BECKHOFF New Automation Technology

Documentation | EN

IL230x-B905

Fieldbus Box for EtherNet/IP

2022-03-24 | Version: 1.1.0

Table of contents

1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

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1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Document Issue Status

Version	Comment
1.1.0	• Chapter *EthernetIP Tag Wizard* added • Chapter *Notes on information security* added
1.0.1	System overview updated
1.0	First version

1.4 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

1.5 Bus Coupler as a general term

Parts of this manual give general information about Ethernet implementation in Beckhoff products.
Thus in the following often the term *Bus Coupler* is used, that describes not only the IP20 products, but also means the IP67 modules.

2 Product Overview

2.1 The Fieldbus Box System

Fieldbus box modules are robust fieldbus stations for a large number of different fieldbus systems. They offer a wide range of I/O functionality. All relevant industrial signals are supported. As well as digital and analog inputs and outputs including thermocouple and RTD inputs, there are also incremental encoder interfaces available for displacement and angle measurement as well as serial interfaces to solve a large number of communications tasks.

Three varieties of signal connection

The digital inputs and outputs can be connected with snap-on 8 mm diameter plugs, screw-in M8 connectors, or with screw-in M12 pendants. The M12 version is provided for analog signals.

All important signal types

Special input and output channels on the combination I/O modules can be used for either input or output. It is not necessary to configure them, since the fieldbus interface is available for every combination channel as well as for input and output data. The combination modules give the user all of the advantages of fine signal granularity.

The processor logic, the input circuitry and the power supply for the sensor are all fed from the control voltage. The load voltage for the outputs can be supplied separately. In those Fieldbus Boxes in which only inputs are available, the load power supply, UP, can optionally be connected in order to pass it on downstream.

The states of the Fieldbus Box, the fieldbus connection, the power supplies and of the signals are indicated by LEDs.

The label strips can be machine printed elsewhere, and then inserted.

Fieldbus Boxes can be combined for greater flexibility

In addition to the Compact Box, the Fieldbus Box series also includes extendable devices, namely the Coupler Box and the Extension Box, as well as intelligent devices, the PLC Boxes.

Compact Box

The Compact Box makes the I/O data from the connected digital and analog sensors and actuators available to the fieldbus.

Coupler Box

The Coupler Box also collects I/O data from the Extension Boxes via an interference-proof optical fiber connection (IP-Link). Up to 120 Extension Boxes can be connected to a Coupler Box. In this way a distributed IP67 I/O network is formed with only one fieldbus interface.

The Coupler Box is capable of automatically recognizing the extension modules connected to it during start-up, and maps the I/O data automatically into the fieldbus process image – a configuration is not necessary. The Coupler Box appears, from the fieldbus point of view, along with all of the networked Extension Boxes, as a single participating bus device with a corresponding number of I/O signals.

The Coupler Box corresponds to the Bus Coupler in the BECKHOFF Bus Terminal system. BECKHOFF fieldbus devices made to protection class IP20 (Bus Terminals) and IP67 (Fieldbus Box) can be combined without difficulty – the data is handled in the same way in either case.

IP-Link

The IP-Link is an optical fiber connection with a transmission rate of 2 MBits/s which is capable of transmitting 1000 items of binary I/O data in approx. 1 ms, rapidly and securely. Smaller configurations are correspondingly faster. Because of the high usable data rate, the coupling via IP-Link does not reduce the performance of the fieldbus at all.

Low-priced plug connectors made according to Protection Class IP67 can be used for the rapid and simple preparation of the IP-Link cable, in situ. The connection does not require special tools, and can be performed quickly and simply. The IP-Link cables can also be obtained with prepared plugs if required.

The separate supply of the output voltage allows output groups to be switched off individually. Differing potentials can also be created within an extension ring without difficulty, since the IP-Link naturally has optimum electrical isolation.

Extension box

Like the Compact Boxes, the Extension Boxes cover the full spectrum of I/O signals, and may be up to 15 m apart. They are remarkably small in size, and lead to particularly economical I/O solutions with high levels of protection. Here again, the digital inputs and outputs may optionally be connected via snap-on 8 mm connectors, or via screw-in connectors (M8 and M12). Analog signal types are provided with the M12 version. The snap-on connectors lock in place positively, forming a shake-proof connection, while the screw-in connectors offer the advantage of high resistance to being pulled out.

PLC Box

The PLC Box is an intelligent Fieldbus Box with PLC functionality for distributed pre-processing of the I/O signals. This allows parts of the application to be farmed out from the central controller. This reduces the load on the CPU and the fieldbus. Distributed counting, controlling and switching are typical applications for the PLC Box. The reaction times are independent of the bus communication and of the higher-level controller.

In the event of a bus or controller failure, maintenance of function (e.g. bringing the process to a safe state in an orderly manner) is possible.

Programming is carried out with TwinCAT in accordance with IEC 61131-3. Five different programming languages are available:

- Instruction List (IL)
- Function Block Diagram (FBD)
- Ladder Diagram (LD)
- Sequential Function Chart (SFC)
- Structured Text (ST)

The program download occurs either via the fieldbus or via the programming interface.

Extensive debugging functions (breakpoint, single step, monitoring, etc) are also available. The PLC Box contains a powerful 16 bit controller, 32/96 kByte program memory and 32/64 kByte data memory. A further 512 bytes of non-volatile memory are available for remanent flags.

PLC Box with IP-Link

The programmable PLC Box with IP-Link provides almost unlimited I/O possibilities. Up to 120 extension modules, with more than 2000 I/Os, can be directly addressed from the PLC program. The PLC Box is thus also suitable for use as a small, autonomous controller for the operation of parts of equipment or small machines.

2.2 Fieldbus Box - Naming conventions

The identifications of the Fieldbus Box modules are to be understood as follows:
IXxxxy-zyyy

IX describes the design:

"IP" stands for the Compact Box design [▶ 11]
"IL" stands for the Coupler Box design (with IP-Link) [▶ 11]
"IE" stands for the Extension Box design [▶ 11]

xxxy describes the I/O connection:

xxx describes the I/O property:
"10x" - 8 x digital inputs
"15x" - counter module
"20x" - 8 x digital outputs
"25x" - PWM module
"23x" - 4 x digital inputs and 4 x digital outputs
"24x" - 8 x digital inputs and 8 x digital outputs
"3xx" - 4 x analog inputs
"4xx" - 4 x analog outputs
"5xx" - incremental encoder or SSI transducer
"6xx" - Gateway module for RS232, RS422, RS485, TTY

y represents the mechanical connection:
"0" stands for 8mm snap-on connection,
"1" stands for M8 bolted connection
"2" stands for M12 bolted connection and
"9" stands for M23 bolted connection

zyyy describes the programmability and the fieldbus system

z distinguishes whether the device is a slave or is a programmable slave:

"B" - not programmable
"C" - programmable (PLC Box [▶ 11])

"yyy" stands for the fieldbus system and the bus connection:
"110" - EtherCAT
"200" - Lightbus
"310" - PROFIBUS
"318" - PROFIBUS with integrated tee-connector
"400" - Interbus
"510" - CANopen
"518" - CANopen with integrated tee-connector
"520" - DeviceNet
"528" - DeviceNet with integrated tee-connector
"730" - Modbus
"800" - RS485
"810" - RS232
"900" - Ethernet TCP/IP with RJ45 for the bus connection
"901" - Ethernet TCP/IP with M12 for the bus connection
"903" - PROFINET
"905" - EtherNet/IP

Compact Box

The Compact Box modules offer a wide range of I/O functionality. All relevant industrial signals are supported. The digital inputs and outputs can be connected either with snap-on 8 mm diameter plugs, screw-in M8 connectors, or screw-in M12 connectors. The M12 version is made available for analog signals.

Depending on the module, the I/O section and the power supply section can differ.

Coupler Box

There are three versions of the coupler box named IL230x-Bxxx. It differs from the compact box in that this module offers an interface to what are known as extension boxes. This interface is a subsidiary bus system based on the optical fiber what is known as IP Link. This powerful subsidiary bus system can handle up to 120 extension boxes at one coupler box.

Extension Box

Extension Modules, that are independent of the fieldbus and that can only be operated together with a coupler box via IP Link.

PLC Box

A PLC Box differs from the Coupler Box in that this module can be programmed in IEC 61131-3. This means that this slave is also capable of working autonomously, without a master, for instance for control or regulation tasks.

2.3 Firmware and hardware issue status

The documentation refers to the hardware and software status that was valid at the time it was prepared. The properties are subject to continuous development and improvement. Modules having earlier production statuses cannot have the same properties as modules with the latest status. Existing properties, however, are always retained and are not changed, so that these modules can always be replaced by new ones. The number beginning with a *D* allows you to recognize the firmware and hardware status of a module.

Syntax:

D . ww yy x y z u

ww - calendar week
yy - year
x - bus board firmware status
y - bus board hardware status
z - I/O board firmware status
u - I/O board hardware status

Example:

D.22081501

- Calendar week 22
- in the year 2008
- bus board firmware status: 1
- bus board firmware hardware status: 5
- I/O board firmware status: 0 (no firmware is necessary for this board)
- I/O board hardware status: 1

2.4 Technical Data

Technical data	IL230x-B905
Extension modules (IL....)	max. 120
Maximum number of bytes (IL....)	512Byte In- and 512 Byte Output
Transmission medium	4 x 2 twisted pair copper cable; category 3 (10 MBaud), category 5 (100 MBaud)
Transfer rate	10/100 MBaud
Topology	star shaped cabling
Distance between modules	100 meters (Hub/Switch to Fieldbus Box)
Configuration	via KS2000 or via controller
Protocols	Ethernet/IP
Power supply	Control voltage: 24V_{DC} (-15%/+20%); load voltage: according to I/O type
Control voltage current consumption	according to I/O type + current consumption of sensors, max. 0.5 A
Load voltage current consumption	according to I/O type
Power supply connection	Feed: 1 x M8 connector 4-pin downstream connection: 1 x M8 socket 4-polig
Connection Fieldbus	1 x M12 d-coded socket (female)
Electrical isolation	Channels / control voltage: no between the channels: no control voltage / fieldbus: yes
Permissible ambient temperature range during operation	0°C ... +55°C
Permissible ambient temperature range during storage	-25°C ... +85°C
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst / ESD	according to EN 61000-6-2 (EN 50082) / EN 61000-6-4 (EN 50081)
Protection class	IP 65/66/67 (according to EN 60529)
Installation position	variable
Approvals	CE

Note

Detailed technical data about all available I/O types can be found in the document Signal Types, Installation, Configuration of the I/O modules, that may be found on the Beckhoff CD Products & Solutions or in the internet (http://www.beckhoff.com) under Download/Fieldbus Box.

3 Ethernet

3.1 Ethernet

Ethernet was originally developed by DEC, Intel and XEROX (as the DIX standard) for passing data between office devices. The term nowadays generally refers to the *IEEE 802.3 CSMA/CD* specification, published in 1985. Because of the high acceptance around the world this technology is available everywhere and is very economical. This means that it is easy to make connections to existing networks.

There are now a number of quite different transmission media: coaxial cable (10Base5), optical fiber (10BaseF) or twisted pairs (10BaseT) with screen (STP) or without screen (UTP). A variety of topologies such as ring, line or star can be constructed with Ethernet.

Ethernet transmits Ethernet packets from a sender to one or more receivers. This transmission takes place without acknowledgement, and without the repetition of lost packets. To achieve reliable data communication, there are protocols, such as TCP/IP, that can run on top of Ethernet.

MAC-ID

The sender and receiver of Ethernet packets are addressed by means of the MAC-ID. The MAC-ID is a 6 byte identification code unique to every Ethernet device in the world. The MAC-ID consists of two parts. The first part (i.e. the first 3 bytes) is a manufacturer identifier. The identifier for Beckhoff is 00 01 05. The next 3 bytes are assigned by the manufacturer and implement a unique serial number. The MAC-ID can, for example, be used for the BootP protocol in order to set the TCP/IP number. This involves sending a telegram containing the information such as the name or the TCP/IP number to the corresponding node. You can read the MAC-ID with the KS2000 configuration software.

The Internet Protocol (IP)

The internet protocol (IP) forms the basis of this data communication. IP transports data packets from one device to another; the devices can be in the same network, or in different networks. IP here looks after the address management (finding and assigning MAC-IDs), segmentation and routing. Like the Ethernet protocol, IP does not guarantee that the data is transported - data packets can be lost, or their sequence can be changed.

TCP/IP was developed to provide standardized, reliable data exchange between any number of different networks. TCP/IP is thus substantially independent of the hardware or software being used. Although the term is often used as if it were a single concept, a number of protocols are layered together: e.g. IP, TCP, UDP, ARP and ICMP.

Transmission Control Protocol (TCP)

The Transmission Control Protocol (TCP) which runs on top of IP is a connection-oriented transport protocol. It includes error detection and error handling mechanisms. Lost telegrams are repeated.

User Datagram Protocol (UDP)

UDP is connectionless transport protocol. It provides no control mechanism when exchanging data between sender and receiver. This results in a higher processing speed than, for example, TCP. Checking whether or not the telegram has arrived must be carried out by the higher-level protocol.

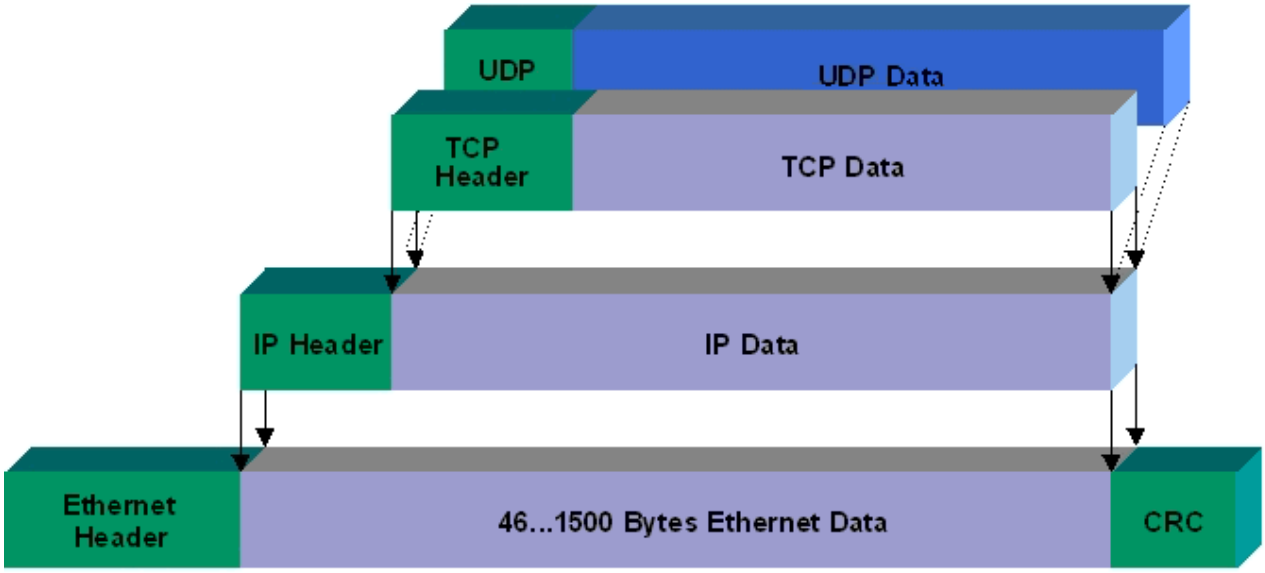


Fig. 1: Ethernet protocol

3.2 Topology

In 10BaseT and 100BaseT a number of stations are star connected according to the Ethernet standard.

Star topology

The simplest form of a star LAN consists of a single point-to-point connection. All messages pass via a central node (the hub or switch), which then passes the information to the desired device according to the destination address.

Tree topology

A tree topology consists of a number of connected star networks. As soon as the network contains a number of hubs or switches, the topology is classified as a tree. Ideally the connections between the star couplers have a particularly wide bandwidth, since these transport the most traffic. When constructing tree topologies, the repeater rule must be observed. This is also known as the 5-4-3 repeater rule. There must be no more than two pairs of repeaters (or of hubs) in the transmission path between any two stations, unless they are separated by bridges, switches or routers. A transmission path may consist of at most five segments and four repeater sets (two repeater pairs). Up to three of these segments may be coaxial segments to which the stations are connected. The remaining segments must consist of point-to-point connections; these are also known as IRL (inter repeater link) connections.

Cabling guidelines

Structured cabling provides general guidelines for constructing the cabling for a LAN. It specifies maximum permitted cable lengths for the wiring within the grounds, building or floor. Standardized in EN 50173, ISO 11801 and TIA 568-A, *structured cabling* provides the basis for an advanced, application-independent and economical network infrastructure. The wiring standards are applicable to a range defined as having a geographical extent of up to 3 km and an office area of up to one million sq meters, with between 50 and 50,000 end devices. Recommendations for the structure of a cabling system are also given. The figures can vary, depending on the topology selected, the transmission media and coupling modules used under industrial conditions, and on the use of components from various manufacturers in one network. The given figures should therefore only be considered as recommendations.

3.3 Ethernet Cable

Transmission standards

10Base5

The transmission medium for 10Base5 consists of a thick coaxial cable ("yellow cable") with a max. transmission speed of 10 MBaud arranged in a line topology with branches (drops) each of which is connected to one network device. Because all the devices are in this case connected to a common transmission medium, it is inevitable that collisions occur often in 10Base5.

10Base2

10Base2 (Cheapernet) is a further development of 10Base5, and has the advantage that the coaxial cable is cheaper and, being more flexible, is easier to lay. It is possible for several devices to be connected to one 10Base2 cable. It is frequent for branches from a 10Base5 backbone to be implemented in 10Base2.

10BaseT

Describes a twisted pair cable for 10 MBaud. The network here is constructed as a star. It is no longer the case that every device is attached to the same medium. This means that a broken cable no longer results in failure of the entire network. The use of switches as star couplers enables collisions to be reduced. Using full-duplex connections they can even be entirely avoided.

100BaseT

Twisted pair cable for 100 MBaud. It is necessary to use a higher cable quality and to employ appropriate hubs or switches in order to achieve the higher data rate.

10BaseF

The 10BaseF standard describes several optical fiber versions.

Short description of the 10BaseT and 100BaseT cable types

Twisted pair copper cable for star topologies, where the distance between two devices may not exceed 100 meters.

UTP

Unshielded twisted pair
This type of cable belongs to category 3, and is not recommended for use in an industrial environment.

S/UTP

Screened/unshielded twisted pair (screened with copper braid)
Has a general screen of copper braid to reduce influence of external interference. This cable is recommended for use with Bus Couplers.

FTP

Foiled shielded twisted pair (screened with aluminum foil)
This cable has an outer screen of laminated aluminum and plastic foil.

S/FTP

Screened/foiled-shielded twisted pair (screened with copper braid and aluminum foil)
Has a laminated aluminum screen with a copper braid on top. Such cables can provide up to 70 dB reduction in interference power.

STP

Shielded twisted pair
Describes a cable with an outer screen, without defining the nature of the screen any more closely.

S/STP

Screened/shielded twisted pair (wires are individually screened)
This identification refers to a cable with a screen for each of the two wires as well as an outer shield.

ITP

Industrial Twisted-Pair
The structure is similar to that of S/STP, but, in contrast to S/STP, it has only one pair of conductors.

4 Mounting and Wiring

4.1 Dimensions

All dimensions are given in millimeters.

