with an integral snap-on device used to snap the module to a 35mm DIN rail. The housing trough including the optical fibres for the status indicators, the side face and the front is made of plastic and contains the module. The optical fibres for the signal state indicators (LEDs) are located next to the spring-assisted combi plug. They slightly protrude from the housing and allow a clear diagnosis at a glance.

## 3.3 Contents of Package


Contents of the Kuhnke FIO I/O Module package:

- Kuhnke FIO I/O module
- System connector

## 3.4 Connectors

Multi-connector plugs provide many connections in a tight space.

- Unlock buttons make it easier to unplug larger connectors where there is little space.
- Screw fittings reliably hold small connectors in place.

	<b>NOTE</b>
	<i>To avoid excessive force being exerted on the board or problems with the contacts, do not expose the connectors to inadmissibly high tension / pressure. One reason for too much pulling force is the wiring being too short.</i>

**Spring-assisted multiple socket connectors** support quick and easy wiring.

Single row

Tool: Screwdriver, 0.4 x 2.5 x 75 [mm] blade (DIN 5264-A)  
 Wires: 320 V / 10 A / 0.2 - 1.5 mm<sup>2</sup> (IEC)  
 Nominal current: 300 V / 10 A / 28 - 14 AWG (UL)

Supported wires with connector sleeves:

Connector sleeve type	Wire cross section [mm <sup>2</sup> ]						
	0.13	0.25	0.34	0.50	0.75	1	1.5
Connector sleeve w/ collar to DIN 46 228/4	8 / 10	8 / 10	8 / 10	8 / 10	10 / 12	10 / 12	
Connector sleeve w/o collar to DIN 46 228/1	8 / 10	8 / 10	8 / 10	8 / 10	8 / 10	8 / 10	8 / 10
Stripped end [mm] / sleeve length [mm]							


**The spring-assisted PUSH-IN connector** allows you to quickly attach the wires by direct insertion without any tools. Just insert the connector sleeve end of the stripped solid or fine wire in the correct opening.

Two rows:

Wires: 320V / 13.4 A / 0.14 - 1.5 mm<sup>2</sup> (IEC)  
 Nominal current: 300 V / 9.5 A / 26 - 16 AWG (UL)

Supported wires with connector sleeves:

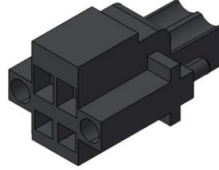
Connector sleeve type	Wire cross section [mm <sup>2</sup> ]						
	0.14	0.25	0.34	0.50	0.75	1	1.5
Connector sleeve w/ collar to DIN 46 228/4	8 / 10	8 / 10	8 / 10	10 / 12	12 / 14	12 / 15	
Connector sleeve w/o collar to DIN 46 228/1	10 / 10	10 / 10	10 / 10	10 / 10	10 / 10	10 / 10	10 / 10
Stripped end [mm] / sleeve length [mm]							

	<b>NOTE</b>
	<i>Do not connect the power supply lines through from one Kuhnke FIO to the next. To ensure that there is as little interference as possible, install a central power supply point and establish a star topology of as short wires as possible between the central point and Kuhnke FIO.</i>

### 3.4.1 Bus Coupler

The system power supply connects to the bus coupler through a 2-pole plug-type terminal block with a bolt flange. Since the bus coupler supplies power to both the E-bus and the logic circuits of the I/O modules, its power consumption depends on the number of I/O modules connected.

Power to the I/O module outputs is supplied separately.

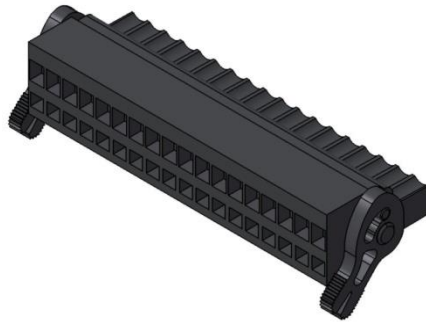


Spring-assisted plug with bolt flange for bus coupler connection

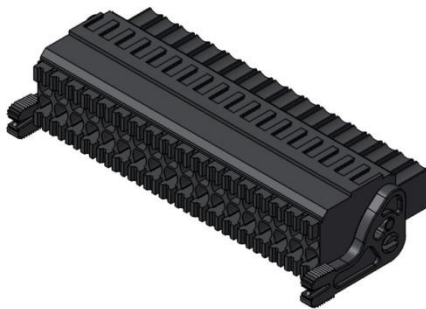


### 3.4.2 Modules with I/Os


The I/O supply connects to the I/O module using plug-type terminal blocks with different numbers of poles. The bus coupler supplies power to the logic circuits of I/O modules without their own micro-controller. Modules equipped with a micro-controller may feature a power supply unit that power is supplied to through the I/O connector.




