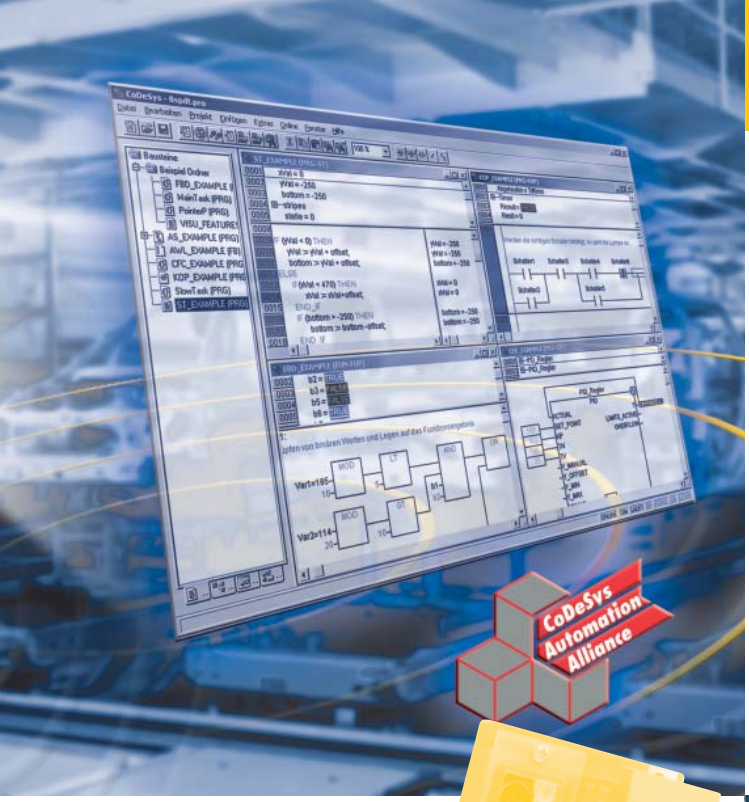


TURCK

Industrial Automation

BL67 -

programmable Gateway BL67-PG-EN-IP

USER MANUAL

Edition 10/2007

Before starting the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighboring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0 105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 (VDE 0 100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have

been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.

- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC 60 364 and HD 384 and national work safety regulations).
- All shrouds and doors must be kept closed during operation.

Table of Contents

About this Manual

Documentation Concept

This manual contains information about the programmable BL67 gateway for EtherNet/IP BL67-PG-EN-IP.

The following chapters contain a short BL67 system description, a description of the field bus system Ethernet, exact information about function and structure of the BL67 Ethernet gateways as well as all bus specific information concerning the connection to automation devices, the maximum system extension etc.

The bus-independent I/O-modules for BL67 as well as all further fieldbus-independent chapters like mounting, labelling etc. are described in a separate manual.

- BL67 I/O-modules
  (TURCK-Documentation-No.: German D300572/
  English D300529)

Furthermore, the manual mentioned above contains a short description of the project planning and diagnostics software for TURCK I/O-systems, the engineering software I/O-ASSISTANT.

General Information

Attention

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

This manual contains all necessary information about the prescibed use of the programmable TURCK gateway BL67-PG-EN-IP.
It has been specially conceived for personnel with the necessary qualifications.

Prescribed use

Warning

The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

Notes concerning planning /installation of this product

Warning

All respective safety measures and accident protection guidelines must be considered carefully and without exception.

Description of Symbols Used

Warning

This sign can be found next to all notes that indicate a source of hazards. This can refer to danger to personnel or damage to the system (hardware and software) and to the facility.

This sign means for the operator: work with extreme caution.

Attention

This sign can be found next to all notes that indicate a potential hazard.

This can refer to possible danger to personnel and damages to the system (hardware and software) and to the facility.

Note

This sign can be found next to all general notes that supply important information about one or more operating steps. These specific notes are intended to make operation easier and avoid unnecessary work due to incorrect operation.

List of Revisions

In comparison to the previous manual edition, the following changes/ revisions have been made:

Table 1: List of revisions

Chapter	Subject/ Description	new	changed
Chap. 5	Configuration of the BL67-PG-EN-IP in RSLogix, page 5-27.	X	

Note

The publication of this manual renders all previous editions invalid.

1 BL67 Philosophy

The Basic Concept

BL67 is a modular IP67 I/O-system for use in industrial automation. It connects the sensors and actuators in the field to the higher-level master.

BL67 offers modules for practically all applications:

- Digital input and output modules
- Analog input and output modules
- Technology modules (RS232 interface,...)

A complete BL67 station counts as **one** station on the bus and therefore occupies **one** fieldbus address in any given fieldbus structure. A BL67 station consists of a gateway, power distribution modules and I/O-modules.

The connection to the relevant fieldbus is made via the bus-specific gateway, which is responsible for the communication between the BL67 station and the other fieldbus stations.

The communication within the BL67 station between the gateway and the individual BL67 modules is realized via an internal module bus.

Note

The gateway is the only fieldbus-dependent module on a BL67 station. All other BL67 modules are not dependent on the fieldbus used.

Flexibility

A BL67 station can contain modules in any combination, which means it is possible to adapt the system to practically all applications in automated industries.

Convenient handling

All BL67 modules, with the exception of the gateway, consist of a base module and an electronic module.

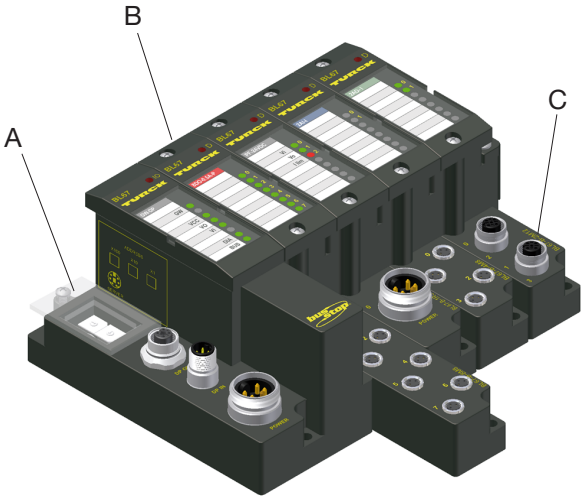
The gateway and the base modules are either snapped onto a mounting rail or are directly mounted onto the machine frame. The electronic modules are plugged onto the appropriate base modules.

After disconnection of the load, the electronic modules can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

BL67 Components

Figure 1:
BL67 station

A *gateway*
B *electronic module*
C *base module*



Gateways

The gateway connects the fieldbus to the I/O-modules. It is responsible for handling the entire process data and generates diagnostic information for the higher-level master and the software tool I/O-ASSISTANT.

Figure 2:
BL67 gateway

Electronic modules

Electronic modules contain the functions of the BL67 modules (Power Feeding modules, digital and analog input/output modules, technology modules).

Electronic modules are plugged onto the base modules and are not directly connected to the wiring. They can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

Figure 3: electronic module

Power feeding modules

Power Feeding modules distribute the required 24 V DC field voltage to the I/O-modules. They are necessary for building groups of modules with different potentials within a BL67 station, or if the rated supply voltage for the outputs cannot be guaranteed.

Power Feeding modules are potentially isolated from the gateway, the adjoining power supply module and the I/O-modules to the left side.

Note

For detailed information about the individual BL67 I/O components, please refer to the chapters 2 to 8 of the manual "BL67- I/O-modules" (TURCK Documentation-No.: German D300572; English: D300529).
The "Appendix" to the manual mentioned above contains (amongst others) a list of all BL67 components and the assignment of electronic modules to base modules.

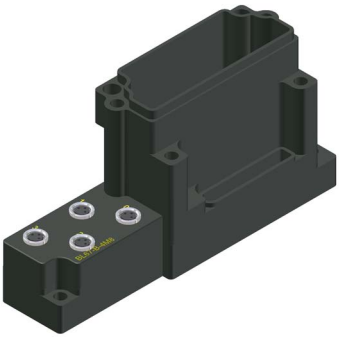
Base modules

The field wiring is connected to the base modules.

These are available in the following connection variations:

- 1 x M12, 2 x M12, 2 x M12-P, 4 x M12, 4 x M12-P
- 4 x M8, 8 x M8
- 1 x M12-8
- 1 × M23, 1 x M23-19
- 1 x 7/8" (for Power Feeding Module)

Figure 4: example of a base module

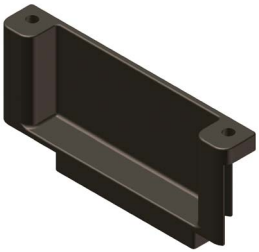


End plate

An end plate on the right-hand side physically completes the BL67 station.

It protects the module bus connections of the last base module in a station and guarantees the protection class IP67.

Figure 5: end plate



2 EtherNet/IP

System Description

Ethernet Industrial Protocol (EtherNet/IP) is a communication system for industrial applications.

It is used to exchange time-critical application information between industrial devices such as simple I/O devices (sensors/actuators) or even complex control devices (robots, programmable logic controllers, etc.).

EtherNet/IP is an open network because it uses:

- IEEE 802.3 Physical and Data Link standard
- Ethernet TCP/IP protocol suite (Transmission Control Protocol/ Internet Protocol), the Ethernet industry standard.
- Common Industrial Protocol (CIP), the protocol that provides real-time I/O messaging and information/peer-to-peer messaging. ControlNet and DeviceNet networks also use CIP.

Note

For further infomation about CIP and EtherNet/IP, please contact also the user organization ODVA (www.odva.org).

IP (Internet Protocol)

The Internet Protocol is a connection-free transport protocol. Since the protocol does not use acknowledgement messages, telegrams can get lost. Therefore it is not suitable for safe data transfer. The main functions of the internet protocol are the addressing of hosts and the fragmentation of data packages.

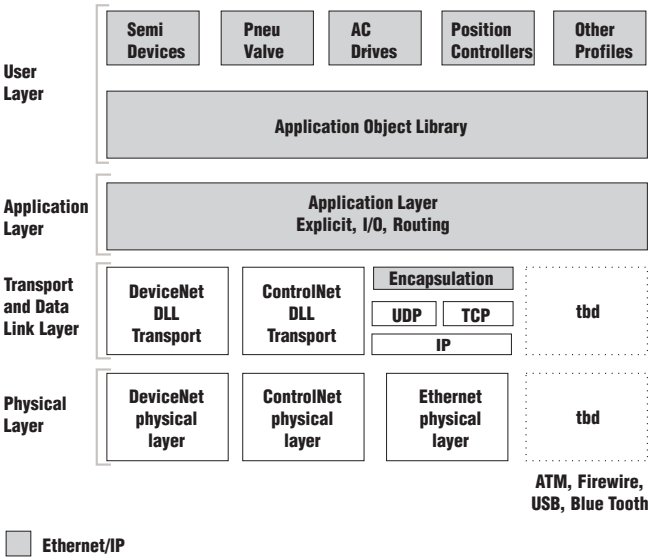
TCP (Transmission Control Protocol)

The Transmission Control Protocol (TCP) is a connection-oriented transport protocol and is based on the Internet Protocol. A safe and error-free data transport can be guaranteed by means of certain error diagnostic mechanisms. For example, the acknowledgement and time monitoring of telegrams.

UDP/IP (User Datagram Protocol)

UDP/IP provides the fast, efficient data transport necessary for real-time data exchange. To make EtherNet/IP successful, CIP has been added on top of TCP/UDP/IP to provide a common application layer.

Figure 6: EtherNet/IP in OSI 7 layer model



Network-topology

EtherNet/IP network uses an active star topology in which groups of devices are connected point-to-point to a switch.

Products with both transmission speeds (10 and 100 Mbit/s) can be used in the same network and most Ethernet switches will negotiate the speed automatically.

Transmission media

For communication via Ethernet, different transmission media can be used:

- coaxial cable (10Base5)
- optical fibre (10BaseF)
- twisted two-wire cable (10BaseT) with shielding (STP) or without shielding (UTP)

Addressing on EtherNet/IP

Ethernet MAC-ID

The Ethernet MAC-ID is a 6-byte-value which serves to identify an Ethernet device. The MAC-ID is determined for each device by the IEEE (Institute of Electrical and Electronics Engineers, New York).

The first 3 bytes of the MAC-ID contain a manufacturer identifier (Turck: 00:07:46:xx:xx:xx). The last 3 bytes can be chosen freely by the manufacturer for each device and contain a serial number.

The MAC-ID can be read from the module using the software tool "I/O-ASSISTANT".

IP address

Each Ethernet-host receives its own IP address. In addition, the node knows its netmask and the IP address of the default gateway.

The IP address is a 4-byte-value which contains the address of the network to which the node is connected as well as the host address in the network.

The IP address of the BL67-PG-EN-IP gateway is predefined as follows:

IP address: 192.168.1.×××

netmask: 255.255.255.0

gateway: 192.168.1.001

The netmask shows which part of the IP address defines the network as well as the network class, and which part of the IP address defines the single node in the network.

In the example mentioned above, the first 3 bytes of the IP address define the network. They contain the subnet-ID 192.168.1.
The last byte of the IP address defines the node's address within the network.

Note

In order to build communication between a PC and an Ethernet-module, both have to be nodes on the same network.

If necessary, the nodes' network addresses have to be adapted one to another. Please read Chapter 8, „Changing the IP address of a PC/network interface card", page 8-3.

Network classes

The available networks are divided into the different network classes A, B, and C.

Figure 7: Network classes

Class	Network addresses	Bytes for net address	Bytes for host address	No. of possible networks/ hosts
A	1.xxx.xxx.xxx-126.xxx.xxx.xxx	1	3	126/ 2^{24}
B	128.0.xxx.xxx - 191.255.xxx.xxx	2	2	2^{14}/ 2^{16}
C	192.0.0.xxx - 223.255.255.xxx	3	1	2^{21}/ 256

According to their predefined address 192.168.1.xxx BL67 gateways are nodes on a Class C network.

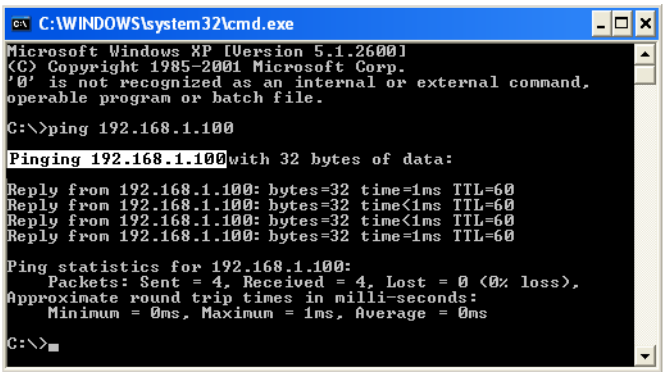
Checking the communication via "ping-signals"

You can check the communication between nodes in a network using ping-signals in the DOS-prompt of your PC.

For that purpose, enter the command "ping" and the IP address of the network node to be checked.

If the node answers the ping-signal, it is ready for communication and takes part in the data transfer.

Figure 8: ping-signal



ARP (Address Resolution Protocol)

In each TCP/IP-capable computer, ARP serves to clearly assign the worldwide unique hardware addresses (MAC-IDs) to the single IP addresses of the network nodes via internal tables.

Using ARP in the DOS-prompt, every node in a network can be clearly identified via its MAC-ID.

- Write a ping command for the respective station/ IP address: (example: "x:\\ping 192.168.1.100").
- Via the command "x:\\arp -a", the MAC-ID (00-07-46-ff-60-13) for this IP address is determined. This MAC-ID clearly identifies the network node.

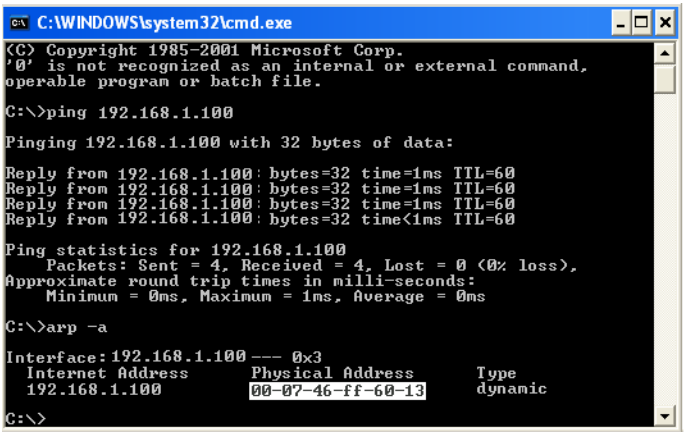


Figure 9: Determination of the MAC-ID of a BL67 module via ARP

3 Technical Features

General

This chapter contains the general technical description of the programmable BL67 gateway for EtherNet/IP.

Function

The programmable BL67 gateways can be used as an autonomous PLC or as a de-central PLC in a network interconnection for fast signal processing

Note

The programmable BL67 gateway BL67-PG-EN-IP is designed as a Single Task System.

The gateway is the connection between the BL67 I/O-modules and the Ethernet-network.

It handles the entire process data traffic between the I/O-level and the fieldbus and generates diagnostic information for higher-level nodes and the software tool I/O-ASSISTANT.

Programming

The gateways BL67-PG-××× are programmable according to IEC61131-3 using the software tool CoDeSys V2.3 from 3S - Smart Software Solutions GmbH.

