

EtherCAT®

CANopen®

Kuhnke FIO I/O System

Product Manual: System Coupler

E 747 GB

12.03.2024

Table of Contents

- 1 Preface 3
 - 1.1 Legal Notice..... 3
 - 1.2 About this Manual..... 3
- 2 System Coupler 4
 - 2.1 Generalities 4
 - 2.1.1 Numeric Values 4
 - 2.2 Bus Coupler 5
 - 2.2.1 Terminals..... 5
 - 2.2.2 Status LEDs 6
 - 2.2.3 Process Data Objects 6
 - 2.2.4 Technical Data 6
 - 2.3 Bus Coupler DI16/DO16..... 7
 - 2.3.1 Terminals..... 7
 - 2.3.2 Status LEDs 8
 - 2.3.3 Process Data Objects 8
 - 2.3.4 Technical Data 9
 - 2.4 Bus Coupler DI8/DO8..... 10
 - 2.4.1 Terminals..... 10
 - 2.4.2 Status LEDs 11
 - 2.4.3 Process Data Objects 11
 - 2.4.4 Technical Data 12
 - 2.5 1-port Extender..... 13
 - 2.5.1 Terminals..... 13
 - 2.5.2 Status LEDs 14
 - 2.5.3 Process Data..... 14
 - 2.5.4 Technical Data 14
 - 2.6 Two-port Extender 15
 - 2.6.1 Terminals..... 15
 - 2.6.2 Status LEDs 16
 - 2.6.3 Process Data..... 16
 - 2.6.4 Technical Data 16
- 3 Appendix..... 17
 - 3.1 Order Data..... 17
 - 3.1.1 Modules..... 17
 - 3.1.2 Accessories..... 17

1 Preface

1.1 Legal Notice

Contact Details

Kendrion Kuhnke Automation GmbH
Industrial Control Systems
Lütjenburger Str. 101
D-23714 Malente
Germany

Support (phone) +49 4523 402-300
Support (email) controltechnology-ics@kendrion.com
Switchboard +49 4523 402-0
Sales (email) sales-ics@kendrion.com
Internet www.kendrion.com

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.

2 System Coupler


2.1 Generalities


System couplers are a group of devices that includes all Kuhnke FIO bus couplers and Kuhnke FIO extenders.

A bus coupler is required to integrate Kuhnke FIO I/O modules in an EtherCAT network. The bus coupler converts the communication signals from Ethernet-100BASE-TX format to the E-Bus format (LVDS). It also supplies power to the E-Bus.

An extender is needed to link further EtherCAT slaves to a FIO Controller, for example. The extender converts the communication signals from E-Bus format to Ethernet-100BASE-TX format. It also provides the option of configuring an EtherCAT network as a star topology.

- To interconnect your EtherCAT devices, only use category 5 Ethernet cables (Cat.5e SF/UTP) pursuant to EN 50173 or ISO/IEC 11801.
- Owing to the automatic cable detection feature (auto crossing) you can interconnect EtherCAT devices by both symmetrical (1:1) and crossover cables.
- Up to 100 metres length of cable are allowed between any two EtherCAT devices.

	Information
	<p><i>Torsional and permanent tensile stress near the Ethernet cable connector strain the connections. An Ethernet connector with too much play and insufficient guidance in its socket will provoke tipping in the plug connections which often causes contact and, thus, fieldbus interruptions.</i></p> <p><i>Vibration tests show that the robustness of a connection increases with the depth of plugging the connector into the socket. Mechanical requirements of vibration and impact resistance are commonly known to be stricter in industrial environments than in IT environments.</i></p> <p><i>Depending on the manufacturer and system, the plugging depths of commercially available connectors vary from about 8 mm to almost 12 mm and are rated at about 9 mm for standard connectors. According to manufacturer specifications, connectors designed for industrial environments have a plugging depth of up to 11.8 mm.</i></p>

	Information
	<p><i>Best noise emission results are obtained by connecting the shield of the EtherCAT cable to operative earth.</i></p> <p><i>One good way of doing so is using one of our FIO shield terminals</i></p>