Spring-assisted connector with I/O module unlock button



Two-row push-In connector with unlock button

	<b>NOTE</b>
	<p><i>Externally turning off the I/O power supply (L+) can be used to trip all outputs. In that case, LED Power indicates that no voltage is being supplied. Mind, though, that not all modules have a voltage watchdog to indicate the state to the control unit.</i></p> <p><i>To have your control program check whether power is supplied to the I/Os, connect L+ to a digital input and poll that input as an indirect indicator of the I/O power supply.</i></p>

Remember the following if you choose to do so:

	<b>NOTE</b>
	<p><i>Avoid any reverse feeding of outputs while the power supply to the outputs is turned off.</i></p>

This applies if the system is still supplied with power.

Outputs enabled by the user program may be supplied power via the protective diode of a reversely fed output, thus overriding the switch-off function of these outputs. Moreover, the protective diode of the feeding outputs may yield under high loads and be destroyed.

## 3.5 Indicators and Controls

### 3.5.1 LED "EtherCAT Run"

An LED labelled "EtherCAT Run" is located on both the bus coupler and the I/O modules. It indicates the state of the EtherCAT ASIC.

State	LED flash code	Explanation
Init	Off	Initialising, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	On	Operational, unrestricted data exchange
Bootstrap	Flickering	Optional if the bootstrap mode is supported

### 3.5.2 LED "IO"

Every I/O module has an LED labelled "IO". It indicates the state of the module's I/Os. Refer to the I/O module sections in this manual to know which states of a module are monitored and indicated.

### 3.5.3 LED "Power"

An LED labelled "Power" is located on every module that has a power supply connector (e.g. for digital outputs). It indicates the state of the I/O module's I/O power supply.

State	LED	Explanation
On	Green	24 VDC supply to I/Os (load) ok
Off	Off	24 VDC supply not ok

### 3.5.4 LED "In L/A", LED "Out L/A"

The "In L/A" and "Out L/A" LEDs are located on the bus coupler. They indicate the physical state of the Ethernet.

State	LED flash code	Explanation
Not connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing	Data traffic

## 4 Installation and Operation

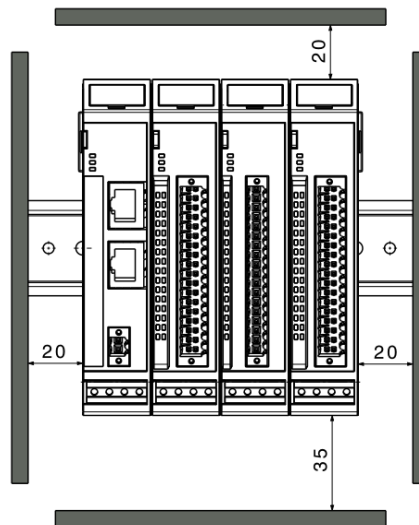
### 4.1 Generalities

This section explains how to install and operate the Kuhnke FIO I/O system.

For module-specific descriptions, refer to the product manuals of the applicable groups of or single modules.

### 4.2 Mounting Position

Mount with rail horizontally with the modules' multiple socket connectors pointing away from the wall. To ensure that enough air gets in through the ventilation slots, leave at least 20 mm to the top and 35 mm to adjacent devices or cabinet surfaces. Leave at least 20 mm of lateral distance to third-party units and cabinet surfaces.