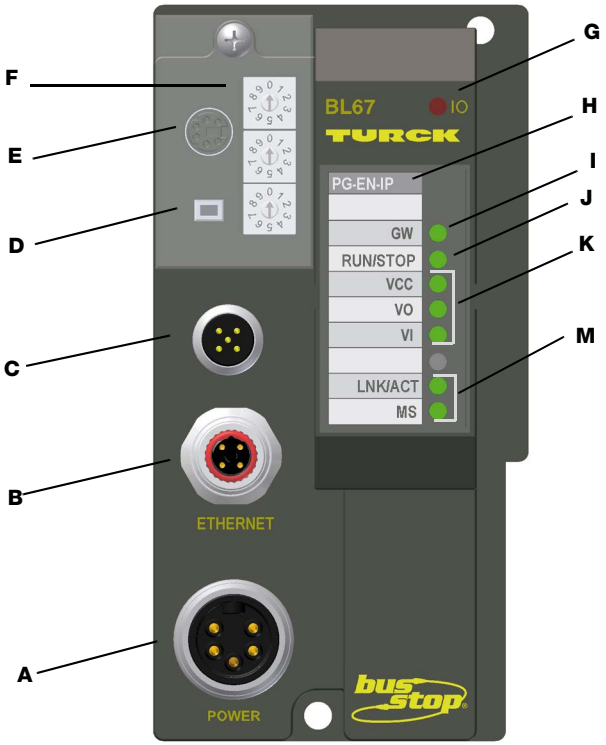
For programming the gateway, the following programming languages according the standards can be used:

LD	= Ladder
FDB	= Function Block Diagram
IL	= Instruction List
ST	= Structured Text
SFC	= Sequential Function Chart

Technical Data

Figure 10:
BL67-PG-EN-IP

A *power supply*
B *Ethernet*
C *n.c.*
D *SET-button*
E *service-interface*
F *rotary coding switches*
G *module bus LED*
H *designation*
I *status LED*
J *RUN/STOP LED*
K *LEDs for supply voltage monitoring*
L *Ethernet LEDs*



Gateway structure

The BL67 gateway has the following structure:

Figure 11: Gateway structure

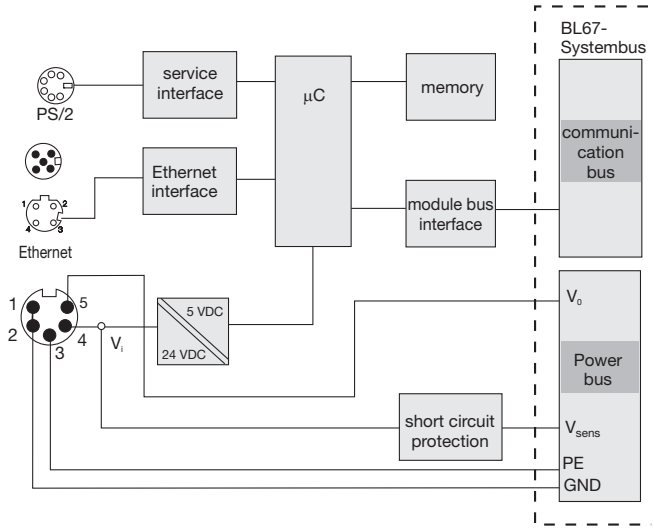


Table 2: Technical data Ethernet gateway

Supply voltage		
System supply V_I (U_B)	24 VDC	used to generate the galvanically isolated module bus supply
permissible range	18 to 30 VDC	
Field supply V_O (U_L)	24 VDC	
permissible range	18 to 30 VDC	
I_{sys}	600 mA	current consumption CPU + module bus at maximum system extension

I_{MB}	max. 1,3 A	maximum output current of module bus supply
I_{VI}	max. 4 A	short-circuit and overload protection of the sensor supply from gateway or power feeding module
Isolation voltages		
U_{RS} (Ethernet/ service interface)	500 V AC	
U_{EN} (Ethernet/ module bus)	500 V DC	
U_{sys} (V_O/V_I to U_{sys})	1000 V DC	

PLC-data	
Programming	
– Software – Released for	CoDeSys V 2.3 V 2.3.5.8
– Programming languages	IEC 61131-3 (IL, LD, FDB, SFC, ST)
– Application tasks	1
– No. of POUs (Program Organization Unit)	1024
– Programming interfaces	RS232-interface, Ethernet
Processor	RISC, 32 bit
– Cycle time	< 1 ms for 100 IL-commands (without I/O-cycle)

Memory	
– Program memory	512 kByte
– Data memory	512 kByte
– Input data	4 kByte (physical input data and network variables)
– Output data	4 kByte (physical output data and network variables)
– Non-volatile memory	16 kByte

Ambient conditions

Ambient temperature	
– $t_{Ambient}$	0 to +55 °C /32 to 131 °F
– t_{Store}	- 25 to +85 °C / - 13 to 185 °F
Relative humidity	5 up to 95 % (inside), level RH-2, no condensation (at 45 °C storage temperature)
Climatic tests	according to IEC 61131-2
Corrosive gas	according to IEC 60068-2-42/43
– SO_2	10 ppm (rel. humidity < 75 %, no condensation)
– H_2S	1.0 ppm (rel. humidity < 75 %, no condensation)
Resistance to vibration	according to EN 61131
– 10 to 57 Hz,constant amplitude 0.075 mm, 1 g	yes
– 57 to 150 Hz, constant acceleration 1 g	yes
– Vibration mode	frequency cycles with a change rate of 1 octave/min

– Vibration duration	20 frequency cycles per coordinate axis
Application conditions	according to EN 61131
Shock resistant	according to IEC 68-2-27, 18 shocks, semi-sinusoidal 15 g threshold/11 ms, each in ± direction per space coordinate
Repetitive shock resistance	according to IEC 68-2-29, 1000 shocks, semi-sinusoidal 25 g threshold/6 ms, each in ± direction per space coordinate
Drop and topple	according to IEC 68-2-31 and free fall according to IEC 68-2-32
– Drop height (weight < 10 kg)	1 m
– Drop height (weight 10 to 40 kg)	0.5 m
– Test cycles	7
Protection class	IP67 according to IEC 60529
Electromagnetic capability (EMC)	according to EN 61131-2/ EN 50082-2 (Industrial)
Static electricity according to EN 61000-4-2	
Air discharge (direct)	8 kV
Relay discharge (indirect)	4 kV
Electromagnetic HF fields	according to IEC 61131-2
Fast transients (Burst)	according to IEC 61131-2
Conducted interferences induced by HF fields	according to IEC 61000-4-6 10 V Criteria A

High energy transients (Surge) **A** voltage supply	according to IEC 61000-4-5 0,5 kV CM, 12 Ω/ 9 µF 0,5 kV DM, 2 Ω/ 18 µF Criteria B
Reliability	
Operational life MTBF	min. 120000 h
Electronics modules pull/ plug cycles	20
Housing material	PC-V0 (Lexan)
Dimensions	
Width x length x height (mm/inch)	64,5 x 145,0 x 77,5 / 2,54 x 5,71 x 3,05

A *I/O-line-length ≤ 30 m*

Warning

This device can cause radio disturbances in residential areas and in small industrial areas (residential, business and trading). In this case, the operator can be required to take appropriate measures to suppress the disturbance at his own cost.

Connection possibilities

Field bus connection

The connection of the BL67 Ethernet gateways to the fieldbus is realized via the 4-pole M12 female connector “Ethernet“.

According to CIP-standards, the M12 female connector is designed as a 4-pole and D-coded connector.

Figure 12: M12-female connector

Table 3: Pin assignment

Pin-No.		
1	TD+	Transmission Data +
2	RD+	Receive Data +
3	TD-	Transmission Data -
4	RD-	Receive Data -

Power supply via 7/8" connector

The power supply is realized via a 7/8" male connector on the gateway.

Figure 13: power supply via 7/8" male connector

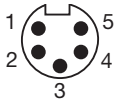


Table 4: Pin assignment of the 7/8" power supply connector

Pin-No.	Color	7/8"	Description
1	black	GND	
2	blue	GND	
3	green/ yellow	PE	Protective earth
4	brown	V_I (U_B)	Feed-in of nominal voltage for input modules (sensor supply); also used for the generation of the system supply voltage
5	white	V_O (U_L)	Feed-in of nominal voltage for output modules (can be switched off separately)

Connection PS2 female connector

The PS/2 female connector is used for the gateway's connection to the I/O-ASSISTANT (project planning and diagnostic software).

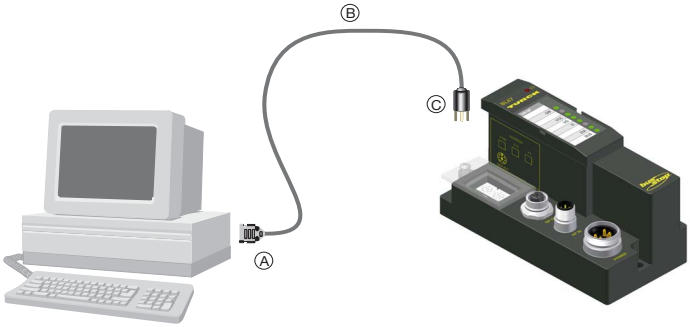
The interface is conceived as a 6-pole mini DIN connector.

In order to connect the gateway to the PC, two types of cables can be used:

- special I/O-ASSISTANT-connection cable from TURCK (IOASSISTANT-ADAPTERKABEL-BL20/BL67; Ident-no.: 6827133)
- Commercially available PS/2 cable with adapter cable SUB-D/ PS/2

Connection with I/O-ASSISTANT-connection cable

Figure 14: BL67-gateway connected to PC via special cable



The I/O-ASSISTANT-cables have a PS/2 male connector (connection for female connector on gateway) and a SUB-D female connector (connection for male connector on PC).

Figure 15: PS/2 male connector on the connection cable to the gateway (top view)

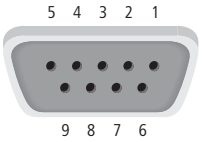


Figure 16: 9-pole SUB-D female connector on the cable for connecting to PC (top view)

Connection using commercially available cables

A further possibility to connect PC and BL67 gateway is to use a commercially available connection and adapter cable.

The connection shown in the following figure (PS2-male/ PS2-male) is a 6-wire 1:1 connection.

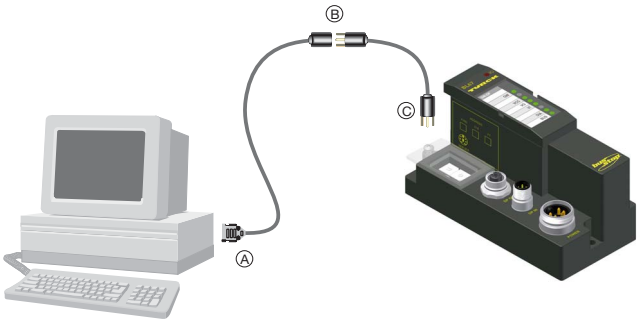


Figure 17: Connection between PC and BL67 gateway via commercially available cable

A *SUB-D- female*
B *PS/2-female <–> PS/2-male*
C *PS/2-male*

The following two cables are necessary:

- 1 x PS/2 cable (PS/2 male connector/PS/2 male connector) (commercially available keyboard extension cable)
- 1 x adapter cable (PS/2 female connector/SUB-D female connector) (commercially available extension cable for a PC mouse)

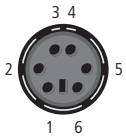


Figure 18: PS/2 female connector on the gateway (top view)

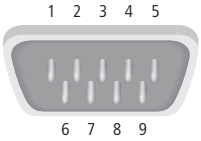


Figure 19: 9-pole SUB-D male connector on PC (top view)

Pin assignment

The table below shows the pin assignment when using a PS/2 cable and adapter:

Table 5: Pin assignment when using PS/2 cable and adapter

A *not supported by all adapter cables.*

PS/2			**9-pole serial interface on PC**	
Pin-No.	Standard PS/2 male connector	BL67 gateway: PS/2 female connector	Pin-No.	Male connector
1	CLK	+5 V (from gateway)	4, 6 **A**	DTR, DSR
2	GND	GND	5	GND
3	DATA	not connected	–	–
4	n.c. (DATA2)	TxD	2	RxD
5	+5 V	/CtrlMode	7	RTS
6	n.c. (CLK2)	RxD	3	TxD

Address Setting

The addressing of BL67-PG-EN-IP can be realized via different modes:

- rotary mode (manual addressing via rotary coding-switches)
- PGM mode (manual addressing via software)
- BootP mode, DHCP mode (automatic addressing via BootP/ DHCP-server at the boot-up of the gateway).

The setting of the address modes is done via the 3 rotary coding-switches at the gateway.

Note

It is not necessary to address the station's internal module bus.

Attention

The cover of the decimal rotary coding-switches must be closed by tightening the screw after use.

The seal in the cover must not be damaged or slipped.

The protection class IP67 can only be guaranteed when the cover is closed correctly.

LED-behavior

During it's start-up, the module waits for the address setting via the BootP-server. This is indicated by the red flashing "MS" LED. The LED begins to flash green, as soon as the address setting via the server is completed. The station is ready for communication.

Default settings of the gateway

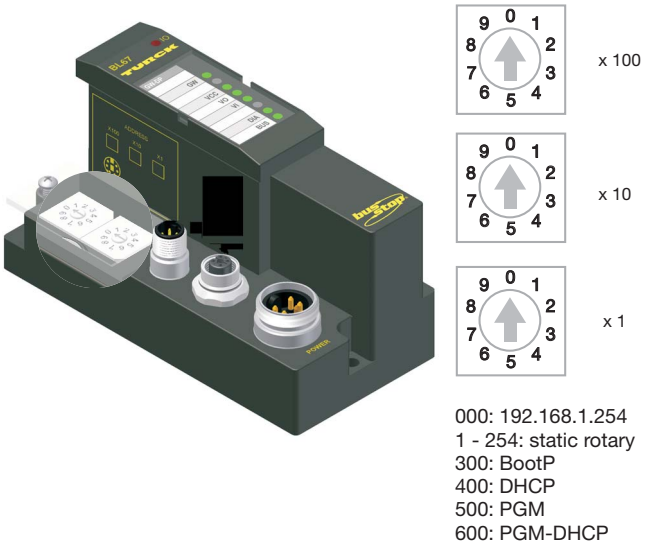
The gateway's default-settings are the following:

IP address	192.168.1.254
subnet mask	255.255.255.000
default gateway	192.168.1.1

Note

The gateway can be reset to these default settings by the user at any time.
To reset the gateway, please set the three coding-switches at the gateway to "000" followed by a power-on reset.

Figure 20: Decimal rotary coding-switches for the address setting



Attention

After every change of the address-mode, a voltage reset must be carried out.

Address setting via the rotary-mode

When using the rotary-mode, the last byte of the gateway's IP address can be set via the rotary coding-switches at the gateway.

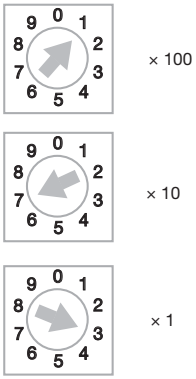
Note

All other network settings are stored in the module's non-volatile EEPROM and can not be changed in the rotary-mode.

Addresses in the range from 0 to 254 can be allocated. The addresses 0 and 255 are reserved for broadcast messages in the subnet.

The following example shows the setting of the address **173**.

Figure 21: Address setting



Attention

The settings carried out in the rotary-mode are not stored in the module's EEPROM. Thus, they will get lost in case of a subsequent address-assignment via a BootP/ DHCP or PGM.

Attention

After changing the position of the rotary coding-switches, a voltage reset must be carried out to store the new address.

Address setting via BootP-mode

The address setting is carried out by a BootP-server in the network after the start-up of the gateway.

In order to activate the BootP-mode, the rotary coding-switches have to be set to "300".

Figure 22: BootP-mode

Note

The IP address as well as the default subnet mask assigned to the gateway by the BootP-server are stored in the gateway's non-volatile memory.

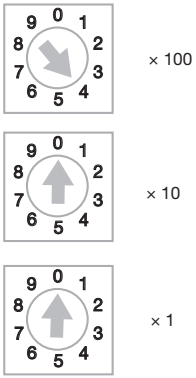
If the gateway is subsequently switched to rotary- or PGM-mode, the settings carried out via BootP (IP address, subnet mask, etc) will be taken from the module's EEPROM.

Address setting via DHCP-mode

The address setting is carried out by a DHCP-server in the network after the start-up of the gateway.

In order to activate the DHCP-mode, the rotary coding-switches have to be set to "400".

Figure 23: DHCP-mode



Note

The IP address as well as the default subnet mask assigned to the gateway by the DHCP-server are stored in the gateway's non-volatile memory.

If the gateway is subsequently switched to rotary- or PGM-mode, the settings carried out via DHCP (IP address, subnet mask, etc) will be taken from the module's EEPROM.

DHCP supports three mechanisms for IP address allocation:

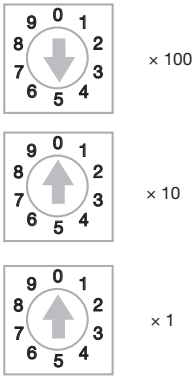
- In "automatic allocation", the DHCP-server assigns a permanent IP address to a client.
- In "dynamic allocation", DHCP assigns an IP address to a client for a limited period of time. After this time or until the client explicitly relinquishes the address, the address can be re-assigned.
- In "manual allocation", a client's IP address is assigned by the network administrator, and DHCP is used simply to convey the assigned address to the client.

Address setting via PGM-mode

The PGM-mode enables the access of I/O-ASSISTANTs to the module's network settings.

In order to activate the PGM-mode, the rotary coding-switches have to be set to "500".

Figure 24: PGM-mode



Note

In the PGM-mode, all network settings (IP address, subnet mask, etc.) are read from the module's internal EEPROM.

The settings carried out in the rotary-mode are stored in the module's non-volatile EEPROM.

Addressing via PGM-DHCP

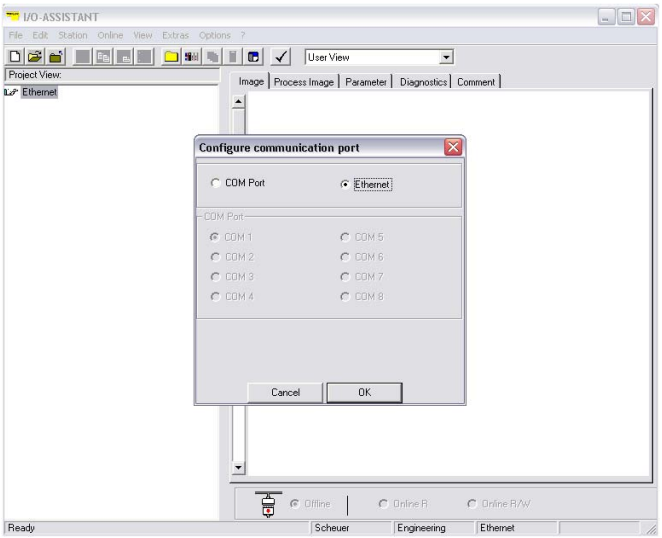
The addressing of the BL67 EtherNet/IP gateway via PGM-DHCP is at the moment comparable to the addressing via DHCP (see page 3-19).