2.1.1 Numeric Values

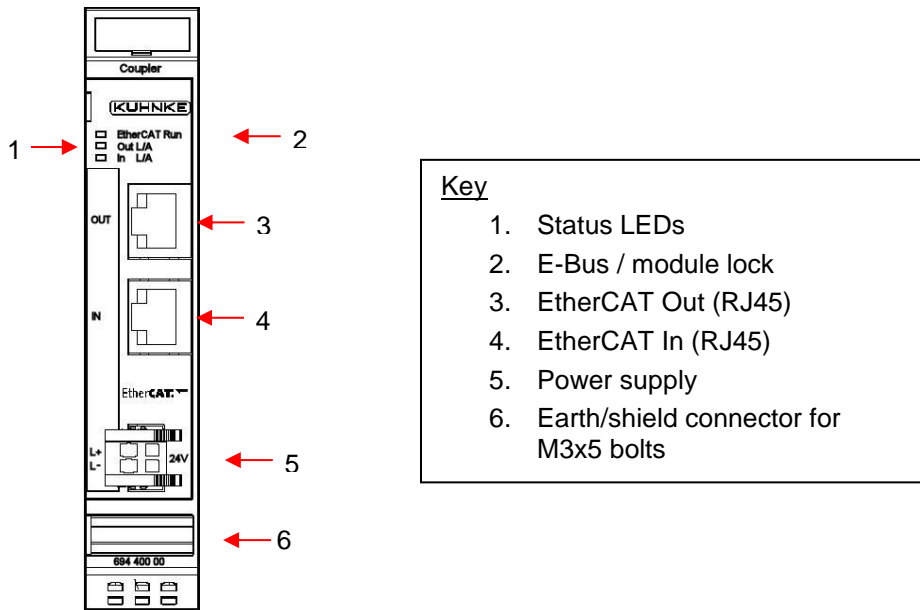
As a general rule, numeric values are shown as decimals.

A prefixed 0x marks hexadecimal values (example: 0xFFFF)

A prefixed 0b marks binary values (example: 0b01010011)

Objects from the object dictionary generally show as hexadecimal value.

2.2 Bus Coupler



2.2.1 Terminals

Coupler power supply (bus coupler to logic circuitry)

L+ 24 VDC

L- 0 V

EtherCAT

IN female RJ45 input (from upstream EtherCAT station)

OUT female RJ45 output (to downstream EtherCAT station)

E-Bus 10-pole pin strip for directly connecting other Kuhnke FIO modules

2.2.2 Status LEDs

LED "EtherCAT Run":

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	Green, on	Operational, unrestricted data exchange

LED "L/A" (Link/Activity)

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

2.2.3 Process Data Objects

Variable	Data type	Explanation
Undervoltage	BOOL	Undervoltage: voltage < 19.2 V

2.2.4 Technical Data

Function Connects a 100 Base-TX EtherCAT with the Kuhnke FIO I/O modules
 Generates the E-Bus system voltages (LVDS)

EtherCAT slave controller..... ASIC ET1100

Baud rate 100 Mbit/s

Cable type..... CAT5

Cable length max. 100 m between 2 bus couplers

EtherCAT connector (In/Out)..... 2 x RJ45

Power supply 24 VDC (-15% ... +20%)

Power connector..... male 2-pole connector (included in module package)

Input current 50 mA & E-bus plus

E-bus connector (Out) 10-pole system plug in side wall

E-bus power max. 3 A (approx. 20 modules)

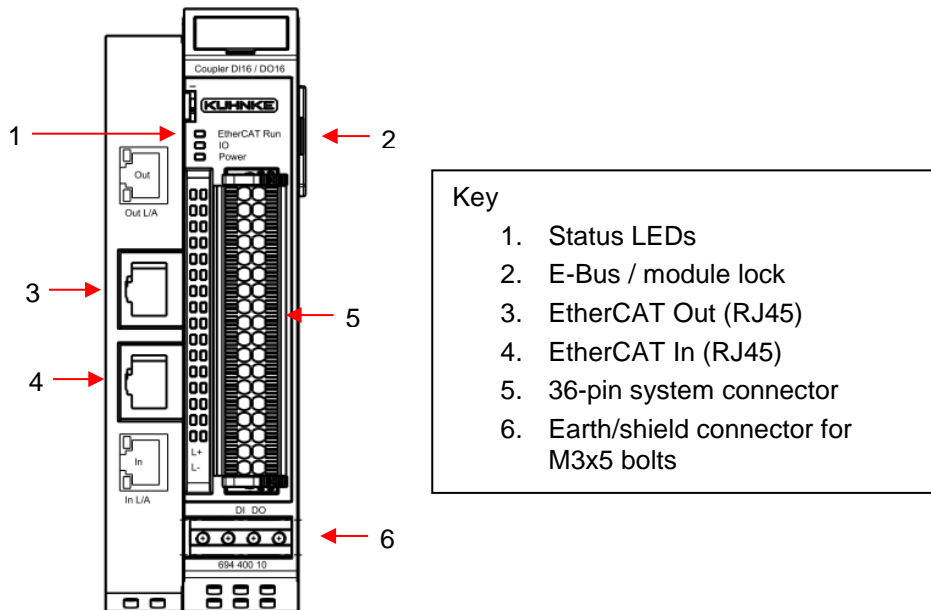
E-bus load..... 195 mA

Part no. 694.400.00



Permits:.....