#### Order of Modules in Multi-FIO Systems



#### **NOTE**

*In order to ensure that the entire FIO system works properly, arrange the FIO modules by their specific E-bus load, placing the modules with the highest E-bus load immediately next to the head module (bus coupler or controller). Take account of the head module's maximum bus load.*

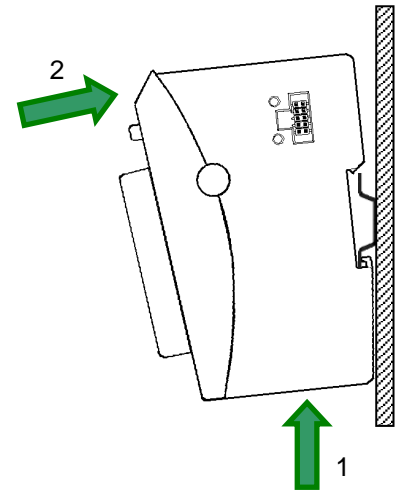
*If possible, place the Kuhnke FIO Safety I/O modules immediately next to the head module.*

## 4.3 Mechanical Installation

Kuhnke FIO I/Os mount on 35 mm x 7.5 mm rails as per DIN EN 50022.

### To Snap on a Single Module

1. Push up the module against the mounting rail from below, allowing the metal spring to snap in between mounting rail and mounting area as illustrated.
2. Push the top of the module against the mounting wall until it snaps in.




### To Interconnect Two Modules


- After snapping on the first module to the rail, snap on the second module about 1cm away towards the right of the first module.
- Push the second module along the rail towards the first module until you hear the locking device snap in.

## 4.4 Electrical Installation

A system connector supplies the Kuhnke FIO system with system power picked up from the E-Bus connector which receives it from an upstream bus coupler or a compact controller. This system power supply is used for the analysis circuitry and for bus communication only.

I/O power (if required) is supplied by the system connector.

	<b>Information</b>
	<i>Study the connector layout printed on the device before you install it in any electric circuitry.</i>

	<b>WARNING</b>
	<p><b>Potentially hazardous failures due to wrong voltages supplied</b></p> <p><i>Supplying the wrong voltages may damage or destroy the unit and may provoke potentially hazardous failures.</i></p> <p><i>Preventive measures:</i></p> <ul style="list-style-type: none"> <li>⇒ We recommend only using PELV/SELV-ready power supply units to EN50178 or EN60950-1 to supply 24 VDC to bus couplers or compact PLCs.</li> <li>⇒ Only use the GND terminal to connect the power supply unit to earth (PELV system). Do not use earthing variants that connect earth to +24V.</li> <li>⇒ Remember that, even in case of a fault, a maximum voltage of <math>U_{max.} &lt; 33 \text{ V}</math> may be supplied to these assemblies. Externally protecting the power supply unit is compulsory if you cannot exclude this risk.</li> <li>⇒ To ensure that there is as little interference as possible, install a central power supply point and establish a star topology of as short wires as possible between the central point and the block of FIO modules.</li> </ul>

### Earthing

Connect the Kuhnke FIO modules to earth by attaching the metal housing to functional earth.

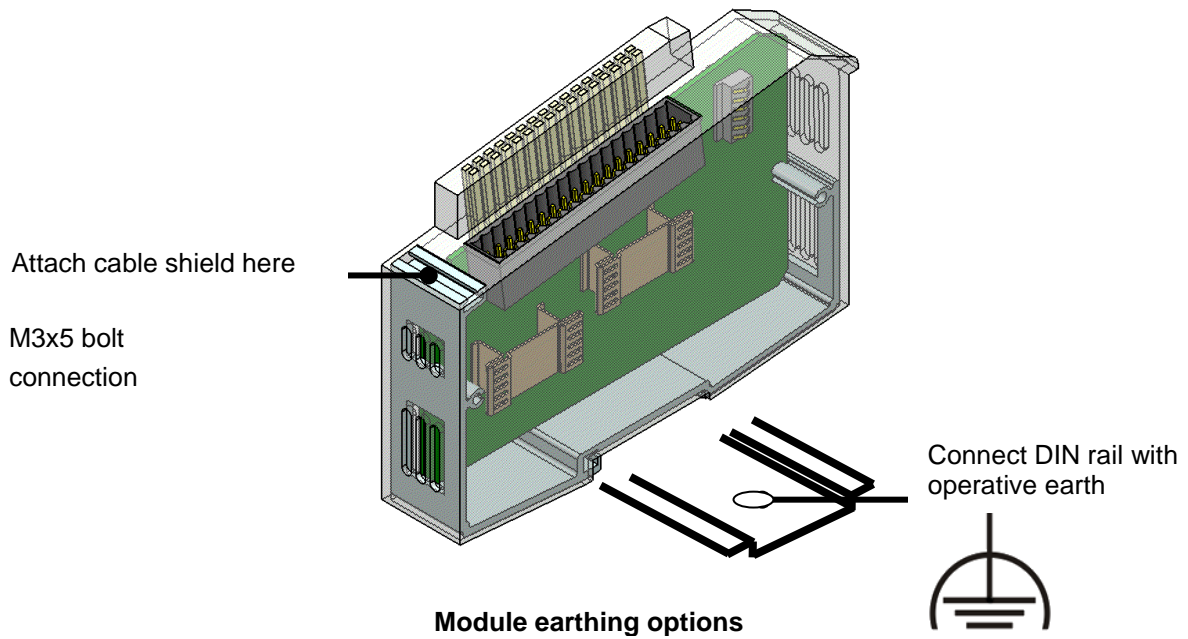
Since the functional earth connector dissipates HF currents, it is of utmost importance for the module's noise immunity.