Address setting via the software "I/O-ASSISTANT"

The software-tool "I/O-ASSISTANT" enables direct access to the Ethernet-network via the fieldbus cable.

Naturally, the access to the single station via the service interface at the gateway is possible as well.

Figure 25: Interface Ethernet



The IP address as well as the subnet mask of the TURCK Ethernet gateways can be changed according to the application by using the integrated Address Tool.

Changes in the network-configuration are only accepted in the PGM-mode (see page 3-20).

Figure 26: Opening the Address-Tool

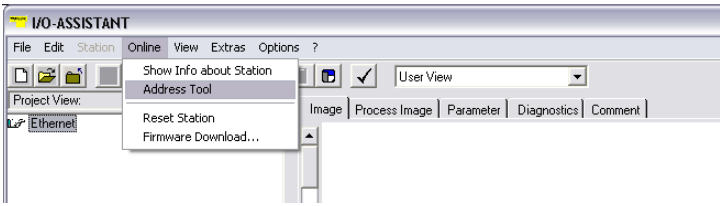
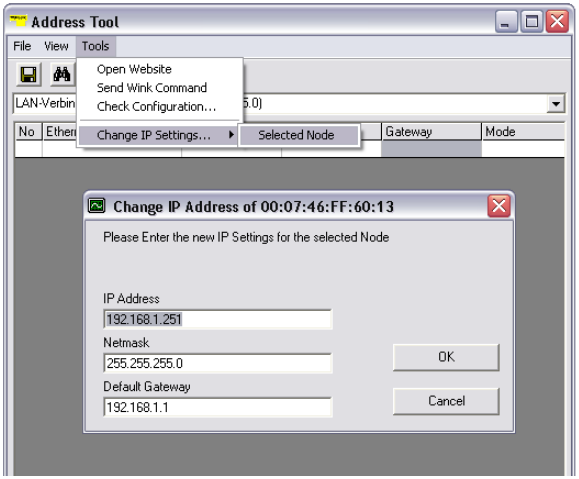


Figure 27: change IP address



Attention

Please observe that, if the system integrated Windows-firewall is activated, difficulties may occur during the communication between the gateway and the Address-tool. The firewall may possibly inhibit the access of the tool on Ethernet.

SET Button

The SET button on the gateway is used to save the Current Configuration of the station as the Reference Configuration in the gateway's non volatile configuration memory.

Note

Please press the SET button for 10 seconds after every change in the station's hardware configuration in order to save the Current Configuration as the Reference Configuration in the Gateway.

Status Indicators/Diagnostic Messages Gateway

The gateway sends the following diagnostic messages:

- undervoltage monitoring for system- and field supply,
- monitoring of the station status,
- monitoring of the communication via the internal module bus,
- monitoring of the communication to Ethernet
- monitoring of the gateway status

Diagnostic messages are displayed in two different ways:

- via the LEDs
- via the respective configuration software

Diagnostic messages via LEDs

Every BL67 gateway displays the following statuses via LEDs:

- 2 LEDs for module bus communication (module bus LEDs): **GW** and **IO**
- 1 LED for displaying if the gateway/ the program in the gateway has started: **RUN/STOP**
- 3 LEDs for monitoring the voltage supply (system, $\mathbf{V_{CC}}$/ inputs, $\mathbf{V_i}$/ outputs, $\mathbf{V_o}$).
- 2 LEDs for the Ethernet communication (fieldbus-LEDs): **LINK/ ACT** and **MS**.

Table 6: LED-displays

LED	Status	Meaning	Remedy
GW	Off	CPU not supplied.	
	Green	Firmware active, gateway ready to operate and transmit	-
	Green, flashing, 1 Hz	Firmware not active.	If LED "**IO**" red → Firmware download necessary
	Green, flashing, 4 Hz	Firmware active, gateway hardware defect.	Replace the gateway.
	Red	Controller is not ready, VCC level is not within the required range → possible reasons: – too many modules connected to the gateway – short circuit in connected module – hardware error in gateway	– Check wiring at the gateway and the voltage supply. – Dismount modules – Replace the gateway.

Table 6: LED-displays

LED	Status	Meaning	Remedy
IO	Off	CPU not supplied.	– Check the voltage supply at the gateway.
	Green	Module bus is running, the configured module bus station corresponds to the physically connected station, communication is active.	-
	Green, flashing 1 Hz	Station is in the I/O-ASSISTANT Force Mode.	– Deactivate the I/O-ASSISTANT Force Mode.
	Green, flashing 4 Hz	Maximum number of modules at the gateway is exceeded.	– Check the number of modules connected to the gateway, dismount modules
	Red	Controller is not ready, V_{CC} level is not within the required range → possible reasons: – too many modules connected to the gateway – short circuit in connected module – hardware error in – gateway	– Check wiring at the gateway and the voltage supply. – Dismount modules – Replace the gateway.

Table 6: LED-displays

LED	Status	Meaning	Remedy
IO	Red flashing, 1 Hz	Non-adaptable modification of the physically connected station.	– Compare the planned BL67 station with the physical station. – Check the physical station for defective or incorrectly fitted electronics modules.
	Red flashing, 4 Hz	no module bus communication	– At least one module has to be plugged and has to be able to communicate with the gateway.
	Red/ green flashing, 1 Hz	Adaptable modification of the physically connected station; data transfer possible	– Check the physical station for pulled or new but not planned modules.
RUN/ STOP	Off	No program loaded into the gateway.	–
	Green	Application loaded to gateway, program running.	–
	Green flashing	Application loaded to gateway, PLC not yet started or stopped.	– Start the gateway/ the PLC program.
	Red	PLC test during gateway start.	–
V_{cc}	Off	CPU not supplied	– Check the system supply at the gateway.
	Green	Module bus and CPU running	-

Table 6: LED-displays

LED	Status	Meaning	Remedy
V_O	Off	No voltage supply.	Check the system supply at the gateway.
	Output supply ok.	– Check the wiring at the gateway and the voltage supply.	Green
	Green flashing, 1 Hz	Undervoltage V_O, system running	– Check the system supply at the gateway
	Green flashing, 4 Hz	Overvoltage V_O, system running	
V_I	Off	No voltage supply.	– Check the wiring of the voltage supply at the gateway
	Green	sensor supply ok.	-
	Green, flashing, 1Hz	Undervoltage V_I, system running	– Check the wiring of the voltage supply at the gateway
	Green, flashing, 4 Hz	Overvoltage V_I, system running	
	Red	Short circuit or overload at sensor supply → sensor supply is switched off	– Automatic restart when debugging.

Table 6: LED-displays

LED	Status	Meaning	Remedy
LINK/ ACT	Off	No Ethernet link	– Check the Ethernet-connection
	Green	Link, 100 Mbit/s	
	Green flashing	Ethernet Traffic 100 Mbit/s	
	Yellow	Link, 10 Mbit/s	
	Yellow, flashing	Ethernet Traffic 10 Mbit/s	
MS	Green	Displays an active CIP Class 1 I/O connection	
	Green, flashing	Gateway is ready for operation	
	Red	Gateway indicates error	
	Red, flashing	DHCP/BootP search of settings	

4 Implementation of EtherNet/IP

The EtherNet/IP Communications Profile

EtherNet/IP is based on a connection-oriented communication model. This means that it is only possible to exchange data via specified connections assigned to the devices.

Communication between the nodes in the EtherNet/IP network can be carried out either via I/O Messages or Explicit Messages.

I/O messages

I/O Messages serve to exchange high priority process and application data over the network. Communication between the slaves in the EtherNet/IP network is carried out according to the Server/Client Model, which means a producing application transmits data to another or a number of consuming applications. It is quite possible that information is passed to a number of Application Objects in a single device.

Explicit messages

Explicit Messages are used to transmit low-priority configuration data, general management data or diagnostic data between two specific devices. This is a point-to-point connection in a Server/Client System that requires a request from a client always to be confirmed by a response from the server.

Explicit messages, whether connected or unconnected, use the Message Router (for detailed information, read Section “Message Router Request/Response Formats“, page 4-12).

- Message Router Request
  Consists of a service code, path size value, a message router path and service data. An EPATH is used in the message router path to indicate the target object.
- Message Router Response
  Consists of a service field with the most significant bit set. This is an echo of the service code in the request message with the most significant bit set. A reserved byte follows the service code, which is followed by the General Status code.

Communications profile of the BL67 EtherNet/IP gateway

The EtherNet/IP gateway behaves as an EtherNet/IP Server in the network; the scanner of the higher-level controller operates as a EtherNet/IP Client.

The following EtherNet/IP communications types are supported:

- Point to Point or Multicast
- COS Connection
- Cyclic I/O Connection
- Cyclic and Change of State I/O Triggers
- Unconnected (UCMM) Explicit Messaging
- Connected Explicit Messaging

Point to point

A connection that exists between two nodes only.

Multicast

A packet with a special destination address, which multiple nodes on the network may be willing to receive.

COS I/O connection

COS (Change Of State) I/O Connections establish event-controlled connections. This means that the EtherNet/IP devices generate messages as soon as a change of status occurs.

Cyclic I/O connection

Messages are triggered time-controlled in Cyclic I/O connections by means of a time generator.

UCMM

The EtherNet/IP gateway offers the option of establishing explicit messaging via the UCMM port (Unconnected Message Manager Port).

UCMM-based explicit messaging is normally used for random, non-periodic requests. It is not recommended for frequent messaging because the UCMM input queue in a product is typically limited to just a few messages. Once this limit is reached, subsequent requests are ignored and must be retried.

Connected explcit messaging

CIP is a connection-based system. For most communications between nodes, a connection is used.

A connection is a path or a virtual circuit between two or more end points in a system. The purpose is to transfer data in the most efficient manner possible.

The Connection ID is a number that is associated with a communication relationship. Receiving nodes decode this key to know whether they must accept the data or not.

Classes and Instances of the EtherNet/IP-Gateway

EtherNet/IP standard classes

The BL67 gateway supports the following EtherNet/IP Standard Classes in accordance with the CIP specification.

Table 7: EtherNet/IP Standard Classes

Class Code	Object-Name	Description
01 (0×01)	Identity	The Identity Object is required on all devices and provides general information about the device. It enables clear and unambiguous identification of modules. Contains information such as manufacturer name, product type, ident number, revision number etc.
02 (0×02)	Message Router	The Message Router Object provides a messaging connection point through which a Client may address a service to any object class or instance residing in the physical device.
04 (0×04)	Assembly	The Assembly Object binds attributes of multiple objects, which allows data to or from each object to be sent or received over a single connection. Assembly objects can be used to bind input data or output data. The terms ”input” and ”output” are defined from the network’s point of view. An input will produce data on the network and an output will consume data from the network.
06 (0×06)	Connection Manager	The Connection Manager Class allocates and manages the internal resources associated with both I/O and Explicit Messaging Connections. The specific instance generated by the Connection Manager Class is referred to as a Connection Instance or a Connection Object.

Class Code	Name	Description
15 (0×0F)	Parameter Object	Provides a known, public interface to the device configuration data.
244 (0×F4)	Port Object	Provides a standard way of describing a device's ports.
245 (0×F5)	TCP/IP Interface Object	Contains the device TCP/IP-related configuration information.
246 (0×F6)	Ethernet Link Object	Contains link-specific counters and status information for an Ethernet 802.3 communications interface.

Identity Object

The following description of the Identity Object is taken from the CIP specification, Vol. 1, Rev. 2.1, by ODVA & ControlNet International Ltd. and adapted to BL67.

Class attributes

Table 8: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
6 (0×06)	MAX CLASS ATTRIBUTE	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	7

Instance attributes

Table 9: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	VENDOR	G	UINT	Contains the vendor ID, managed by the Open DeviceNet™ Vendor Association, Inc. (ODVA) and ControlNet International (CI): TURCK = 48
2 (0×02)	PRODUCT TYPE	G	UINT	Indicates the general type of product. Communications Adapter 12_{dez} = 0×0C
3 (0×03)	PRODUCT CODE	G	UINT	Identifies a particular product within a device type. Default: 27246
4 (0×04)	REVISION Major Minor	G	STRUCT OF: USINT USINT	Revision of the item the Identity Object is representing. 0x01 0x02
5 (0×05)	DEVICE STATUS	G	WORD	See Table 10: „Device Status”
6 (0×06)	SERIAL NUMBER	G	UDINT	Contains the ident-no. of the product (3 last bytes of the MAC-ID).
7 (0×07)	PRODUCT NAME LENGTH NAME	G	STRUCT OF: USINT STRING [13]	BL67-PG-EN-IP

Device Status

Table 10: Device Status

Bit	Name	Definition
0 to 1	reserved	Default = 0
2	Configured	TRUE → The application of the device has been configured (≠ default-settings).
3	reserved	Default = 0
4 to 7	Extended Device Status	0011 = No I/O connections established 0110 = At least one I/O connection in run mode 0111 = At least one I/O connection established, all in idle mode All other settings = reserved
8 to 15	reserved	Default = 0

Common services

Table 11: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All Returns a predefined listing of this objects attributes.
05 (0x05)	no	yes	Reset Starts the Reset service for the device.
14 (0x0E)	yes	yes	Get_Attribute_Single Returns the contents of a specified attribute.
16 (0x10)	no	no	Set_Attribute_Single Modifies a single attribute.

Message Router Object

This object provides a messaging connection point through which a Client may address a service to any object class or instance residing in the physical device.

The following description of the Message Router Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to BL67.

Class attributes

Table 12: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
4 (0×04)	OPTIONAL ATTRIBUTE NUMBER	G	UINT	0
5 (0×05)	OPTIONAL SERVICE NUMBER	G	UINT	0
6 (0×06)	MAX CLASS IDENTI-FIER	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	2

Instance attributes

Table 13: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	OBJECT LIST	G	STRUCT OF	Structure with an array of object class-codes supported by the device.
	NUMBER	G	UINT	Depending
	CLASSES	G	ARRAY of UINT	Number of the classes supported by the gateway.
2 (0×02)	MAX NUMBER OF CONNEC-TIONS	G	UINT	Count of the maximum number of connections supported.

Common services

Table 14: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single

Message Router Request/Response Formats

- Message Router Request Format:

Table 15: Message Router Request

Parameter	Data Type	Description
Service	USINT	Service code of the request.
Request Path Size	USINT	Number of 16 bit words in the "Request Path".
Request Path	Padded EPATH	Array of bytes containing the information for the path of request (class ID, Instance ID, etc.) for this transaction.
Request Data	Array of octed	Additional service specific data to be delivered in the Explicit Messaging Request.

- Message Router Response Format:

Table 16: Message Router Request

Parameter	Data Type	Description
Reply Service	SINT	Reply service code.
General Status	USINT	General Status Code according to CIP specification. See Table 17: „General Status Codes according to CIP spec.”
Size of Additional Status	USINT	Number of 16 bit words in "Additional Status".
Additional Status	Array of USINT	Additional status.
Response Data	Array of octet	Response data from request or additional error data if an error was indicated in "General Status".

Table 17: General Status Codes according to CIP spec.

Status Code (hex)	Status Name	Description
00	Success	Service successfully performed by the object specified.
01	Connection failure	A connection related service failed along the connection path.
02	Resource unavailable	Resources needed for the object to perform the requested service were unavailable.
03	Invalid parameter value	See Status Code 0x20, which is the preferred value to use for this condition.
04	Path segment error	The path segment identifier or the segment syntax was not understood by the processing node. Path processing shall stop when a path segment error is encountered.
05	Path destination unknown	The path is referencing an object class, instance or structure element that is not known or is not contained in the processing node. Path processing shall stop when a path destination unknown error is encountered.
06	Partial transfer	Only part of the expected data was transferred.
07	Connection lost	The messaging connection was lost.
08	Service not supported	The requested service was not implemented or was not defined for this Object Class/Instance.
09	Invalid attribute value	Invalid attribute data detected.

Status Code (hex)	Status Name	Description
0A	Attribute list error	An attribute in the Get_Attribute_List or Set_Attribute_List response has a non-zero status.
0B	Already in requested mode/state	The object is already in the mode/ state being requested by the service.
0C	Object state conflict	The object cannot perform the requested service in its current mode/ state.
0D	Object already exists	The requested instance of object to be created already exists.
0E	Attribute not settable	A request to modify a non-modifiable attribute was received.
0F	Privilege violation	A permission/privilege check failed.
10	Device state conflict	The device's current mode/state prohibits the execution of the requested service.
11	Reply data too large	The data to be transmitted in the response buffer is larger than the allocated response buffer.
12	Fragmentation of a primitive value	The service specified an operation that will fragment a primitive data value, i.e. half a REAL data type.
13	Not enough data	The service did not supply enough data to perform the specified operation.
14	Attribute not supported	The attribute specified in the request is not supported.
15	Too much data	The service supplied more data than expected.

Status Code (hex)	Status Name	Description
16	Object does not exist	The object specified does not exist in the device.
17	Service fragmentation sequence not in progress	The fragmentation sequence for this service is not currently active for this data.
18	No stored attribute data	The attribute data of this object was not saved prior to the requested service.
19	Store operation failure	The attribute data of this object was not saved due to a failure during the attempt.
1A	Routing failure, request packet too large	The service request packet was too large for transmission on a network in the path to the destination. The routing device was forced to abort the service.
1B	Routing failure, response packet too large	The service response packet was too large for transmission on a network in the path from the destination. The routing device was forced to abort the service.
1C	Missing attribute list entry data	The service did not supply an attribute in a list of attributes that was needed by the service to perform the requested behavior.
1D	Invalid attribute value list	The service is returning the list of attributes supplied with status information for those attributes that were invalid.
1E	Embedded service error	An embedded service resulted in an error.