2.3 Bus Coupler DI16/DO16



2.3.1 Terminals

Coupler power supply (bus coupler to logic circuitry)

L+ (left row of pins of system connector) 24 VDC

L- (left row of pins of system connector) 0 V

I/O Power Supply (Load)

L+ (right row of pins of system connector) 24 VDC

L- (right row of pins of system connector) 0 V

	NOTE
<p><i>Use both 24 V connectors to sustain all function of bus couplers featuring digital inputs and outputs.</i></p> <p><i>The left side supplies voltage to the logic circuitry (coupler), the right side to the I/Os (load)</i></p>	

EtherCAT

Female IN RJ45 input (from previous EtherCAT station)

Female OUT RJ45 output (to next EtherCAT station)

E-Bus 10-pole pin strip for directly connecting other Kuhnke FIO modules

Digital Inputs

Left row of pins of system connector, pins 0... 15

Digital Outputs

Right row of pins of system connector, pins 0... 15

	NOTE
<p><i>The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. In case the short circuit prevails, the outputs are allowed to cool down to be turned back on until the thermal fuse blows again.</i></p>	

2.3.2 Status LEDs

LED "EtherCAT Run":

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	Green, on	Operational, unrestricted data exchange

LED "IO"

State	LED	Explanation
Ok	Off	No error
SC	Red, flashing	Short-circuited digital output

LED "Power"

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

LED "L/A" (Link/Activity), EtherCAT In / Out

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

2.3.3 Process Data Objects

Variable	Data type	Explanation
undervoltage_load	BOOL	Undervoltage: load voltage < 19.2 V
undervoltage_logic	BOOL	Undervoltage: logic circuitry voltage < 19.2 V
ShortcutOutput	BOOL	Overload / short circuit: digital outputs
DigitalOutput0 ... DigitalOutput15	BOOL	Digital outputs 0 ... 15
DigitalInput0 ... DigitalInput15	BOOL	Digital inputs 0 ... 15

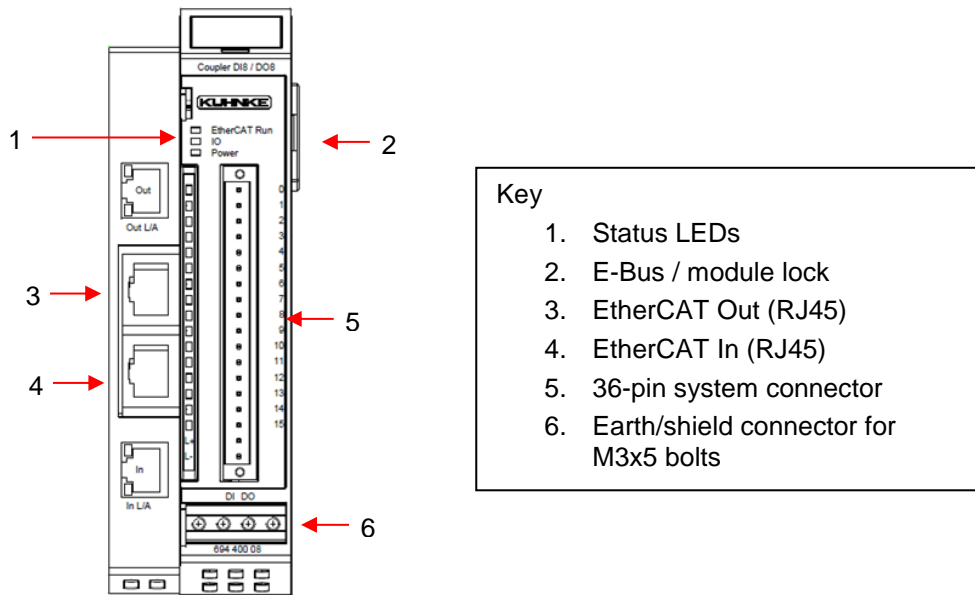
2.3.4 Technical Data

Function	Connects a 100 Base-TX EtherCAT with the Kuhnke FIO I/O modules	
	Generates the E-Bus system voltages (LVDS) IO module	
EtherCAT slave controller.....	ASIC ET1100	
Baud rate	100 Mbit/s	
Cable type.....	CAT5	
Cable length	max. 100 m between 2 bus couplers	
EtherCAT connector (In/Out).....	2 x RJ45	
Power supply	24 VDC (-15% ... +20%)	
I/O/Power connector	36-pole connector (included in module package)	
Input current	40 mA & E-bus plus	
E-bus connector (Out)	10-pole system plug in side wall	
E-bus power	max. 2 A (approx. 11 modules)	
Digital inputs	16	
Rising delay	3 ms (typically)	
Signal level	Off: -3V ... 5V	(EN 61131-3, type 1)
	On: 15V ... 30V	
Digital outputs	16	
Max. current.....	0.5 A each	
Max. total current.....	8 A	
Part no.	694.400.10	

Permits:.....