General

Technical data	Fieldbus Box
Material	PA6 (polyamide), casting compound: polyurethane
Assembly	2 x fixing holes for M3
Metal parts	Brass, nickel-plated
Contacts	CuZn, gold-plated
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst / ESD	according to EN 61000-6-2 (EN 50082) / EN 61000-6-4 (EN 50081)
Permissible ambient temperature during operation	0 ... 55°C
Permissible ambient temperature during storage	-25 ... + 85°C
Installation position	any
Type of protection	IP65/66/67 when screwed together
Approvals	CE, UL E172151

IPxxxx-Bxx8, IL230x-Bxx8, IL230x-B110, IXxxxx-B400, IXxxxx-B90x, IXxxxx-C900

Technical data	Compact and Coupler Box with integrated tee connector
Dimensions (H x W x D)	ca. 210 x 30 x 26,5 mm (height to upper edge of fieldbus socket: 30 mm)
Weight	ca. 260 g - 290 g, depending on module type

IPxxxx-Bxx0, IL230x-Bxx0, IL230x-Cxx0

Technical data	Compact and Coupler Box
Dimensions (H x W x D)	Approx. 175 x 30 x 26.5 mm (height to upper edge of fieldbus socket: 30 mm, with T- connector ZS1031-2600 height approx. 65 mm)
Weight	Approx. 250 g - 280 g, depending on module type

IExxxx

Technical data	Extension box
Dimensions (H x W x D)	Approx. 126 x 30 x 26.5 mm
Weight	Approx. 120 g - 200 g, depending on module type

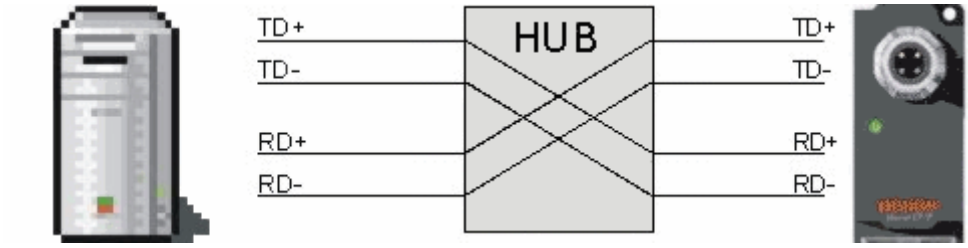
4.2 Ethernet Connection

The connection to the Ethernet bus is made via an d-coded M12 female socket.

The cable should be CAT5 or CAT5e cable.

Cabling

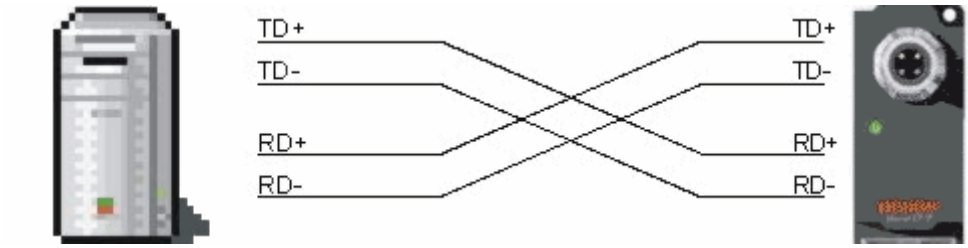
Connection via hub or switch



Connect the PLC's network interface to the hub using a standard Ethernet cable, and connect the hub, again using a standard Ethernet cable, to the Fieldbus Box.

Connection via a switch is done in the same way.

Direct connection between PLC and IL230x-B90x



To connect the PLC directly to the Fieldbus Box, you must use an Ethernet cable in which the pairs of cores have been crossed (a crossover cable).

Pin assignment of the M12 connector

PIN	Signal	Description
1	TD +	Transmit Data +
2	RD +	Receive Data +
3	TD -	Transmit Data -
4	RD -	Receive Data -
housing	Shield	Shield

Note: There is no standardized color setting for the wires!

4.3 Ethernet connector: M12

The connection to the Ethernet is done with an d-coded M12 socket (IP67).

1	TD +
2	RD +
3	TD -
4	RD -
Housing	Shield

5 Parameterization and Commissioning

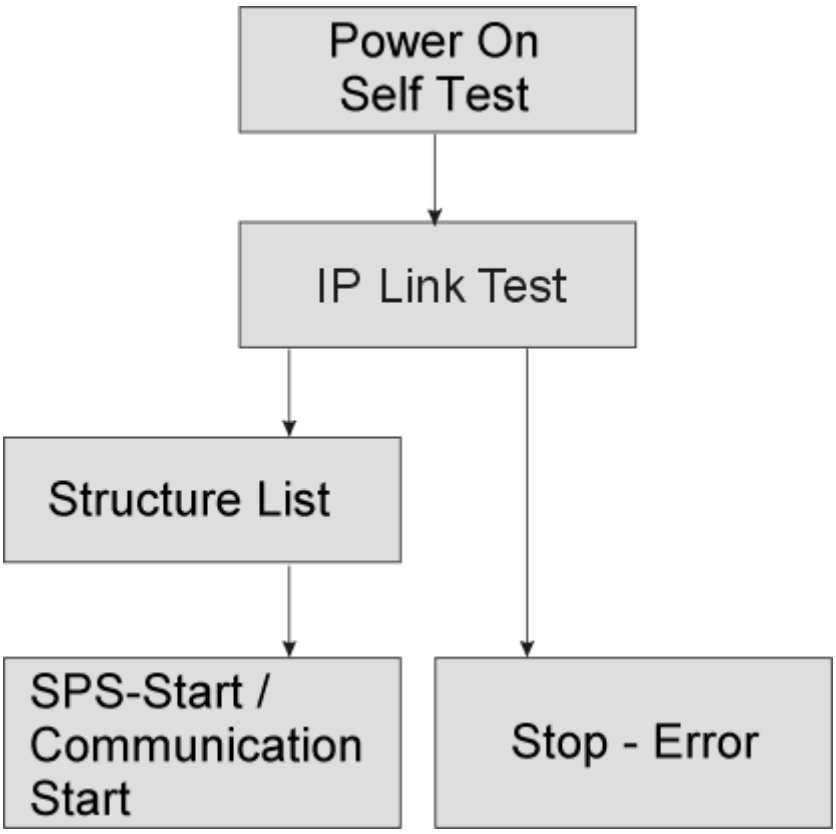
5.1 Note about parameterization

Note

Changes, e.g. the MAC-ID, that were done with the KS2000 configuration software are only stored in the volatile memory (RAM) of the Fieldbus Box.After the changes a software reset is required. By this, the changes will be copied into the flash memory and are permanent.A Cold-Start (Power-ON/ OFF) is not enough. It has to be a software reset!

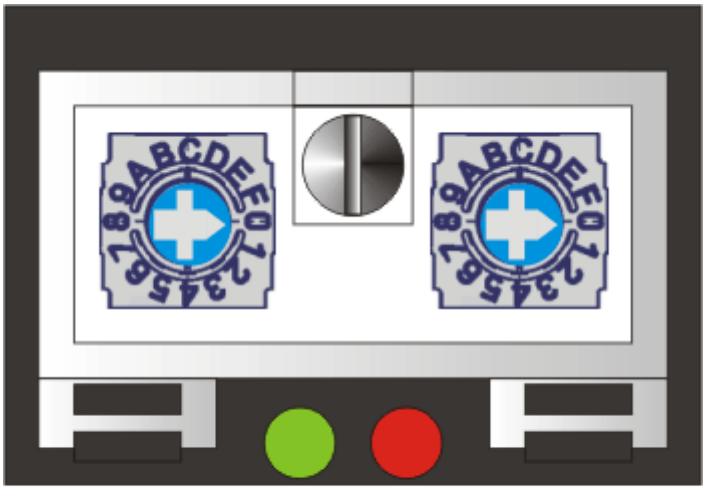
5.2 Start-up behavior of the Fieldbus Box

After power up, the Fieldbus Box checks its state, configures the IP-Link (if present) and refers to the extension modules to create a structure list. If the Fieldbus Box contains a decentralized controller (IL230x-C310) the local PLC is started once the structure list has successfully been created.
The I/O LEDs illuminate and flash as the module starts up. If there are no errors, the I/O LEDs should stop flashing within about 2-3 seconds. If there is an error, then the LED that flashes will depend on the type of that error (see Diagnostic LEDs [▶ 57]).



5.3 Parameterizing via Rotary Switches

By using the rotary switches, the following parameterizations are possible without software changes.



Hex switch x10	Hex switch x1	Meaning
0x0 - D	0x0 - F	IP address direct via switch
0xF	0x0	IP address via DHCP server
0xF	0x1	IP address via BootP server
0xF	0x2	BootP save address

Hex switch x10	Hex switch x1	Meaning (Power ON/OFF)
0xF	0x3	Fast ModbusTCP active (only B900, B901)
0xF	0x4	Fast ModbusTCP inactive (only B900, B901)
0xF	0x5	BOOTP / DHCP Server 2.3 (Rockwell) (only B905)
0xF	0x6	reserved
0xF	0x7	reserved
0xF	0x8	reserved
0xF	0x9	reserved
0xF	0xA	reserved
0xF	0xB	reserved
0xF	0xC	deletes AMS NetID table
0xF	0xD	sets fieldbus specific default values
0xF	0xE	deletes boot project (only for Controller Box IL230x-C900)
0xF	0xF	Sets module back to manufacturer settings

Restoring the manufacturer settings

- Switch off the module.
- Set the rotary switches to 0xFF and switch on the module.
- After setting the default parameter successfully, the LEDs *I/O RUN* and *I/O ERR* are flashing simultaneously.

- Now you can switch off the module again, to set the IP address.

Delete the boot project (only for Controller Box IL230x-C900)

- Switch off the module.
- Set the rotary switches to 0xFE and switch on the module.
- After deleting the boot project successfully, the LEDs *I/O RUN* and *I/O ERR* are flashing simultanously.
- Now you can switch off the module again, to set the IP address.

Setting the Ethernet parameters

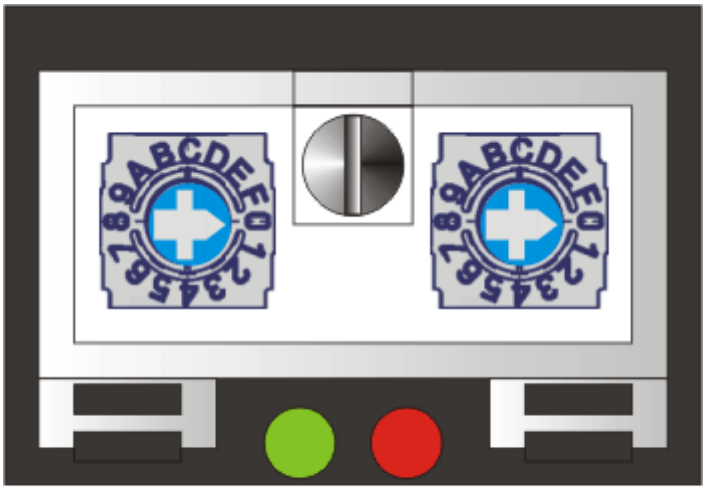
- Switch off the module.
- Set the rotary switches to 0xFD and switch on the module.
- The LEDs *I/O RUN* and *I/O ERR* are flashing.
- The default values of table 100 are set.
- Now you can switch off the module again, to set the IP address.

5.4 IP Address

5.4.1 IP-address

The IP address can be set using four different procedures, and these will be described in more detail below.

Procedure	Explanation	Necessary components
KS2000	Addressing using the KS2000 configuration software and DIP switches	KS2000 configuration software and KS2000 cable
ARP	Addressing via the ARP table	PC with network
BootP	Addressing via BootP server	BootP-Server
DHCP	Addressing via DHCP server	DHCP-Server



Hex switch x10	Hex switch x1	Meaning
0x0 - D	0x0 - F	IP address direct via switch
0xF	0x0	IP address via DHCP-Server
0xF	0x1	IP address via BootP-Server
0xF	0x2	BootP save Address
0xF	0x3	Fast ModbusTCP active (only IL230x-B900,- B901)
0xF	0x4	Fast ModbusTCP inactive (only IL230x-B900,- B901)
0xF	0x5	IP address via BootP-Server (Rockwell, only IL230x-B905)
0xF	0x6	reserved
0xF	0x7	reserved
0xF	0x8	reserved
0xF	0x9	reserved
0xF	0xA	reserved
0xF	0xB	reserved
0xF	0xC	delete AMS NetID table
0xF	0xD	set fieldbus specific default values
0xF	0xE	delete Boot project (only for IL230x-C900)
0xF	0xF	manufacturer setting

5.4.2 Network Classes

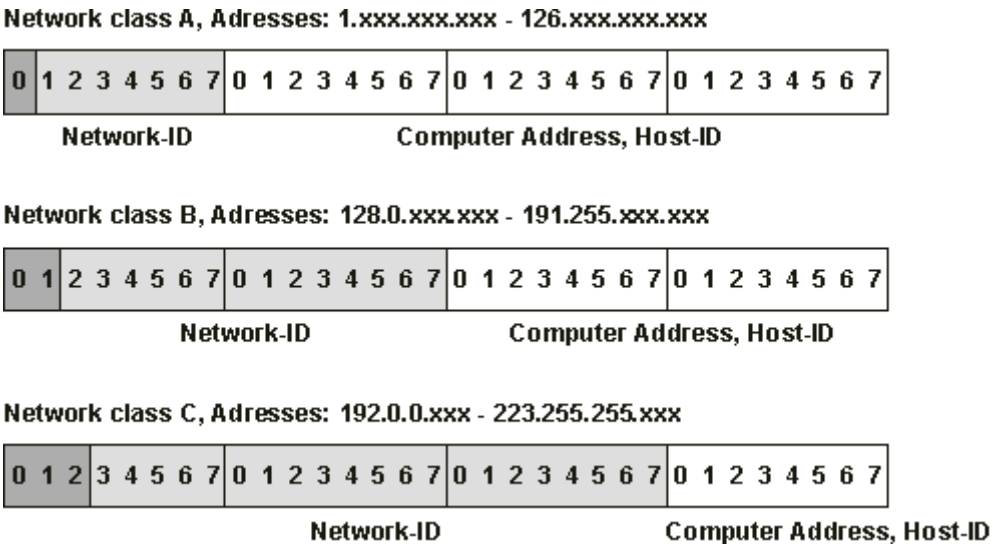
Three different network classes are distinguished. They specify how many address bits are reserved for the Network -ID and how many for the computer number (or node number). The difference is located in the first 3 bits of the IP address.

Network-class	Number of bits for the Network ID	Possible number of networks	Number of bits for the node address	Possible number of nodes per network
A	7	126	24	16 777 214
B	14	16 382	16	65 536
C	21	2 097 150	8	254

NOTE

Warning

An IP address must be unique within the entire connected network!



Note

In a communication with another Ethernet devices, the IP address set must have the same network class. Example: Your PC has address 172.16.17.55, which means that the Bus Coupler must have address 172.16.xxx.xxx (each xxx stands for a number between 0...255. The 0 is normally used for routers/switches, and should therefore be reserved).

In order to see the PC's own address, the command *ipconfig* can be entered into a DOS window under Windows NT/2000/XP.

5.4.3 Subnet mask

The subnet mask is subject to the control of the network administrator, and specifies the structure of the subnet.

Small networks without a router do not require a subnet mask. The same is true if you do not use registered IP numbers. A subnet mask can be used to subdivide the network with the aid of the mask instead of using a large number of network numbers.

The subnet mask is a 32-bit number.

- Ones in the mask indicate the subnet part of an address region.
- Zeros indicate that part of the address region which is available for the host IDs.

Description	Binary representation	Decimal representation
IP address	10101100.00010000.00010001.11001000	172.16.17.200
Subnet mask	11111111.11111111.00010100.00000000	255.255.20.0
Network ID	10101100.00010000.00010000.00000000	172.16.16.0
Host ID	00000000.00000000.00000001.11001000	0.0.1.200

Standard subnet mask

Address class	Standard subnet mask (decimal)	Standard subnet mask (hex)
A	255.0.0.0	FF.00.00.00
B	255.255.0.0	FF.FF.00.00
C	255.255.255.0	FF.FF.FF.00

Note

Neither subnet 0 nor the subnet consisting only of ones may be used. Neither host number 0 nor the host number consisting only of ones may be used! If the IP address is set using the KS2000 configuration software, it is necessary for the subnet mask also to be changed with the KS2000 configuration software. If ARP addressing is used, the associated standard subnet mask, based on the IP address, is entered. Under BootP or DHCP the subnet mask is entered by the server.

5.4.4 Setting of the IP address via the ARP table

An easy method to change the addressing is using the DOS window. Only addresses in the same network class can be changed though! The new address will be stored and kept even when the module is powered down.

Procedure:

- switch to any IP address. DHCP or BootP shall not be activated.
- open the DOS box on your PC
- generate an entry in your ARP table using "ping >IP address<
- read the ARP table with "ARP -a"
- delete the module from the table with "ARP-d >IP-Address OLD<
- carry out a manual entry in the table "ARS -s >IP Address NEW< >MAC-ID [▶ 35]<"
- check with "ping -l 123 >IP-Address NEW<" if the new IP-Address is valid

Temporary flashing of the ERROR LED during the initializing phase shows, that the module is addressed via ARP. The switches have no information about the actual module address!

Note

When changing the IP address, all dynamic ARP entries should be deleted. Only a ping with a length of 123 Byte for changing the address is accepted (>ping -l "IP-Address<).

Example

1. C:>ping 172.16.17.255
2. C:>ARP -a
   172.16.17.255 00-01-05-00-11-22
3. C:>arp -d 172.16.17.255
4. C:>arp -s 172.16.44.44 00-01-05-00-11-22
5. C:>ping -l 123 172.16.44.44

5.4.5 Setting of the address using KS2000 and switch

The setting of the IP address can be done via the KS2000 and the 2 rotary switches.

Only the last Byte will be changed! All the other settings will be read directly from table 100. These values can only be changed with the KS2000 configuration software.

Before power on, the rotary switch x10 has to have a value <> 0xF.

To change the IP address it is necessary to reset the write protection in the KS2000. After the setting a Reset of the box is necessary.