Status Code (hex)	Status Name	Description
1F	Vendor specific error	A vendor specific error has been encountered. The Additional Code Field of the Error Response defines the particular error encountered. Use of this General Error Code should only be performed when none of the Error Codes presented in this table or within an Object Class definition accurately reflect the error.
20	Invalid parameter	A parameter associated with the request was invalid. This code is used when a parameter does not meet the requirements of this specification and/ or the requirements defined in an Application Object Specification.
21	Write-once value or medium already written	An attempt was made to write to a write-once medium (e.g. WORM drive, PROM) that, has already been written, or to modify a value that cannot be changed once established.
22	Invalid Reply Received	An invalid reply is received (e.g. reply service code does not match the request service code, or reply message is shorter than the minimum expected reply size). This status code can serve for other causes of invalid replies.
23 to 24	Reserved by CIP for future extensions	
25	Key Failure in path	The Key Segment that was included as the first segment in the path does not match the destination module. The object specific status shall indicate which part of the key check failed.

Status Code (hex)	Status Name	Description
26	Path Size Invalid	The size of the path which was sent with the Service Request is either not large enough to allow the Request to be routed to an object or too much routing data was included.
27	Unexpected attribute in list	An attempt was made to set an attribute that is not able to be set at this time.
28	Invalid Member ID	The Member ID specified in the request does not exist in the specified Class/ Instance/Attribute
29	Member not settable	A request to modify a non-modifiable member was received
2A	Group 2 only server general failure	This error code may only be reported by DeviceNet™ Group 2 Only servers with 4K or less code space and only in place of Service not supported, Attribute not supported and Attribute not settable.
2B to CF	Reserved by CIP for future extensions	
D0 to FF	Reserved for Object Class and service errors	This range of error codes is to be used to indicate Object Class specific errors. Use of this range should only be performed when none of the Error Codes presented in this table accurately reflect the error that was encountered.

Assembly Object

Assembly Objects bind attributes of multiple objects to allow data to or from each object to be sent or received over a single connection.

The following description of the Assembly Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to BL67.

Class attributes

Table 18: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	2
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	2

Instance attributes

Table 19: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	NUMBER OF MEMBERS IN LIST	G	UINT	0 (no dynamic)
2 (0×02)	MEMBER LIST	G	ARRAY of STRUCT UINT UINT Packed EPATH	Depends on Instance.
3 (0×03)	DATA	S	ARRAY OF BYTE	
4 (0×04)	SIZE	G	UINT Number of bytes in Attr. 3	256

Instance 101

Contains the station's input data as long as no PLC program has been downloaded to the device.

2 Bytes Status information + process data.

Note

If a PLC program is downloaded to the PG, this instance contains the station's input data (2 Bytes Status information + process data) mapped in CoDeSys to the PGs output words for external EtherNet/IP communication with superordinate EtherNet/IP clients (e. g. ControlLogix) → Section "Mapping of the EtherNet/IP input and output words", page 5-17.

Instance 102

Contains the station's output data as long as no PLC program has been downloaded to the device.

2 Bytes Control data + process data

Note

If a PLC program is downloaded to the PG, this instance contains the station's output data (2 Bytes Control data + process data) mapped in CoDeSys to the PGs input words for external EtherNet/IP communication with superordinate EtherNet/IP clients (e. g. ControlLogix) → Section "Mapping of the EtherNet/IP input and output words", page 5-17.

Common services

Table 20: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	no	yes	Get_Attribute_Single

Connection Manager Object

This object is used for connection and connectionless communications, including establishing connections across multiple subnets.

The following description of the Connection Manager Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to BL67.

Common services

Table 21: Common services

Service Code	Class	Instance	Service Name
84 (0x54)	no	yes	FWD_OPEN_CMD (Opens a connection)
78 (0x4E)	no	yes	FWD_CLOSE_CMD (Closes a connection)
82 (0x52)	no	yes	UNCONNECTED_SEND_CMD (Unconnected Send Service. Only originating devices and devices that route between links need to implement).

Port Object

The following description of the Port Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to BL67.

Class attributes

Table 22: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0×03)	NUMBER OF INSTANCES	G	UINT	1
8 (0×08)	ENTRY PORT	G	UINT	1
9 (0×09)	ALL PORTS	G	ARRAY of STRUCT UINT UINT	0,0 for class 4,2 for TCP_IP_PORT

Instance attributes

Table 23: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	ATTRIBUTE PORT TYPE	G	UINT	4 for TCP_IP_PORT
2 (0×02)	ATTRIBUTE PORT NUMBER	G	UINT	2
3 (0×03)	ATTRIBUTE PORT OBJECT	G	UINT EPATH Logical path	2 0x12, 0x02 0x00, 0x00

Common services

Table 24: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single

TCP/IP Interface Object

The following description of the TCP/IP Interface Object is taken from the CIP specification, Vol. 2, Rev. 1.1 and adapted to BL67.

Class attributes

Table 25: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0×03)	NUMBER OF INSTANCES	G	UINT	1
6 (0×06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Instance attributes

Table 26: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	STATUS	G	DWORD	Interface status (see page 4-27)
2 (0×02)	CONFIGU-RATION CAPABILITY	G	DWORD	Interface Capability Flag (see page 4-27)
3 (0×03)	CONFIGU-RATION CONTROL	G/S	DWORD	Interface Control Flag (see page 4-28)
4 (0×04)	PHYSICAL LINK OBJECT	G	Struc-ture of:	
	Path size		UINT	Number of 16bit words: 0×02
	Path		Padded EPATH	0×20, 0×F6, 0×24, 0×01
5 (0×05)	INTERFACE CONFIGU-RATION	G	Struc-ture of:	TCP/IP Network Interface Configuration (see page 4-28)
	IP ADDRESS	G	UDINT	0 = no IP address configured
	NETWORK MASK	G	UDINT	0 = no network mask address configured
	GATEWAY ADDRESS	G	UDINT	0 = Default gateway IP address configured
	NAME SERVER	G	UDINT	0 = no name server address configured
	NAME SERVER 2		UDINT	0 = no secondary name server address config-ured

Attr. No.	Attribute Name	Get/ Set	Type	Description
5 (0×05)	DOMAIN NAME	G	UDINT	0 = no Domain Name configured
6 (0×06)	HOST NAME	G	STRING	0 = no Host Name configured (see page 4-30)

Common services

Table 27: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
02 (0x02)	no	no	Set_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
16 (0×10)	no	yes	Set_Attribute_Single

Interface Status

The Status attribute indicates the status of the TCP/IP network interface.
Refer to the state diagram, Figure 28: „TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)" for a description of object states as they relate to the Status attribute.

Table 28: Interface Status

Bit(s)	Name	Definition
0-3	Interface Configuration Status	Indicates the status of the Interface Configuration attribute: 0 = The Interface Configuration attribute has not been configured 1 = The Interface Configuration attribute contains valid configuration. 2 to 15 = Reserved
4 to 31	reserved	

Configuration Capability

The Configuration Capability indicates the device's support for optional network configuration capability.

Table 29: Configuration Capability

Bit(s)	Name	Definition	Value
0	BOOTP Client	The device is capable of obtaining its network configuration via BOOTP.	1
1	DNS Client	The device is capable of resolving host names by querying a DNS server.	0
2	DHCP Client	The device is capable of obtaining its network configuration via DHCP.	1

Configuration Control

The Configuration Control attribute is used to control network configuration options.

Table 30: Configuration Control

Bit(s)	Name	Definition
0-3	Startup Configuration	Determines how the device shall obtain its initial configuration at start-up. 0 = The device shall use the interface configuration values previously stored (for example, in non-volatile memory or via hardware switches, etc). 1 to 3 = reserved
4	DNS Enable	Always 0
5-31	Reserved	Set to 0.

Interface Configuration

This attribute contains the configuration parameters required to operate as a TCP/IP node.

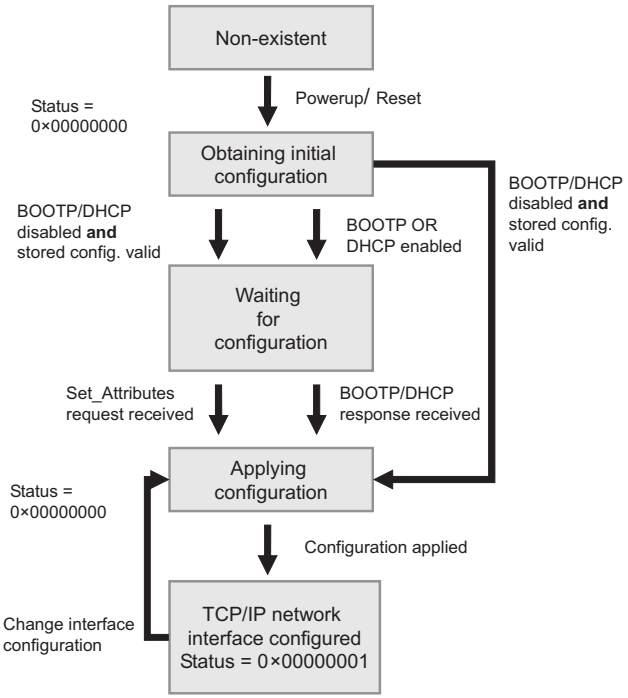
To modify the Interface Configuration attribute, get the Interface Configuration attribute first, change the desired parameters, then set the attribute.
The TCP/IP Interface Object applies the new configuration upon completion of the Set service. If the value of the Startup Configuration bits (Configuration Control attribute) is 0, the new configuration is stored in non-volatile memory.
The device does not reply to the set service until the values are safely stored to non-volatile memory.
An attempt to set any of the components of the Interface Configuration attribute to invalid values results in an error (status code 0x09) returned from the Set service.
If initial configuration is obtained via BOOTP or DHCP, the Interface Configuration attribute components are all zeros until the BOOTP or DHCP reply is received.
Upon receipt of the BOOTP or DHCP reply, the Interface Configuration attribute shows the configuration obtained via BOOTP/DHCP.

Host Name

The Host Name attribute contains the device's host name.

The host name attribute is used when the device supports the DHCP-DNS Update capability and has been configured to use DHCP upon start up.
The mechanism allows the DHCP client to transmit its host name to the DHCP server. The DHCP server then updates the DNS records on behalf of the client. The host name attribute does not need to be set for the device to operate normally. The value of the Host Name attribute, if it is configured, is used for the value of the FQDN option in the DHCP request. If the Host Name attribute has not been configured, then the device shall not include the FQDN option in the DHCP request.

Figure 28: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)



Ethernet Link Object

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 1.1 by ODVA & ControlNet International Ltd. and adapted to BL67.

Class attributes

Table 31: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0×03)	NUMBER OF INSTANCES	G	UINT	1
6 (0×06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Instance Attributes

Table 32: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	INTERFACE SPEED	G	UDINT	Speed in megabits per second (e.g., 10, 100, 1000, etc.)
2 (0×02)	INTERFACE FLAGS	G	DWORD	see Table 33: „Interface flags”
3 (0×03)	PHYSICAL ADDRESS	G	ARRAY OF USINTs	Contains the interface’s MAC address (TURCK: 00:07:46:××:××:××)

Table 33: Interface flags

Bits	Name	Definition	Default-Value
0	Link Status	Indicates whether or not the Ethernet 802.3 communications interface is connected to an active network. 0 = inactive link 1 = active link.	Depends on application
1	Half / Full Duplex	0 = half duplex; 1 = full duplex If the Link Status flag is 0, the value of the Half/Full Duplex flag is indeterminate.	Depends on application
2 to 4	Negotiation Status	Indicates the status of link auto-negotiations. 0 = Auto-negotiation in progress 1 = Auto-negotiation and speed detection failed. Using default values for speed and duplex (10Mbps/ half duplex). 2 = Auto negotiation failed but detected speed (default: half duplex). 3 = Successfully negotiated speed and duplex. 4 = Auto-negotiation not attempted. Forced speed and duplex.	Depends on application

Bits	Name	Definition	Default-Value
5	Manual Setting Requires Reset	0 = interface can activate changes to link parameters (auto-negotiate, duplex mode, interface speed) automatically 1 = device requires a Reset service to be issued to its Identity Object in order to adapt the changes	0
6	Local Hard-ware Fault	0 = interface detects no local hardware fault 1 = a local hardware fault is detected	0

Common services

Table 34: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
76 (0×4C)	no	yes	Enetlink_Get_and_Clear

VSC-Vendor Specific Classes

In addition to supporting the above named CIP Standard Classes, the BL67 gateway for EtherNet/IP supports the below vendor specific classes.

It is possible to gain read (**G**= Get) and/or write (**S**= Set) access to the attributes of classes described in the following:

Table 35: VSC-Vendor Specific Classes

Class Code	Name	Description
100 (0×64)	Gateway Class, page 4-36	Contains data and settings concerning the gateway and the BL67 system as a whole.

Class Instances of the VSC

Note

Class Instance attributes are the same for each Vendor Specific Class.

Class-specific Object Instances and the corresponding attributes are explained below for the different VSC.

The general VSC - Class Instance attributes are defined as follows:

Table 36: Class instance

Attr. No.	Attribute Name	Get/ Set	Type	Description
100 (0×64)	CLASS REVISION	G	UINT	States the revision number of the class: Maj. Rel. *1000 + Min. Rel..
101 (0×65)	MAX INSTANCE	G	USINT	Contains the number of the highest instance of an object created on this level in the class hierarchy.
102 (0×66)	# OF INSTANCES	G	USINT	Contains the number of Object Instances created in this class.
103 (0×67)	MAX CLASS ATTRIBUTE	G	USINT	Contains the number of the last Class Attribute to be implemented.

Gateway Class (VSC 100)

The Gateway Class contains all the parameters of the BL67 system and the gateway.

Class instance

Note

Please refer to paragraph „Class Instances of the VSC", page 4-35, for the description of the class instances for VSC.

Object instances

Table 37: Object Instance 2, Gateway Instance

Attr. No.	Attribute Name	Get/ Set	Type	Description
109 (0×6D)	STATUS REGISTER 2	G	STRUCT	Gateway-Status contains general gateway status information: **Gateway** – Bit 15: "I/O Controller Error" The communication controller for the I/O-system is faulty. – Bit 14: "Force Mode Active Error" The Force Mode is activated. – Bit 13: reserved – Bit 12: reserved **Module bus** – Bit 11: "I/O Cfg Modified Error" The I/O-configuration has been changed and is now incompatible. – Bit 10: "I/O Communication Lost Error" No communication on the I/O module bus.

Attr. No.	Attribute Name	Get/ Set	Type	Description
109 (0×6D)	STATUS REGISTER 2	G	STRUCT	**Voltage errors** Bit 09: "U_{sys} too low" System supply voltage too low (< 18 VDC). Bit 08: "U_{sys} too high" System supply voltage too high (> 30 VDC). Bit 07: "U_L too low" Load voltage too low (< 18 VDC). Bit 06: "U_L too high" Load voltage too high (> 30 VDC) Bit 05: "I_{sys} too high" Overload of the system voltage supply. Bit 04: reserved **Warnings** Bit 03: "I/O Cfg Modified Warning" Bit 02: reserved Bit 01: reserved Bit 00: "I/O Diags Active Warning" At least one I/O-module sends active diagnosics.

Attr. No.	Attribute Name	Get/ Set	Type	Description
116 (0×74)	MODULE DIAG SUMMARY	G	ARRAY OF STRUCT	Contains diagnostic information for all modules. ARRAY OF STRUCT: USINT SLOT #: Indicates the slot number (module position) with diagnostic messages. BYTE SLOT FLAGS: Offers slot-related information. Bit 7 = module missing Bit 6 = false module plugged DWORD DIAG: Contains the module diagnostic information. Module diagnostic bits that are not used are indicated by a "0".

5 Configuration of the programmable gateway with CoDeSys

General

This chapter describes the configuration of a BL67 station with the programmable BL67 gateway for EtherNet/IP in CoDeSys (Controller Development System) from "3S - Smart Software Solutions GmbH" on the basis of an example.

System requirements

- Installation of CoDeSys (version 2.3.5.8)
- Installation of the BL67 target files "TSP_Turck_×××.zip" (can be downloaded from www.turck.com)

Figure 29: CoDeSys from 3S

Installation of the BL67 Target Support Packages

Before configuring the BL67 station with CoDeSys and programming the BL67-PG-EN-IP, the BL67 Target Support Package (short: targets) have to be installed.

Target files contain all information necessary for integrating a system into the programming tool.

The Target Support Package (TSP) for the BL67-PG-EN-IP can be downloaded from the TURCK homepage as a zipped archive (TSP_Turck_BL67_PG_EN_IP ×××.zip).

This archive contains the target file and other manufacturer specific files like libraries etc. which are necessary for the operation of the gateway at CoDeSys.

The files have to be stored on your PC showing following directory structure:

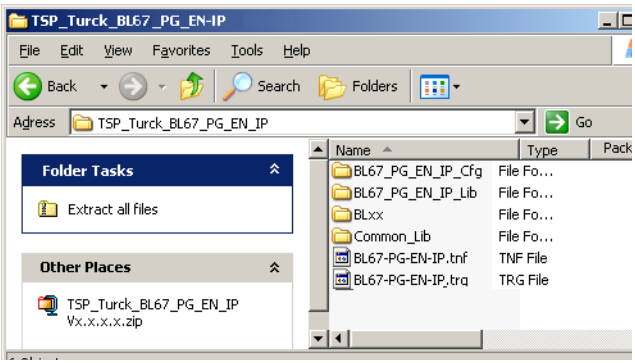


Figure 30: Directory structure of the target file

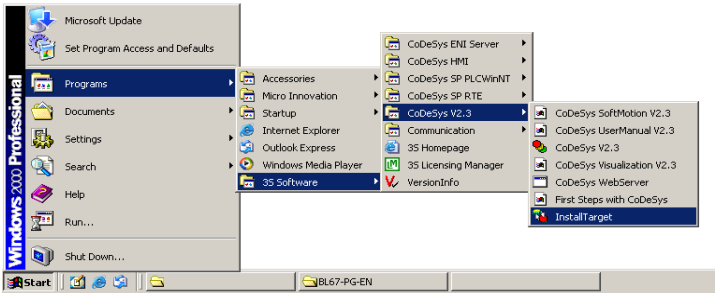
Note

Please observe, that the files have to be stored in this directory structure after having been extracted from the *.zip-file. Otherwise, problems may occur during the target installation.