2.4 Bus Coupler DI8/DO8



2.4.1 Terminals

Power Supply to Coupler and I/Os (Logic Circuitry and Load)

L+ 24 VDC

L- 0 V

EtherCAT

Female IN RJ45 input (from previous EtherCAT station)

Female OUT RJ45 output (to next EtherCAT station)

Digital Inputs

System connector pins 0 ... 7

Digital Outputs

System connector pins 8 ... 15



NOTE

The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. In case the short circuit prevails, the outputs are allowed to cool down to be turned back on until the thermal fuse blows again.

2.4.2 Status LEDs

LED "EtherCAT Run":

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	Green, on	Operational, unrestricted data exchange

LED "IO"

State	LED	Explanation
Ok	Off	No error
SC	Red, flashing	Short-circuited digital output

LED "Power"

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

LED "L/A" (Link/Activity), EtherCAT In / Out

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

2.4.3 Process Data Objects

Variable	Data type	Explanation
Undervoltage	BOOL	Undervoltage: load voltage < 19.2 V
ShortcutOutput	BOOL	Overload / short circuit: digital outputs
DigitalOutput0 ... DigitalOutput7	BOOL	Digital outputs 0 ... 7
DigitalInput8 ... DigitalInput15	BOOL	Digital inputs 0 ... 8

2.4.4 Technical Data

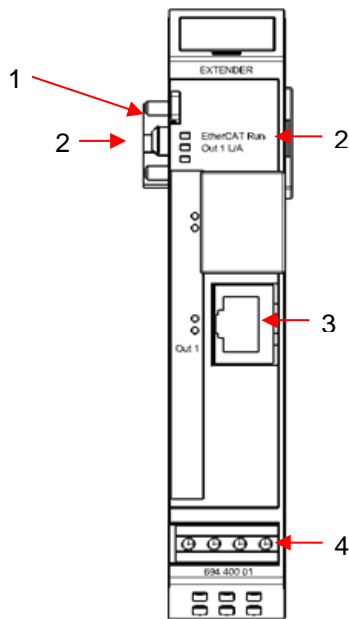
Function	Connects a 100 Base-TX EtherCAT with the Kuhnke FIO I/O modules
	Generates the E-Bus system voltages (LVDS) IO module
Controller	ASIC ET1100
Baud rate	100 Mbit/s
Cable type.....	CAT5
Cable length	max. 100 m between 2 bus couplers
EtherCAT connector (In/Out).....	2 x RJ45
Power supply	24 VDC (-15% ... +20%)
I/O/Power connector	18-pole connector (included in module package)
Input current	40 mA & E-bus plus
E-bus connector (Out)	10-pole system plug in side wall
E-bus power	max. 2 A (approx. 11 modules)
Digital inputs	8
Rising delay	3 ms (typically)
Signal level	Off: -3V ... 5V (EN 61131-3, type 1)
	On: 15V ... 30V
Digital outputs.....	8
Max. current.....	0.5 A each
Max. total current.....	4 A

Part no. 694.400.08



Permits:.....

2.5 1-port Extender



Key

1. Status LEDs
2. E-Bus / module lock
3. EtherCAT Out 1 (RJ45)
4. Earth/shield connector for M3x5 bolts

2.5.1 Terminals

EtherCAT

Out1 Female RJ45 output 1 (to next EtherCAT station)

E-Bus In Female 10-pole connector for directly connecting other Kuhnke FIO modules

E-Bus Out 10-pole pin strip for directly connecting other Kuhnke FIO modules

2.5.2 Status LEDs

LED "EtherCAT Run":

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	Green, on	Operational, unrestricted data exchange

LED Out 1 "L/A" (Link/Activity), EtherCAT Out

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

2.5.3 Process Data

None

2.5.4 Technical Data

Function Extends a Kuhnke FIO block or a Kuhnke FIO Controller
 Converts the physical transfer technology
 from LVDS (E-Bus) to 100Base-TX.