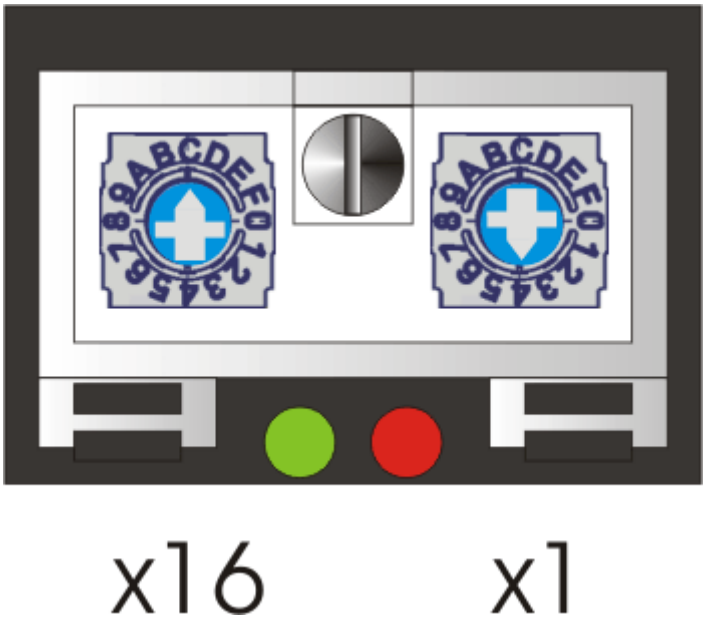
Table 100

Register	High-Byte	Low-Byte
0	IP-Byte 2	IP-Byte 1
1	not used	IP-Byte 3

Default

IP-Byte	Default value (hex)	Default value (dec)
1	0xAC	172_{dec}
2	0x10	16_{dec}
3	0x11	17_{dec}
4	(rotary switches)	(0 to 239_{dec})

Example



Switch		x16	x1
multiplicator		16	1
this example	**Switch position**	C_{hex} = 12_{dec}	4_{hex}
	value	12_{dec} x 16_{dec} = 192_{dec}	4_{dec}
	IP address	172.16.17.**196**	

5.4.6 Address Configuration via DHCP Server

To set the address by means of a DHCP server, set the rotary switches to 0xF0. In this state, the DHCP service is switched on, and the module is automatically assigned an IP number by the DHCP server. For this purpose the DHCP server must know the module's MAC-ID [▶ 35]. The IP address should be set statically. The *TCP/IP Error* LED flashes while the address is being allocated.

5.4.7 BOOTP Server

5.4.7.1 Setting the IP-address via the Beckhoff BootP-server

Turn the rotary switch to 0xF1 resp. 0xF2 for using the Beckhoff BootP-server. The LED *TCP/IP ERROR* will flash during the address allocation.

Rotary switch in position 0xF2

The address assigned by the BootP server is stored, and the BootP service will not be restarted after the next cold start.

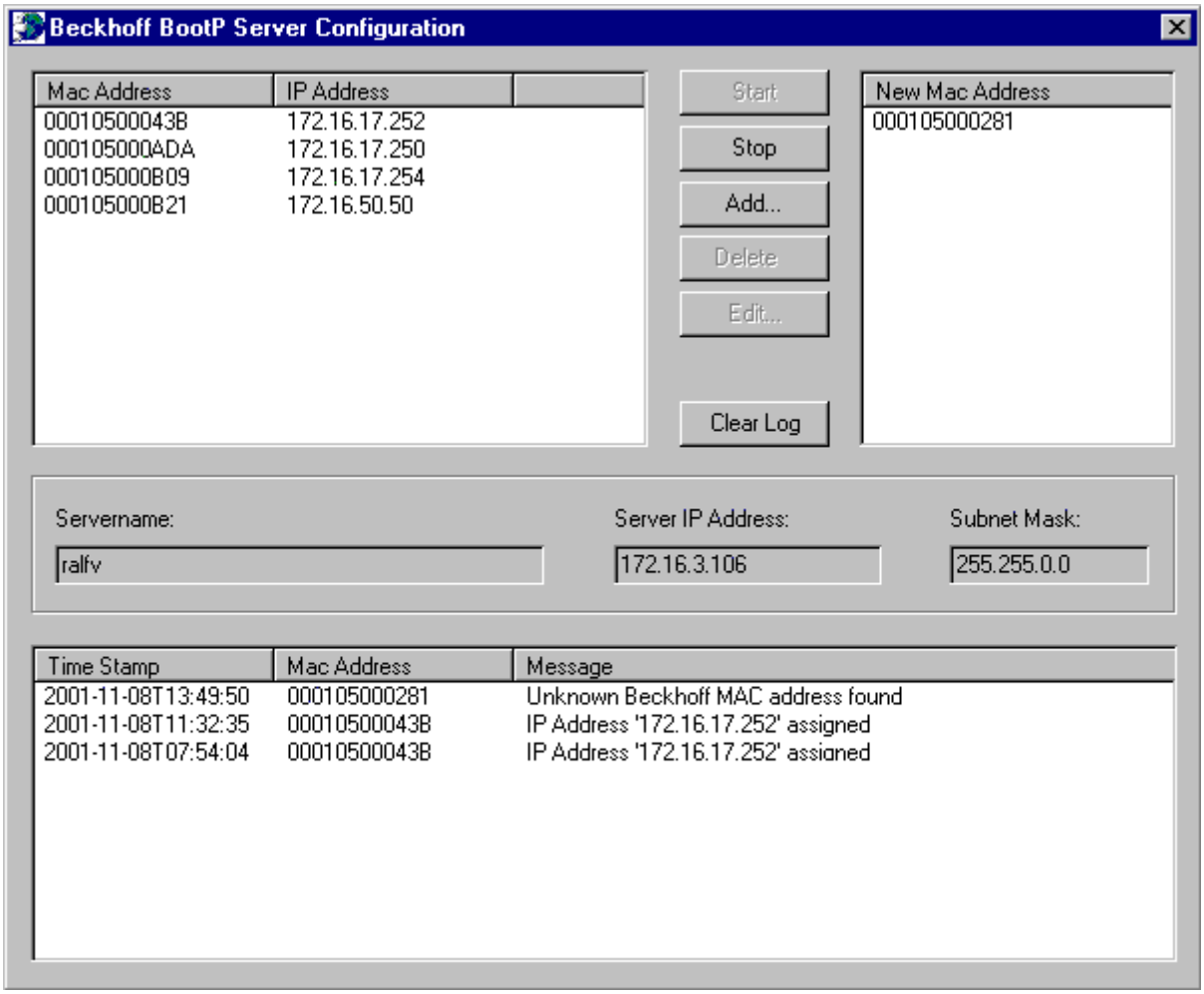
The address can be deleted by switching to manufacturer setting with the KS2000 or via the rotary switch (0xFF).

Rotary switch in position 0xF1

The IP address assigned by the BootP server is only valid until the module is switched off. At the next cold start, the BootP server must assign a new IP address to the module.
The address is, however, retained through a software reset of the module.

Beckhoff BootP server

Beckhoff supplies a BootP server for Windows 98, ME, NT4.0, NT2000 and XP.
You find the installation version on the Beckhoff TwinCAT CD in folder *Unsupported Utilities* or from http://download.beckhoff.com/download/Software/TwinCAT/TwinCAT2/Unsupported Utilities/TcBootP Server.



As soon as the BootP server has started, the *New MAC Address* window shows all the Beckhoff nodes that are working in BootP mode and still have not received an IP address. The assignment of the MAC-ID [▶ 35] to IP address is made with the "<<" button. Successful assignment is displayed in the log window.
To start the BootP server automatically when your PC boots, it is only necessary to provide a shortcut in the Windows autostart folder. Include the */Start* parameter in the shortcut (.../TcBootPDlg.exe/start).

5.4.7.2 Rockwell Bootp-Server

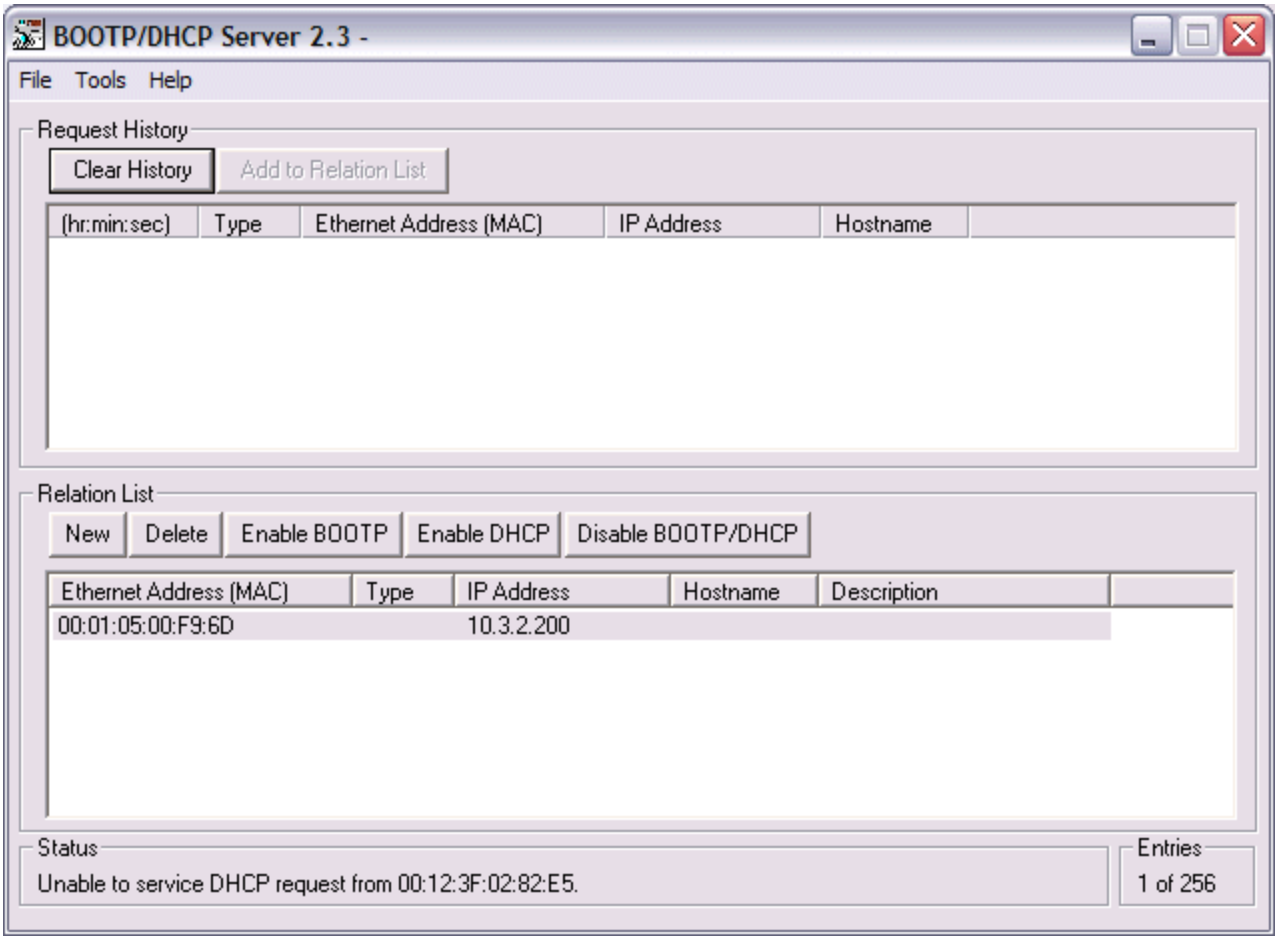
Addressing with the BOOTP/DHCP Server 2.3

IP address save modes

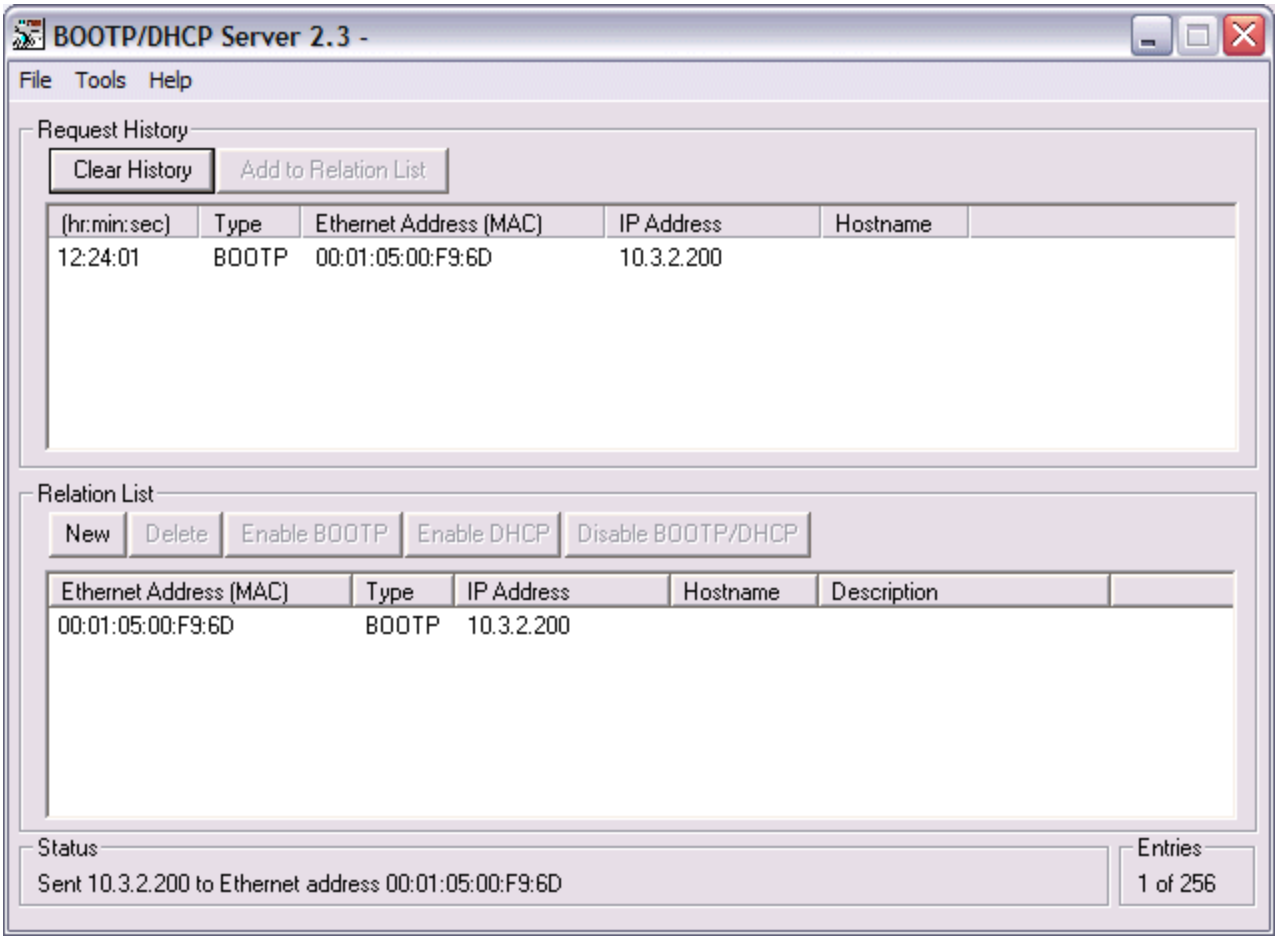
Rotary Switch = 0xF5

The IP address assigned by the BootP server is only valid until the Coupler Box is switched off. The BootP server must assign a new IP address to the Coupler Box at the next cold start.
The address is, however, retained through a software reset of the Coupler Box.

The MAC Address starts with 00-01-05-xx-xx-xx.

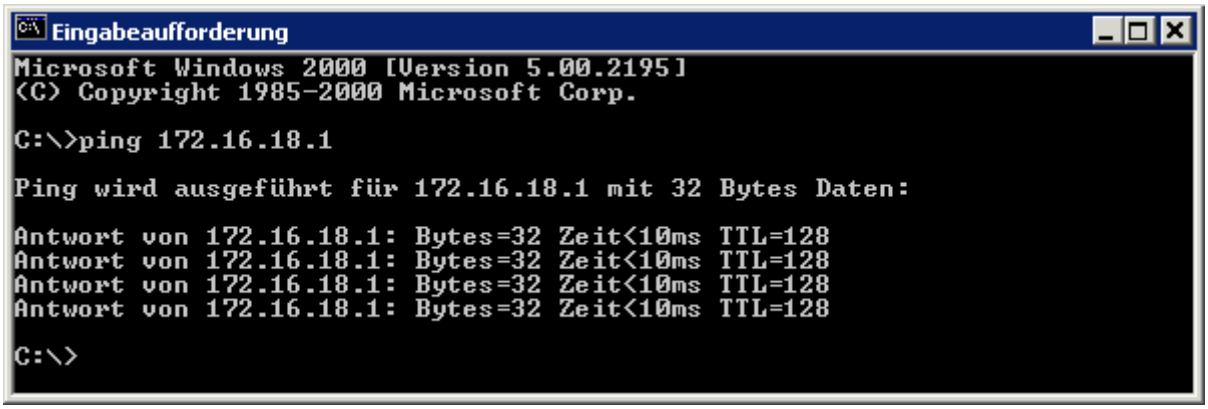


After a successful addressing you can disable the BOOTP addressing.



5.4.8 Testing the IP Address

Use the *Ping* command to test the IP address.



5.4.9 Reading the MAC-ID

Proceed as follows to read the MAC-ID:

- Change the IP address of your PC to 172.16.x.x and the Subnet mask to 255.255.0.0
  The default IP address of the Ethernet Fieldbus Boxes is 172.16.18.1 (rotary switch setting: 0, 1).
- Start the DOS Window
- Send a Ping to IP address 172.16.17.1
- Read the MAC-ID with *arp -a*.

5.5 Mapping

Type: ETHERNET-MODULE Generic Ethernet Module
Comm Format: SINT, INT or DINT
Assembly Instance:
- Input: 101 Size: 4 x SINT (BYTE) + terminals (2 x INT + terminals or 1 x DINT + terminals)
- Output: 102 Size: 4 x SINT (BYTE) + terminals (2 x INT + terminals or 1 x DINT + terminals)
- Configuration: 100 Size 0

Mapping rules

Complex terminals* (see documentation terminals)
- Word Alignment
- complex mapping

Comm Format: SINT

Offset	Inputs	Outputs
0	Status Byte 0	Control Byte 0
1	Status Byte 1	Control Byte 1
2	Status Byte 2	Control Byte 2
3	Status Byte 3	Control Byte 3
4...x	complex terminals*	complex terminals*
x...y	digital terminals**	digital terminals**

* complex terminals, example IE15xx, IE3xxx, IE4xxx, IE25xx, IE2808, IE5xxx, IE6xxx
** digital terminals, example IE1xxx, IE20xx, IE23xx, IE24xx

Comm Format: INT

Offset	Inputs	Outputs
0	Status Word 0	Control Word 0
1	Status Word 1	Control Word 1
2...x	complex terminals*	complex terminals*
x...y	digital terminals**	digital terminals**

* complex terminals, example IE15xx, IE3xxx, IE4xxx, IE25xx, IE2808, IE5xxx, IE6xxx
** digital terminals, example IE1xxx, IE20xx, IE23xx, IE24xx

Comm Format: DINT

Offset	Inputs	Outputs
0	Status DWord 0	Control DWord 0
1...x	complex terminals*	complex terminals*
x...y	digital terminals**	digital terminals**

* complex terminals, example IE15xx, IE3xxx, IE4xxx, IE25xx, IE2808, IE5xxx, IE6xxx
** digital terminals, example IE1xxx, IE20xx, IE23xx, IE24xx

Mapping terminals

Example:
Comm Format DINT
Size: 7 x Input, 7 x Output
1 x IL2301-B905
1 x IE3312
1 x IE1001
1 x IE2001

Offset	Name	Inputs	Outputs
0	Control/Status Word 0	DeviceName:I.data[0]	DeviceName:O.data[0]
1	IE3312 Channel 0 Control/Status, Data	DeviceName:I.data[1] (Bit 0...7 = Status, 8...15 unused,16...31 = Data)	DeviceName:O.data[1] (Bit 0...7 = Control, 8...15 unused)
2	IE3312 Channel 0 Control/Status, Data	DeviceName:I.data[2] (Bit 0...7 = Status, 8...15 unused,16...31 = Data)	DeviceName:O.data[2] (Bit 0...7 = Control, 8...15 unused)
3	IE3312 Channel 0 Control/Status, Data	DeviceName:I.data[3] (Bit 0...7 = Status, 8...15 unused,16...31 = Data)	DeviceName:O.data[3] (Bit 0...7 = Control, 8...15 unused)
4	IE3312 Channel 0 Control/Status, Data	DeviceName:I.data[4] (Bit 0...7 = Status, 8...15 unused,16...31 = Data)	DeviceName:O.data[4] (Bit 0...7 = Control, 8...15 unused)
5	digital channels	DeviceName:I.data[5] (Bit 0...3 = IL2301, 4...11 = IE1001, 12...31 unused)	DeviceName:O.data[5] (Bit 0...3 = IL2301, 4...11 = IE2001, 12...31 unused)

B905 Control and Status

Status Bits 0...31

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16-23	24-31
K1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	IP-Link Error Code	IP-Link Error argument

K1 - if K1 = TRUE, IP-Link error, Error Code bit 16-31 (see IP-Link Error LED)

Control Bits 0...31

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16-23	24-31
K1	R1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

K1 - 0->1 rising Trig IP-Link Reset
R1 - 1->0 falling Trig Reboot IL230x-B905

5.6 EthernetIP Tag Wizard

Mapping

The Bus Coupler can be mapped as short integer (byte), integer (word), or double integer (double word). In the following description it is mapped as double integer!