HF interference is dissipated from the electronics board to the metal housing. The metal housing therefore needs to be suitably connected to a functional earth connector.

You will normally have to ensure that

- the connection between module housing and DIN rail conducts well,
- the connection between DIN rail and switching cabinet conducts well,
- the switching cabinet is safely connected to earth.

In special cases you may attach the earth wire straight to the module.



**Information**

Earth wires should be short and have a large surface (copper mesh). Refer to [https://en.wikipedia.org/wiki/Chassis\\_ground](https://en.wikipedia.org/wiki/Chassis_ground) or a similar source for further details

## 4.5 Operation

Following mechanical and electrical installation, you can start using your Kuhnke FIO I/O system.


Operation requires the presence of any EtherCAT master. Do not turn on the power supply until you have connected your EtherCAT master to a Kuhnke FIO I/O block.

The EtherCAT master will set the parameters of the Kuhnke FIO I/O modules according to type and render the modules ready to operate afterwards. In this state, you can pick up signals or address the actuators.

## 4.6 Maintenance and Servicing

### 4.6.1 General

Only qualified persons are allowed to work on Kuhnke FIO I/O systems.

	<b>CAUTION</b>
	<p><b><i>Wrong or excessive supply voltage</i></b> <i>Electric shock hazard</i></p> <p>⇒ Do not plug, mount, unplug or touch the connectors during operation! You may otherwise provoke destruction or malfunction. Turn off all power sources before working on the unit. This also applies to any peripherals connected such as encoders, programming devices with external power source, etc.</p>

### 4.6.2 Servicing

The Kuhnke FIO I/O system requires neither servicing for the specified service life nor any action if it is kept and operated at the admissible ambient conditions specified in section Technical Data.

## 4.7 Removal and Disposal

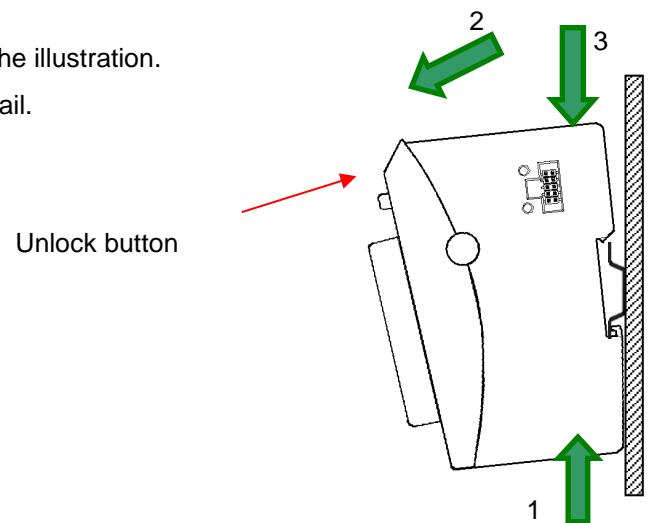
### 4.7.1 Removal

#### To Disconnect Two Modules

- Push down the unlock button of the module that you wish to disconnect from the module to the left of it.
- With the button still pressed, push both modules away from one another until they are about 1 cm apart.

#### To Take Down a Single Module

1. Push the module up and against the metal spring located on the underside of the rail guide.
2. Tip the module away from the rail as shown in the illustration.
3. Pull the module down and out of the mounting rail.



### 4.7.2 Disposal

Disposal requires the device to be disassembled and entirely taken apart. All metal components can be given to metal recycling.