EtherCAT slave controller..... ASIC ET1100

Baud rate 100 Mbit/s

Cable type..... CAT5

Cable length max. 100 m

EtherCAT port..... 1x RJ45

Power supply Via E-bus

E-bus connector 10-pole system plug in side wall

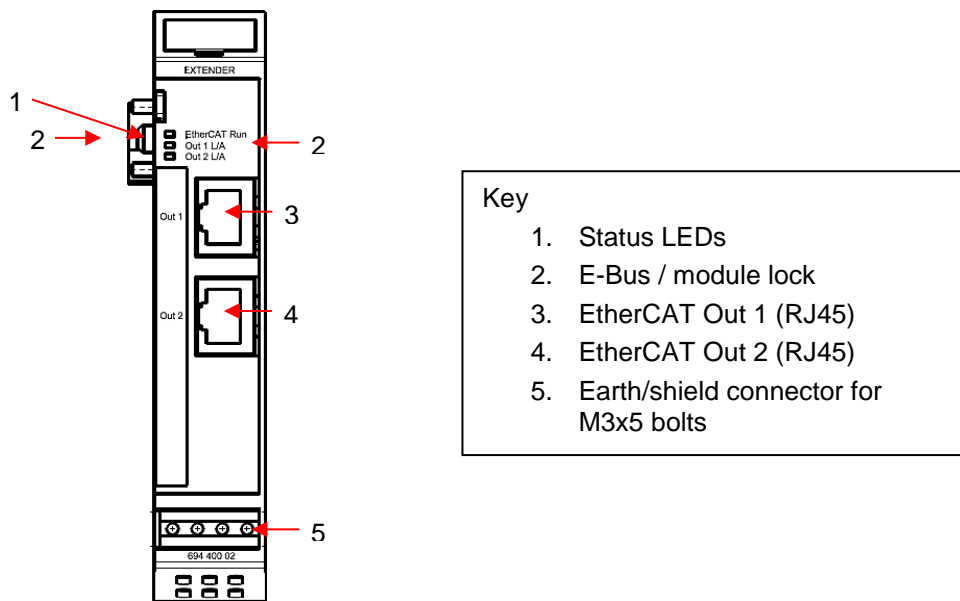
E-bus load..... 160 mA

Part no. 694.400.01



Permits:.....

2.6 Two-port Extender



2.6.1 Terminals

EtherCAT

Out1 Female RJ45 output 1 (to next EtherCAT station)

Out2 Female RJ45 output 1 (to next EtherCAT station)

E-Bus In Female 10-pole connector for directly connecting other Kuhnke FIO modules

E-Bus Out 10-pole pin strip for directly connecting other Kuhnke FIO modules

2.6.2 Status LEDs

LED "EtherCAT Run":

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	Green, on	Operational, unrestricted data exchange

LED Out 1 "L/A" and Out 2 "L/A" (Link/Activity), EtherCAT Out

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

2.6.3 Process Data

None

2.6.4 Technical Data

Function	Extends a Kuhnke FIO block or a Kuhnke FIO Controller Converts the physical transfer technology from LVDS (E-Bus) to 100Base-TX.
EtherCAT slave controller.....	ASIC ET1100
Baud rate	100 Mbit/s
Cable type.....	CAT5
Cable length	max. 100 m
EtherCAT port.....	2x RJ45
Power supply	Via E-bus
E-bus connector	10-pole system plug in side wall
E-Bus load	160 mA (Out1) / 210 mA (Out1+Out2)
Part no.	694.400.02



Permits:.....

3 Appendix

3.1 Order Data

3.1.1 Modules

Kuhnke FIO Bus Coupler.....	694 400 00 / 182633
Kuhnke FIO Bus Coupler DI16 / DO16	694 400 10 / 184111
Kuhnke FIO Bus Coupler DI8 / DO8	694 400 08 / 192874
Kuhnke FIO 1-port Extender	694 400 01 / 196942
Kuhnke FIO 2-port Extender	694 400 02 / 182647

3.1.2 Accessories

Kuhnke FIO Shield Terminal 2x8mm	694 412 03 /
Kuhnke FIO Shield Terminal 1x14mm	694 412 04 /
Kuhnke FIO Shield Terminal 4x8mm	694 412 05 /
Kuhnke FIO Shield Terminal 2x14mm	694 412 06 /

Kendrion Kuhnke Automation GmbH
Industrial Control Systems

Lütjenburger Str. 101
D-23714 Malente

Tel.: +49 4523 402 0
Fax: +49 4523 402 201

sales-ics@kendrion.com
www.kendrion.com