Installation

- Download the file *EIPTOOL.zip* from this documentation click on the following Link https://infosys.beckhoff.com/content/1033/fbb-x905/Resources/zip/4524990475.zip

- Extract all the contained files from the ZIP file into a folder on your PC.

- Start the EtherNetIPConfigTool.exe

Overview

This application note covers how to use the EthernetIP Tag Wizard. After reading this note you will be able to build a rack of Beckhoff IO and automatically import it into RSLogix 5000. Not only will the nodes be automatically created, but the IO will have an exact description in the IO map.

Supporting Documents and References

Put link to BK9105 here, as well as the link to the EIP tool.

Key Concepts

With this tool a user will be able to create the Beckhoff IO Rack, save the IO mapping configuration and Import that configuration into RSLogix 5000. RSLogix 5000 does not need to be installed on the PC you have the Tag Wizard on, however it will be convenient.

Procedure

To get started we have to have an RSLogix configuration with a minimum of a processor and Ethernet IP Master. If you are simply adding a rack to an existing configuration, this process will be the same.

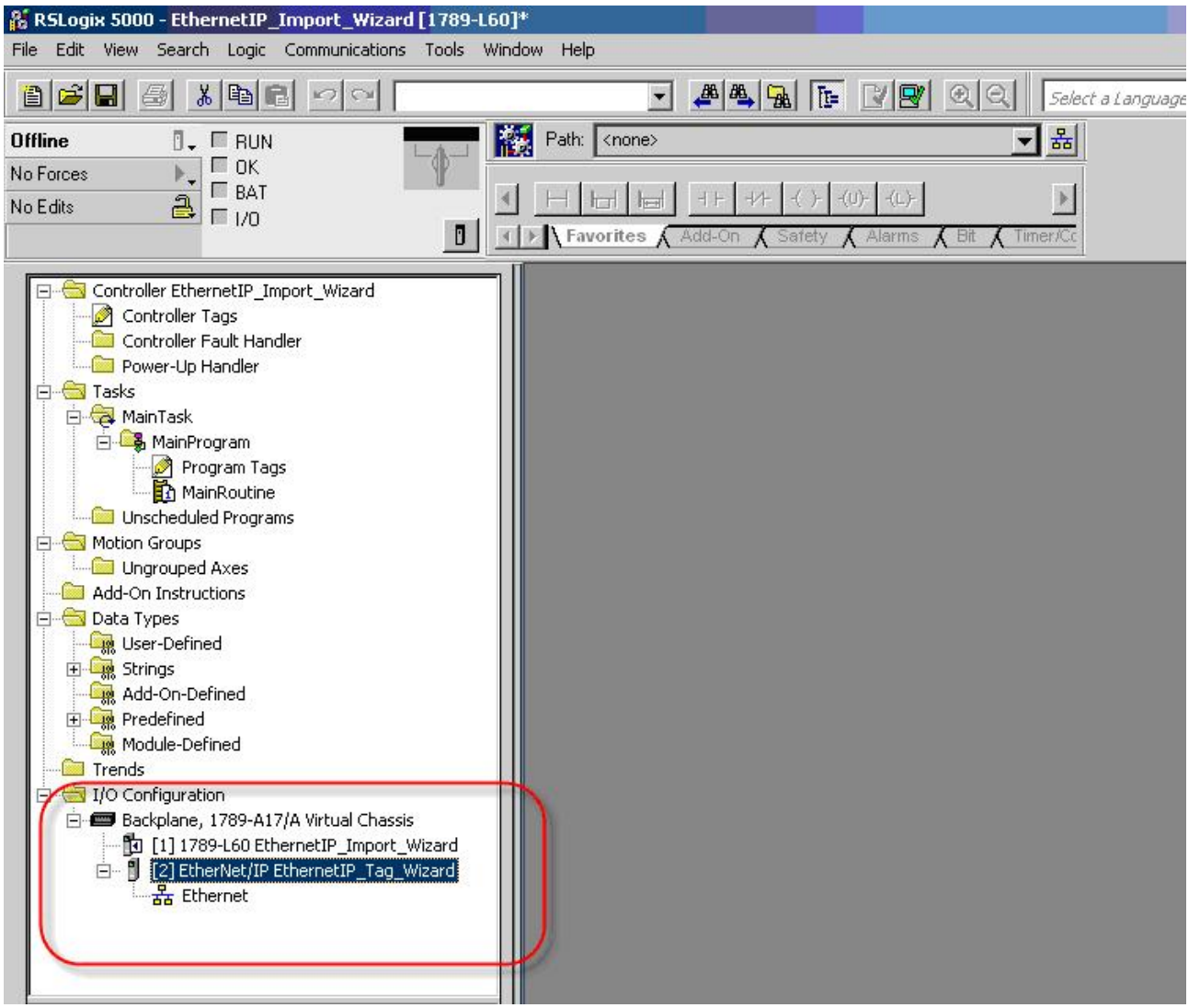


Fig. 2: EthernetIP Tag Wizard

All one has to do is simply save this configuration as an .L5K file to the desired location. In this example, all files are saved to the root directory of the Tag Wizard.

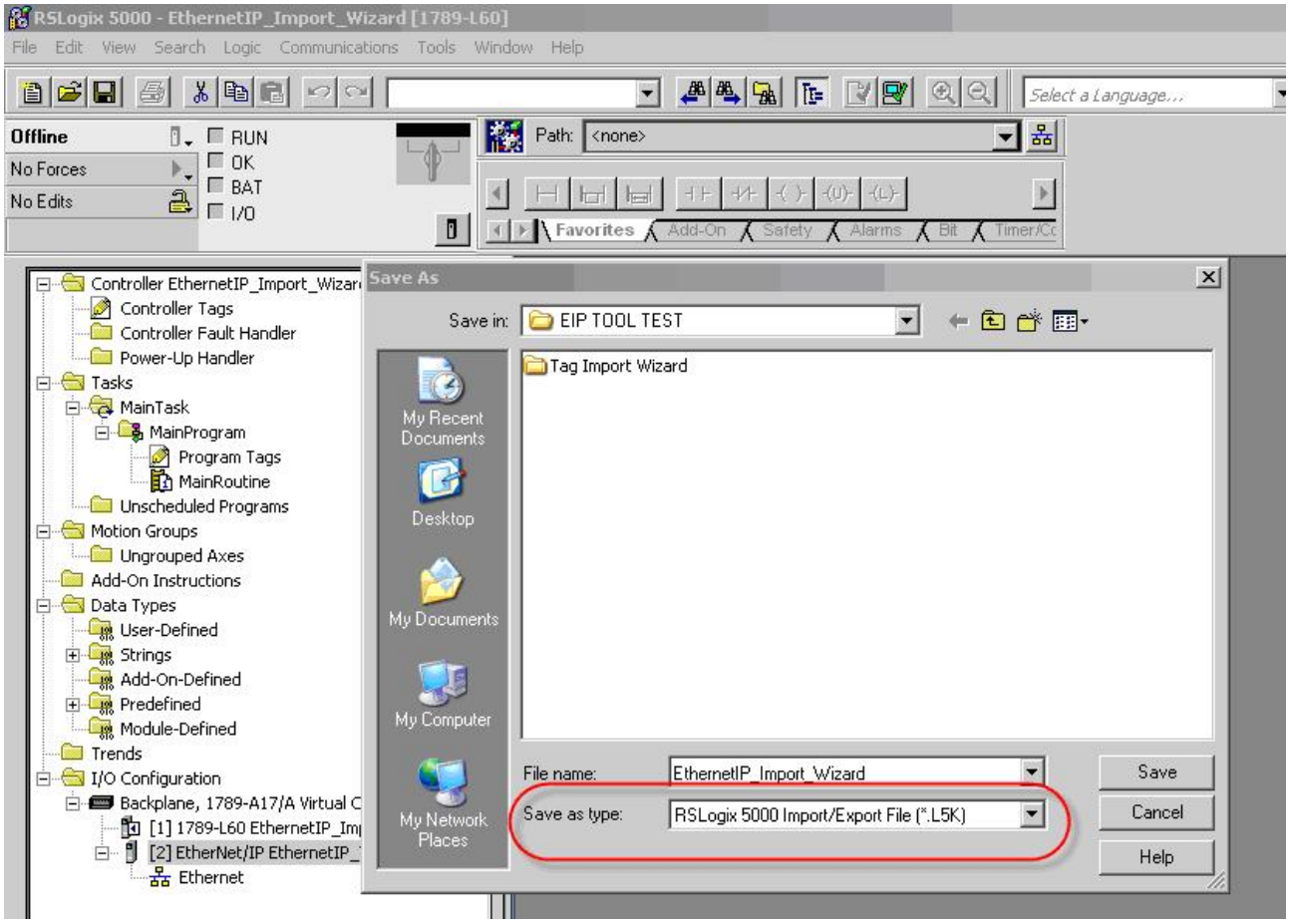


Fig. 3: EthernetIP Tag Wizard - Save as type

Once the RSLogix 5000 configuration is saved please minimize and open up the folder where the tag wizard is stored. In this folder you will find a couple reference files. The EthernetIPMaster.txt is very important. This is a text file that stores the name that Rockwell gives its scanners. If your scanner is NOT in the list, please feel free to add it. It is VERY important that the scanner is added just as it appers in your .L5K file.

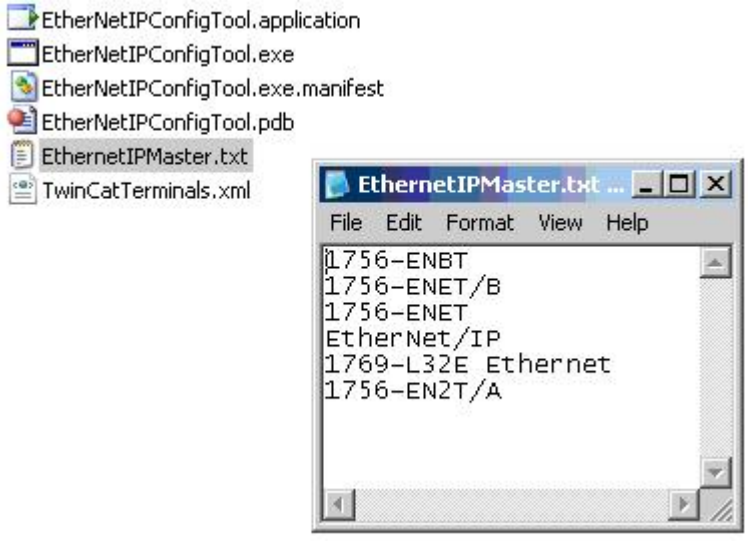


Fig. 4: EthernetIP Tag Wizard - EthernetIPMaster.txt

At this point all one has to do is double click on EtherNetIPConfigTool.exe and it will open. Once open, add your BK9105 or IL230x-B905 to the configuration.

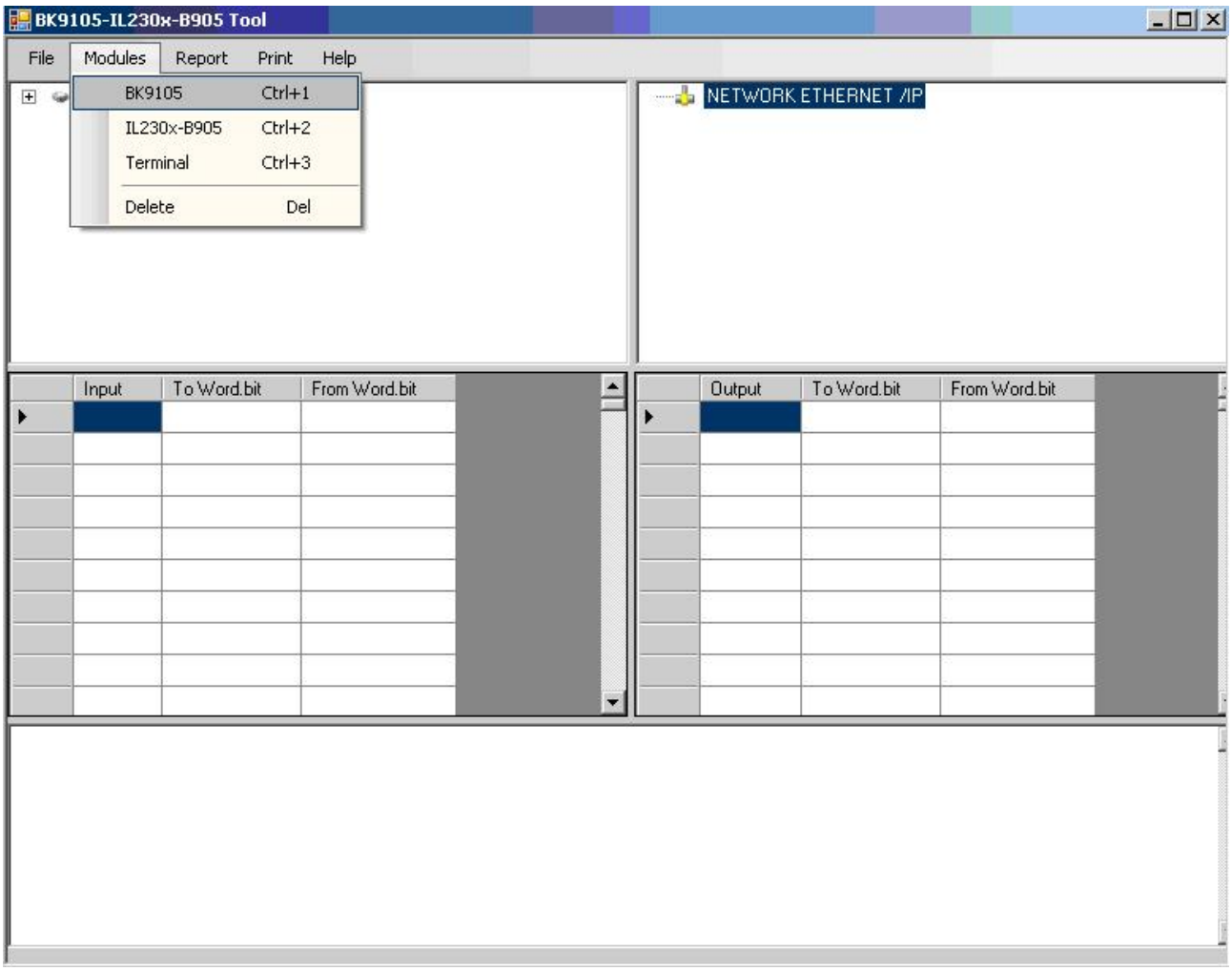


Fig. 5: EthernetIP Tag Wizard - EtherNetIPConfigTool

When adding your coupler you will be prompted to enter the correct IP address.

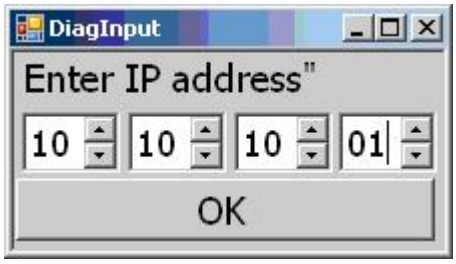


Fig. 6: EthernetIP Tag Wizard - Enter IP address

If you select the Field Bus Box IL230X-B905 you will be prompted additionally with the following.

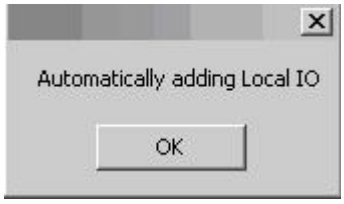


Fig. 7: EthernetIP Tag Wizard - Automatic adding Local IO

The software automatically is adding the 230x combo box to your configuration.

At this point you simply add the IO to your configuration in the order that they are left to right on the coupler, by simply double clicking on the correct terminal.