Installation

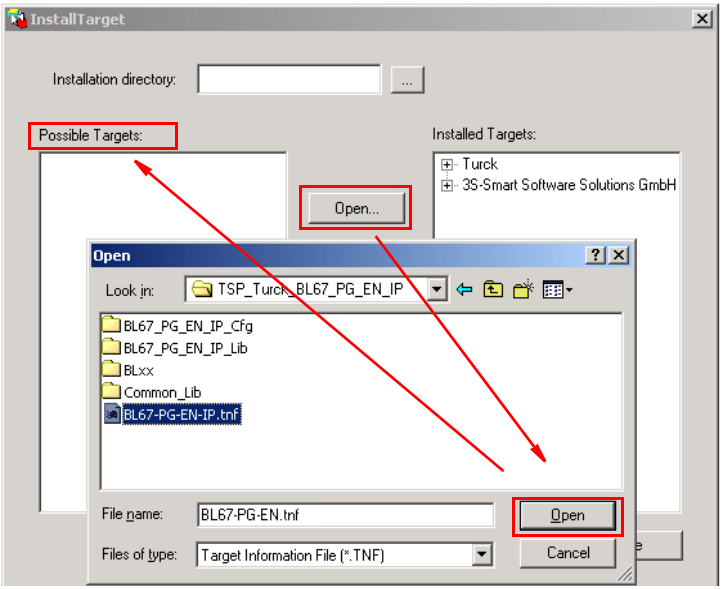
The target installation in CoDeSys is done using the "Start → Programs→ 3S Software → CoDeSys → V2.3 → Install Target"-command.

Figure 31: Install Target



Search the target information file "BL67-×××.tnf" using the „Open“ button and add the TURCK gateways to „Possible Targets“.

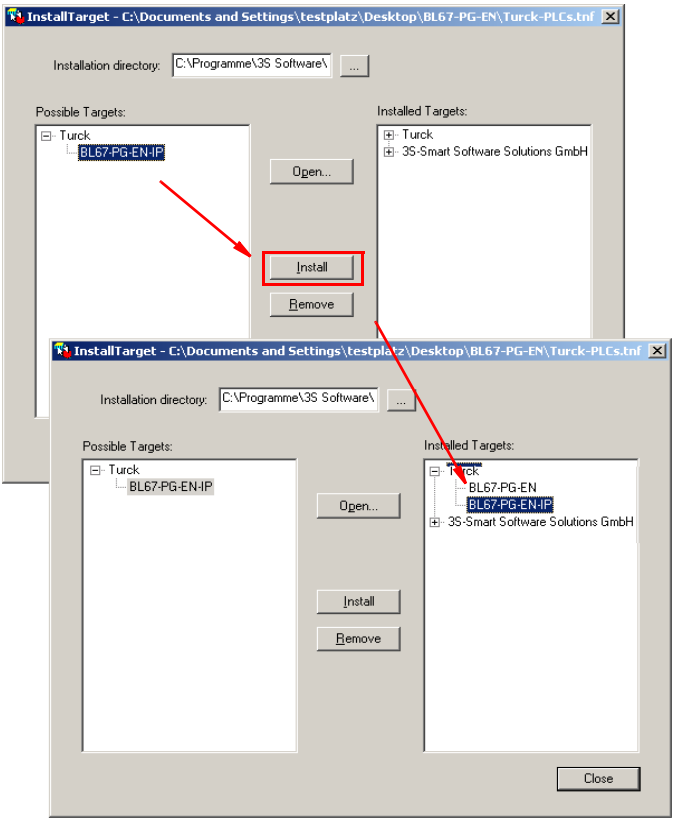
Figure 32: Select the target file



The BL67 target is installed using the "Install" button.

The BL67-PG-EN-IP can now be found under "Installed Targets" and can be chosen in CoDeSys as a target now.

Figure 33: Installation of the TURCK target



BL67 Hardware Configuration

1. At first, configure your BL67 station (BL67-PG-EN-IP and I/O modules) and switch on the power supply.
2. The gateway saves the actual station configuration, if the SET button under the cover on the gateway is pressed for approx. 10 seconds.
   The actual station configuration is now stored in the gateway as a reference module list.

Note

As soon as an application is loaded to the PG, the station configuration stored in the application is stored to the PG as reference module list.
If no application is loaded to the PG, the SET button has to be pressed for approx. 10 seconds after every change in the station configuration.

3. The gateway now executes a reset.
4. If the "IO"-LED lights up green after the gateway's reset, the new station configuration has been successfully stored.

Configuration/ Programming of the PG in CoDeSys

Creating a new project

Start the Software an create a new project using the "File → New"-command.

Chose the BL67-PG-EN-IP as target.

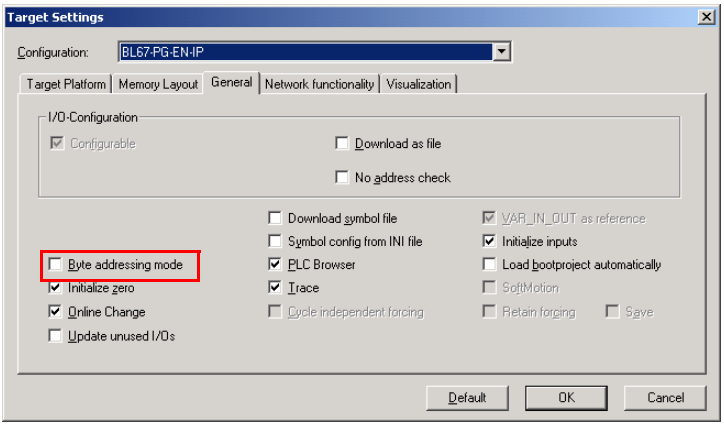
Normally, a further configuration of the gateway in the dialog box „target settings“ is not necessary.

Note

The BL67-PG-EN-IP uses the word addressing mode (see the following table).
Please observe therefore, that the parameter "Byte addressing mode" in the "General" tab is always deactivated.

%IX**0**.0 - %IX**0**.7	%IX**0**.8 - %IX**0**.15	%IX**1**.0 - %IX**1**.7	%IX**1**.8 - %IX**1**.15	%IX**2**.0 - %IX**2**.7	%IX2.8 - %IX**2**.15	%IX**3**.0 - %IX**3**.7	%IX**3**.8 - %IX**3**.15	%IX**4**.0 - %IX**4**.7	%IX**4**.8 - %IX**4**.15	%IX**5**.0 - %IX**5**.7	%IX**5**.8 - %IX**5**.15
%IB0	%IB1	%IB2	%IB3	%IB4	%IB5	%IB6	%IB7	%IB8	%IB9	%IB10	%IB11
%IW**0**		%IW**1**		%IW**2**		%IW**3**		%IW**4**		%IW**5**	
%ID0				%ID1				%ID2			

Figure 34: Target settings



Pressing the "OK" button created a new CoDeSys-project.

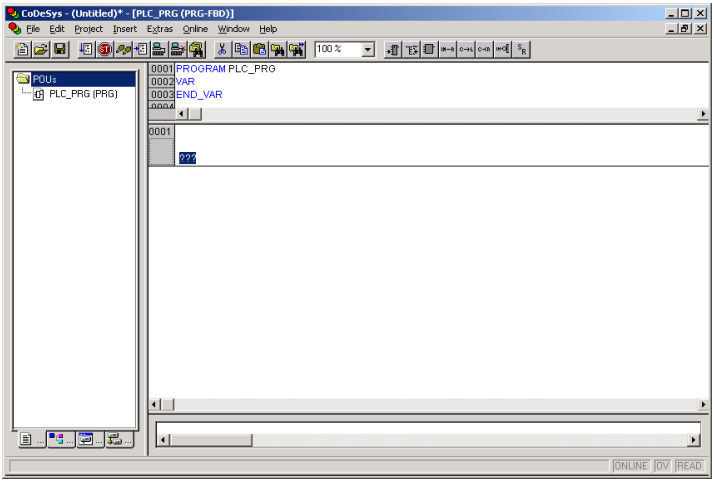
Attention

CoDeSys offers the possibility to control the processing of a project using the task management.

If no task configuration is defined, the project must contain a program named **PLC_PRG**.
The block PLC_PRG is automatically generated and is cyclically called by the runtime system.

PLC_PRG is always the main program in a Single-Task program.
If PLC_PRG is deleted or renamed, the project **must** be controlled using a task configuration.

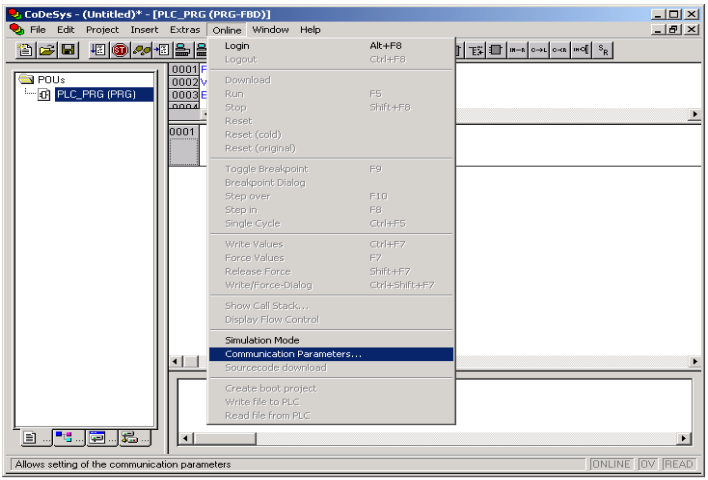
Figure 35: New CoDeSys-project



Now, the communication parameters for the target have to be adapted.

Communication parameters of the target

Figure 36: Opening the communication parameters



Mark "'localhost' via TCP/IP" in the „Channels“ field and define a new channel by pressing the „New“ button.

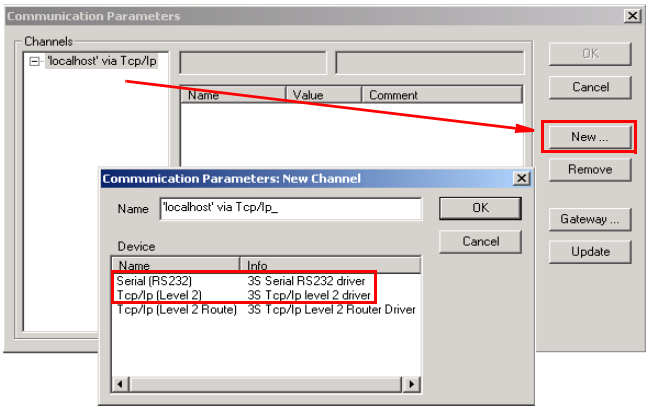
In the dialog box „Communication Parameters: New Channel“ the name for the new channel is edited and the communication interface is selected in the „Device“ field.

The BL67-PG-xxx offers 2 possible communication interfaces:

1 PS/2 female connector for a serial RS232-communication

2 Ethernet connector (M12, 4-pole, D-coded) for a „TCP/IP (Level 2)"-communication.

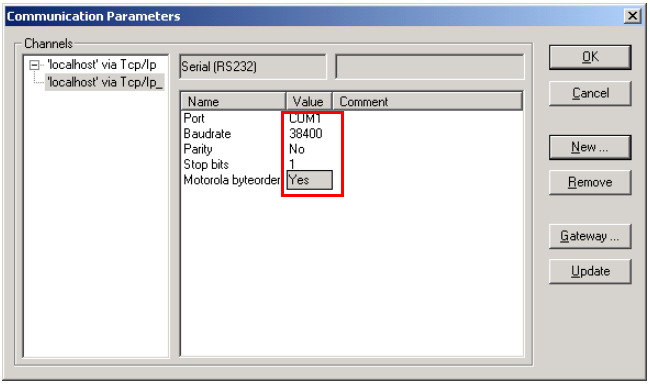
Figure 37: Defining a new channel



Select the preferred interface and set the parameters depending on the interface as follows:

1 serial RS232-communication:

Figure 38: Setting the communication parameters for RS232



Attention

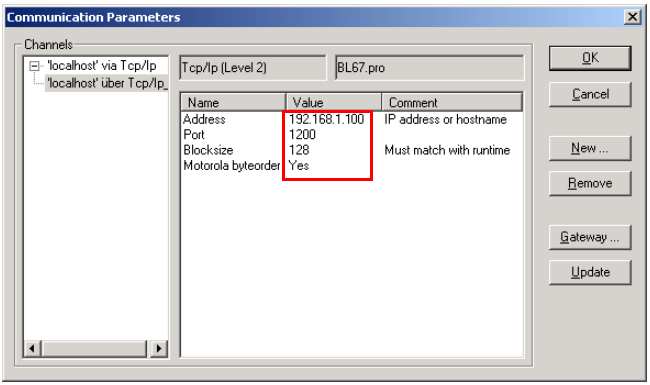
The Parameter "Motorola byteorder" must be set to "YES". Otherwise, no error-free communication with the gateway is possible.

Please observe that the communication with the PG is only possible with a baudrate of 115200 Baud, when using the serial RS32-interface.

2 TCP/IP (Level 2)-communication

Adapt the gateway's communication parameters (IP address, Motorola byteorder) as shown in the following figure.

Figure 39: Setting the communication parameters for TCP/IP (Level 2)



Attention

The Parameter "Motorola byteorder" must be set to "YES". Otherwise, no error-free communication with the gateway is possible.

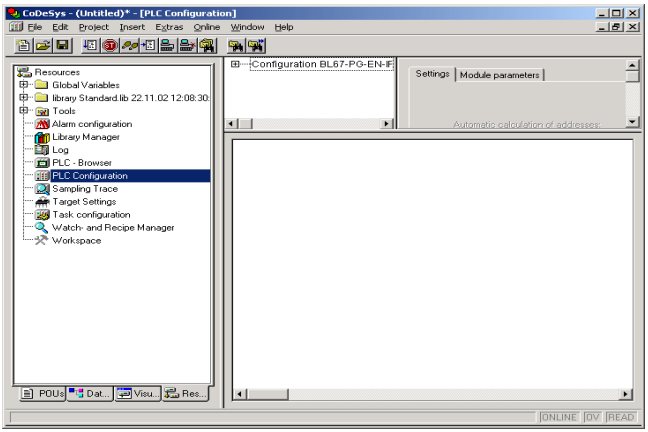
Note

When setting the IP address of the gateway, please observe that it has to match the settings of you PC network interface card. Otherwise, no communication can be built up between PC and PG (please read Chapter 8, "Network Configuration").

Configuration of the BL67 Station

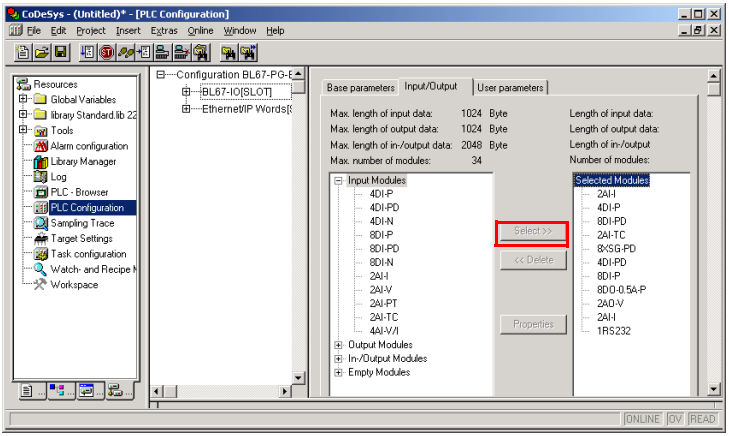
Open the „PLC Configuration“ in the „Resources“ tab.

Figure 40: PLC Configuration



Mark the BL67-IO[SLOT] and add the I/O modules to the gateway in the „Input/Output“ tab.

Figure 41: Selecting the I/O modules



Attention

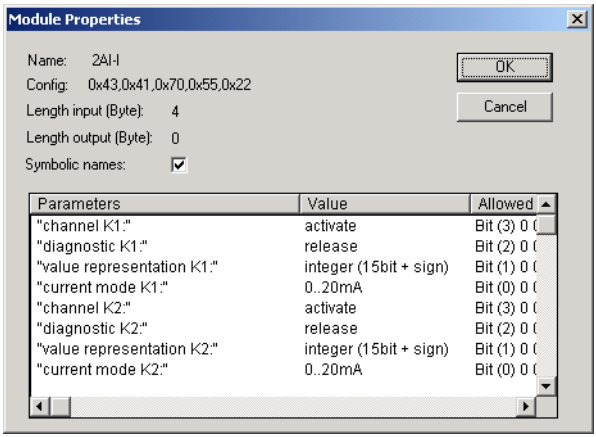
When configuring the BL67 station in the software, please observe that the order of the modules added to the gateway has to match the physical module order of the hardware configuration.

Parameterization of the I/O modules

For the parameterization of an I/O module mark the respective module in the „Selected Modules“ field and press the „Properties“ button.

In the „Module Properties“ dialog box each Parameter can be changed by double clicking the „Value“.

Figure 42: Parameterization of I/O modules



Addressing the input and output data

In- and output addresses as well as diagnostic addresses are automatically assigned to the gateway and the connected modules.

In addition to that, the gateway automatically receives a module ID as a unique identifier of the node within the entire configuration and

a node number shows the gateway's position in the configuration structure.

Note

The assignment of the in- and output addresses is done automatically and cannot be changed by the user.
In case of configuration changes, this assignment is also adapted automatically which may cause byte adjustments.
It is therefore recommended to add symbolic addresses to the logical address assignment of in- and outputs and to use only these symbolic addresses in the PLC program. (see Figure 43: „Hardware configuration with symbolic address allocation").