Sort and dispose of electronic components by type. For details on proper disposal please check your national laws and regulations making sure that your method of disposal complies with them.

Treat the packaging as recyclable paper and cardboard.



## 5 Appendix

### 5.1 Breakdown of Kendrion Kuhnke FIO Products

<a href="#">Link to the Product Finder</a>	Part no.	ID no.	Power / I/O connector
<b>Control Units</b>			
<a href="#">Kuhnke FIO Controller 113</a>	694.300.13	178.445	3-pin, 10-pin
<a href="#">Kuhnke FIO Controller 116</a>	694.xxx.16.00x		3-pin, 10-pin
<b>Bus Couplers / Extenders</b>			
<a href="#">Kuhnke FIO Bus Coupler</a>	694.400.00	182.633	2-pin
<a href="#">Kuhnke FIO Bus Coupler DI16/DO16</a>	694.400.10	184.111	36-pin
<a href="#">Kuhnke FIO Bus Coupler DI8/DO8</a>	694.400.08	192.874	18-pin
<a href="#">Kuhnke FIO Bus Coupler DI8/DO4</a>	694.400.04	193.512	18-pin
<a href="#">Kuhnke FIO 1-port Extender</a>	694.440.01	196.942	none
<a href="#">Kuhnke FIO 2-port Extender</a>	694.440.02	182.673	none
<b>Digital FIO Modules</b>			
<a href="#">Kuhnke FIO DI16/DO16 1ms/0.5A</a>	694.450.03	182.642	36-pin
<a href="#">Kuhnke FIO DI16/DO16 5ms/0.5A</a>	694.450.01	182.643	36-pin
<a href="#">Kuhnke FIO DI16/DO16 LS 1ms/0.5A</a>	694.450.13	182.641	36-pin
<a href="#">Kuhnke FIO DI16/DO8 1ms/1A</a>	694.450.02	176.617	36-pin
<a href="#">Kuhnke FIO DI8/DO8 5ms/0.5A</a>	694.450.04	182.638	18-pin
<a href="#">Kuhnke FIO DI8/DO8 1ms/0.5A</a>	694.450.05	182.637	18-pin
<a href="#">Kuhnke FIO DI16 1ms</a>	694.451.03	182.639	18-pin
<a href="#">Kuhnke FIO DI16 2-Wire</a>	694.451.43	196.425	36-pin
<a href="#">Kuhnke FIO DI16 2-Wire GI</a>	694.451.44	198.500	36-pin
<a href="#">Kuhnke FIO DI32 1ms</a>	694.451.02	182.644	36-pin
<a href="#">Kuhnke FIO DO8 1A</a>	694.452.02	176.618	18-pin
<a href="#">Kuhnke FIO DO8 2A</a>	694.452.06	190.485	18-pin
<a href="#">Kuhnke FIO DO16 0.5A</a>	694.452.01	182.646	18-pin
<a href="#">Kuhnke FIO DO16 2-Wire</a>	694.452.41	196.429	36-pin
<a href="#">Kuhnke FIO DO8 Relay NO 24V</a>	694.452.03	184.720	18-pin
<a href="#">Kuhnke FIO DO8 Relay NO 230VAC</a>	694.452.04	187.657	18-pin
<b>Analogue FIO Modules</b>			
<a href="#">Kuhnke FIO AI4, 12-Bit / AO4, 16-Bit</a>	694.444.65	192.357	36-pin
<a href="#">Kuhnke FIO AO4, 16-Bit</a>	694.442.52	183.564	18-pin
<a href="#">Kuhnke FIO AO4, 12-Bit</a>	694.442.02	182.632	18-pin
<a href="#">Kuhnke FIO AI4-I 12-Bit CoE</a>	694.441.51	184.919	18-pin
<a href="#">Kuhnke FIO AI8-I 12-Bit CoE</a>	694.441.54	183.279	36-pin
<a href="#">Kuhnke FIO AI4/8-U 13-Bit CoE</a>	694.441.52	184.920	18-pin