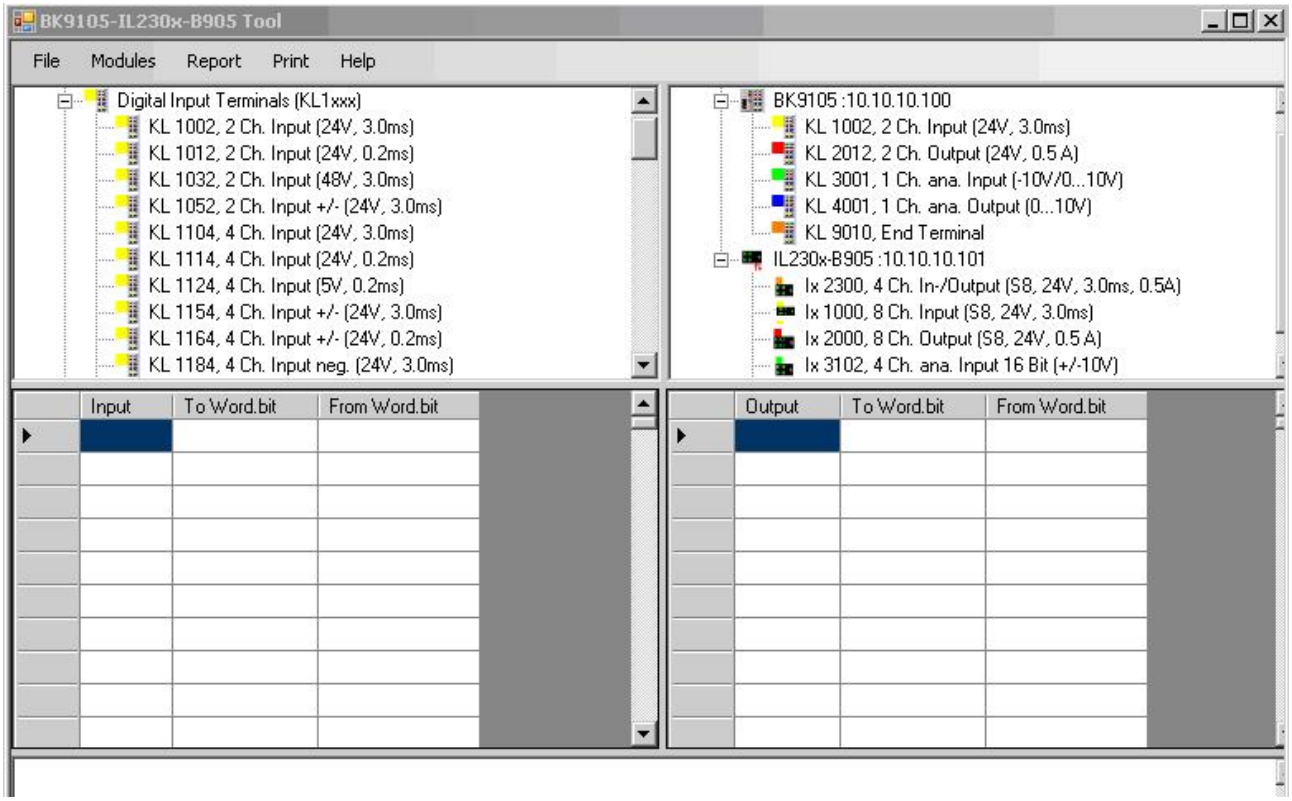


Fig. 8: EthernetIP Tag Wizard - Adding the IO to cour configuration

Once you have all the IO added in the correct order, you have a couple different selections as to how to save review or export this data. To review, all one has to do is simply select the coupler you want to review and then Report>Coupler (Or network [If network is selected only the first coupler will show graphically but the mapping below is correct])

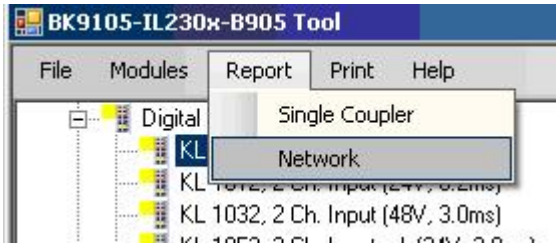


Fig. 9: EthernetIP Tag Wizard - selections

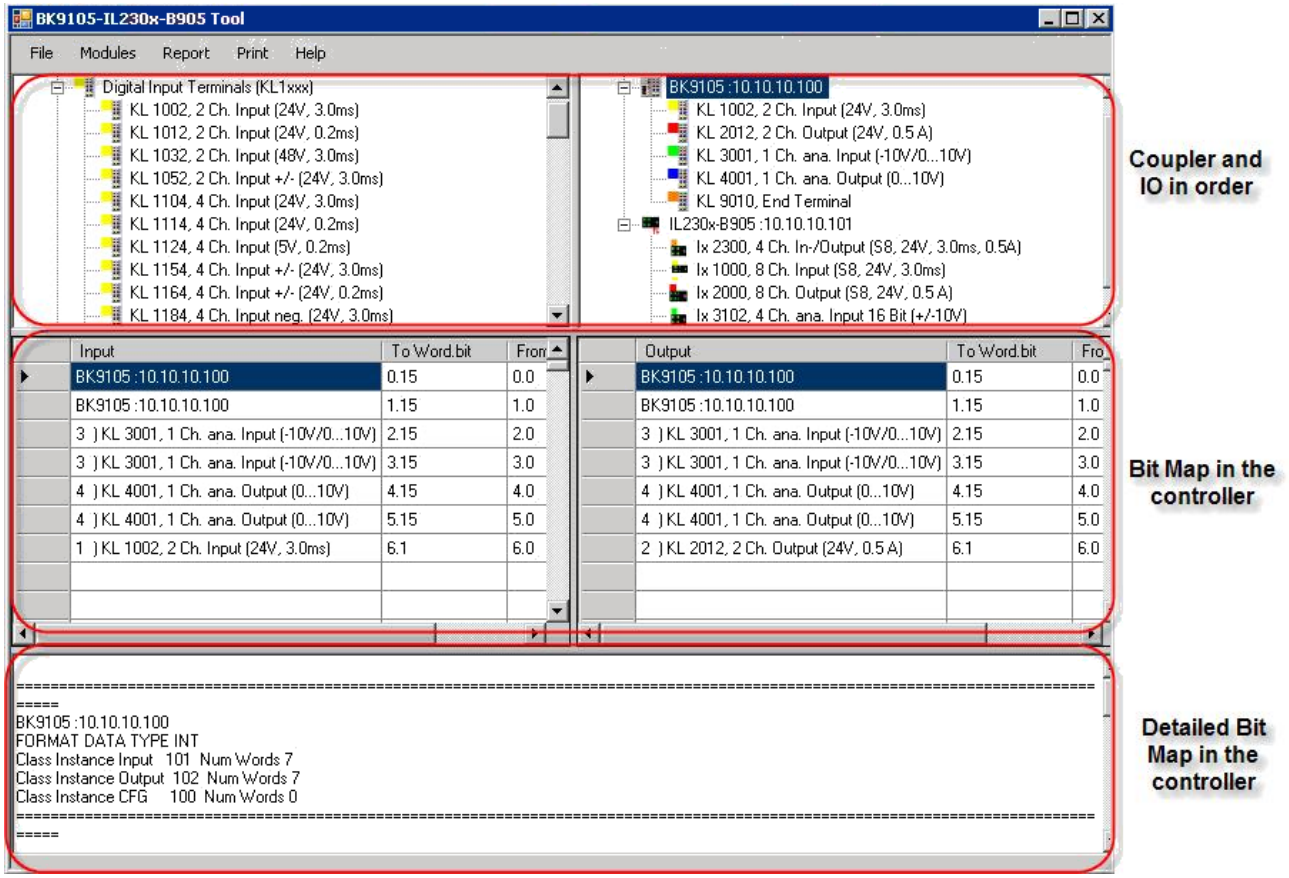


Fig. 10: EthernetIP Tag Wizard - Mapping

All one has to do at this point to save or export the data is File>Save XML (this saves the configuration to a XML file, File>Save Network Report (saves so as you can print it for machine documentation) Save>Configuration (If you want to add to this configuration in the future) and File>Save To L5K file.

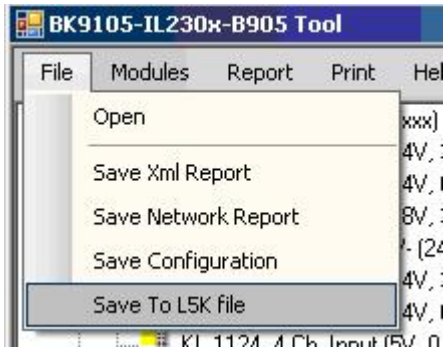


Fig. 11: EthernetIP Tag Wizard - Save To L5K file

When saving to a L5K file you are prompted to select the correct Ethernet IP master (This list is read from the text file mentioned earlier).

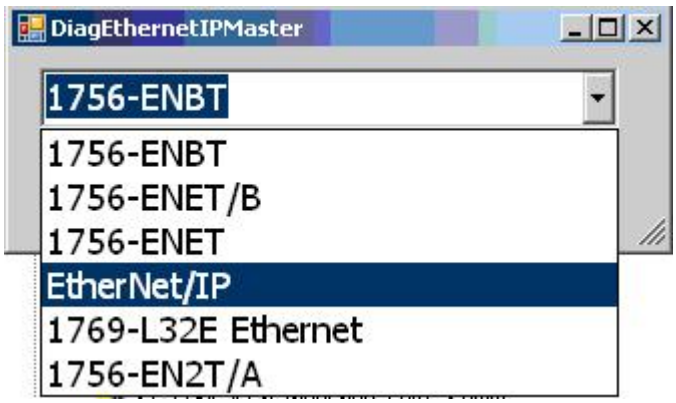


Fig. 12: EthernetIP Tag Wizard - choose the correct Ethernet IP master

Fig. 13: EthernetIP Tag Wizard select the correct Ethernet IP master

Once we have the master selected, then choose OK.

Next you will be prompted to select the correct path to the stored .L5K file, and select Open. Once opened you will notice an AB.L5K file in the same directory you saved the original L5K file.