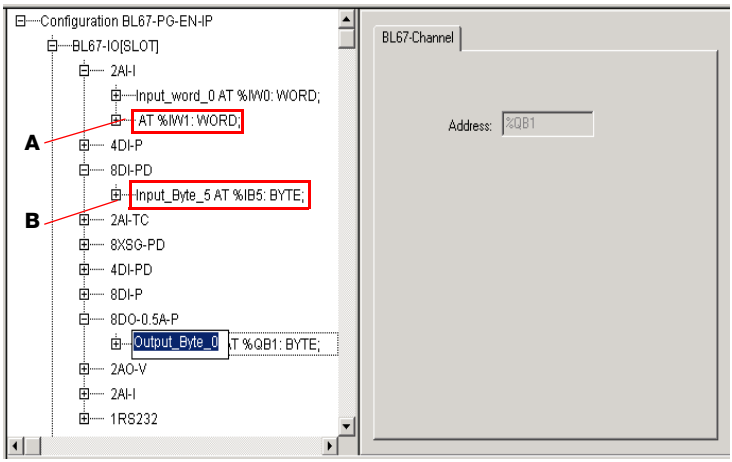
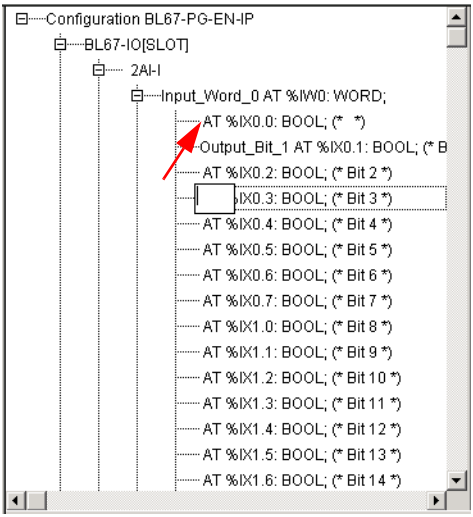


Figure 43: Hardware configuration with symbolic address allocation

A *logical address assignment (automatic)*
B *symbolic address assignment (application specific)*

A double click directly to the left of the entry of automatic addressing „AT%...“ opens the input field for the symbolic addressing.

Figure 44: Symbolic addressing



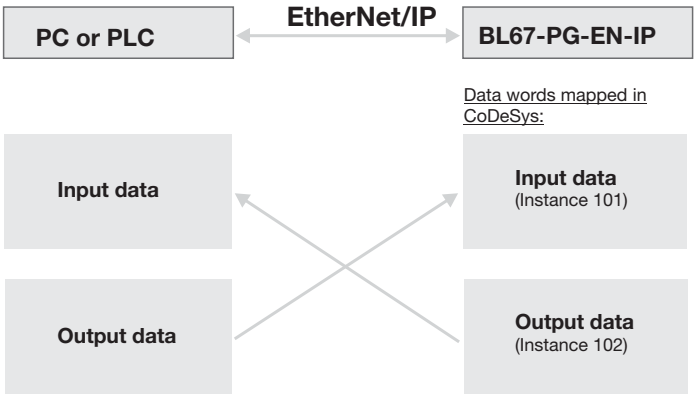
Mapping of the EtherNet/IP input and output words

In order to enable EtherNet/IP communication of BL67-PG-EN-IP with other EtherNet/IP nodes, the EtherNet/IP in- and output words have to be added to the PG configuration.

The output data coming from an external client are mapped as input data in the PG.

The output data from the PG are input data on the PLC-side.

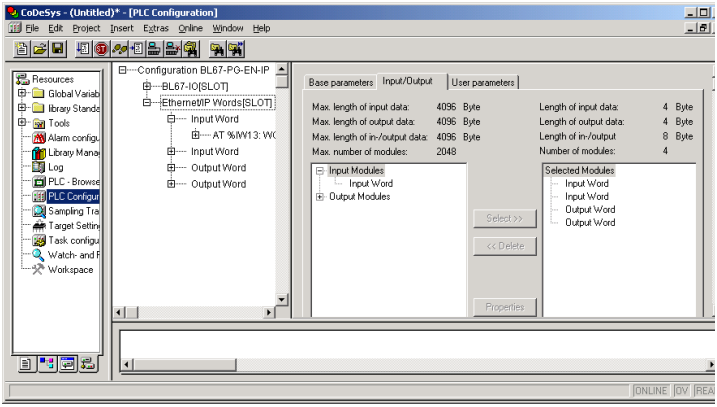
Figure 45: Mapping of in- and output words



Add the necessary in- and output words to the PG configuration under "Configuration BL67-PG-EN-IP → Ethernet/IP Words [SLOT]".

The in- and output addresses are automatically assigned to the in- and output words.

Figure 46: Configuration of EtherNet/IP in- and output words



Therefore, a symbolic address allocation is also recommended for the in- and output words (see also Note on page 5-15).

Note

Please observe, that BL67 EtherNet/IP gateways are Big-Endian-systems (Motorola format).

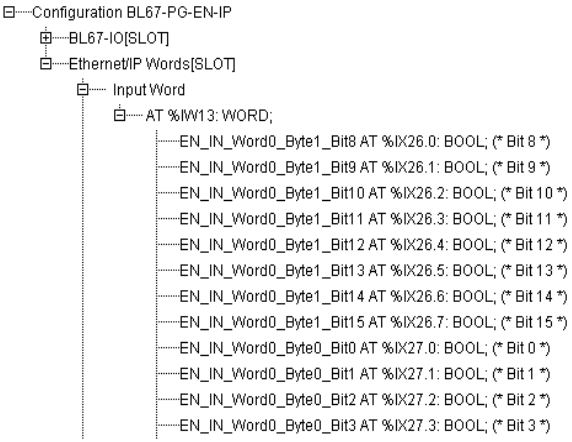
As shown in the following figure, the high byte of the word is listed first (%IX26 → bit 8 to bit 15), the low byte follows the high byte (%IX27 → bit 0 to bit 7).

The comments (*Bit 0*, *Bit 1* etc.) in the example have been changed according to the application.

Attention

Up to the time of the release of this manual, the automatic allocation of the comments by the software was faulty and did not show the correct bit order.
The CoDeSys-comments always start with *Bit 0* for the first bit of the in- and output words. But, due to the Big-Endian (Motorola format) of the BL67-PG-EN-IP, this is not correct!
The correct data mapping starts with the high byte (bit 8 to bit 15) of the data word, the low byte (bit 0 to bit 7) follows the high byte (see the following figure).

Figure 47: Symbolic address allocation for EtherNet/IP words



Programming of the BL67-PG-xxx

Programming is done in the "POUs" tab.

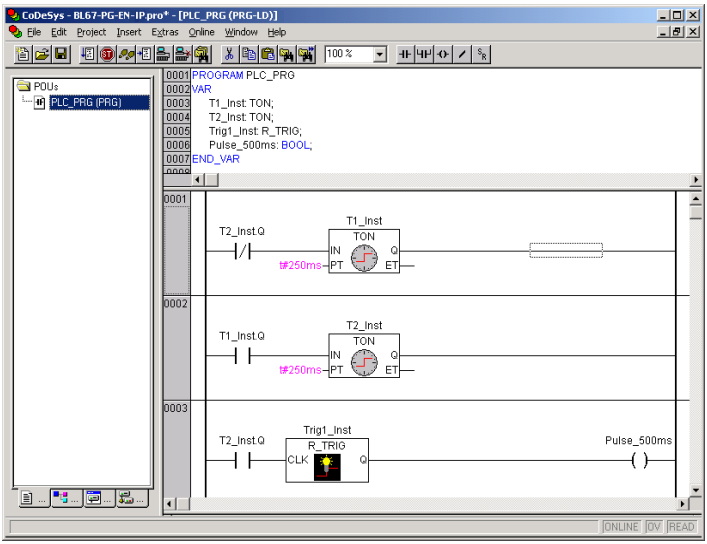


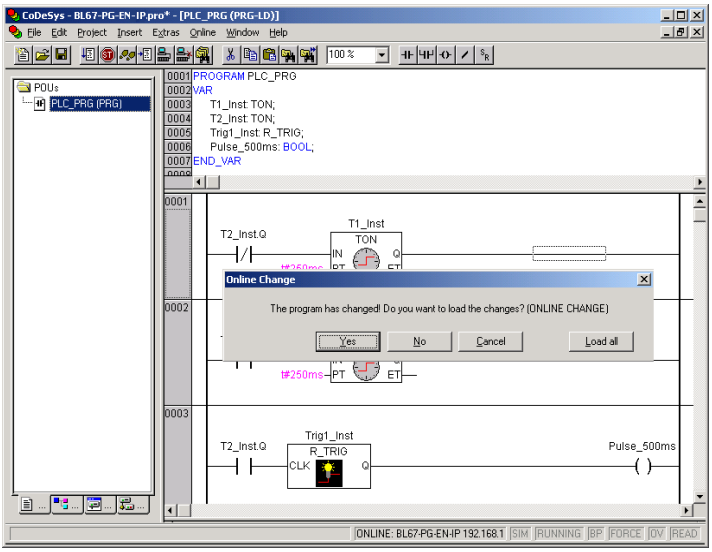
Figure 48: Example for programming in "POUs" tab

After the completion of the program, it is compiled using the „Project → Rebuild all..." command.

Online

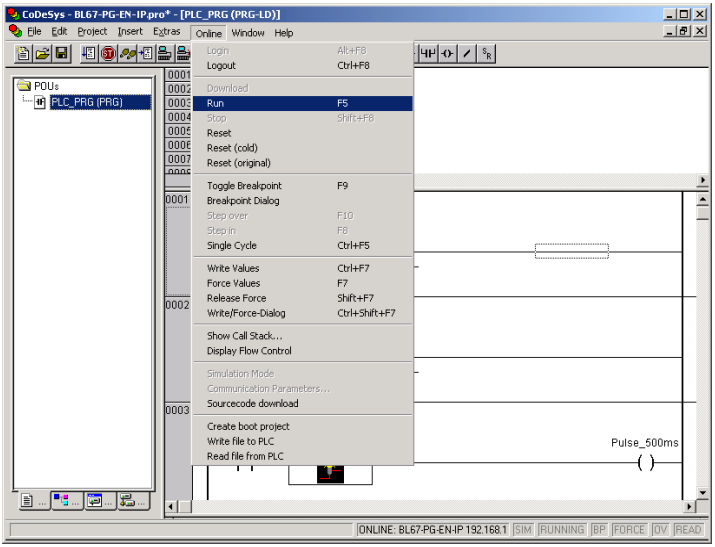
The connection to the gateway is established with "Online → Login".

Figure 49: Download of the program



Download the program to the gateway and start it with "Online → Run".

Figure 50: Starting the program



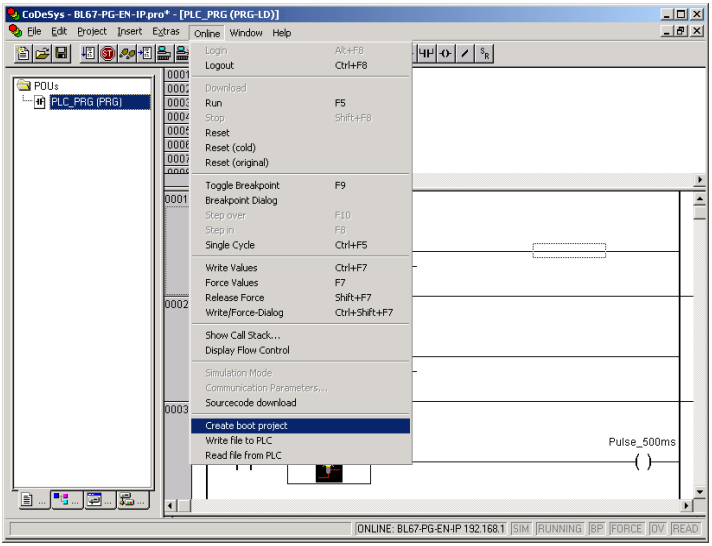
Note

Please observe, projects must be downloaded and saved as boot projects (for further information see the description in the following section "Creating a boot project") in order to be stored permanently to the gateway!
All other projects are deleted in case of a boot-up of the gateway!

Creating a boot project

With "Online → create boot project" your program is downloaded and saved as a boot project which is stored to the BL67-PG-EN-IP and is automatically loaded at every re-start of the gateway.

Figure 51: Create boot project



EtherNet/IP-Communication between PG and Superordinate PLC

The following pictures show an example for the data image correlation between the BL67-PG-EN-IP and a superordinate PLC (ControlLogix by Allen Bradley) with EtherNet/IP-scanner.

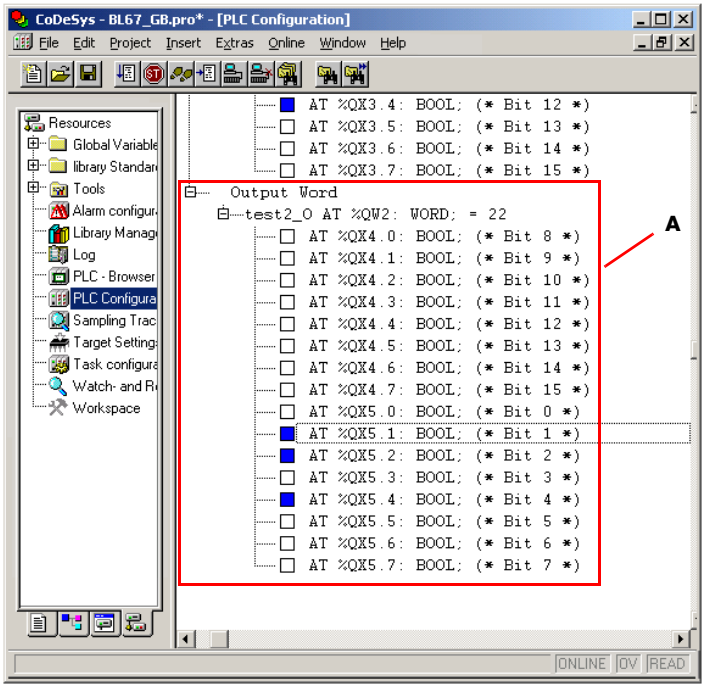


Figure 52: Output word in CoDeSys

A *Output word 2 in BL67-PG-EN-IP*

Figure 53: Inputs in the ControlLogix

A *Input word 2 in RSLogix-Software*

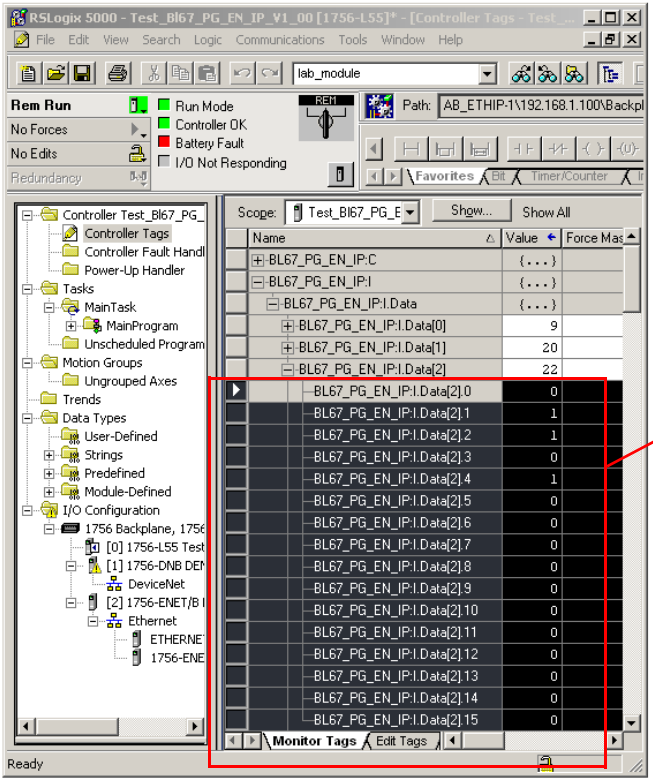
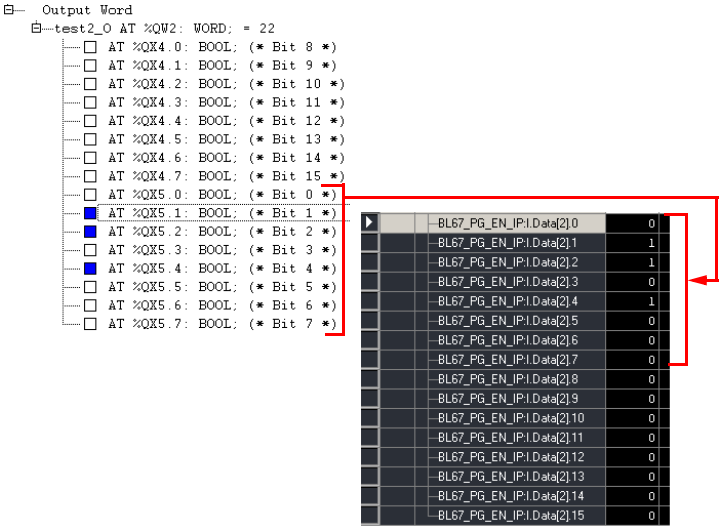


Figure 54: Data image correlation (BL67-PG-EN-IP and ControlLogix)

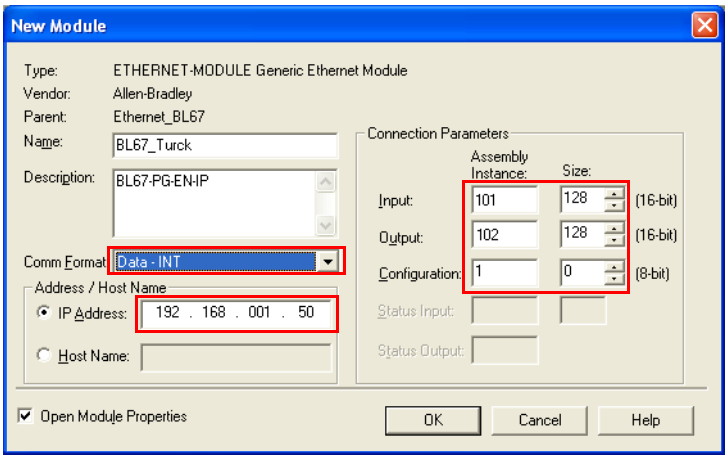


Configuration of the BL67-PG-EN-IP in RSLogix

Note

When configuring the Generic Ethernet Module BL67-PG-EN-IP as a new module in RSLogix, its connection parameters have to be set as follows (see Figure 55:) .