<a href="#">Link to the Product Finder</a>	Part no.	ID no.	Power / I/O connector
<a href="#">Kuhnke FIO AI8/16-U 13-Bit CoE</a>	694.441.53	184.921	36-pin
<a href="#">Kuhnke FIO AI4-Pt/Ni/TC CoE</a>	694.443.57	184.894	18-pin
<a href="#">Kuhnke FIO AI8-Pt/Ni/TC CoE</a>	694.443.58	184.895	36-pin
Counter / Posi / Drive / CAM Modules			
<a href="#">Counter2 5V</a>	694.444.01	182.634	36-pin
<a href="#">Kuhnke FIO Counter/Posi2 5V</a>	694.454.01	182.636	36-pin
<a href="#">Kuhnke FIO Counter / Encoder CoE</a>	694.454.53	192.359	36-pin
<a href="#">Kuhnke FIO OC Counter / Encoder</a>	694.434.53	197.674	36-pin
<a href="#">Kuhnke FIO Drive Control</a>	694.454.16.00	196.876	36-pin
<a href="#">Kuhnke FIO Stepper Control 3 Axes</a>	694.454.56	192.867	36-pin
<a href="#">Kuhnke FIO CAM Control</a>	694.444.11	186.682	36-pin
Mixed I/O Modules			
<a href="#">Kuhnke FIO MIX 02 CoE</a>	694.444.62	176.215	36-pin
<a href="#">Kuhnke FIO MIX 04 CoE</a>	694.444.64	192.358	36-pin
Communication Modules			
<a href="#">Kuhnke 1-port FIO RS485</a>	694.455.02	187.270	18-pin
<a href="#">Kuhnke 2-port FIO RS232</a>	694.455.04	185.725	18-pin
<a href="#">Kuhnke FIO CAN</a>	694.455.06	187.272	18-pin
Safety Modules			
<a href="#">Kuhnke FIO Safety PLC</a>	694.330.00	178.779	none
<a href="#">Kuhnke FIO Safety SDI4/SDO2</a>	694.430.00	186.696	18-pin
<a href="#">Kuhnke FIO Safety SDI8/SDO2</a>	694.430.10	188.895	18-pin
<a href="#">Kuhnke FIO Safety SDI16/SDO4</a>	694.430.20	192.405	36-pin
<a href="#">Kuhnke FIO Safety SDI16</a>	694.431.00	192.406	36-pin

## 5.2 Breakdown of Kuhnke FIO Accessories

<a href="#">Link to the Product Finder</a>	Part no.	ID no.	Connectors
Kuhnke FIO Power Distributor			
<a href="#">Kuhnke FIO Power Distributor 2x16</a>	694.411.00	155.915	36-pin
Kuhnke FIO Shield Terminal			
<a href="#">Kuhnke FIO Shield Terminal 2x8 mm</a>	694.412.03	196.445	no
<a href="#">Kuhnke FIO Shield Terminal 1x14 mm</a>	694.412.04	196.446	no
<a href="#">Kuhnke FIO Shield Terminal 4x8 mm</a>	694 412 05	196.448	no
<a href="#">Kuhnke FIO Shield Terminal 2x14 mm</a>	694 412 06	197.524	no

## 5.3 Kuhnke FIO — Ventura FIO

Regular product update cycles include successive revisions of the Ventura FIO modules since 2014. Revisions focused on improving the ESD properties and ensuring conformity with the guidelines of ETG (power engineering association of VDE). The revised modules are therefore referred to Kuhnke FIO or FIO V2.

Kuhnke FIO and Ventura FIO are compatible if they share the same order number. If so they are interchangeable without having to modify the control programs.

Ventura FIO modules are controlled by a wide process model map.

Kuhnke FIO modules equipped with a controller such as the analogue modules are available as variants compatible with the process map control methodology of the Ventura FIO modules or as object-controlled variants (CoE - CAN over EtherCAT).

The module descriptions in this manual will make readers aware of exceptions such as the signal range of the AO4 module.

The table below lists the visible differences between Ventura FIO and Kuhnke FIO.

Feature	Ventura FIO	Kuhnke FIO
Production date		2014, successively
Design	green dot	no dot
Module lock	green	grey
Unlock button (connector)	green	black
LED label	EtherCAT	EtherCAT Run
EtherCAT LED	green/red	green/off
LED label (RJ45)	In, Out	In L/A, Out L/A
Module control	process image	process image
		CoE
Process signal plug	extra	included
	green unlock button (including 2-pole)	black unlock button (2-pole: screw-type)
	spring return (36-pole)	push-in (36-pole)

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