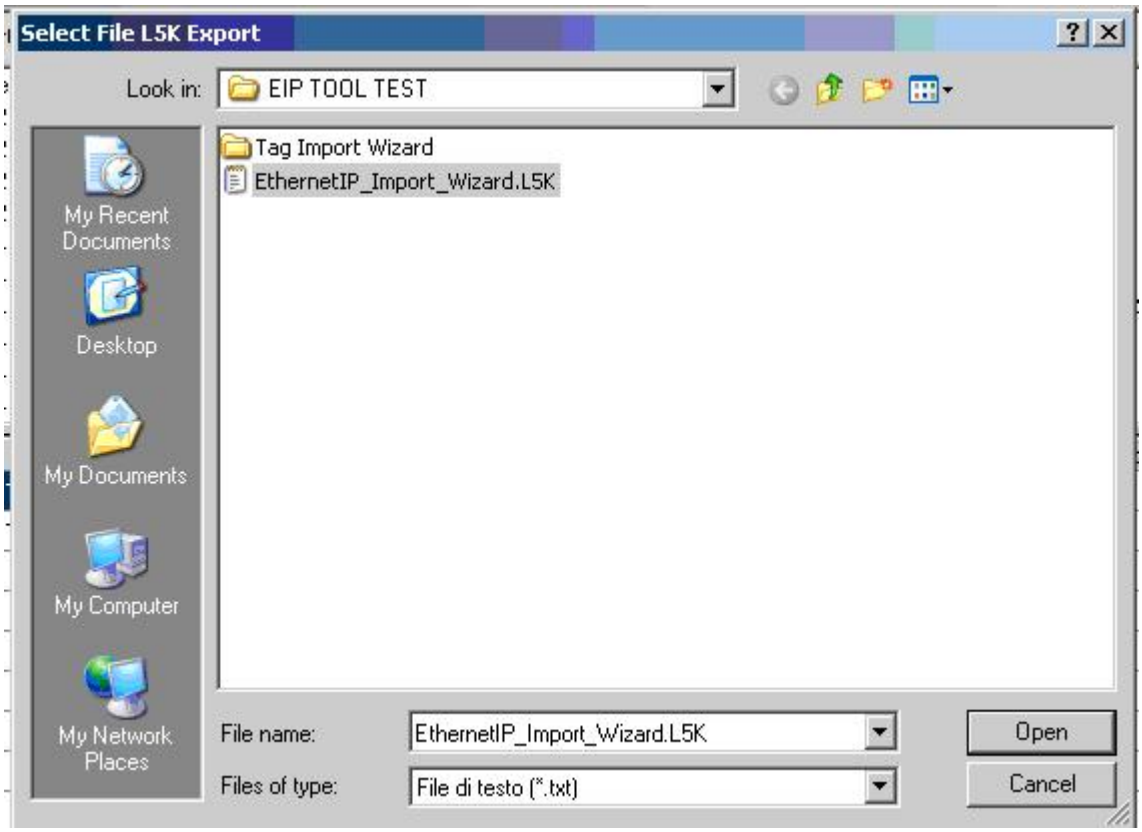


Fig. 14: EthernetIP Tag Wizard - select the correct path to the stored .L5K file

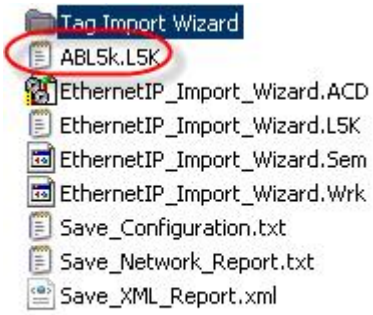


Fig. 15: EthernetIP Tag Wizard - ABL5k.L5K

Go back to RSLogix 5000, File>Open>

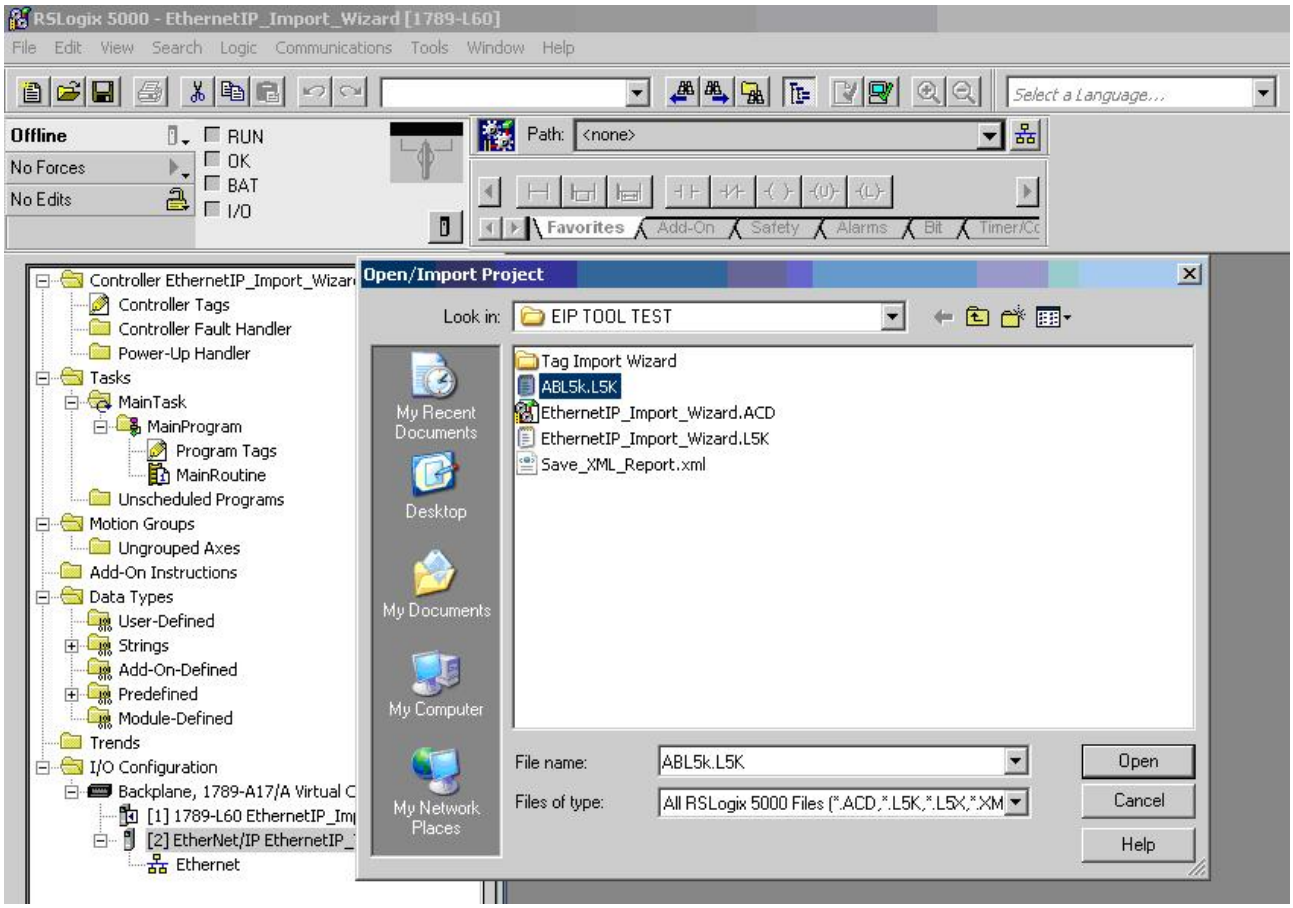


Fig. 16: EthernetIP Tag Wizard - open the L5K file

Select the NEW .L5K file then Import

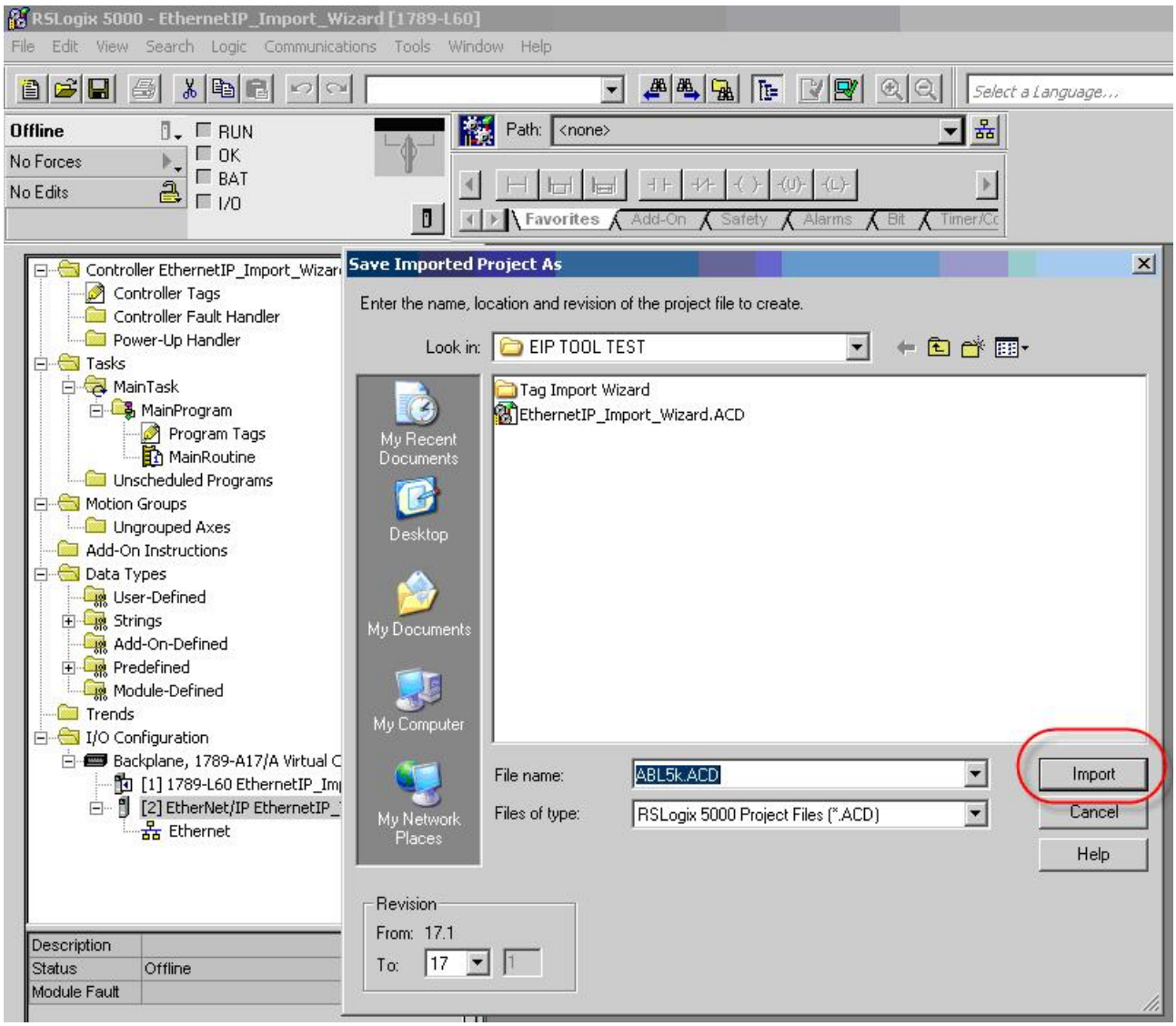


Fig. 17: EthernetIP Tag Wizard - Safe the Imported Project

Now to check out all of the new IO

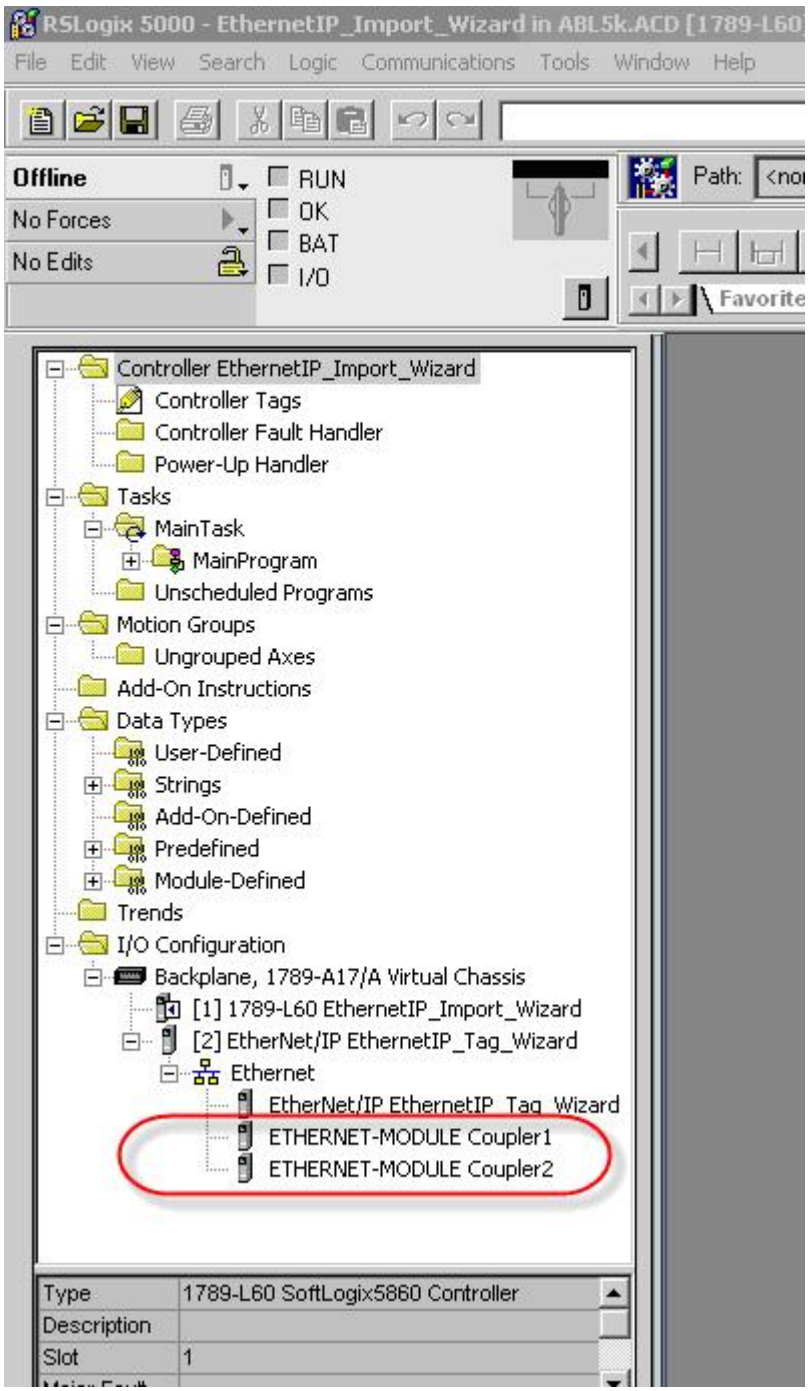


Fig. 18: EthernetIP Tag Wizard - check out all of the new IO

Please note to look in the Controller tags for not only did the software create new module defined tags, it labeled them accordingly in the Logical order, NOT the physical order.

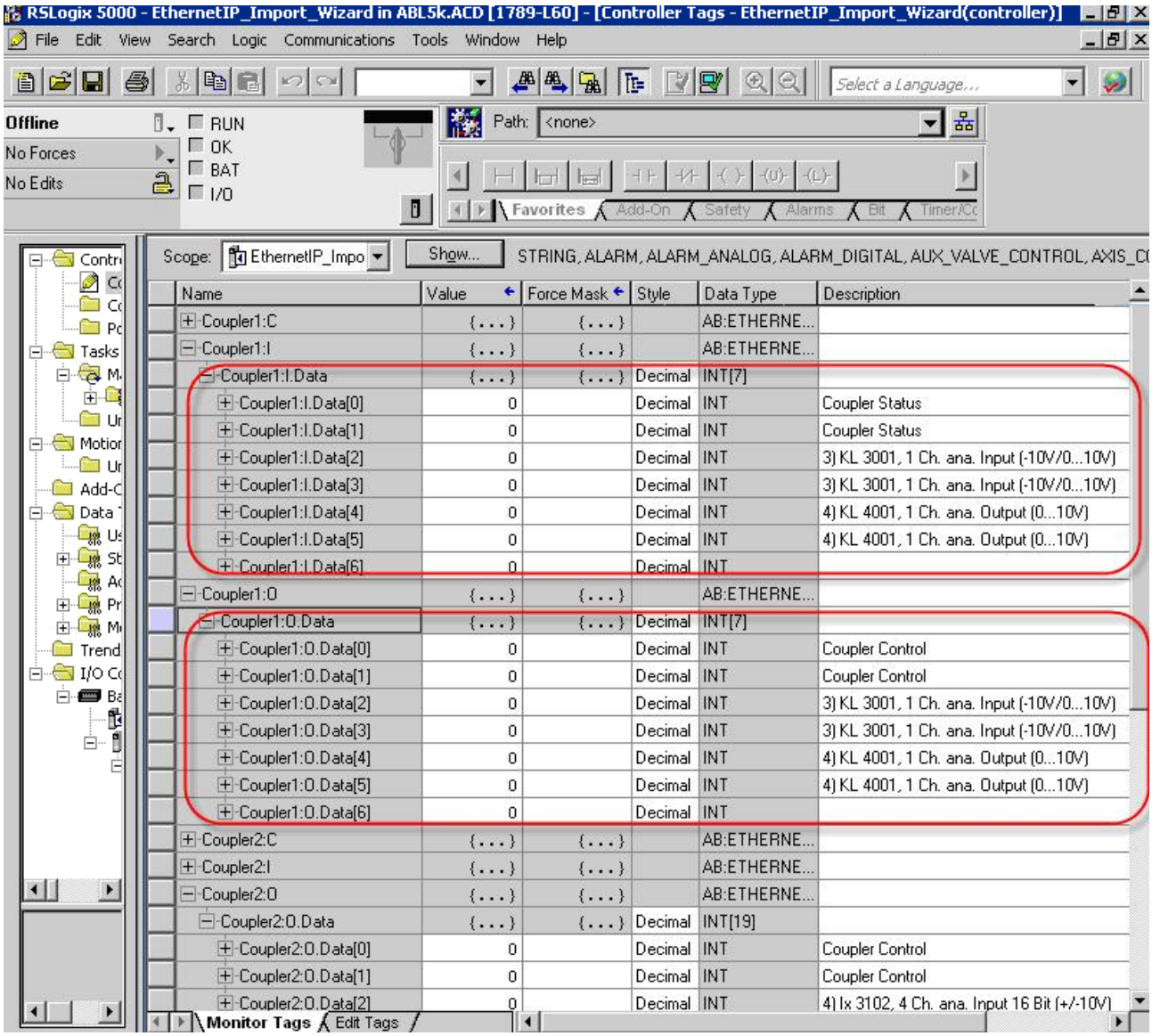


Fig. 19: EthernetIP Tag Wizard - Controller tags

Coupler Status and Coupler Control

After the import is successful, please see that the Coupler Status and Coupler Control is described at the bit level. Also the status and control for each complex channel is defined with the HBYTE->Empty LBYTE Status or Ctrl as the upper byte is padded.

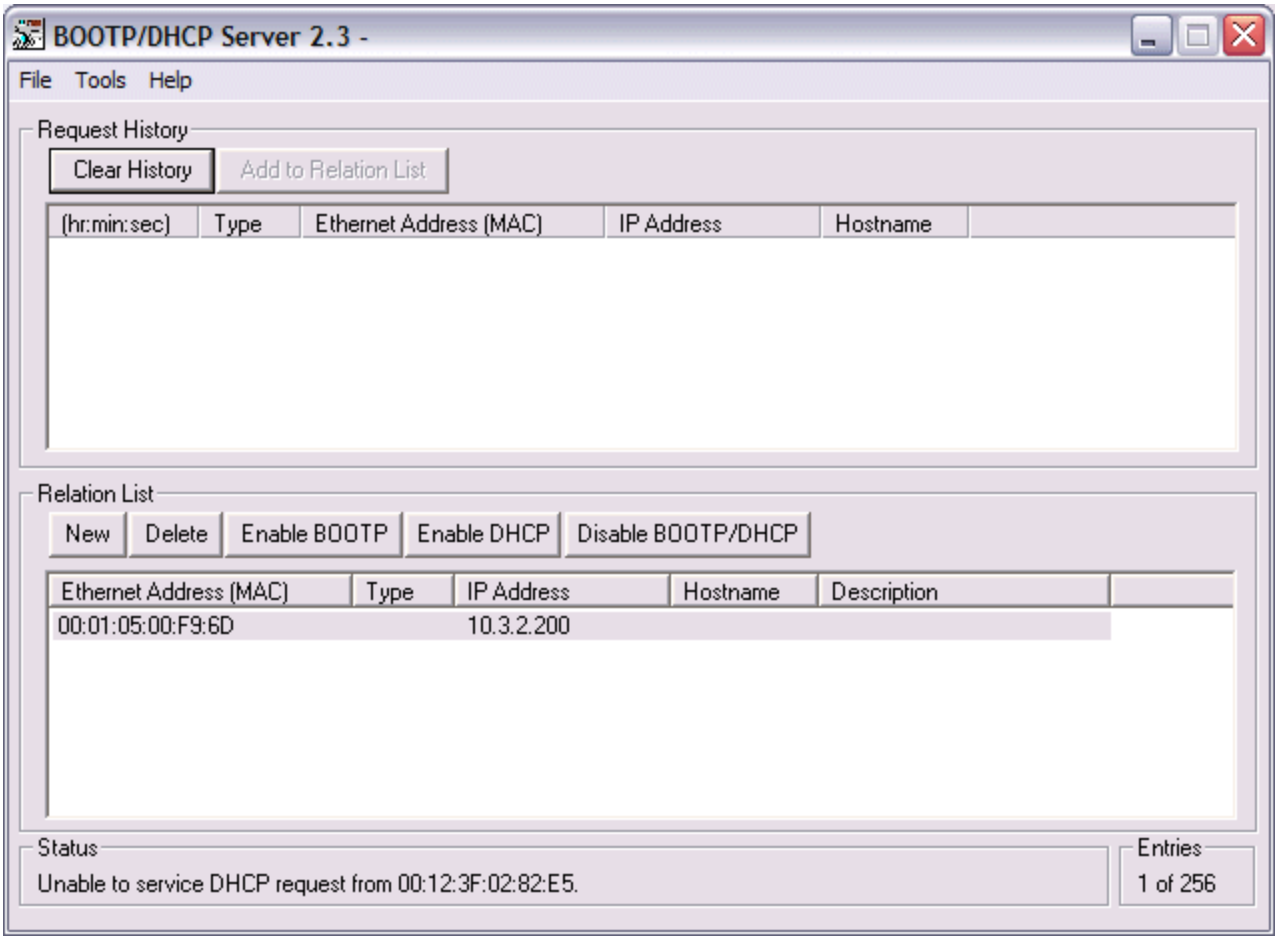
6 First Steps

6.1 Process Image

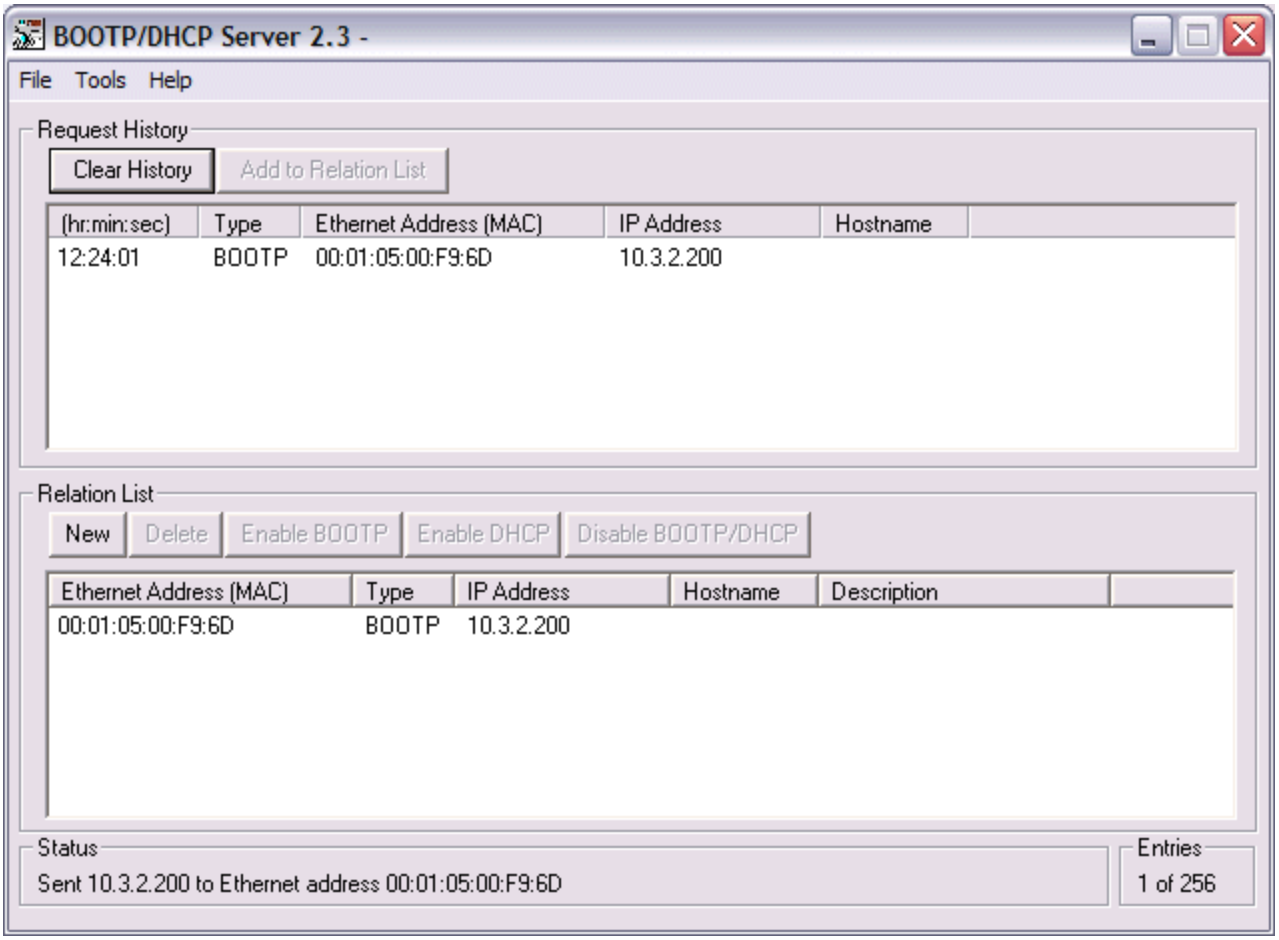
Addressing with the BOOTP/DHCP Server 2.3

Switch the rotary switch to 0xF5.

The MAC Address begin with 00-01-05-xx-xx-xx (the MAC address of each IL230x-B905 is printed on the right side of the box).

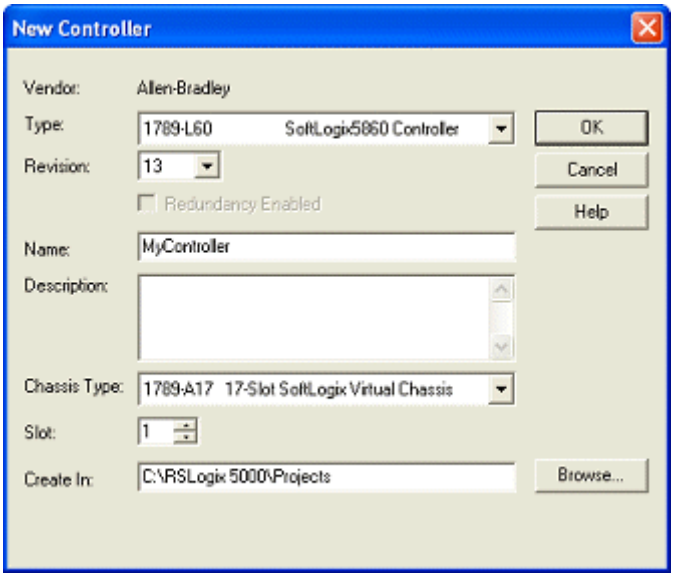


After a successful addressing you can disable the BOOTP addressing.



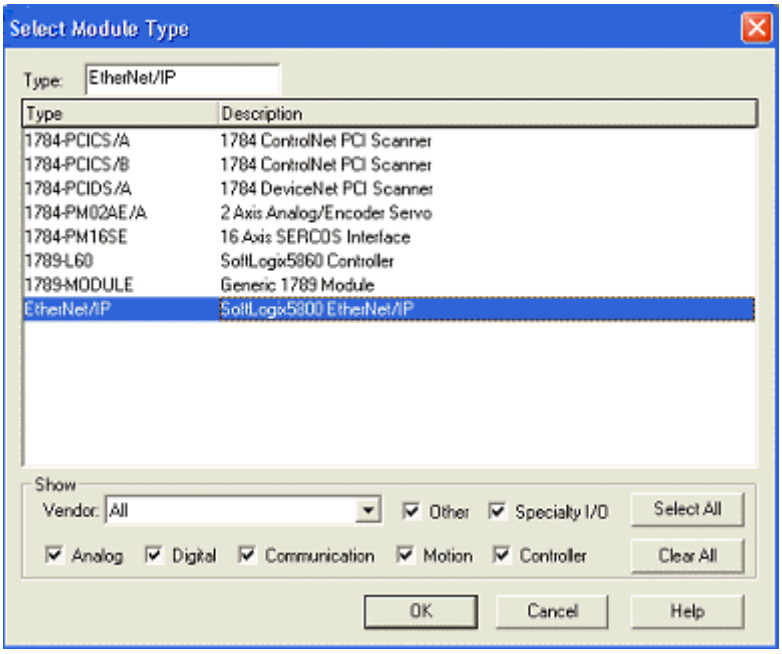
Open RSLogix 5000 and Create a new PLC project

When creating a new project make sure to select the correct controller type and controller settings. In this example we are using a SoftLogix Virtual Chassis, with the IL2301-B905 (Beckhoff Ethernet/IP Coupler Box)



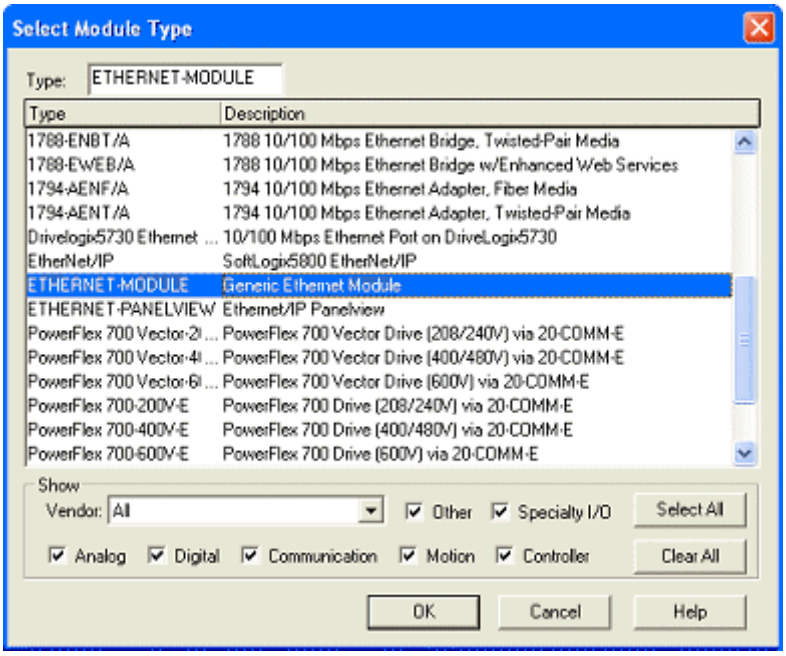
Add Ethernet IP Module

Now you need to add your main communications module. Make sure you know the IP address of the card that is setup as the EtherNet IP card, that address will have to be set in the module settings along with the slot the card is in.