Figure 55: Configuration of BL67-PG-EN-IP



6 Guidelines for Station Planning

Module Arrangement

Random module arrangement

The arrangement of the I/O-modules within a BL67 station can basically be chosen at will.

Attention

Please observe, that RFID modules used within a station always should be mounted directly following the gateway (slot 1 to 34).

Nevertheless, it can be useful with some applications to group certain modules together.

Complete Planning

The planning of a BL67 station should be thorough to avoid faults and increase operating reliability.

Attention

If there are more than two empty slots next to one another, the communication is interrupted to all following BL67 modules.

Maximum System Extension

A BL67 station can consist of a gateway and a maximum of 32 modules (equivalent to 1 m station length).

The following overview shows the maximum number of channels possible under these conditions:

- The entire station is made up of the respective channel type only.

Table 38: Maximum system extension

Module type	maximum number	
	Channels	Modules
BL67-4DI-P	128	32
BL67-8DI-P	256	32
BL67-4DO-xA-P	128	32
BL67-8DO-xA-P	256	32
BL67-16DO-0.1A-P	512	32
BL67-4DI4DO-PD	256	32
BL67-8XSG-PD	256	32
BL67-2AI-x	64	32
BL67-2AI-PT	64	32
BL67-2AI-TC	64	32
BL67-4AI-V/I	128	32
BL67-2AO-I	64	32
BL67-2AO-V	50 **A**	25 **A**
BL67-1RS232	10 **A**	10 **A**
BL67-1RS485/422	21 **A**	21 **A**
BL67-1SSI	26 **A**	26 **A**
BL67-1CVI	32	32

A *limited due to the high current consumption (max. 1,5 A) on the module bus (5 V)*

Module type	maximum number	
	Channels	Modules
BL67-2RFID-A	8	4
BL67-2RFID-C	8	4

Attention

Ensure that a sufficient number of Power Feeding modules are used if the system is extended to its maximum.

Note

If the system limits are exceeded, the software I/O-ASSISTANT generates an error message when the user activates the command ‹Station → Verify›.

Creating potential groups

Power Feeding modules can be used to create potential groups. The potential isolation of potential groups to the left of the respective power distribution modules is provided by the base modules.

Plugging and Pulling Electronic Modules

BL67 enables the pulling and plugging of electronic modules without having to disconnect the field wiring. The BL67 station remains in operation if an electronic module is pulled.
The voltage and current supplies as well as the protective earth connections are not interrupted.

Attention

If the field and system supplies remain connected when electronic modules are plugged or pulled, short interruptions to the module bus communications can occur in the BL67 station. This can lead to undefined statuses of individual inputs and outputs of different modules.

Extending an Existing Station

Attention

Please note that extensions to the station (mounting further modules) should be carried out only when the station is in a voltage-free state.

7 Guidelines for Electrical Installation

General Notes

General

Cables should be grouped together, for example: signal cables, data cables, heavy current cables, power supply cables.

Heavy current cables and signal or data cables should always be routed in separate cable ducts or bundles. Signal and data cables must always be routed as close as possible to ground potential surfaces (for example support bars, cabinet sides etc.).

Cable routing

Correct cable routing prevents or suppresses the reciprocal influencing of parallel routed cables.

Cable routing inside and outside of cabinets

To ensure EMC-compatible cable routing, the cables should be grouped as follows:

Various types of cables within the groups can be routed together in bundles or in cable ducts.

Group 1:

- shielded bus and data cables
- shielded analog cables
- unshielded cables for DC voltage ≤ 60 V
- unshielded cables for AC voltage ≤ 25 V

Group 2:

- unshielded cables for DC voltage > 60 V and ≤ 400 V
- unshielded cables for AC voltage > 25 V and ≤ 400 V

Group 3:

- unshielded cables for DC and AC voltages > 400 V

The following group combination can be routed only in separate bundles or separate cable ducts (no minimum distance apart):

- **Group 1/Group 2**

The group combinations:

- **Group 1/Group 3 and Group 2/Group 3**

must be routed in separate cable ducts with a minimum distance of 10 cm apart. This is equally valid for inside buildings as well as for inside and outside of switchgear cabinets.

Cable routing outside buildings

Outside of buildings, cables should be routed in closed (where possible), cage-type cable ducts made of metal. The cable duct joints must be electrically connected and the cable ducts must be earthed.

Warning

Observe all valid guidelines concerning internal and external lightning protection and grounding specifications when routing cables outside of buildings.

Lightning protection

The cables must be routed in double-grounded metal piping or in reinforced concrete cable ducts.

Signal cables must be protected against overvoltage by varistors or inert-gas filled overvoltage arrestors. Varistors and overvoltage arrestors must be installed at the point where the cables enter the building.

Transmission media

For a communication via Ethernet, different transmission media can be used:

- coaxial cable
  10Base2 (thin koax),
  10Base5 (thick koax, yellow cable)
- optical fibre (10BaseF)
- twisted two-wire cable (10BaseT) with shielding (STP) or without shielding (UTP).

Note

TURCK offers a variety of cable types for fieldbus lines as premoulded or bulk cables with different connectors.
The ordering information for the available cable types can be found in the BL67 catalog.

Potential Relationships

General

The potential relationship of a Ethernet system realized with BL67 modules is characterized by the following:

- The system supply of gateway and I/O-modules as well as the field supply are realized via one power feed at the gateway.
- All BL67 modules (gateway, Power Feeding and I/O-modules), are connected capacitively via base modules to the mounting rails.

The block diagram shows the arrangement of a typical BL67 station.

7

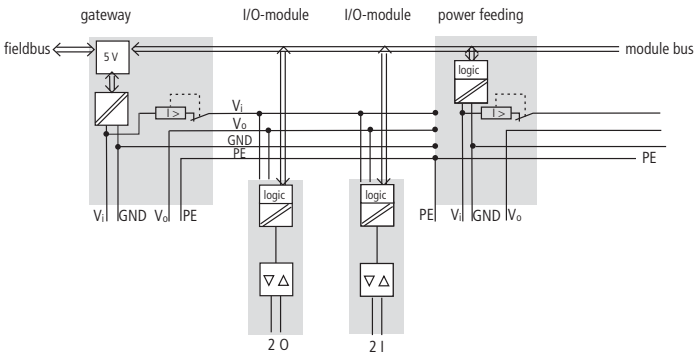


Figure 56: Block diagram of a BL67 station

Electromagnetic Compatibility (EMC)

BL67 products comply in full with the requirements pertaining to EMC regulations.

Nevertheless, an EMC plan should be made before installation. Hereby, all potential electromechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

Ensuring Electromagnetic Compatibility

The EMC of BL67 modules is guaranteed when the following basic rules are adhered to:

- Correct and large surface grounding of inactive metal components.
- Correct shielding of cables and devices.
- Proper cable routing – correct wiring.
- Creation of a standard reference potential and grounding of all electrically operated devices.
- Special EMC measures for special applications.

Grounding of inactive metal components

All inactive metal components (for example: switchgear cabinets, switchgear cabinet doors, supporting bars, mounting plates, tophat rails, etc.) must be connected to one another over a large surface area and with a low impedance (grounding). This guarantees a standardized reference potential area for all control elements and reduces the influence of coupled disturbances.

- In the areas of screw connections, the painted, anodized or isolated metal components must be freed of the isolating layer. Protect the points of contact against rust.
- Connect all free moving groundable components (cabinet doors, separate mounting plates, etc.) by using short bonding straps to large surface areas.

- Avoid the use of aluminum components, as its quick oxidizing properties make it unsuitable for grounding.

Warning

The grounding must never – including cases of error – take on a dangerous touch potential. For this reason, always protect the ground potential with a protective cable.

PE connection

A central connection must be established between ground and PE connection (protective earth).

Earth-free operation

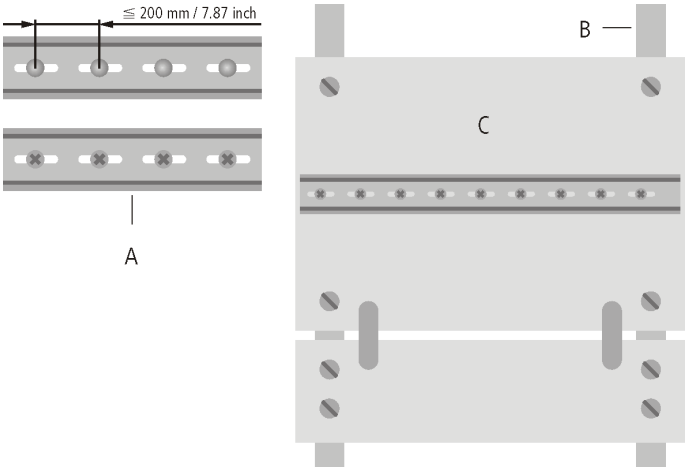
Observe all relevant safety regulations when operating an earthfree system.

Mounting rails

All mounting rails must be mounted onto the mounting plate with a low impedance, over a large surface area, and must be correctly earthed.

Figure 57:
Mounting options

A *TS 35*
B *Mounting rail*
C *Mounting plate*



Mount the mounting rails over a large surface area and with a low impedance to the support system using screws or rivets.

Remove the isolating layer from all painted, anodized or isolated metal components at the connection point. Protect the connection point against corrosion (for example with grease; caution: use only suitable grease).

Shielding of Cables

Shielding is used to prevent interference from voltages and the radiation of interference fields by cables. Therefore, use only shielded cables with shielding braids made from good conducting materials (copper or aluminum) with a minimum degree of coverage of 80 %.

The cable shield should always be connected to both sides of the respective reference potential (if no exception is made, for example, such as high-resistant, symmetrical, analog signal cables). Only then can the cable shield attain the best results possible against electrical and magnetic fields.

A one-sided shield connection merely achieves an isolation against electrical fields.

Attention

When installing, please pay attention to the following...

– the shield should be connected immediately when entering the
– system,
– the shield connection to the shield rail should be of low
– impedance,
– the stripped cable-ends are to be kept as short as possible,
– the cable shield is not to be used as a bonding conductor.

If the data cable is connected via a SUB-D connector, the shielding should never be connected via pin 1, but to the mass collar of the plug-in connector.

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is not in operation. The connection and securing of the shield should be made using metal shield clamps. The shield clamps must enclose the shielding braid and in so doing create a large surface contact area. The shield rail must have a low impedance (for example, fixing points of 10 to 20 cm apart) and be connected to a reference potential area.

The cable shield should not be severed, but routed further within the system (for example, to the switchgear cabinet), right up to the interface connection.

Note

Should it not be possible to ground the shield on both sides due to switching arrangements or device specific reasons, then it is possible to route the second cable shield side to the local reference potential via a capacitor (short connection distances). If necessary, a varistor or resistor can be connected parallel to the capacitor, to prevent disruptive discharges when interference pulses occur.

A further possibility is a double-shielded cable (galvanically separated), whereby the innermost shield is connected on one side and the outermost shield is connected on both sides.

Potential Compensation

Potential differences can occur between installation components that are in separate areas and these

- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

A potential-compensation cable must be routed to the potential compensation.

Warning

Never use the shield as a potential compensation.

A potential compensation cable must have the following characteristics:

- Low impedance. In the case of compensation cables that are routed on both sides, the compensation line impedance must be considerably smaller than that of the shield connection (max. 10 % of shield connection impedance).
- Should the length of the compensation cable be less than 200 m, then its cross-section must be at least 16 mm^2 / 0.025 $inch^2$. If the cable length is greater than 200 m, then a cross-section of at least 25 mm^2 / 0.039 $inch^2$ is required.
- The compensation cable must be made of copper or zinc coated steel.
- The compensation cable must be connected to the protective conductor over a large surface area and must be protected against corrosion.
- Compensation cables and data cables should be routed as close together as possible, meaning the enclosed area should be kept as small as possible.

Switching inductive loads

In the case of inductive loads, a protective circuit on the load is recommended.

Protection against Electrostatic Discharge (ESD)

Attention

Electronic modules and base modules are at risk from electrostatic discharge when disassembled. Avoid touching the bus connections with bare fingers as this can lead to ESD damage.

8 Appendix

Network Configuration

Note

In order to build up the communication between the BL67-gateway and a PLC/ PC or a network interface card, both devices have to be hosts in the same network.

The network is already defined by the default-settings in the BL67-gateways.

The default IP address for the BL67-gateways is 192.168.1.254 (see also Chapter 2, page 2-5, section „IP address").

If necessary, please adjust the IP address of the PLC/ PC or the network interface card.

Changing the IP address of a PC/network interface card

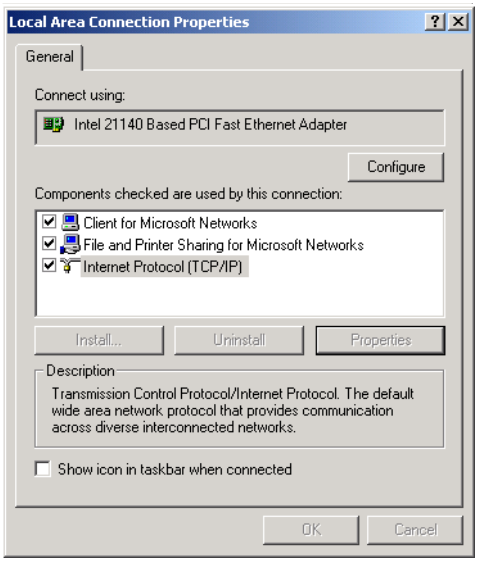
Changing the IP address in Windows 2000/ Windows XP

The IP address is changed in the "Control Panel" in "Network and Dial-up Connections":

1 Open the folder "Local Area Connection" and open the dialog "Local Area Connection Properties" via the button "Properties" in the dialog "Local Area Connection Status".

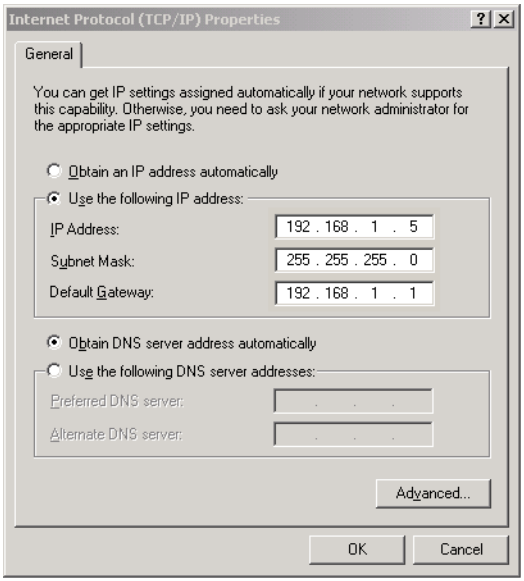
2 Mark "Internet Protocol (TCP/IP)" and press the "Properties"-button to open the dialog "Internet Protocol (TCP/IP) Properties".

Figure 58: Local Area Connection Properties



3 Activate "Use the following IP address" and assign an IP address of the network mentioned above to the PC/ Network interface card (see the following figure).

Figure 59: Changing the PC's IP address

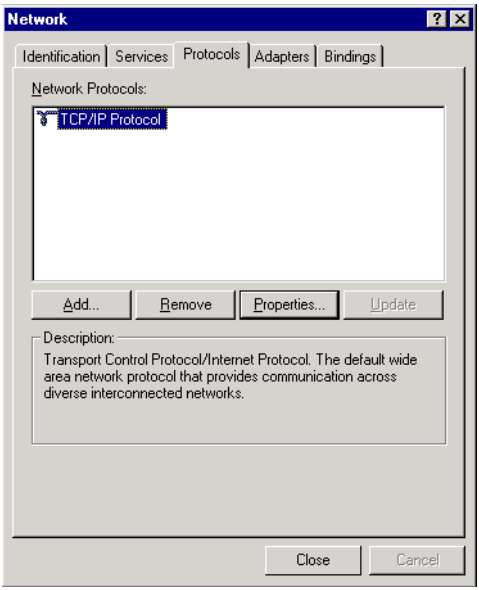


Changing the IP address in Windows NT

1 Open the folder "Network" in the Control Panel.

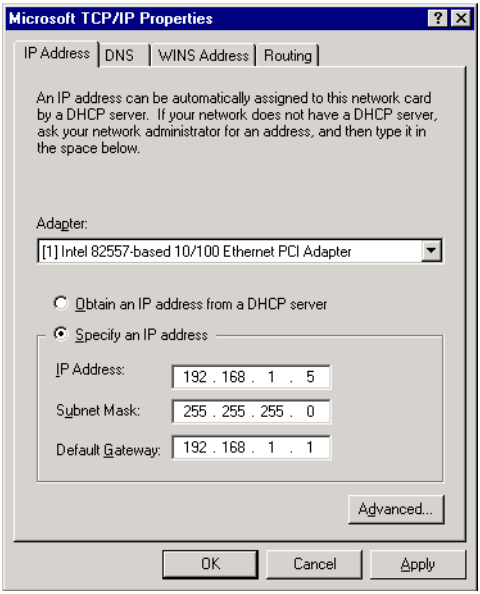
2 Activate TCP/IP connection in the tab "Protocols" and click the "Properties" button.