Add Ethernet IP Box

When adding the IL2301-B905 box you must select the "ETHERNET-MODULE" as it is a generic Ethernet/IP device and we will configure it to work with our Coupler Box.



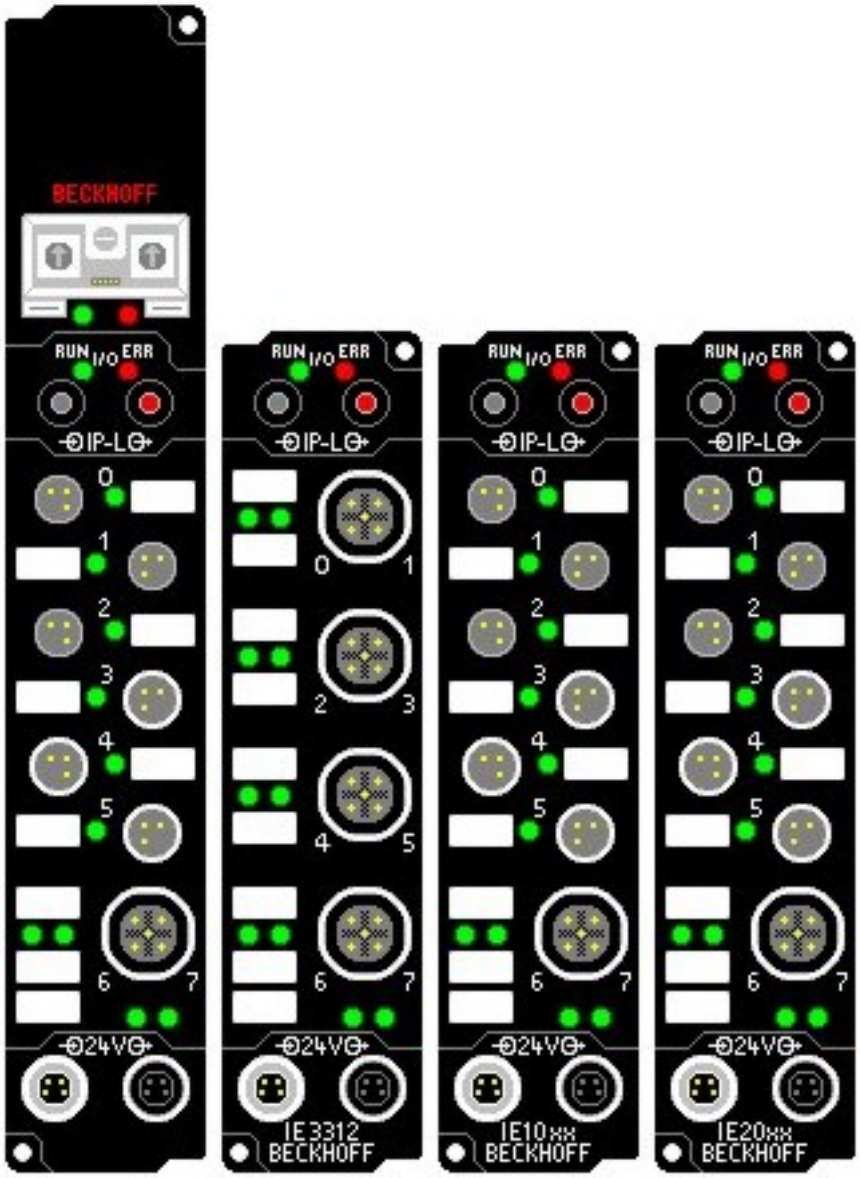
The figure below illustrates the hardware of the Beckhoff node in this example.

The process image table (I/O map) is displayed in double word format below the figure.

In order to properly configure the Ethernet Bridge, the process image of the Beckhoff IL2301-B905 node must be determined. When the Coupler Box is powered up, it automatically addresses the I/O modules of the node. The data for complex modules (modules using 2 or more bytes) are mapped first in the process image in the order of their physical position after the coupler. As such, they start at Double word 3. Following this, the digital modules are grouped into the next available Integer. The bits are arranged in the order of the

modules location. When the number of digital points exceeds 32 (1-double integer), the coupler automatically starts the next Double Integer. THe Coupler Box itself has 4 digital input and 4 digital output bits. These shall not be forgotten, when looking for the signals in the data image!

Note: The modules can be mapped as Byte, Word, or Double Word. The example below maps them as Double Word, using 1 analog input module (IE3312), 1 digital input module (IE1001) and 1 digital output module (IE2001).



Input Process Image

• Double Word 0 - IL2301-B905 Status

• Double Word 1 – Channel 1 IE3312 (High Word) and Status (Low Word)

• Double Word 2 – Channel 2IE3312(High Word) and Status (Low Word)

• Double Word 3 – Channel 3IE3312(High Word) and Status (Low Word)

• Double Word 4 – Channel 4IE3312(High Word) and Status (Low Word)

• Double Word 5 – digital inputs IL2301-B905, IE1001

Output Process Image

• Double Word 0 - IL2301-B905 Status

• Double Word 1 – Channel 1 IE3312 (High Word) and Control (Low Word)

• Double Word 2 – Channel 2IE3312(High Word) and Control (Low Word)

• Double Word 3 – Channel 3IE3312(High Word) and Control (Low Word)

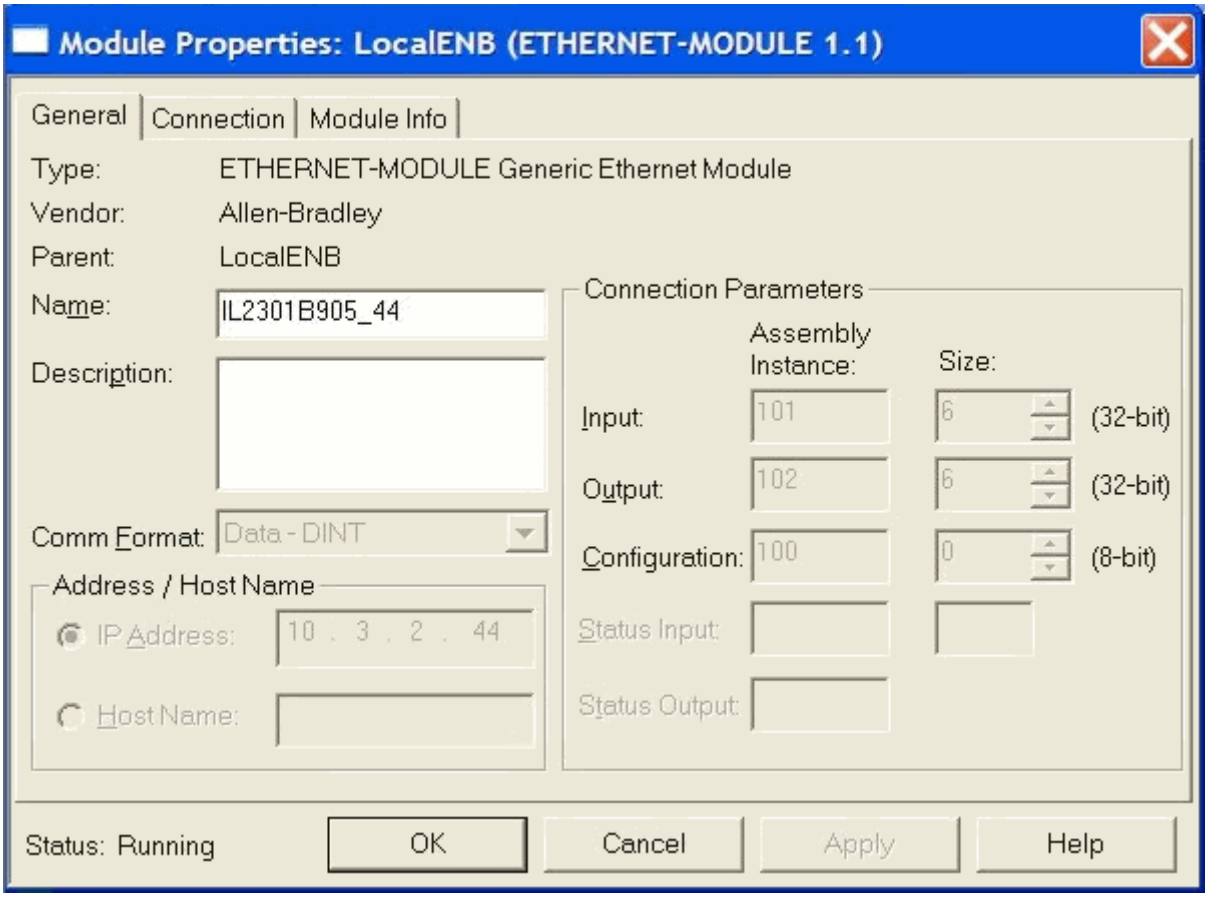
• Double Word 4 – Channel 4IE3312(High Word) and Control (Low Word)

• Double Word 5 – digital ouputs IL2301-B905, IE2001

Configuring the IL2301-B905 in RSLogix

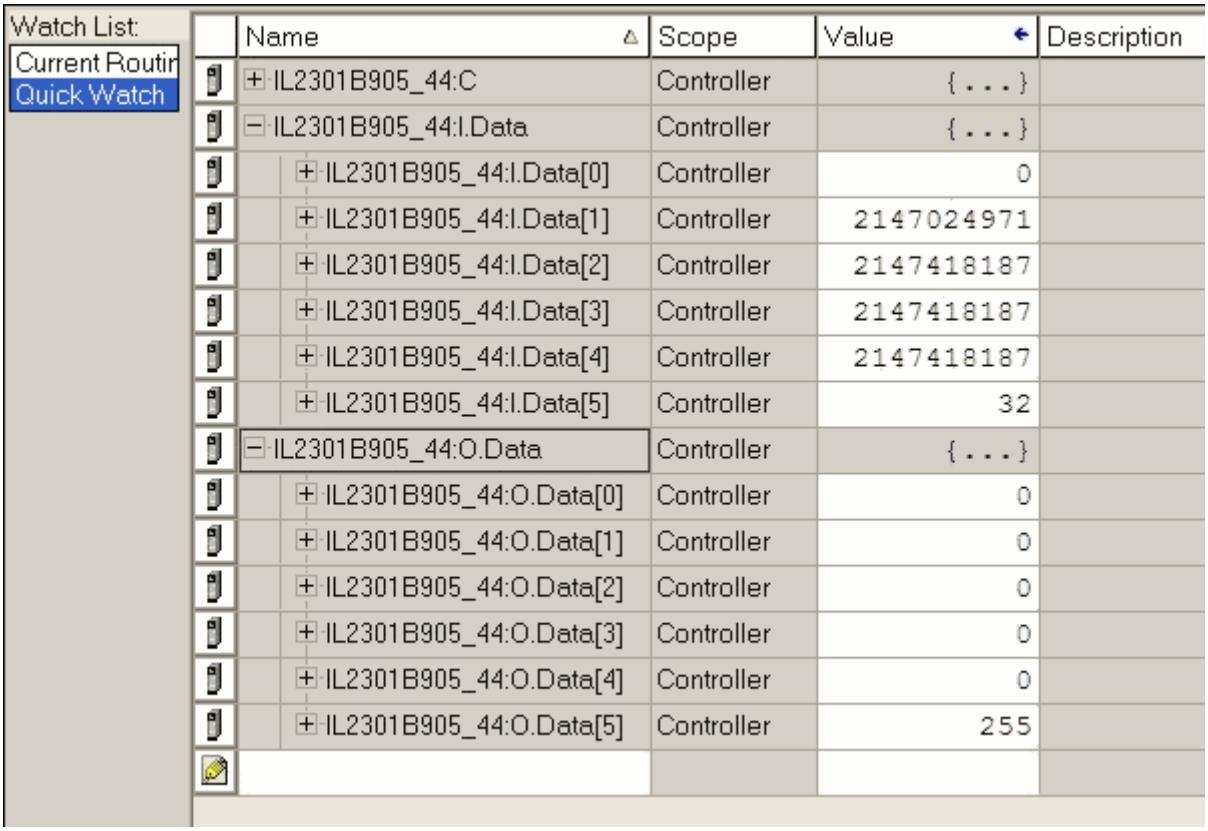
For the example here we used one IE3312, one IE1001 and one IE2001 extension boxes. With these cards that gave us 2 words total of input and output data. On the properties dialog you will need to change some of the box settings, please read below for recommendations on settings.

- IP Address (Refer to IP Address section of documentation)
- The Assembly Instances will be as follows
  - Input: 101
  - Output: 102
  - Configuration: 100
- Things to keep in mind when entering the data size for I/O
  - There will always be 4 bytes of input and 4 bytes of output data that is used for the Coupler itself
  - Digital IO: each channel will consume 1 bit of process data.
  - Complex IO: please refer to terminal documentation for consumed data size.

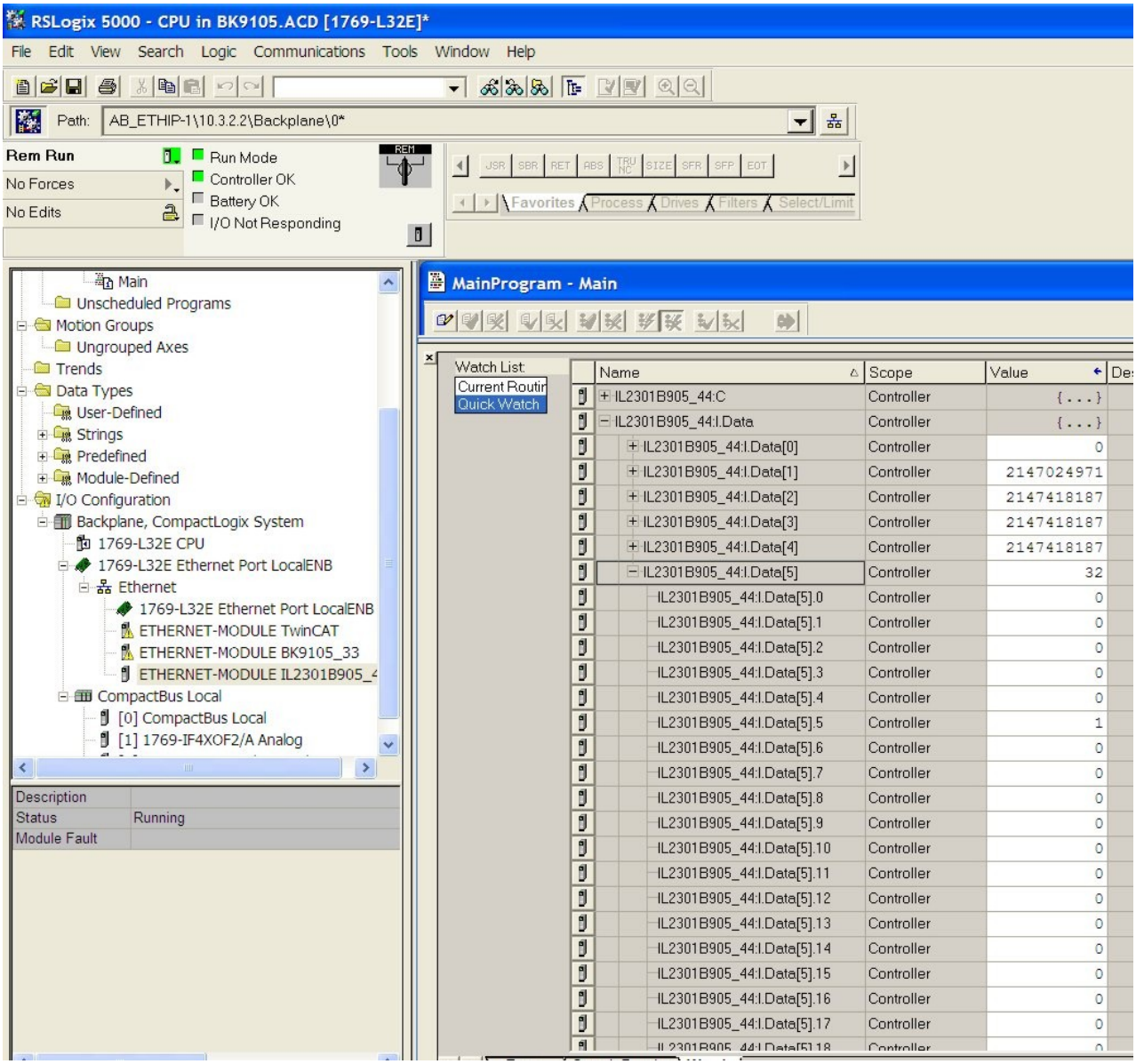


Working with IO data

Download the code to the controller unit, once you go online you will be able to toggle IO. Keep in mind that the first DINT is the Status for both the input and output data. At this point if you have the controller in RUN mode you will be able to toggle inputs and see the value in "IL2301B905_44:I.Data[5]" change and you should be able to update the values in "IL2301B905_44:O.Data[1]" and see the outputs change. Data[1] to [4] are the Status und Data form the 4 channel analog input module IE3312.



"IL2301B905_44:I.Data[5].5" is the second digital channel on the IE1001 (do not forget the 4 Bits for the IL2301-B905)


RSLogix 5000 - CPU in BK9105.ACD [1769-L32E]*
File Edit View Search Logic Communications Tools Window Help
Path: AB_ETHIP-1\10.3.2.2\Backplane\0*
Rem Run
Run Mode
Controller OK
Battery OK
I/O Not Responding
No Forces
No Edits
Favorites Process Drives Filters Select/Limit
Main
Unscheduled Programs
Motion Groups
Ungrouped Axes
Trends
Data Types
User-Defined
Strings
Predefined
Module-Defined
I/O Configuration
Backplane, CompactLogix System
1769-L32E CPU
1769-L32E Ethernet Port LocalENB
Ethernet
1769-L32E Ethernet Port LocalENB
ETHERNET-MODULE TwinCAT
ETHERNET-MODULE BK9105_33
ETHERNET-MODULE IL2301B905_4
CompactBus Local
[0] CompactBus Local
[1] 1769-IF4XOF2/A Analog
Description
Status Running
Module Fault
MainProgram - Main
Watch List:
Current Routir
Quick Watch
Name Scope Value
IL2301B905_44:C Controller {...}
IL2301B905_44:I.Data Controller {...}
IL2301B905_44:I.Data[0] Controller 0
IL2301B905_44:I.Data[1] Controller 2147024971
IL2301B905_44:I.Data[2] Controller 2147418187
IL2301B905_44:I.Data[3] Controller 2147418187
IL2301B905_44:I.Data[4] Controller 2147418187
IL2301B905_44:I.Data[5] Controller 32
IL2301B905_44:I.Data[5].0 Controller 0
IL2301B905_44:I.Data[5].1 Controller 0
IL2301B905_44:I.Data[5].2 Controller 0
IL2301B905_44:I.Data[5].3 Controller 0
IL2301B905_44:I.Data[5].4 Controller 0
IL2301B905_44:I.Data[5].5 Controller 1
IL2301B905_44:I.Data[5].6 Controller 0
IL2301B905_44:I.Data[5].7 Controller 0
IL2301B905_44:I.Data[5].8 Controller 0
IL2301B905_44:I.Data[5].9 Controller 0
IL2301B905_44:I.Data[5].10 Controller 0
IL2301B905_44:I.Data[5].11 Controller 0
IL2301B905_44:I.Data[5].12 Controller 0
IL2301B905_44:I.Data[5].13 Controller 0
IL2301B905_44:I.Data[5].14 Controller 0
IL2301B905_44:I.Data[5].15 Controller 0
IL2301B905_44:I.Data[5].16 Controller 0
IL2301B905_44:I.Data[5].17 Controller 0

7 Error Handling and Diagnosis

7.1 Diagnostic LEDs - Overview

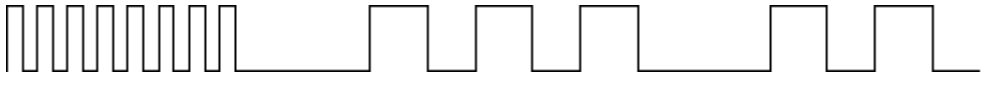
Error diagnosis

There are 2 sorts of errors:

- Fieldbus Errors [▶ 58]
- Local Errors [▶ 60] on Compact Box or Coupler Box

Blink Codes

Blink sequence	Meaning
Fast flashing	Beginning of the Blink Code
first slow sequence	Error code
second slow sequence	Error argument
third slow sequence (optional)	Error argument



Beginning Error code Error argument

7.2 Diagnostic LEDs for Ethernet/IP

After switching on, the Fieldbus Box 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 Inputs/ Outputs is indicated. The error code can be determined from the frequency and number of blinks. This permits rapid rectification of the error.

The module has two groups of LEDs for the display of status.
The upper group with four LEDs indicates the status of the respective fieldbus. The significance of the fieldbus status LEDs is explained in the appropriate sections of this manual. It corresponds to the usual fieldbus display.

At the lower end of the module are two more green LEDs that indicate the supply voltage. The left hand LED indicates the presence of the 24 V_{DC} supply for the Fieldbus Box. The right hand LED indicates the presence of the supply to the power contacts.

Fig. 20: B905_EN_DiaLED

LEDs for Ethernet diagnosis

LED	On	Out
LINK	Physical connection present	No physical connection present
ACT	Flashing: Bus traffic present	No bus traffic (bus idle)

LEDs for Ethernet/IP diagnosis

Ethernet/IP diagnostis	EIP R (green)	EIP E (red)
IP address OK	0.5s	off
No IP Address (Switch 8,9 -> on)	off	off
Online	on	off
Offline PLC Stop	0.1s	off
TimeOut	off	0.5s
IP Address conflict	off	on

LEDs for power supply diagnosis

LED	Meaning
Left LED off	Module has no power
Left LED red	Short circuit detection for sensor supply (< 500mA) is active. Sensors/Inputs are not supplied anymore
Right LED off	No 24 V_{DC} power for the outputs connected

7.3 Diagnostic LEDs for local errors

Local error in a Coupler Box (IL230x-Bxxx/Cxxx)

The term *local error* means that an error has occurred in the Fieldbus Box or the IP-Link. IP-Link errors most often turn out to be a result of inappropriate use of the optical fiber.

LED green	LED red			Description	Remedy
off	off			No data exchange	Module in synchronous mode or - activate PROFIBUS cyclic data
off	1	0		EEPROM checksum error	Set manufacturer's setting with the KS2000 software
off	2			Reserved	-
off	3			Break location has been recognized	interruption before the master's receiver
	3	n		Break location has been recognized	n-th module before the master's receiver
	3	n	m	Break location has been recognized	(n*10)+m-th module before the master's receiver
off	4	n		Too many faulty telegrams have been detected (more than 25%)	The optical fiber wiring in front of the nth extension module should be checked
off	5	n		Register access to complex modules has failed	Check the nth module
off	11	n		Complex module working incorrectly	Exchange the nth module
off	12	n		More than 120 modules in the ring	Connect fewer modules
off	13	n		nth module unknown	Firmware update required
on	off			Module is exchanging data	no error

Local errors in an Extension Box

LED green	LED red	Description
off	on	No data is being received over the IP-Link
off	blinks, flickers	Faulty IP-Link protocols are being received (very poor data connection)
blinks, flickers	blinks, flickers	Faulty IP-Link protocols are being received (poor data connection), does not necessarily lead to an error
on	off	IP-Link protocols are being received, no error

Faulty protocols can occur, because of:

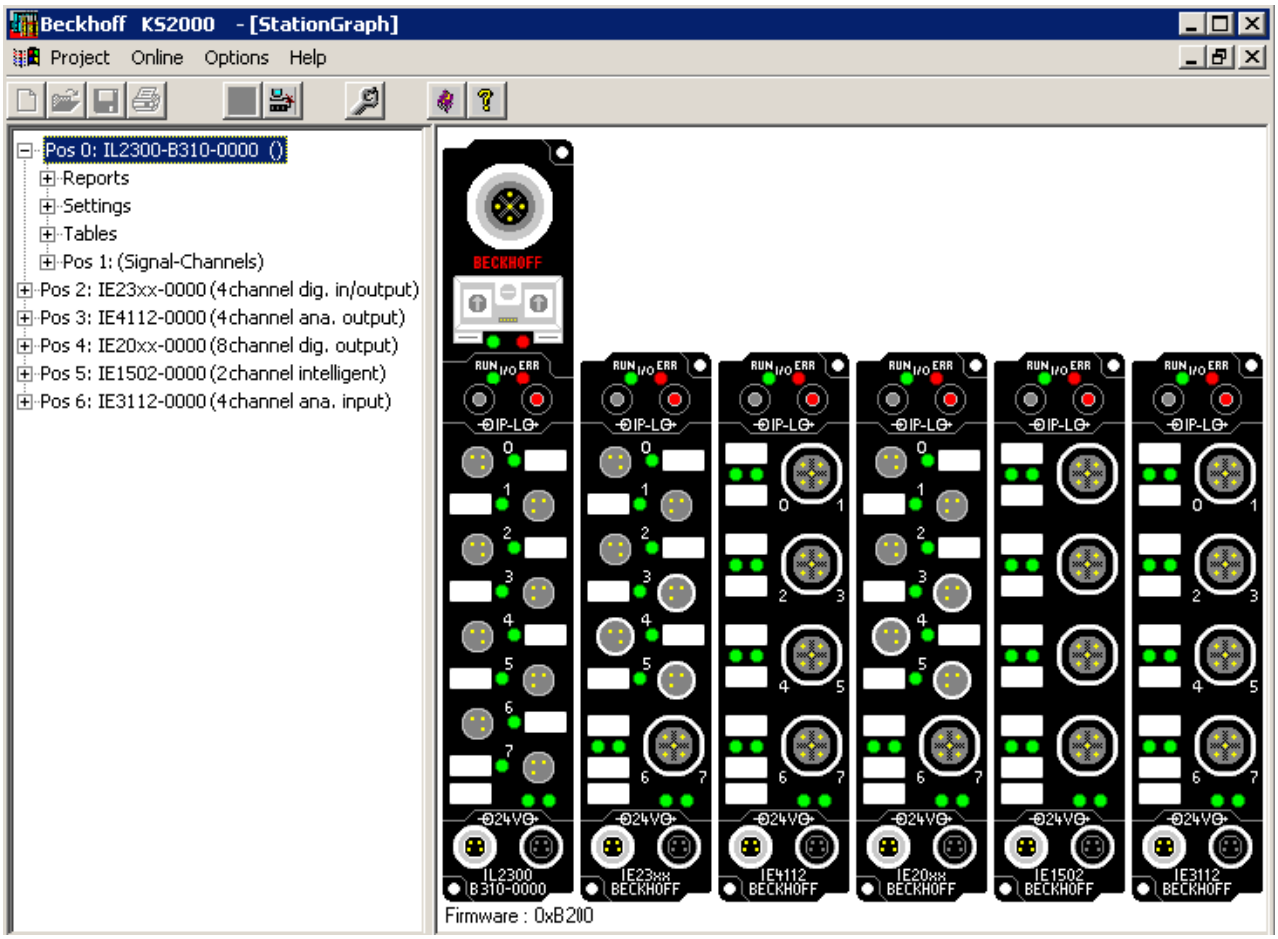
- bad configured IP-Link connectors
- IP-Link cable with higher dampening, e.g. because of a sharp curve
- contaminated sender LED (module before the faulty one)
- contaminated receiver

The internal IP-Link error counter [▶ 61] of the Coupler Box can be read with the KS2000 software.

7.4 Check of the IP-Link connection

A correct assembled IP-Link cable will assure an error free transmission.

An additional testing of the transmission quality and error diagnostics is possible with the KS2000 configuration software.



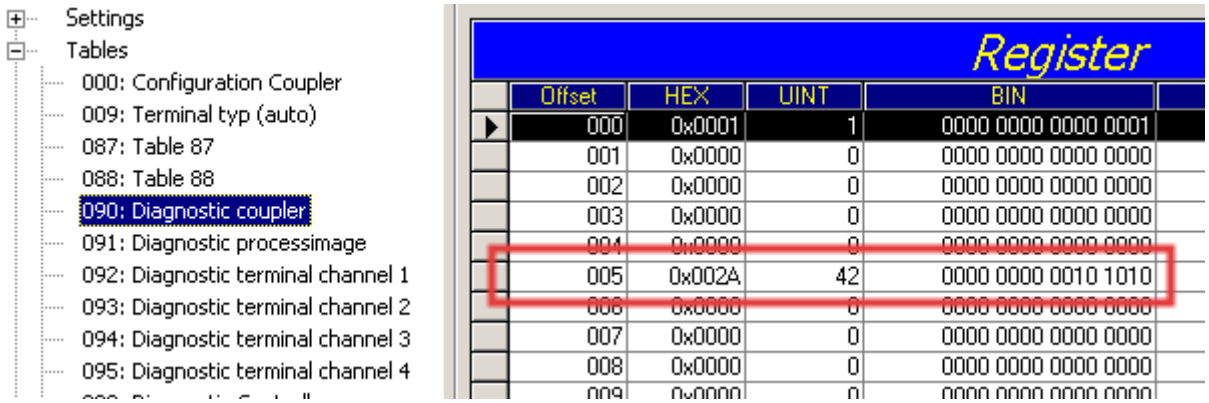
For this test, the fieldbus master (e.g. a PROFIBUS PC Card) should be on the bus and it should transmit data cyclical. Another way to generate cyclic data is, to switch the coupler to *free running* via the KS2000 software.

The result should be, that the I/O RUN LED flashes in a bright green. This shows, that a data exchange with the connected extension boxes takes place. A red blinking I/O ERR LED shows faulty IP-Link telegrams. These faulty telegrams will be repeated automatically like in any other fieldbus system. This way a transmission of the data is guaranteed.

Error counter

Table 90, offset 005 shows possible IP-Link errors. Sporadic appearing errors do not mean any problem for the communication, as long as they do not reach a critical limit.

This error counter is only reset by the Power ON/OFF.



If lots of errors occur in a very short time, this will be interpreted as a heavy disturbance of the communication and the coupler box will report this error. This can be seen at offset 006 and 007. Both values will show a value > 200 and the I/O ERR LEDs of the coupler box will blink the according error code.

Note

The KS2000 Configuration Software communicates with the Coupler Box via the serial channel. The content of the registers will not be refreshed automatically.

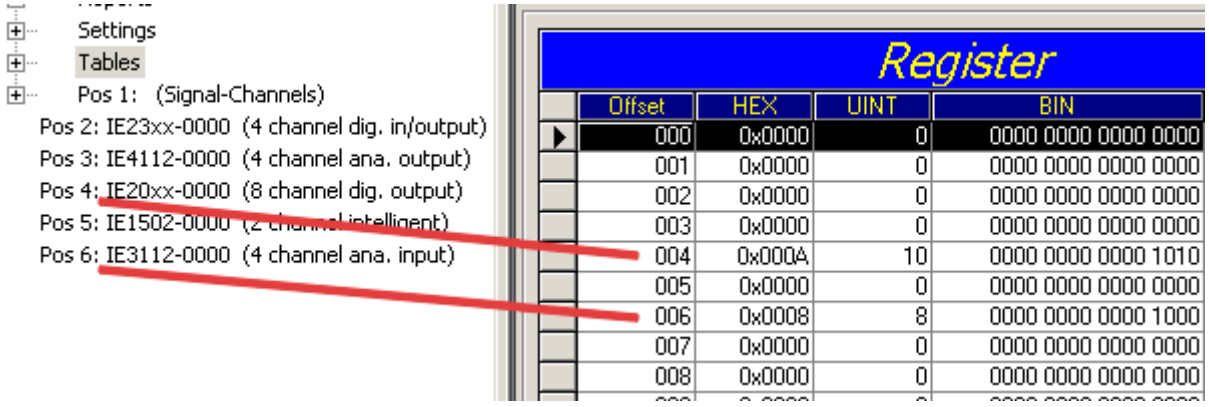
Position of the error

In case of an IP-Link error, the Coupler Box tries to read the error location from the register of the Extension Box. If the fiber optic ring is interrupted or the communication is heavily disturbed, this is not possible. Only the position of the last functioning Extension Box before the receiver of the Coupler Box can be recognized. The box will then flash this error code via the I/O ERR LED.

If the communication via IP-Link is still running, table 87 shows the error counter of each Extension Box.

The offset register corresponds to the position of the Extension Box in the KS2000 tree (left side of graphic). This example shows errors at offset 004 and 006.

In the "real" world the faulty IP-Link telegram was reported from the IE20xx and the IE3112, that means the problem has to looked for before these modules.



The error can be up to:

- the sending module
- the receiving module
- the IP-Link cable
- the connectors

If there is an error in table 90 and none in table 87, the faulty transmission is between the last Extension Box and the Coupler Box.

In most cases the transmission errors can be traced back to bad configured IP-Link connectors or a too high attenuation of the cable due to sharp bending.

The values of table 87 directly come from the extension boxes. In case of an IP-Link interruption these values will be set to zero and only table 90 can be used.

Note

If you want to operate a Coupler Box (e.g. IL2300-Bxxx, IL2301-Bxxx or IL2302-Bxxx) totally without Extension Box Modules (IExxxx), you have to connect the send and receive socket of this Coupler Box directly by using an IP Link Cable! For this the IP Link Jumper ZK1020-0101-1000 fits perfect.

8 Accessories

8.1 Fieldbus Box accessories

The necessary accessories for the Fieldbus Box Modules are also available from Beckhoff in protection class IP67. You may get an overview from the Beckhoff catalog or from our internet pages (http://www.beckhoff.com).

Fieldbus Accessories

- Pre-assembled cable
- Plug
- Distributor

Power supply

- Pre-assembled cable
- Plug
- Distributor

Sensor power supply

- Pre-assembled cable
- Plug
- Distributor

IP-Link

- Pre-assembled cable
- Plug

8.2 Power cables

Ordering data

Order designation	Power lead	Screw-in connector	Contacts	Cross-section	Length
ZK2020-3200-0020	Straight socket, open end	M8	4-pin	0.34 mm^2	2.00 m
ZK2020-3200-0050					5.00 m
ZK2020-3200-0100					10.00 m
ZK2020-3400-0020	Angled socket, open end				2.00 m
ZK2020-3400-0050					5.00 m
ZK2020-3400-0100					10.00 m
ZK2020-3132-0001	Straight socket, straight socket				0.15 m
ZK2020-3132-0005					0.50 m
ZK2020-3132-0010					1.00 m
ZK2020-3132-0020					2.00 m
ZK2020-3132-0050					5.00 m
ZK2020-3334-0001	Angled socket, angled socket				0.15 m
ZK2020-3334-0005					0.50 m
ZK2020-3334-0010					1.00 m
ZK2020-3334-0020					2.00 m
ZK2020-3334-0050					5.00 m

Further available power cables may be found in the Beckhoff catalog or on our internet pages (http://www.beckhoff.com).

Technical data

Technical data	
Rated voltage according to IEC60 664-1	60 V_{AC} / 75 V_{DC}
Contamination level according to IEC 60 664-1	3/2
Insulation resistance IEC 60 512-2	>10^9W
Current carrying capacity according to IEC 60512-3	4 A
Volume resistance according to IEC 60512-2	< 5 mW
Protection class according to IEC 60529	IP65/66/67, when screwed together
Ambient temperature	-30°C to +80°C

9 Appendix

9.1 General operating conditions

Protection degrees (IP-Code)

The standard IEC 60529 (DIN EN 60529) defines the degrees of protection in different classes.

1. Number: dust protection and touch guard	Definition
0	Non-protected
1	Protected against access to hazardous parts with the back of a hand. Protected against solid foreign objects of Ø50 mm
2	Protected against access to hazardous parts with a finger. Protected against solid foreign objects of Ø12,5 mm.
3	Protected against access to hazardous parts with a tool. Protected against solid foreign objects Ø2,5 mm.
4	Protected against access to hazardous parts with a wire. Protected against solid foreign objects Ø1 mm.
5	Protected against access to hazardous parts with a wire. Dust-protected. Intrusion of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the device or to impair safety.
6	Protected against access to hazardous parts with a wire. Dust-tight. No intrusion of dust.

2. Number: water* protection	Definition
0	Non-protected
1	Protected against water drops
2	Protected against water drops when enclosure tilted up to 15°.
3	Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water. Water splashed against the disclosure from any direction shall have no harmful effects
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water. Intrusion of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water for 30 min. in 1 m depth.

*) These protection classes define only protection against water!

Chemical Resistance

The Resistance relates to the Housing of the Fieldbus Box and the used metal parts.

Character	Resistance
Steam	at temperatures >100°C: not resistant
Sodium base liquor (ph-Value > 12)	at room temperature: resistant > 40°C: not resistant
Acetic acid	not resistant
Argon (technical clean)	resistant

Key

resistant: Lifetime several months
non inherently resistant: Lifetime several weeks
not resistant: Lifetime several hours resp. early decomposition

9.2 Approvals

UL in preparation

Conformity mark

CE

Type of protection

IP65/66/67 in accordance with EN60529

9.3 Test standards for device testing

EMC

Resistance: EN 61000-6-2

Emission: EN 61000-6-4

Resistance to Vibration

EN 60068-2-2 Vibration test, Amplitude 2 g (Standard 1 g)

EN 60068-2-27 Shock Test, Shock count 1000 (Standard 2)

9.4 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: https://www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline:	+49 5246 963 157
Fax:	+49 5246 963 9157
e-mail:	support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49 5246 963 460
Fax:	+49 5246 963 479
e-mail:	service@beckhoff.com

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
Germany

Phone:	+49 5246 963 0
Fax:	+49 5246 963 198
e-mail:	info@beckhoff.com
web:	https://www.beckhoff.com

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com