Figure 60: Network configuration WIN NT



3 Activate "Specify IP address " and set the address as follows.

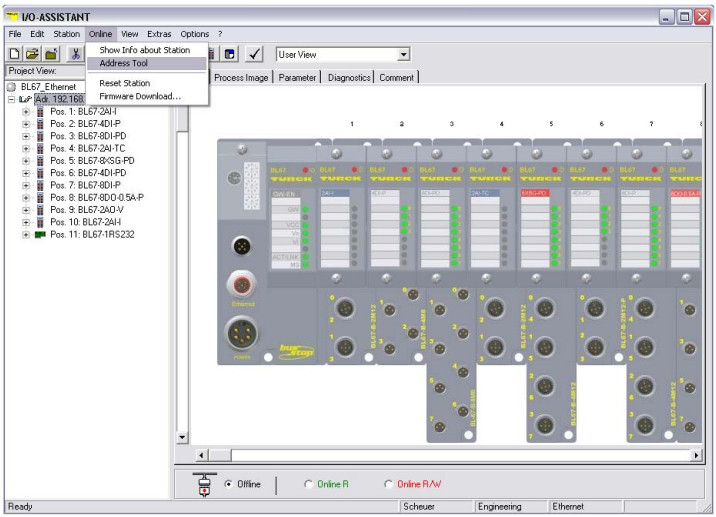
Figure 61:
Specify IP address



Changing the IP address via I/O-ASSISTANT

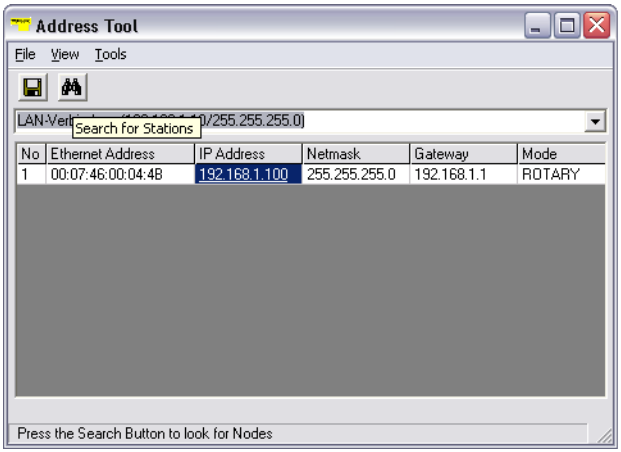
The Address Tool integrated in the I/O-ASSISTANT offers the possibility to browse the whole Ethernet network for connected nodes and to change their IP address as well as the subnet mask according to the application.

Figure 62: Address Tool in the I/O-ASSISTANT



The network is browsed by using the search function in the Address Tool.

Figure 63: Search function in the Address Tool



Attention

If Windows XP is used as operating system, problems with the system internal firewall may occur.

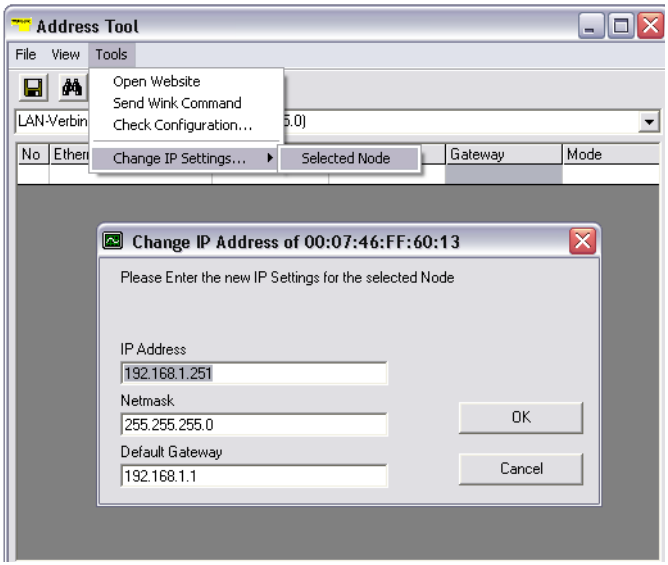
It may eventually inhibit the access of the I/O-ASSISTANT to the Ethernet. Please adapt your firewall settings accordingly or deactivate it completely (see also „Deactivating/ adapting the firewall in Windows XP", page 8-10).

The network is browsed for connected hosts which are then listed in the Address Tool.

The address changing is done via "Tools → Changing IP settings...".

It is now possible to change the address settings for all nodes in the list or only for the selected one.

Figure 64: Address changing for selected nodes



Deactivating/ adapting the firewall in Windows XP

If Windows XP is used as operating system, problems with the system-integrated firewall may occur in case of an access of outside sources to your computer or in case of tools like the I/O-ASSISTANT which are used for changing the IP address of the gateways.

In this case, you can deactivate the system integrated Windows XP firewall completely or adapt it to your application.

- **Deactivating the firewall**
  Open the "Windows Firewall" dialog in the control panel of your PC and deactivate it as follows:

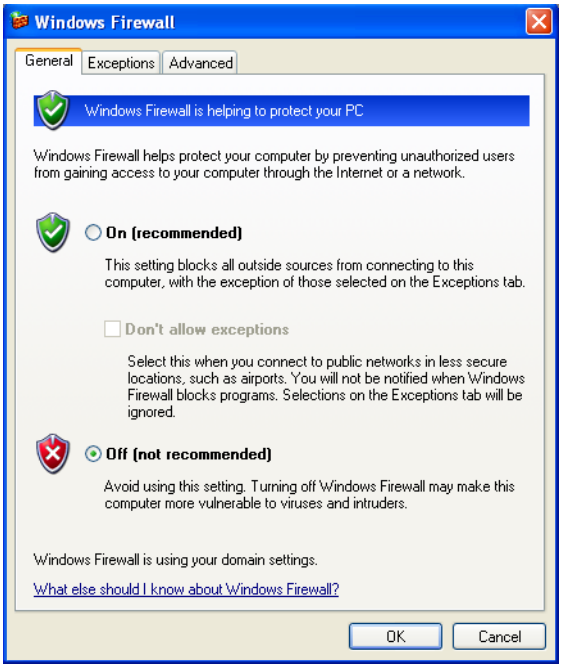
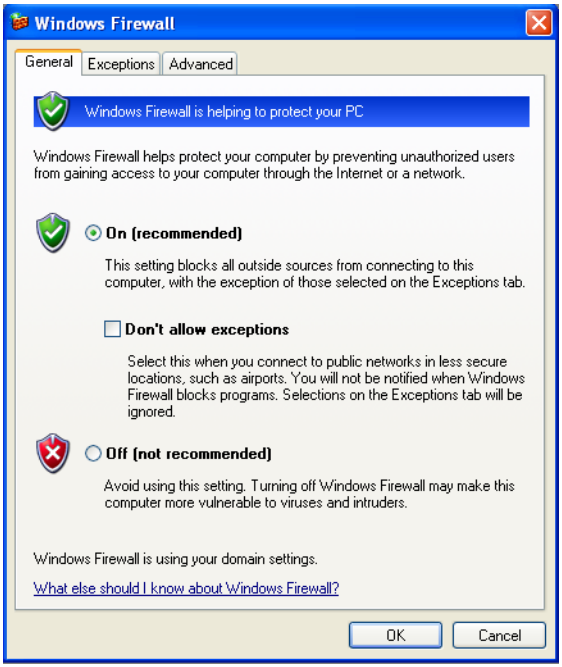


Figure 65: Deactivating the Windows firewall

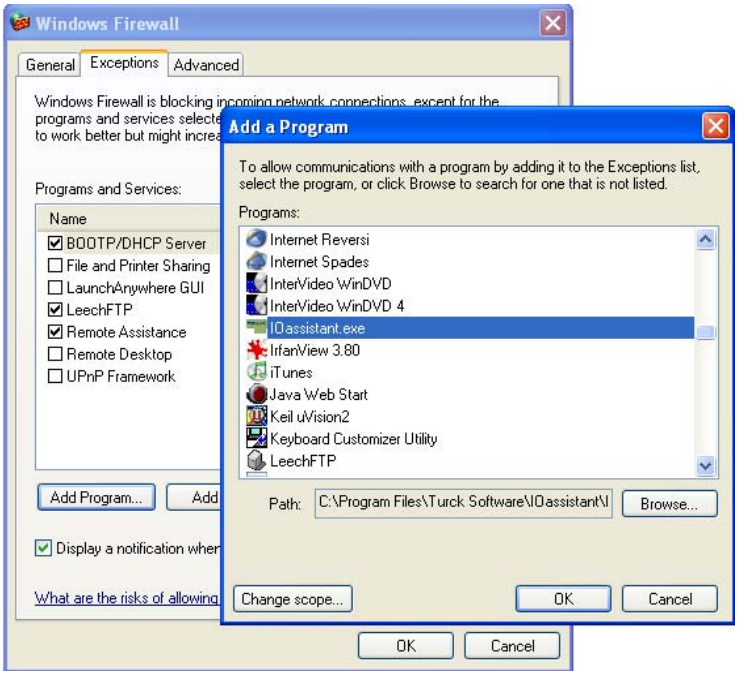
- **Adapting the firewall**
  The firewall remains active, the option "Don't allow exceptions" it deactivated:

Figure 66: Activating the Windows firewall



- In the "Exceptions"-tab, add the programs or services for which you want to allow the access to your computer.

Figure 67: "Exceptions"-tab



Note

Despite an active firewall, the I/O-ASSISTANT for example is now able to browse the network for hosts and the address changing via the software is possible for the connected nodes.

Nominal Current Consumption of Modules at Ethernet

Table 39: nominal current consumptions of the modules at Ethernet

Module	Current consumptions on 24 V DC
BL67-PG-EN	
Power supply modules	
BL67-PF-24VDC	≤ 9 mA
Digital input modules	
BL67-4DI-P	≤ 9 mA
BL67-8DI-P	≤ 9 mA
BL67-4DI-PD	≤ 35 mA
BL67-8DI-PD	≤ 35 mA
BL67-4DI-N	≤ 8 mA
BL67-8DI-N	≤ 8 mA
Analog input modules	
BL67-2AI-I	≤ 10 mA
BL67-2AI-V	≤ 10 mA
BL67-2AI-PT	≤ 13 mA
BL67-2AI-TC	≤ 10 mA
Digital output modules	
BL67-4DO-0.5A-P	≤ 9 mA
BL67-4DO-2A-P	≤ 9 mA
BL67-8DO-0.5A-P	≤ 9 mA
BL67-4DO-2A-N	≤ 24 mA
BL67-8DO-0.5A-N	≤ 24 mA
BL67-16DO-0.1A-P	≤ 9 mA

Analog output modules	
BL67-2AO-I	≤ 12 mA
BL67-2AO-V	≤ 17 mA
Digital combi modules	
BL67-4DI/4DO-PD	≤ 35 mA
BL867-8XSG-PD	≤ 35 mA
Technology modules	
BL67-1RS232	≤ 28 mA
BL67-1RS485/422	≤ 20 mA
BL67-1SSI	≤ 32 mA
BL67-1CVI	≤ 24 mA

Note

Please find any information about the bus-independent, module specific current consumptions in the manual "BL67- I/O-modules" (TURCK-Documentation No.: German D300572/ English D300527).

9 Glossary

A

Acknowledge

Acknowledgment of a signal received.

Active metal component

Conductor or conducting component that is electrically live during operation.

Address

Identification number of, e.g. a memory position, a system or a module within a network.

Addressing

Allocation or setting of an address, e. g. for a module in a network.

ARP

Used to definitely allocate the hardware addresses (MAC-IDs) assigned world-wide to the IP addresses of the network clients via internal tables.

Analog

Infinitely variable value, e. g. voltage. The value of an analog signal can take on any value, within certain limits.

Automation device

A device connected to a technical process with inputs and outputs for control. Programmable logic controllers (PLC) are a special group of automation devices.

B

Baud

Baud is a measure for the transmission speed of data. 1 Baud corresponds to the transmission of one bit per second (bit/s).

Baud rate

Unit of measurement for measuring data transmission speeds in bit/s.

Bidirectional

Working in both directions.

Bonding strap

Flexible conductor, normally braided, that joins inactive components, e. g. the door of a switchgear cabinet to the cabinet main body.

Bus

Bus system for data exchange, e. g. between CPU, memory and I/O levels. A bus can consist of several parallel cables for data transmission, addressing, control and power supply.

Bus cycle time

Time required for a master to serve all slaves or stations in a bus system, i. e. reading inputs and writing outputs.

Bus line

Smallest unit connected to a bus, consisting of a PLC, a coupling element for modules on the bus and a module.

Bus system

All units which communicate with one another via a bus.

C

Capacitive coupling

Electrical capacitive couplings occur between cables with different potentials. Typical sources of interference are, for example, parallel-routed signal cables, contactors and electrostatic discharges.

Check-back interface

The check-back interface is the interface from the counter module to the internal module bus. The bits and bytes are converted by the gateway from the respective type of communication applicable to the fieldbus in to the module-specific bits and bytes.

Coding elements

Two-piece element for the unambiguous assignment of electronic and base modules.

Configuration

Systematic arrangement of the I/O-modules of a station.

Control interface

The control interface is the interface from the internal module bus to the counter module. The commands and signals directed to the counter module are converted by the gateway from the respective type of communication applicable to the fieldbus in to the module-specific bits and bytes.

CPU

Central Processing Unit. Central unit for electronic data processing, the processing core of the PC.

D

DHCP

Client-Server-protocol which reduces the effort of assigning IP addresses or other parameters. Serves for dynamic and automatic configuration of devices.

Digital

A value (e. g. a voltage) which can adopt only certain statuses within a finite set, mostly defined as 0 and 1.

DIN

German acronym for German Industrial Standard.

E

EIA

Electronic Industries Association – association of electrical companies in the United States.

Electrical components

All objects that produce, convert, transmit, distribute or utilize electrical power (e. g. conductors, cable, machines, control devices).

EMC

Electromagnetic compatibility – the ability of an electrical part to operate in a specific environment without fault and without exerting a negative influence on its environment.

EN

German acronym for European Standard.

ESD

Electrostatic Discharge.

F

Field power supply

Voltage supply for devices in the field as well as the signal voltage.

Fieldbus

Data network on sensor/actuator level. A fieldbus connects the equipment on the field level. Characteristics of a fieldbus are a high transmission security and real-time behavior.

Force Mode

Software mode which enables the user to set his plant to a required state by forcing certain variables on the input and output modules.

G

GND

Abbreviation of ground (potential "0").

Ground

Expression used in electrical engineering to describe an area whose electrical potential is equal to zero at any given point. In neutral grounding devices, the potential is not necessarily zero, and one speaks of the ground reference.

Ground connection

One or more components that have a good and direct contact to earth.

Ground reference

Potential of ground in a neutral grounding device. Unlike earth whose potential is always zero, it may have a potential other than zero.

H

Hexadecimal

System of representing numbers in base 16 with the digits 0... 9, and further with the letters A, B, C, D, E and F.

Hysteresis

A sensor can get caught up at a certain point, and then "waver" at this position. This condition results in the counter content fluctuating around a given value. Should a reference value be within this fluctuating range, then the relevant output would be turned on and off in rhythm with the fluctuating signal.

I

I/O

Input/output.

Impedance

Total effective resistance that a component or circuit has for an alternating current at a specific frequency.

Inactive metal components

Conductive components that cannot be touched and are electrically isolated from active metal components by insulation, but can adopt voltage in the event of a fault.

Inductive coupling

Magnetic inductive couplings occur between two cables through which an electrical current is flowing. The magnetic effect caused by the electrical currents induces an interference voltage. Typical sources of interference are for example, transformers, motors, parallel-routed network and HF signal cables.

Intelligent modules

Intelligent modules are modules with an internal memory, able to transmit certain commands (e. g. substitute values and others).

IP

Abbreviation for Internet-Protocol, protocol for the packet-oriented and connectionless transport of data packets from a transmitter to a receiver crossing different networks.

L

Lightning protection

All measures taken to protect a system from damage due to overvoltages caused by lightning strike.

Low impedance connection

Connection with a low AC impedance.

LSB

Least Significant bit

M

Mass

All interconnected inactive components that do not take on a dangerous touch potential in the case of a fault.

Master

Station in a bus system that controls the communication between the other stations.

Module bus

The module bus is the internal bus in a station. The modules communicate with the gateway via the module bus which is independent of the fieldbus.

MSB

Most Significant bit

P

Ping

Implementation of an echo-protocol, used for testing whether a particular host is operating properly and is reachable on the network from the testing host.

PLC

Programmable Logic Controller.

Potential compensation

The alignment of electrical levels of electrical components and external conductive components by means of an electrical connection.

Potential free

Galvanic isolation of the reference potentials in I/O-modules of the control and load circuits.

Potential linked

Electrical connection of the reference potentials in I/O-modules of the control and load circuits.

Protective earth

Electrical conductor for protection against dangerous shock currents. Generally represented by PE (protective earth).

R

Radiation coupling

A radiation coupling appears when an electromagnetic wave hits a conductive structure. Voltages and currents are induced by the collision. Typical sources of interference are for example, sparking gaps (spark plugs, commutators from electric motors) and transmitters (e. g. radio), that are operated near to conducting structures.

Reaction time

The time required in a bus system between a reading operation being sent and the receipt of an answer. It is the time required by an input module to change a signal at its input until the signal is sent to the bus system.

Reference potential

Potential from which all voltages of connected circuits are viewed and/or measured.

Repeater

Amplifier for signals transmitted via a bus.

Root-connecting

Creating a new potential group using a power distribution module. This allows sensors and loads to be supplied individually.

RS 485

Serial interface in accordance with EIA standards, for fast data transmission via multiple transmitters.

S

Serial

Type of information transmission, by which data is transmitted bit by bit via a cable.

Setting parameters

Setting parameters of individual stations on the bus and their modules in the configuration software of the master.

Shield

Conductive screen of cables, enclosures and cabinets.

Shielding

Description of all measures and devices used to join installation components to the shield.

Short-circuit proof

Characteristic of electrical components. A short-circuit proof part withstands thermal and dynamic loads which can occur at its place of installation due to a short circuit.

Station

A functional unit or I/O components consisting of a number of elements.

T

TCP

Abbreviation for Transmission Control Protocol, connection-oriented transport protocol within the Internet protocol suite. Certain error detection mechanisms (i.e. acknowledgements, time-out monitoring) can guarantee a safe and error free data transport.

Terminating resistance

Resistor on both ends of a bus cable used to prevent interfering signal reflections and which provides bus cable matching. Terminating resistors must always be the last component at the end of a bus segment.

To ground

Connection of a conductive component with the grounding connection via a grounding installation.

Topology

Geometrical structure of a network or the circuitry arrangement.

U

UDP

Abbreviation for User Datagram Protocol. UDP is an transport protocol for the connectionless data between Ethernet hosts.

Unidirectional

Working in one direction.

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